# Technology Innovation and Digital Revolution: Adoption and Diffusion of Digital Network Platforms, 1995-2001, with Implications for Future Development

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## ABSTRACT

Leading digital platforms as of the early 2020s are valued in the trillions of dollars. Web-based technology pioneers such as Alphabet, Microsoft, Amazon, and Meta, among others, have reshaped the world. The work introduces the theory of signal innovation (SI) to explain the causes and conditions behind the emergence of general-purpose technologies (GPTs), those pathbreaking technology innovations responsible for global political-economic and sociocultural transformation. It applies signal innovation theory to a narrative history of the origin moment of the twenty-first century digital platform economy, specifically the rise of the world wide web from years 1995 to 2001. Intensive primary source investigation of the Netscape and Microsoft corporations and detail on their respective Navigator and Internet Explorer web-browsing software forms the basis of this work. The theoretical concept of signal innovation is used to analyze primary source research on the rise of the world wide web. The web here is understood as the confluence of three core parallel technology development pathways in (1) personal web browsing software, (2) web-based billing, payments, and financial transaction protocols, and (3) web-based encryption methods. Empirical research is supported by a review of the multidisciplinary business and technology innovation literature, and its connections to economic growth and progress. The work concludes with extensions of the theory of signal innovation. Specific attention is given to contemporary applications such as the blockchain and other decentralized technology products and services.

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## ACKNOWLEDGEMENTS

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**DEDICATION**

For Frances.

# Chapter 1 – Introduction and Overview

*The Relevance of Innovation—Research Structure and Approach*

*The Relevance of Innovation*

The digital revolution that began with the microprocessor and personal computer of the 1970s is now in the 2020s a product of the "fourth industrial revolution" or "second machine age."[1] The current digital revolution relies on technological innovations across three axes in the fields of computing hardware (i.e., microprocessors), computing software (i.e., operating systems), and digital communications networks or digital platforms (i.e., the internet and world wide web). These technological innovations have exercised transformational effects globally across polities, societies, and economies. This dissertation explores innovation in the field of digital communications and digital platforms and its role in driving larger paradigmatic technology-led change. It looks at the success of the internet as a function of the narrower success of the world wide web, referred henceforth as simply, *the web*.

The work introduces a new theory of innovation called *signal innovation* to analyze empirics consisting of primary source research through a historical case study detailing the origin moment of the world wide web and digital platforms from 1995 to 2001.

Signal innovation theory explains the causes and conditions behind *general-purpose technologies,* global pathbreaking technology transformations that induce large-scale social, economic, and geopolitical change. Though research exists on the economic contributions, dynamics, and classification of general-purpose technologies, less has been written on the nature, root causes, and dynamics inspiring their adoption and diffusion. As one scholar specializing in the field of innovation presented the issue, "A fundamental problem in the field of the economics

[1] Castells (2010), McAfee and Brynjolfsson (2014). See also See Schwab (2017) and the United Nations Industrial Development Organization program on Industry 4.0 at https://www.unido.org/unido-industry-40. (2022). Also see "Making the Fourth Industrial Revolution Work for All," https://unece.org/fileadmin/DAM/ceci/documents/2018/ICP/TOS-ICP/draft_programme_2910.pdf.

of innovation is how to explain the sources of path-breaking innovations that support the human development and socio-economic progress in complex societies." He and other scholars contend with how economic subjects, operating under what conditions, cause and sustain general-purpose technologies, the core of technological and economic change.[2]

The theory of *signal innovation* is introduced and applied to *the web* to explain how *the internet* found successful global adoption and diffusion as a general-purpose technology. The *web* is a signal innovation. It unlocked through improved user experience and business economic factors the power of the internet, a general-purpose technology. This dissertation explains how this happened. It sets forth guidelines for future inquiry into the dynamics of technological revolution and ends with a review of possible applications in the domain of decentralized web3 technologies.

Given that this work brings together multiple disciplines in a case study of the web, history offers a template for exploring technological innovation. Anticipating and navigating the future well depends on understanding the causal relationships between and among phenomena that drive change. A historical study of the specific (the web and the internet) can offer clues toward understanding the universal (other transformational technologies).[3] Our modern digital platform economy, which consists of virtualized online landing areas for connection and transaction, is a consequence of the development, adoption, and diffusion of the digital network platform of the world wide web, which is the specific focus of this dissertation.[4] To understand what a future digital network platform built around the blockchain might hold, for example, it makes sense to

[2] Coccia (2015), Colombo, Franzoni and Veugelers (2015).

[3] This work begins from the philosophical stance that an objective reality exists and can be tested via first principles thinking. It takes as a central assumption that principles can be generalized to understanding the past and future, and that encompassing, objective, systems-level thinking can aid in the building of an economic, political, and financial world that fosters ever greater levels of human well-being. This is a reason-based treatment of technological innovation. It leaves aside critical theories and socially constructed approaches.

[4] Cusumano, Gawer, and Yoffie (2019), Evans, Hagiu and Schmalensee (2008), Srnicek, (2017), Wu (2017).

start with the adoption and diffusion of the world wide web, the first global digital network platform.

Netscape Navigator and Microsoft Internet Explorer each contributed to the standards now commonplace for the web.[5] This dissertation develops a history of the development, adoption, and diffusion of the web by focusing on the desktop web browsing sector. Specific attention is paid to Netscape and Microsoft, the two companies most responsible for the web and internet's achievement of adoption escape velocity between the years 1995 and 2001. These companies produced the software and products that catalyzed the web's growth and the expansion of the web and internet's infrastructure. By peering into these companies during this time period and investigating the activities surrounding their web browsing products—Navigator and Internet Explorer—we can reason inductively the "how" and "why" behind the web's growth and the internet's transformative power. The consequences of digital network platforms are empirically validated in the sustained high-performance and profitability of, among others, the web and "Big Tech" corporate entities operating in the space, the socioeconomic impact of zero marginal cost internet-based digital goods and services, the elimination of transaction and friction costs brought about by digital technologies, and the accelerating technical developments occurring in artificial intelligence, machine learning, natural language processing, encryption, and virtual reality, which rely on the internet and web in order to function.

[5] Berners-Lee and Fischetti (1999), Greenstein (2012).

*Research Structure and Approach*

Framed as a historical question this dissertation asks: How did the internet gain traction as a general-purpose technology, growing, evolving, adopting, and diffusing with such speed and transformative power? Framed as a question of the social science the dissertation asks: How do we explain technological innovations that become widely adopted and diffused, and emerge as general-purpose technologies—those innovations that exert profound change across economies, polities, and societies at the national or global level? More narrowly, what are the principles or critical factors that explain general-purpose technologies? More broadly, why do specific technologies take over the world, changing everything, while others do not?

This uses the theory of signal innovation to open the black box of *general-purpose technologies* and answer these questions. Signal innovations explain the emergence of transformational technologies classified as general-purpose.[6] The twofold combination of internet-built technologies, first the web itself and the protocols later implemented to secure information exchange—specifically payments and transactions—and second, the usability and innovative user experience of the personal web browser, are explored in detail. This work offers a close historical analysis of a technology innovation of real consequence—the internet—and a social sciences explanation of the factors and conditions that precipitated innovation-led global change. Signal innovations explain the causes and conditions behind general-purpose technologies. A thorough analysis of three core technology developmental pathways in (1) personal web browsing software, (2) web-based billing, payments, and financial transaction protocols, and (3) web-based encryption methods, from years 1995 through 2001, constitutes the bulk of the historical work.

[6] In the sciences, a black box is understood as a system or process that can be viewed in terms of its inputs and outputs without knowledge of its internal workings. Opening a black box in context here refers to understanding the inner workings of the system or process called general-purpose technologies.

The work opens the black box of general-purpose technologies for analysis. It hypothesizes that innovation system catalysts known as signal innovations, which are built upon the technologies retrospectively classified as general-purpose technologies, help foster a general-purpose technology's adoption and diffusion.

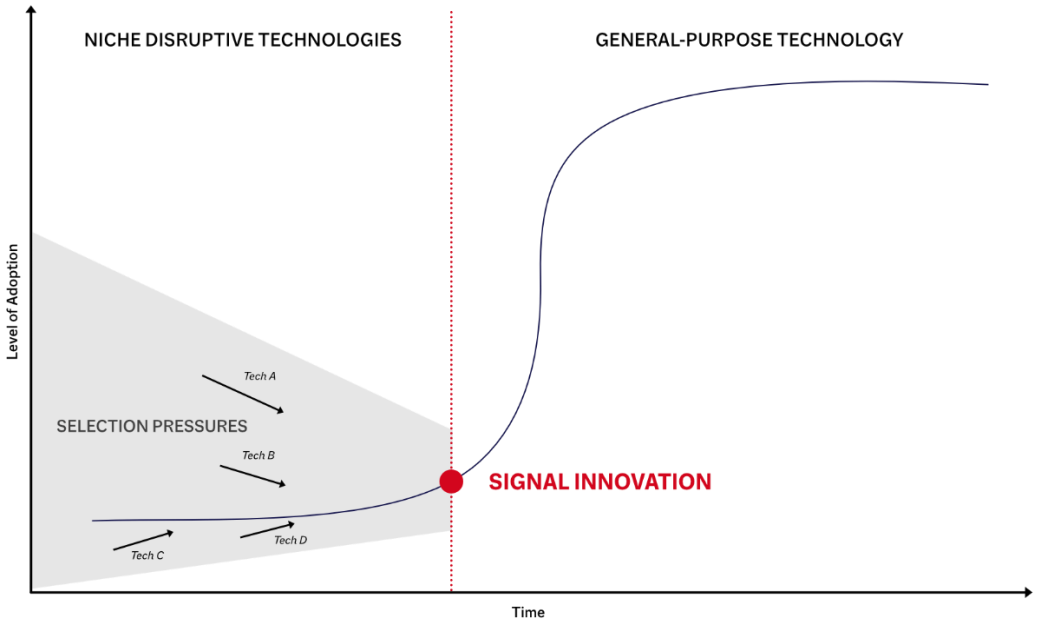


Figure 1.1 – Signal innovation and general-purpose technology adoption curve

This dissertation benefited from the thoughtful comments of my committee members. It reflects insight from subject matter experts in global economic history, finance and business economics, managerial economics and strategy, and political science, national security, and global affairs. What began as a descriptive theoretical construct and classifier through discourse rematerialized as a predictive model. Future contributions to signal innovation theory development will focus on the building of quantitative measures and analyses. For now, ex-ante identification of a signal innovation requires capturing a mutually exclusive and comprehensively exhaustive set

of nascent technical innovations generating hype and interest coincident and paired with a better-established technology upon which the possible signal innovation is being built.

The theory of signal innovation is articulated within a context and review of interdisciplinary literature on technology innovation to support the disciplinary methods of the paper. The theory draws from business management and mainstream economics and leverages findings in the behavioral sciences and behavioral finance—specifically narrative economics—in addition to contemporary and historical legal and international political economic literature. From the management and economic fields, endogenous growth theory, long-wave economic and business cycles, and creative destruction contribute intermediary theoretical framing to the signal innovation concept. Additional literature on economic bubbles and bubble economies, complexity sciences, and user experience design further supports the argument. Literature on anti-trust findings and analyses helps situate the question of paradigmatic innovation and the drive toward monopoly that accompany large-scale technological change.

A thorough description of the signal innovation model is covered in Chapter 2. Eight (8) defining principles that detail the nature and structure of signal innovations and (5) pre-incident indicators that enable forecasting future signal innovation-general-purpose technology pairings are presented. This translates what would otherwise be a historical classifier for usage ex-post into a model that accommodates ex-ante prediction. To anticipate this discussion, signal innovations must represent distinct technology innovations unto themselves, which build upon and catalyze the later growth, development, adoption, and diffusion of a more fundamental transformational technology. Signal innovations must serve as the focal point for a set of economic narratives surrounding said transformational technology and function as technological intermediaries that unlock the utility or value of a more fundamental technology. Finally, they must operate or have

operated in relation to a technology classified as a general-purpose technology, and have catalyzed the proliferation, adoption, and diffusion of said fundamental technology such that in retrospect it classifies as general-purpose technology.

The dissertation proceeds as follows: Chapter 1, this chapter, titled "Introduction and Overview," introduces technology innovation as an interdisciplinary global policy and strategy topic of inquiry. It presents a mutually exclusive and comprehensively exhaustive theory of signal innovation for understanding the causes and conditions of paradigmatic technology-led change. It establishes the theoretical and empirical methods used in the dissertation, reviews the logic driving the approach, and prefaces the contents of the study.

Chapter 2, titled "Theoretical Context and Literature Review," details signal innovations as a testable theory and answer to the question of what causes the emergence of general-purpose technologies. Multiple disciplines and their treatments of innovation as a concept support the advance of signal innovation as a new theory. The work builds a bridge toward a better understanding of the causal mechanisms responsible for technology-led transformations. As stated earlier, in spite of robust classification of and theorizing on the nature of transformative technological innovations, a thorough description of their causes remains outstanding and is requiring of further study.

Chapter 3, titled "Research Chronology & Summary," features a reference timeline and summary of the contents of the historical narrative. Chapter 4, titled "Netscape, Microsoft, and the Browser Wars," Chapter 5, titled "The Digital Economy and the Browser War Boom," Chapter 6, titled "The Transaction Wars and Digital Currency," and Chapter 7, titled "The Encryption Wars, Fintech, and New Frontiers" form the bulk of the work and feature empirical analysis supporting a narrative history of the origin moment and rise of the web from 1995-2001. The web serves as a

case study of signal innovation. The theory of signal innovation and the case of the web demonstrate how the evolution, adoption, and diffusion of the internet's growth and emergence as a general-purpose technology.

The narrative histories of these three conflicts of the web each involve transformational technology firms operating amidst myriad forces promoting innovation, including technology, global finance, and geopolitical trends. These conflicts served as the basis for the modern information and communication technology-driven world, the present platform economy, and the nascent decentralized web3 revolution. The empirical chapters of the work provide one of the first comprehensive primary source research on the institutions, individuals, and technical advancements behind the emergence of the digital platform economy.

Chapter 8, titled "Concluding Thoughts and Extensions," offers potential applications and extensions of the theory. It makes initial moves toward explaining the advent and significance of decentralization technology products and services (i.e., web3 technologies). Topics discussed include decentralized finance (DeFi), cryptocurrencies, smart contracts (all resting on the blockchain) and their collective impact on future technology developments. Space is allotted to understand varying political-economic trends resulting from the web's continuing transformative effects and present day web3 developments.

The work concludes with an epilogue extending the theory of signal innovations to an examination of present-day trends suggestive of newly emergent general-purpose technologies. Technologists, business analysts, and researchers are postulating that the blockchain may later be understood as a general-purpose technology unto itself. Blockchain's utility as a technology resides in mitigating or eliminating altogether the trust and transparency-related issues of the internet. Initial exploration of trends in the decentralized web—which resides on the blockchain—

including cryptocurrencies, smart contracts, and nonfungible tokens will help open the door to new applications of signal innovation theory and forecasting the probability of the blockchain becoming a general-purpose technology.

## Chapter 2 – Theoretical Context and Literature Review

*Signal Innovations and General-Purpose Technologies—Innovation Defined—Innovation Processes, Diffusion and Adoption, and Economic Growth— Narrative Economics, Adaptive Markets, and the Rise of the Web—The Fintech and Web Narratives of Digital Economy Origins*

In this chapter I introduce signal innovations (SIs) as a testable theory and answer to the question of "What causal factors or conditions explain technological innovations that emerge as general-purpose technologies (GPTs)?" I posit the theory of signal innovation in context of a review and analysis of the interdisciplinary innovation literature. The purpose of this chapter is to give readers a research foundation for understanding signal innovations and their relationship to general-purpose technologies. The theory of signal innovation fills a gap in the literature by addressing how certain technologies prove to be so impactful and come into widespread use. The material consequence of this being that global politics, economics, and sociocultural dynamics are transformed and said technologies are subsequently classified as general-purpose.

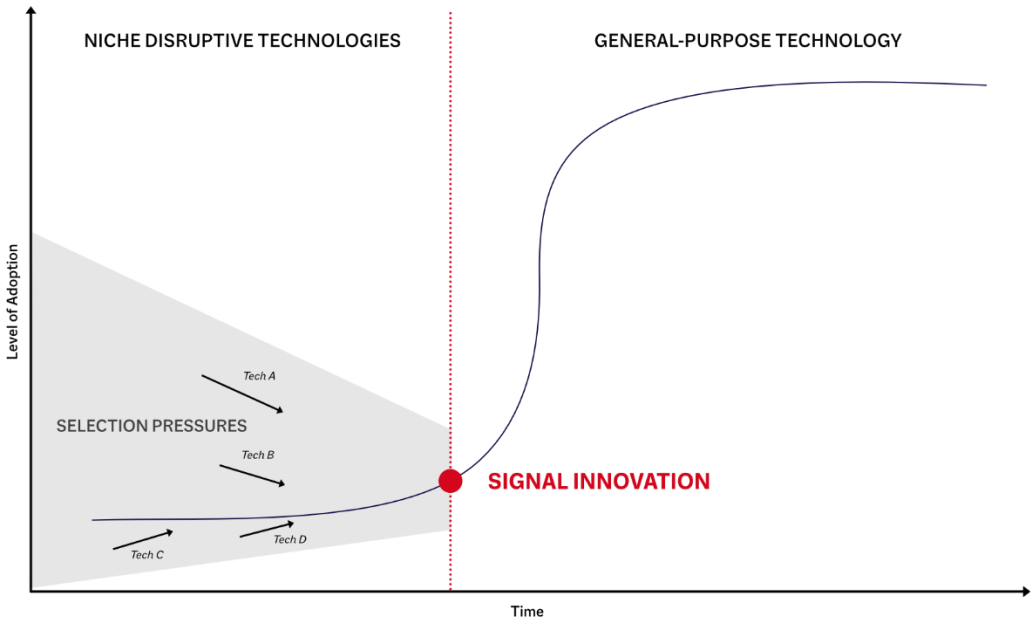


Figure 1.1 – Signal innovation and general-purpose technology adoption curve

As stated in the introduction and restated here for emphasis: Significant research exists on the economic contributions, dynamics, and classification of general-purpose technologies, but

precious little on the nature, root causes, and dynamics inspiring their adoption and diffusion. Competing theories addressing the manifestation of general-purpose technologies are uncommon: As one scholar specializing in the field of innovation presented the issue, "A fundamental problem in the field of the economics of innovation is how to explain the sources of path-breaking innovations that support the human development and socio-economic progress in complex societies." He and other scholars have begun to contend with how economic subjects, operating under what conditions, cause and sustain general-purpose technologies, the core of technological and economic change.[7]

This dissertation benefited tremendously from the comments of my committee members. In reflection of the interdisciplinary nature of this work, the comments incorporated included insight from subject matter experts in global economic history, finance and business economics, managerial economics and strategy, and political science and global affairs, with specific emphasis on the national security implications of digital technologies. What began as a descriptive theoretical construct and classifier was incrementally reframed into a predictive model. Future contributions to signal innovation theory's development will focus on the building of quantitative measures. For now, ex-ante identification of a signal innovation requires qualitative insight into the portfolio of nascent technical innovations generating hype and interest coincident with a better established technology upon which the possible signal innovation is being built. Those intending to forecast signal innovations ex-ante are encouraged to perform comparative case studies of potentially profitable technologies that fit the criteria presented later in this chapter.

A brief caveat before proceeding: The interdisciplinary nature of this work and the interdisciplinary nature of technology innovation research means herein countless debates

[7] Coccia (2015), Colombo, Franzoni and Veugelers (2015).

necessarily will remain unaddressed, discipline-specific treatments of innovation unexplored, and technical details unexplained. The literature review here orients readers toward the most impactful bodies of research that informed the development of signal innovation theory. Certain literatures find direct application in the theory, while others offer additional contrast or context. Where nomenclature has found its way into widespread discourse and practice—Christensen's innovation classifiers, for example—more detail is provided. The chapter gives interested readers gateways into the intellectual influences and precursors to the theory, situating signal innovation theory within a body of technology-centric and economics-centric research it supports or is in dialogue with.

In order for a technology innovation to identify as a signal innovation, a set of eight (8) identifying conditions and characteristics must be met. Case-based investigation and argumentation of the technology artifact should be used to determine whether a given technology innovation can be classified as a signal innovation. A signal innovation must:

1. **Evolve emerging technology.** Build upon and advance the evolution of a more fundamental technology later characterized as general-purpose.
2. **Accelerate user adoption.** Accelerate the adoption and diffusion of said underlying general-purpose technology.
3. **Catalyze innovation ecosystems.** Catalyze the growth of an economic ecosystem around the general-purpose technology.
4. **Intermediate with technology forerunners.** Function as an abstract or concrete technological intermediary between it and the general-purpose technology.
5. **Enhance user experience.** Unlock the usability or value of a general-purpose technology through an enhanced user experience (i.e., usability).

6. **Drive market growth.** Unlock the financial, commercial, or broader business economic potential of the general-purpose technology.
7. **Unlock new value.** Unlock the consumer-relevance and value competitiveness of the general-purpose technology.
8. **Inspire new narratives.** Build upon existing or inspire new economic or innovation narratives surrounding the general-purpose technology.

Thus, a signal innovation is the specific instantiation of a more fundamental technology, a technology systems intermediary, and an innovation ecosystem progenitor that explains the adoption and diffusion of technologies later classified as general-purpose. Signal innovations are technological innovations that operate as systems catalysts built atop general-purpose technologies. Through improved user experience, technical elegance, and converging economic and innovation narratives, a signal innovation unlocks the utility of the more fundamental, underlying, general-purpose technology. Signal innovations in this sense are at once a layer of technological utility built upon a yet-to-be classified and not yet fully actualized general-purpose technology, while also the prime catalyst for the broader innovation system the general-purpose technology underpins. Signal innovations serve as a bridge between the economics-first, systems-level analyses manifest in the general-purpose technology literature (a macro- or meso-level analysis), and the technology-first, firm, individual, or factor-level analyses manifest in signal innovation inquiry (a micro-level approach). Where general-purpose technology and related approaches are interested in systemic conditions, causal mechanisms of adoption and diffusion are generally not the focus of said studies. Signal innovation theory poses here as a corrective.

Drawing from the literature on risk assessment and analysis, specifically open source intelligence and threat analysis, we can apply the same concept to signal innovations, which can

be understood as the inciting incident responsible for the ascent of a general-purpose technology. Thinking in terms of pre-incident indicators, a prospective signal innovation will map to the following five (5) elements. These pre-incident indicators support ex-ante identification of all possible or a defined set of prospective signal innovations. Where the eight principles describe the "what" of a signal innovation, these five elements describe the "how," and what forecasters should look for in anticipation of new signal innovation-general-purpose technology pairings.

1. **Underutilized disruptive technology.** A significant, disruptive, but niche technological artifact or development limited by technical complexity, usability and interfacing capabilities, and product and service use case application. *This the fundamental technology that has the potential to emerge as general-purpose, which often has existed for some time but never achieved general-purpose "escape velocity."*
2. **Competitive innovation ecosystem.** An emerging and highly rivalrous series of complementary technical innovations, built upon said artifact and demarcating a new market ecosystem of no clear winners and aggressive competition. *These are the innovations advancing the fundamental technology and competing for signal innovation status, drawing focus to the underutilized disruptive technology.*
3. **Compelling narratives.** An explosion of economic narratives surrounding said technical market ecosystem, covered more favorably in new media outlets, less favorably in established media outlets, and inspiring new terms and new uses of existing terms. *This circulation of narratives around a singular disruptive technology, amplified by the influx of technical innovations, suggests a higher probability of a signal innovation-general-purpose technology pairing.*

4. **Incumbent investment.** Major investment by incumbent institutions into the productization of a technical innovation, unlocking the business economics and user experience factors of a more fundamental technology, often in competition with smaller, disruptive entrants. *Investment activity by large and established market incumbents drives additional focus and increases market speculation.*
5. **Business model transformation.** Accelerated repurposing of how large institutions carry out business and profit-making activities, coincident with the adoption of said complementary technical innovation. *The emergence of new business models is the last step in the temporal transition from underutilized to general-purpose technology via the instantiation of a signal innovation and general-purpose technology pairing.*

The present work attempts to develop and detail the overall causal architecture behind the adoption, diffusion, emergence, and final designation of technologies as general-purpose. The rest of this chapter will explore the concept of signal innovation in greater detail, specifying its relation to general-purpose technologies, and spend considerable time on the theoretical research and context within which the theory was developed.

### *Signal Innovations and General-Purpose Technologies*

Technologies that come into wide use, enact social, political, and economic transformation on a global scale, and generate spillover effects are described in the literature as *general-purpose technologies*.[8] These technologies are defined as having precipitated revolutionary change from

[8] Andergassen, Nardini and Ricottilli (2017), Bresnahan and Trajtenberg (1995), Helpman (1998), Rosenberg and Nathan (1982), Landes (2003), Carlaw, Lipsey and Bekar (2005), Jovanovic and Rousseau (2005).

preexisting technological trajectories.[9] General-purpose technologies yield outsized impact of technological paradigms, and impart a cascade of social, political, and economic changes at a national or global scale. They exhibit a great capacity for continuous improvement, come in to widely adopted and diffused use, and demonstrate *technological complementarities*.[10] Complementarities here refers to the second and third-order effects of general-purpose technologies. The emergence of respective signal innovations changes the value of technologies subsequently classified as general-purpose, generating opportunities to alter or modify said preexisting general-purpose technologies or create entirely new general-purpose technologies.[11] General-purpose technologies are characterized by their pervasiveness, intrinsic capacity for technical improvement, and the increasing returns-to-scale as seen in the cases of the steam engine, the electric motor, and the semiconductor.[12] They exhibit pervasive impact across firms, industries, states, and economies, and a distinctive long-run between their emergence and subsequent influence on socio-economic systems.[13] As path-breaking innovations, however, the causes and conditions of general-purpose technologies remain opaque and not well understood. (Helpman 1998)[14]

The work seeks to introduce greater consilience between economics and other social sciences literature and build a bridge to history, literature, and philosophy in exploring the causes and conditions behind general-purpose technologies.[15] In this manner, this dissertation extends and

[9] Bresnahan (2010).

[10] Lipsey, Bekar and Carlaw (1998), p. 43.

[11] Lipsey, Carlaw and Bekar (2005), p. 103.

[12] Bresnahan and Trajtenberg (1995), p. 83.

[13] David (1990), Lipsey, Bekar and Carlaw (1998), Rosenberg and Trajtenberg (2001).

[14] Bresnahan and Trajtenberg (1995), Helpman (1998), Bresnahan (2010).

[15] Wilson (1998).

deepens the continuing work of scholars engaged in understanding paradigmatic technology transformation by looking at the emergence of recent general-purpose technology packages. The work draws on observations from leading social science scholars who advocate a bridging with the humanities as an antidote to the at times myopic view advanced within other disciplines. I hypothesize that innovation catalysts that I here describe as signal innovations, built upon and reflecting a specific instantiation of the more fundamental general-purpose technologies, inspire general-purpose technologies' broad-based adoption, diffusion, and impact. This work takes first steps toward opening the black boxed causal conditions of general-purpose technologies for further analysis. It places at the center of the discussion the concept of signal innovations, which operate as technological intermediaries, development and adoption accelerators, and critical path inflection points for the adoption and diffusion of underlying general-purpose technologies. As such, this work's broadest contribution to the interdisciplinary innovation literature comes through the introduction and initial articulation of the concept of signal innovation. The aim here is to understand the causes and conditions of general-purpose technologies, making an initial explanatory effort through the prism of interdisciplinary history, further dissolving the notion of transformational innovation as a black box of driving factors.

While outside the scope of this work, future papers will elaborate and further detail other signal innovations. Economists Richard Lipsey and Kenneth Carlaw suggest, as elucidated earlier in the paper, that based on their original delineation and subsequent review of the general-purpose technology literature, there have only been 24 technologies in history that can be classified as true general-purpose technologies.[16] They define a general-purpose technology as a product, process, or organizational system that fits with the four criteria listed below:

[16] Lipsey, Carlaw, and Bekar (2005).

1. is a single, recognizable, generic technology
2. exhibits early potential for improvement and later comes into wide use across the economy
3. demonstrates an array of differentiated use cases
4. generates many spillover effects

Much can be said and has been said about the applicability of the concept general-purpose technologies and its definition. This paper is less concerned with wading into narrow debates about what pathbreaking, paradigm-shifting technologies fit or do not fit the definition, or the edge cases for how that definition is crystallized and what technologies are best considered general-purpose. Rather, it is more concerned with understanding the dynamics driving global technological impact. To that end, the signal innovations I initially couple here with general-purposes technologies are relatively non-controversial choices to facilitate testing of the theory.

Lipsey and Carlaw identify 24 general-purpose technologies.[17] Cases worth examining that that fit two key dimensions of one (1), being at once highly accessible and intuitively comprehensible, as well as two (2), historically relevant and of high-yield for insight and intellectual inquiry—thus likely to amend, update, or further detail signal innovation theory—while also adhering to definitional factors of signal innovation are as follows. In this case, the general-purpose technologies underlying the signal innovations identified here exhibit broad-based consensus and are generally non-controversial while also being of genuine relevance.

[17] Lipsey, Carlaw and Bekar (2005). See also "General-purpose technology" at https://en.wikipedia.org/wiki/General-purpose_technology. Lipsey (2007) details the logic of constituting any given technology as a general-purpose technology.

| GPT | SI | Date of SI[18] |
|---|---|---|
| Automobile | Ford Model T | 1908 |
| Computer | IBM Model 5150 | 1969 |
| Internet | Netscape Navigator | 1994 |
| Airplane | Boeing 707 | 1957 |

Figure 1.2 – Signal innovation and general-purpose technology pairings

In the explanatory context of general-purpose technologies, a signal innovation is a technology innovation built upon a more fundamental technology. It catalyzes the sustained adoption and diffusion of the fundamental technology in two ways. It does so first by unlocking the greater utility or value of the fundamental technology through a radical improvement in user experience. This can be accomplished through improved user interface design, transference of use cases, elegance of the signal innovation, or by virtue of the scale and reach of the signal innovation's promoting institutions. The second way adoption escape velocity is achieved is by activating business economic dimensions—potential markets and applications—heretofore ambiguous, unclear, or otherwise unaddressed in the more fundamental technology. These factors include the fundamental technology's underlying (1) macroeconomic potential, (2) business investment potential, and (3) consumer spending potential. These factors map roughly to a market-

[18] Designated in accordance with the successful diffusion and adoption of the underlying general-purpose technology. Generally coincident with broad-based economic impact and paradigmatic shift of the national / global socioeconomic and often global geopolitical architecture.

level, firm-level, and individual or household levels of business economic or international political economic analysis.

Thus, signal innovations must represent distinct technology innovations unto themselves, build upon and in kind catalyze the growth, development, adoption, and diffusion of a more fundamental transformational technology. They must unlock the utility or value of a more fundamental technology and activate a set of economic factors surrounding a distinct technology advance and broader transformational technology, thus serving as technological intermediaries to Finally, they must operate or have operated in relation to a technology classified as a general-purpose technology, and advanced the proliferation, adoption, and diffusion of said fundamental technology such that in retrospect it is properly classified as a general-purpose technology. Included again here for reference are the eight (8) principles of signal innovation theory. Signal innovations must:

1. **Evolve emerging technology.** Build upon and advance the evolution of a more fundamental technology later characterized as general-purpose.
2. **Accelerate user adoption.** Accelerate the adoption and diffusion of said underlying general-purpose technology.
3. **Catalyze innovation ecosystems.** Catalyze the growth of an economic ecosystem around the general-purpose technology.
4. **Intermediate with technology forerunners.** Function as an abstract or concrete technological intermediary between it and the general-purpose technology.
5. **Enhance user experience.** Unlock the usability or value of a general-purpose technology through an enhanced user experience.

6. **Drive market growth.** Unlock the financial, commercial, or broader business economic potential of the general-purpose technology.
7. **Unlock new value.** Unlock the consumer-relevance and value competitiveness of the general-purpose technology.
8. **Inspire new narratives.** Build upon existing or inspire new economic or innovation narratives surrounding the general-purpose technology.

Also repeated are the five (5) pre-incident indicators used for ex-ante identification, which requires insight into the portfolio of nascent technical innovations generating hype and interest coincident with a better established technology upon which the possible signal innovation is being built. These include the presence of:

1. **Underutilized disruptive technology.** A significant, disruptive, but niche technological artifact or development limited by technical complexity, usability and interfacing capabilities, and product and service use case application. *This the fundamental technology that has the potential to emerge as general-purpose, which often has existed for some time but never achieved general-purpose "escape velocity."*
2. **Competitive innovation ecosystem.** An emerging and highly rivalrous series of complementary technical innovations, built upon said artifact and demarcating a new market ecosystem of no clear winners and aggressive competition. *These are the innovations advancing the fundamental technology and competing for signal innovation status, drawing focus to the underutilized disruptive technology.*
3. **Compelling narratives.** An explosion of economic narratives surrounding said technical market ecosystem, covered more favorably in new media outlets, less favorably in established media outlets, and inspiring new terms and new uses of

existing terms. *This circulation of narratives around a singular disruptive technology, amplified by the influx of technical innovations, suggests a higher probability of a signal innovation-general-purpose technology pairing.*

4. **Incumbent investment.** Major investment by incumbent institutions into the productization of a technical innovation, unlocking the business economics and user experience factors of a more fundamental technology, often in competition with smaller, disruptive entrants. *Investment activity by large and established market incumbents drives additional focus and increases market speculation.*
5. **Business model transformation.** Accelerated repurposing of how large institutions carry out business and profit-making activities, coincident with the adoption of said complementary technical innovation. *The emergence of new business models is the last step in the temporal transition from underutilized to general-purpose technology via the instantiation of a signal innovation and general-purpose technology pairing.*

Before turning to the theoretical literature on innovation that ultimately supports signal innovation, I would like to speak briefly to the centrality of user experience design as a fulcrum point in signal innovation theory as a value unlock of a technology that later manifests as a general-purpose technology. The birth of computing technology and computer-human interfaces has placed high-demand on usability, with a great focus on reducing friction costs between users and their intended aims in manipulating digital technologies. The web's popularity and its contributions to the internet's popularity came about due the sincere emphasis on design, and the consistent progress made toward abandoning command line norms of computer-human engagement. User experience design is form of interactive design that encompasses all aspects of

a user's journey with a given technology product. It is the crucial translation of complex back-end technology into understandable, navigable, and elegant or pleasant front-end use.

Given its modern emphasis on physical environments and materials, the design discipline has long been affiliated with the disciplines of science and engineering. The demand for user experience designers in the private sector has utterly transformed the tech sector, where it was once a badge of honor to hold fast to working solely in non-graphical environments. The adoption of the personal computer gave birth to the field cognitive engineering or cognitive ergonomics, a field of human-computer interaction or interface design. Consider that computer scientist Jef Raskin, the founder of the Apple Macintosh project, remains one of the field's most prominent thinkers. Cognitive scientist Don Norman was Apple's first User Experience Architect and continues to be one of the most influential voices in the field of user-centered design or human-centered design. This design discipline underpins much of digital user experience design today. Thinker-practitioners like Raskin and Norman have long advocated empirical interdisciplinary approaches and merging the arts and sciences in the solving of real-world problems.

The digital economy has since spurred the creation of a series of specialized design disciplines, among them web or digital user experience design. Designs have since become less "form givers" and more "fundamental interpreters" of innovative technologies and scientific breakthroughs.[19] In an essay accompanying the 2008 Museum of Modern Art exhibition "Design and the Elastic Mind," a show dedicated to the reciprocal relationship between design and science, curator Paola Antonelli used the graphical user interface of the first personal web browser, Mosaic's to show how designers translate technologies into objects for daily use.:

[19] Antonelli (2008), p. 17.

> Without designers, instead of a virtual city of home pages with windows, doors, buttons, and links, the Internet would still be a series of obscure strings of code, all cars would look like technologically updated Model Ts, and appliances would be reduced to standardized skeletons.[20]

Though neither Marc Andreessen nor Eric Bina were designers, their work as authors of Mosaic makes them "interpreters" of the internet, the focus of this work. Specialized design fields like visualization design, Antonelli argues, help scientists to grasp and work with increasing complexity and scale. Antonelli's use of the term "elastic mind" refers to the "byproduct of adaptability + acceleration"—the human mind's ability to negotiate changes brought upon by the increased pace of innovation in the digital age.[21] Design in many ways helps humans negotiate transformational changes and is central to the signal innovation theory and central to our narrative history of the web.

Both adaptability and the ability to construct a narrative are fundamental to what is considered human intelligence. Our ability to determine what are optimal behaviors is closely tied to these skills.[22] This brings the archival research-reliant narrative economics approach and the practitioner-reliant user experience design field to the cognitive sciences-influenced field of behavioral finance, the three-fold areas of disciplinary influence key to the construction of the signal innovation theory and the narrative history of the web, and the rise of the digital economy.

The signal innovation under investigation in this work is the adoption and diffusion of the personal web browser, and its contributions to the development of our modern unified digital platform riding atop the general-purpose technology of the internet, detailed via historical narrative

[20] Antonelli (2008), p. 15.

[21] Antonelli (2008), p. 14.

[22] Lo (2019), p. 117.

in the subsequent empirical chapters. The internet existed prior to the unified platform of personal web browser and world wide web, but it was not until the advent of the individuated, essential web technologies of the universal resource locator (URL), hypertext markup language (HTML), and hypertext transfer protocol (HTTP), incorporated into an accessible, user-friendly personal web browser, that limits on the web and the internet's underlying potential were lifted. The web as unified digital platform inspired further internet technology innovations and catalyzed a series of second and third-order national and global geopolitical and social-economic effects, which are still being felt today, all congruent with and further validating the internet-as-general-purpose technology and the personal web browser-as-signal innovation logic. The rest of this chapter will detail the bodies of literature that contributed to the construction of this theory and that have supplied its conceptual underpinnings.

### *Innovation Defined*

The term *innovation* has been in use throughout recorded history. But in contrast to its modern laudatory connotations, the word was first an accusation amidst the religious atmosphere of sixteenth and seventeenth century Europe.[23] Innovation as a term later took on scientific connotations in concert with the advance of the Industrial Revolution.[24] By all measures economist Joseph Schumpeter's definition is what finally distinguished innovation from simply *invention*, defined as an act of intellectual creativity undertaken without any thought given to its possible economic import. In Schumpeter's positing, *innovation* occurs when firms figure out how to craft

[23] Green (2013) referencing Godin (2014).

[24] Green (2013).

inventions into constructive changes in their business model. Innovation thus has a deep and consequential economic dimension, but at base, *creativity* in service of *invention* frames the project of innovation. Implicit in this lexicon and its foundational meaning is that progress is not only possible, but desirable. Innovation in this understanding is intertwined with the scientific revolution born from the European Enlightenment. Invention and innovation are thus creative acts of individuals and their brains and their subsequent collision between other individuals and individual brains. David Deutsch, quantum physicist and a pioneer in quantum computing, makes this argument.[25]

In concert with gaining a scientific understanding of the world, this paper takes as its root the skeptical empirical traditions of philosophy, and in particular the negative empiricism of Karl Popper upon which Deutsch's argumentation on progress, scientific, moral, economic, and otherwise is built. Popper argues that creative criticism married with creative conjecture form the basis of language acquisition and all other behaviors and is the mechanism by which meaning is extracted from experience.[26] This is the process ultimately by which knowledge is created, and innovation and progress co-occur. Innovation in its most fundamental form is abstract understanding and human intelligence marshaled forward in the name of problem-solving. It is thinking done in the service of creativity toward the aim of human progress, measured in economic terms, and the creative mechanism by which humans grow, thrive, progress, and provide.

So understanding innovation, clarifying what it is and what it is not, helps bring precision to a term that has come under attack from multiple vectors. This work takes as given that progress and innovation are possible as well as *good,* and that the human condition has improved over the

[25] Deutsch (2019).

[26] Popper (1963).

course of history.[27] If institutions fail to vouchsafe, protect, and steward humanity's innate capacity to innovate, we put at risk literally everything should we fall back into an Orwellian 1984-like catastrophe.[28] The term innovation has recently captured the zeitgeist of our tech-forward times since the late 1990s, making academic inquiries at times challenging. To get a sense of what practitioners and scholars are dealing with, multidisciplinary surveys of the innovation literature have been conducted and identified over 40 definitions.[29] The necessity of innovation and its role in human flourishing and well-being has hopefully been established with this brief summation. The next section attempts to synthesize and harmonize these various understandings of innovation and bring clarity to the debate.

The rise of the Cold War and modern corporate methods of organization began in the 1950s and introduced the popular definition of innovation of *bringing to market a new technology*. Government-funded R&D efforts accelerated within academic institutions and independent research laboratories. In turn, innovation came to be understood as a process rather than a singular act. Lab-borne theoretical research translated into feasible applications that came out the other side as commercialized products or services. Since then, as discussed previously, efforts have been made by scholars to distinguish innovation clearly from mere *invention* or *creativity*—"the production of novel and useful ideas by an individual or small group of individuals working together"—and *innovation*, "the successful implementation of creative ideas within an

[27] Early drafts of this paper delved more deeply into critical approaches and their contentions that progress and innovation are mere illusions, and that prehistoric persons in fact were better off than those of any contemporary civilization. I have put aside these debates given the risk of diverting the reader's attention, and instead ask readers to situate this paper within the context of reason and science-based discourses on the project of human flourishing and prosperity.

[28] Ridley (2020).

[29] Baregheh, Rowley and Sambrook (2009).

organization."[30] Schumpeter's articulation has remained the gold standard on which study of this topic has been built. For Schumpeter, innovation was a social activity or function that represented "new combinations" of new or existing knowledge, resources, and equipment—we can call these factors *assets*—carried out within economic life and serving a commercial purpose.[31] He ascribed this combinatory activity to the domain function of entrepreneurs in society. One could also call entrepreneurs, innovators.

Rosabeth Moth Kanter defined innovation as the generation, admission, and realization of new ideas, products, services, and processes.[32] Peter Drucker, who played a crucial role in articulating the purpose of the executive in twentieth-century corporate America, and would later emerge as the first modern business thought leader, described innovation as follows:

> Innovation is the specific function of entrepreneurship, whether in an existing business, a public service institution, or a new venture started by a lone individual in the family kitchen. It is the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth.[33]

In the 1980s, Drucker systematized Schumpeter's contributions into a model for application in the field of strategic management.[34] Walter Isaacson, probably the most prominent modern and popular biographer of contemporary innovators, argues that innovation occurs at the nexus between science and the humanities, and "not just from invention and not just from vision, but from the people who foster it." For Isaacson, what constitutes innovation is a three-stage

[30] Amabile and Pratt (2016), p. 126.

[31] Schumpeter (1934), p. 65.

[32] Kanter (1983).

[33] Drucker (1998).

[34] Drucker (2014).

process, which consists of invention (the creative elemental), the production (implementation of that creativity), and value delivery, via the creation of new markets, optimization of existing markets, or gains in efficiency. [35] His popular treatment fuses the most highly subscribed academic treatments of the concept with a Great Man theory of history—touched upon later—that a small number of highly agentic individuals shape and old the arc of progress.

A survey by Edison at al. posited the following definition: "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace."[36] Crossan and Apaydin's use of the term in the software development sector has been popularly invoked: "Innovation is production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and the establishment of new management systems. It is both a process and an outcome."[37]

Everett Rogers, a pioneer in the field of innovation diffusion, defined innovation as "An idea, practice, or object that is perceived as new by an individual or other unit of adoption."[38] Notably, Rogers introduced (or re-introduced) a diffusion model of innovation, a borrowing from Gabriel Tarde and his S-shaped diffusion curve. Rogers recognized that the spread of innovation is non-linear. Innovations diffuse and are adopted and thus exhibit a lifecycle defined by a sigmoid curve. The S-curve visual illustrates how a given innovation moves from the innovator to other individuals and groups. In the model, revenue growth or productivity is plotted against time. The

[35] Isaacson (2014), p. 150.

[36] Edison, Ali and Torkar (2013).

[37] Crossan and Apaydin (2010), p. 1166.

[38] Rogers (2010), p. 12.

initial slow growth of an innovation continues until an inflection point is reached whereby demand and growth rapidly increase. Incremental innovations, changes, or improvements to the product then help sustain growth. As an innovation reaches the limits of its lifecycle, growth slows as the innovation reaches a saturation point. In later stages, more investment yields rapidly diminishing returns, if any at all, until the innovation is supplanted by newer technologies. This cyclical nature of technology innovation and economic advance encapsulates the creative destructive aspects built into capitalism—with its repeating business cycles of boom and bust—so described by Schumpeter, whom we turn to first in discussing innovation processes and economic growth.

### *Innovation Processes, Diffusion and Adoption, and Economic Growth*

Schumpeter viewed economic growth, business cycles, and innovation as inexorably tied, with innovation being the means of value generation that drives economic development.[39] Scholarship in the field of strategic management has validated Schumpeter's original statement. As but one example Davila, Epstein, and Shelton describe in their 2006 treatment of organization-led innovation, "Companies cannot grow through cost reduction and reengineering alone… Innovation is the key element in providing aggressive top-line growth, and for increasing bottom-line results." As Schumpeter famously argued, "creative destruction is the essential fact about capitalism."[40]

Schumpeter's observations about the role of innovation in economic growth helped define the concept as a locus of study, namely how combinations of existing resources in new form create

[39] Davila, Epstein, and Shelton (2012), p. 6.

[40] Schumpeter (1942), p. 83.

value in the world.[41] Schumpeter also discerned that the clustering patterns of innovative periods of time generated business cycles and "long waves" in the world economy.[42] This concept has since been expanded upon and applied to present-day digital platforms.[43] Innovation adoption and diffusion mechanisms and a model for understanding them were introduced into the mainstream of management via Rogers and his S-curve model.[44] Since Schumpeter and Rogers' analyses, innovation as a topic of inquiry has expanded in disciplinary scope.[45] A recent assessment of the literature disaggregated various constructs utilized in differing innovation models, and classified adoption and diffusion drivers based on meta-level explanatory devices, including social factors, economic factors, organizational factors, etc.[46]

Recently, the economic and financial growth of the web, and the role it and other digital platforms played in the dot-com boom, have inspired inquiry into the dynamics of platforms, their high-growth, high-yield business models and embedded capacity to monopolize certain markets.[47] Analyses in this vein have focused on the multi-sided nature of platforms, which allow for direct interaction between multiple sets of customers enabled by the platform.[48] Given the primacy and market capture of platforms, new questions have been raised around the implications these platforms have on industries, business strategy, and the future of global capitalism itself.[49] Broad-based socioeconomic and geopolitical assessments of technological innovation have assessed the

[41] Fagerberg (2004), Fagerberg, Mowery, and Nelson (2006), Shionoya (1997), Swedberg (2013).

[42] Schumpeter (1934), Schumpeter (1939), Hippel (2017).

[43] Wu (2010).

[44] Rogers (2010).

[45] Fagerberg, Mowery, and Nelson (2006).

[46] Wisdom, Chor, Hoagwood, and Horwitz (2014).

[47] Evans (2003), Wu (2018).

[48] Evans, Hagiu, and Schmalensee (2008), Evans and Schmalensee (2016), Evans and Schmalensee (2013).

[49] Srnicek (2017), Cusumano, Gawer, and Yoffie (2019).

impact of digital network platforms on governments, seeking to understand whether state actors are empowered by these innovations, are diminished by them, or are reconfigured due to the presence of intervening variables.[50] Other analyses in this vein emphasize pioneering leadership, geopolitical and cultural circumstance, or digital technologies and digital network platforms' distinctiveness.[51] Several authors have emphasized the role that financial regulation or deregulation has played, with access to cheap credit emboldening high levels of risk-taking and accompanying innovative enterprises.[52] Finally, the complexity sciences are exploring innovation as a property of self-organized emergent systems, focusing on the role of emergence, spontaneous order, adaptation, and feedback loops, among other properties. (Taleb 2007)[53]

Innovation as a source of competitive advantage and firm-level success has since been explored in several management studies.[54] Michael Porter later tied innovation with competitive performance, arguing that agents achieve competitive advantage via innovation.[55] He also discussed at length the importance of actively cultivating clusters of innovation as a matter of policy.[56] Porter was deeply influenced by his mentor, Clayton Christensen, whose subsequent work on disruptive innovation, *The Innovator's Dilemma,* emerged as a guidebook of sorts for those precipitating the dot-com boom. (Christensen 1997)[57] Innovation matters, in this study's argumentation, to the degree that it confers value upon the world. As the term innovation has come

[50] Friedman, (2006). Wu and Goldsmith (2020), Ferguson (2017).

[51] Brynjolfsson and McAfee (2014). Haskel and Westlake (2018), Collins and Hansen (2011).

[52] Castells (2010), Collier (2018), Metzler (2013), Tooze (2018).

[53] Taleb (2007), West (2017).

[54] Henderson and Clark (1990), Michael and Philip (1986), Anderson and Tushman (1990), Anderson and Tushman (1991), Tushman and Anderson (1997).

[55] Gehl and Porter (2020), Porter (1980), Porter (1998), Porter and Kramer (2006).

[56] Porter (2011).

[57] Christensen (1997).

into widespread use, other types of innovation, such as social innovation, have demarcated new lines of inquiry outside the exclusive domain of markets and economics. For our purposes, however, we will remain centered on its more classical conceptualization, as a sort of applied creativity intended to positively impact economic growth, human flourishing, and general prosperity.

Clayton Christensen, progenitor of the theory of disruptive innovation, offers a third path. Recognizing that the Enlightenment brought about both the formal principles to support new ideas in science, and that the same reason-based approach was leveraged in building institutions, Christensen argues that these options insufficiently capture the truth behind long-term, sustainable economic growth, and hence progress. Updating and revising his previous taxonomy, Christensen argues that *market-creating innovations*—previously designated *disruptive innovations*—drive economic growth, development, progress, and prosperity.[58] Christensen contends that economic growth and development is a function of market-creating innovation. The zero-cost transfer of ideas—"knowledge spillovers"—fails to account for the time, materials, and investment necessary to translate any given idea into material reality. Successful innovation requires focus, commitment, and oftentimes sheer will to get any given idea off the ground. In fact, most innovations never make it past the first hurdle of getting beyond the research laboratory. Christensen takes issue with "expert consensus," and points to history, which demonstrates that market-creating innovation catalyzes institutional growth, "not the other way around." Christensen writes, "Institutions represent the adaptive response of human communities to changes in the environment." He invokes

[58] Christensen, et. al. (2019), p. 10-11.

the example of the automobile, used in city centers, which beget traffic signs, traffic lights, traffic laws, and the rest. Christensen concludes his argument as follows:

> In very different ways, ideas-based and institution-based theories of economic development both fail to account adequately for the central role of market-creating innovation and its close relative, individual agency. Individual agency and innovation bring ideas into economic practice and in so doing they shape the evolution of institutions.[59]

Christensen, as one of innovation's most recognizable exponents, describes the term as "overused and 'under-understood.'" For him, and consistent with Schumpeter, innovation is "a change in the process by which an organization transforms labor, capital, materials, or information into products and services of greater value."[60] Thus technology and newness, even the notion of *invention*, need not be included. In terms of economic value creation, innovations can be market-creating, market-sustaining, or improve efficiency.

*Disruptive innovation*—as of 2019 now referred to as *market-creating innovation*—is an innovation that creates a new market by providing a different set of values, which ultimately (and unexpectedly) overtakes an existing market (e.g., the lower-priced, affordable Ford Model T, which displaced horse-drawn carriages). Interestingly, in 2019, Lingfei Wu, Dashun Wang, and James A. Evans expanded the use of the term disruptive innovation and generalized it to describe the explosion of disruptive science and technological advances from their study of more than 65 million papers, patents and software products from the period 1954–2014.[61] This renewed articulation, and the immense popularity of the piece (it was prominently featured in the academic

[59] Christensen, et. al. (2019), p. 11.

[60] Christensen, et. al. (2019), p. 12.

[61] Wu, Wang, and Evans (2019).

journal *Nature*) may have led Christensen to rename his core innovation theorem. According to Christensen, market-creating/disruptive innovations are critical to long-term success in business and often enabled by disruptive technology. They create new markets that serve people for whom either no products existed, or existing products were not accessible for a variety of reasons, including cost, complexity, or accessibility. Consider, for example, the Apple Macintosh's graphical user interface, which disrupted the command-line dominated IBM/PC compatible personal computing market. In some cases, such innovation can create entirely new product categories.[62]

*Sustaining innovations*, in contrast, are improvements to existing product or services, targeting customers who demand better performance. Sustaining innovations underpin competitiveness (for countries, corporations, or otherwise), but their impact on an economy differs from that of market-creating innovations: companies, for example, need not build new sales, distribution, marketing, and manufacturing systems to support sustaining innovations. A new model of a BMW sedan, to take but one example, will still rely on the same channels and target the same customer group, despite its innovativeness as a vehicle in the auto industry. Lastly, *efficiency innovations* enable ventures to do more with less. While retaining their existing business models, companies optimize operations to extract the most from their resource base, typically in the process domain. In competitive sectors this helps companies stay aloft and free up cash flow. Outsourcing is perhaps the most obvious example, where a firm reduces costs by moving operations to geographies where labor or capital is cheaper, or technology implementations, which streamline processes and improve performance. Commodity based and low-wage manufacturing industries rely heavily on efficiency innovations to sustain their operations.

[62] Christensen, Raynor, and McDonald (2015), Christensen and Overdorf (2000).

Henderson and Clark's 1990 two-by-two Innovation Model, which predates Christensen's work, is worth noting. Unlike Christensen's model, there is no explanatory dimension, nor any specific calls to action. From this standpoint, it is clear it was one of the first attempts to begin to segment and qualify innovations based on their relative impacts. In the Henderson and Clark model, *radical innovations* establish a new dominant design and, hence, a new set of core design concepts embodied in components that are linked together in a new architecture. *Incremental innovations* refine and extend an established design. Improvement occurs in individual components, but the underlying core design concepts, and the links between them, remain the same. *Architectural innovations* change only the relationships between the core design concepts. Lastly, *modular innovations* change only the core design concepts of a technology.[63]

Central to the discussion of economic growth, since at least the 1950s, have been two differing schools of thought. The first line of argumentation posits that ideas are what drive economic growth. This line of thinking is associated most strongly with the economist Paul Romer. Ideas are easily replicable and highly transmittable, easy to share at minimal cost, and thus can be produced, and readily copied, fueling sustained economic growth in ways that are not possible for other factors of production. Economic growth occurs wherever and whenever individuals appropriate resources and rearrange them in ways such that their value is increased in a combined and arranged state.[64] Such "recombinant growth" has been proven out in technological solutions such as 3D printing, autonomous vehicles, robotics, and artificial intelligence. This is why increasingly, given the rapid advancements in transportation and communication (not surprisingly innovations in of themselves), theorems of factor endowments—the amount of land, labor, capital,

[63] Henderson and Clark (1990).

[64] Martin (1998).

and entrepreneurship that a country possesses and can exploit for manufacturing and comparative advantage today—miss critical dimensions of the post-industrial economies where products and services can be propagated at zero marginal cost due to their digital, virtualized nature.[65] The second line of argumentation deemphasizes the importance of ideas and instead argues that institutions, not ideas, drive economic growth. Absent healthy institutions—financial, judicial, legal, political, or otherwise—either formal or informal, no number of brilliant ideas will foster progress. Much of the literature on international development aligns with this latter position, seeing institutions as the necessary precondition to human flourishment and political-economic progress.[66]

Schumpeter's treatment of the innovation-economic growth has been carried forth into modern-day economics, with economists such as Romer introducing combinatorial growth and nonrivalry of knowledge into the lexicon.[67] A key insight of Romer's was to develop an economics of ideas which definitionally are non-rivalrous. An idea—a blueprint of behavior if you will—can be deployed by multiple economic agents simultaneously without impeding the possibility of potentially unbounded "additional users." Ideas then have a natural property to generate aggregate nondecreasing returns to scale. Romer recognized the non-rivalrous character of ideas would render their outputs unprofitable lest some exclusion mechanism be built in to regulate access. We have seen this in using encryption technology, proprietary algorithms, or subscription fees, among other barrier options. In economics, the field of Endogenous Growth Theory (EGT) opened the door to serious inquiry into innovation and entrepreneurship in the modern day, bridging

[65] Entry for "International Trade" in the Encyclopedia Britannica, https://www.britannica.com/topic/international-trade.

[66] Christensen, et. al. (2019), p. 10.

[67] Romer (2021).

neoclassical economics with understandings of long-term growth and economic development postulated most notably by Schumpeter. This is in contrast to classical and neoclassical theories of economic growth, which situates private investment into technological research and development as the prime movers of economic development. Indeed, by exploring the determinants of incentives for economic agents to conduct R&D and generally make productivity-enhancing investments, one could study the role of institutional rules and policies in shaping the trajectory of productivity improvement that ultimately determines long-run prosperity as well as development through *catch-up growth*. Researchers have relied on the insights from EGT to study the impact of public policy and political economy factors shaping how societies prosper or stagnate based on the nature of their institutions.

Since Rogers' seminal work, an enormous body of literature has emerged examining the means by which innovations are adopted and diffuse into societies and economies. A recent comprehensive assessment of various frameworks deconstructed them on the basis of various constructs, or innovation adoption and diffusion drivers. Said works are impossible to describe in detail here as they provide context rather than direct inputs into the theory of signal innovation, and hence only brief mention will be made. These include a factor-based approach to adoption, firm innovation responsiveness, social network models of diffusion, multi-stage adoption frameworks, multi-level frameworks, full contingency adoption models, management-driven characteristics, personal-level adoption attributes, adoption process models, combined individual and organizational adoption barriers and facilitators, research to practice models, process models of program change, reach and effectiveness, multi-step diffusion process frameworks (of which, is a piece alongside research implementation models), evidence-based organizational diffusion

models, diffusion and evaluation processes, synthesized pragmatic models, thematic models, and finally, factor-based conceptual models.[68]

The aforementioned literature relies heavily on insights drawn from the fields of management, economics, and high technology. When considering not just the overall sweep of innovation, innovation drivers, and innovation processes, specific inquiry into adoption and diffusion dynamics attack the translation of innovation-as-invention to innovation-as-technological transformation in several different ways. Studies have demonstrated how network effects and "virtuous spirals" or positive feedback loops can self-reinforce growth dynamics. Put simply, the more a technology is used, the greater its attractiveness relative to substitute technology offerings, and therefore the greater its adoption returns.[69] (David 1985)

One concept invoked in the literature on competing technologies is the notion of increasing returns to adoption. Early research in this domain specified five mechanisms by which technologies are promulgated. They are, first, learning by using, where usage begets greater knowledge which begets greater improvement; second, network externalities, where greater usage inspires third-party adaptations, applications, and support (e.g., the Sony Walkman and headphones); third, scale economies, or operational efficiencies, which decrease production costs, yielding lower retail costs, and inspiring more sales; fourth, informational increasing returns, in essence a followership effect where more attention on the product begets broader and faster

[68] Backer, Liberman and Kuehnel (1986), Wesley and Daniel (1990), Valente (1996), Weinstein, Lyon, Sandman and Cuite (1998), Gallivan (2001), Stetler (2001), Frambach and Schillewaert (2002), Glasgow (2003), Glasgow, Lichtenstein, and Marcus (2003), Graham and Logan (2004), Greenhalgh, Robert, MacFarlane, Bate, and Kyriakidou. 2004 (2004), Berta, Teare, Gilbart, et. al. (2005), Damanpour and Schneider (2006), Feldstein and Glasgow (2008), Godin, Bélanger-Gravel, Eccles, and Grimshaw (2008), Mendel, Meredith, Schoenbaum, et. al. (2008), Oldenburg and Glanz (2008), Mitchell, Fisher, Hastings, et. al. (2010), Rogers (2010), Aarons, Hurlburt, and Horwitz (2011), Godin (2014), Wisdom, Chor, Hoagwood, and Horwitz (2014), Solomons and Spross (2011), Simpson (2002), Diaz (2007).

[69] David (1985), Arthur (1989).

adoption; and fifth, technological interrelatedness, wherein complementary technologies rely on the established innovation and benefit from it. The latter is exemplified by the technology of the web and its protocols such as HTML5 and the rapid rise and adoption of streaming video platforms such as Netflix. (Dosi 1988)[70]

Iansiti and Lakhani have made adjacent efforts to better understand and define the features of those technologies that do, by virtue of their implementation, create new foundations for global technology systems. However, foundational technologies need not be innovations unto themselves or, put in an alternate manner, represent general-purpose technologies. For example, the TCP/IP (transmission control protocol/internet protocol) helped lead to the internet.[71] TCP/IP was introduced in 1972 as "a *single-use* case" for e-mail used by researchers on ARPAnet. Iansiti and Lakhani also map in a 2x2 matrix model the adoption of foundational technologies in four phases against two contextual dimensions, degree of complexity and degree of novelty, which determine the adoption rate and evolution of a foundational technology, such that it could at some point emerge as a general-purpose technology.

Other studies break from the norms of economics and instead view innovation as a socio-cognitive process whereby social groups impart meaning and interpretation, and in the case of innovation, collaboratively generate an innovation's final form. Theories like the social construction of technology (SCOT) theory first sought to answer the questions of why technologies land in their final differentiated form and how does that final form determine their use.[72] Here, social groups activated in the innovation process determine consensus meaning and interpretation. Later expansions introduced a technological frame of social, cognitive and material elements,

[70] Arthur, "Competing Technologies: An Overview," in Dosi (1988).

[71] Marco and Karim (2017).

[72] Kline and Pinch (1996).

comprised of goals, key problems, requirements, tacit knowledge, and testing, to better understand the interpersonal and social dimensions for how institutions develop and deploy technology solutions.[73]

Other scholars have deployed systems and network theory principles in the service of explaining innovation replacement, transition, and broader transformation. Large technical systems and actor network theory (ANT) explore linkages in and around emerging technological transitions. Disparate elements become linked in an organic fashion that, in large technical systems theory, form adoption life-cycles with different classifications of system builders (inventor, inventor-entrepreneur, manager-entrepreneurs, financier-entrepreneurs) active across different phases: invention, development, innovation, growth, competition, and consolidation.[74] Hughes' use of the term "seamless web" is invoked to describe how fractal heterogeneity begins in formulating a network of innovation expansion that is at first fragile, requiring significant investment into upkeep and maintenance, which later stabilizes via emergent coordinating effects benefitting from adoption momentum, that then can reverse from flexibility into rigidity, thereby introducing barriers to further improvement that must be overcome to succeed. In the case of ANT, technologies emerge as heterogeneous configurations of relative few linkages that slowly accumulate additional elements, thereby building a working configuration, until diffusion begins fostering socio-technical linkages.[75] In an example relevant to this study's framing, the web's diffusion relied on the introduction of a compelling user interface via Netscape, which effectively brought the technology into the mainstream.

[73] Bijker (1995).

[74] Hughes (1983), Mayntz and Hughes (1988).

[75] Latour (1987), Callon, Rip, and Law (1986).

Grübler and Nakicenovic explore technology replacement and introduce a formula that describes this process via a logistic substitution curve that looks at the fractional market share of the new competitor and the fractional market share of the old one to generate a predictive model for replacement.[76] Should a given technology offer better performance—however construed—buyers will, acting in accordance with their own value-optimizing logic, purchase more of a given technology innovation and less of another, leading to replacement. As adoption and diffusion of technologies occurs, wide adoption corresponds to a learning curve, where the performance of a given technology improves as more organizations and innovations use it.[77] The accumulation of experience plotted in the power law functions of learning curves suggests that should the learning rate of new technologies exceed that of established technologies, in this argument, the former shall inexorably replace the latter. One may quibble as to whether any replacement technology ever truly substitutes or replaces a prior technology, but as a mental model, such models provide a good baseline heuristic to reality. Human transportation, for example, has gone through stages—horse and buggy, railroad, and automobile—with each successive transition offering more performance. However, user preferences, which erroneously can be assumed to be fixed, do change in response to outside forces, including technology-adjacent innovations such as management principles and work practices.[78]

In the fields of technology management and industrial economics, concepts such as punctuated equilibria and technology cycles have been used to describe and explain technological development as an evolutionary process defined by discontinuous change.[79] In these models,

[76] Nakicenovic (1986), Grubler (1991).

[77] Arrow (1962), Rosenberg (1982).

[78] Lie and Sørensen (1996), Agrawal, Gans, and Goldfarb (2018).

[79] Michael and Philip (1986), Anderson and Tushman (1990), Anderson and Tushman (1991), Tushman and Anderson (1997).

innovation accords with relatively long periods of stable technological progress of an incremental nature. Said periods of stability then are interrupted by periods of rapid change and transformation progress, triggered by the emergence of a technological breakthrough that is relatively rare and tends to be driven by individual genius. In Tushman and Anderson's model, technological substitution and replacement occurs when technologies offer "sharp price performance improvements over existing technologies."[80] Other models offer a slightly different view and separate pure value and performance from emergence. In Mokyr's model, for example, technological discontinuities instead emerge as "hopeful monstrosities," which cannot readily compete with the established technology.[81] A practical example here may be open-source operating systems—Linux being a prime example—that were never fully adopted despite huge leaps in performance over established systems.[82] The literature here does not explain the divide between invention (technical feasibility) and innovation (economic feasibility), reliant as they are on external variables (markets, regulations, and cultural preferences). Notably, discontinuities may not be solely activated at the industry-level. Larger developments in political, institutional, cultural, or economic domains may inspire a similar break in incremental progress.

Among the community of neo-Schumpeterian economists, Nelson, Winter, and Dosi sought to understand the role of organizations in catalyzing innovation.[83] Herein, individuals as actors absorb information interpolated through mental models, predicative maps, and frameworks that are shared within groups and across organizations, conferring attributes of coordination and

[80] Michael and Philip (1986), p. 441.

[81] Mokyr (1990), 291-2.

[82] Of interesting note, Apple upon making the switch to Intel-based chipsets redeployed MacOS as an operating system build off the Linux foundation. Previous generations of Apple chipsets leveraged UNIX-standard chipsets. Linux was developed as a UNIX-shell intended for Intel chips.

[83] Nelson and Winter (1982), Dosi (1982), Dosi (1988).

consistency. Organizations or firms, then, are based on bounded rationality and routines that guide actions. When it comes to the progenitors of an innovation—engineers or designers—cognitive heuristics guide the development of technical trajectories. As each firm is different, each firm thus inspires different search trajectories, which lead to different products, and thereby routines and their originating firms, which are selected in markets. Successful product-firm-routine tetrads carry on while less successful firms die out due to competitive pressures. Technological regimes emerge from mimetic processes, whereby shared routines contribute to sector-level trajectories. Within the practitioner's world, these are known as "best practices." Technological regimes create stability by providing direction for incremental technical development.

The social sciences have deployed an array of approaches to try to explain factors and drivers inspiring large-scale technological and economic change.[84] Research has shown a well-established and positive relationship between gross domestic product per capita and the overall innovative capacity of countries.[85] The induced innovation approach contends that changes in input prices are what inspire broader technological innovation. Producers and sellers of goods and services, in their efforts to economize the use of increasingly expensive input, must do more with less, reifying the folk wisdom, "necessity is the mother of invention," or, in this case innovation.[86] Other works have posited that national systems of innovation are what give rise to general-purpose technologies and increase the competitiveness of nations.[87] Advocates of top-down innovation systems such as Coccia argue that said systems are necessary but not sufficient to support the emergence of new general-purpose technologies, going so far as to argue that certain technologies

[84] Coccia (2010), Coccia (2014a), Coccia (2014b), Coccia (2015), Coccia and Wang (2015), Coccia (2017), Dafoe (2015), Hall and Rosenberg (2010), Elsevier, Felt, Fouché, et. al. (2016), Ruttan (1997), Ruttan (2006).

[85] Porter and Stern (2001).

[86] Hicks (1963).

[87] Nelson and Rosenberg (1993), Lundvall (2010), Soete, Verspagen, and Ter Weel (2010), p. 1176.

fail to convert across all environments in spite of the success of a given national systems approach.[88]

Long-wave theory is a domain of scholarship extant within heterodox economic circles exemplified in the work of authors like Perez, Freeman, and Louca. It is a particular stream of evolutionary economics that looks at long-term technological changes as a full-spectrum shift of technoeconomic paradigms. These paradigms are distinct from conceptualizations of general-purpose technologies invoked in more mainstream economic approaches. These theorists take the position articulated by Schumpeter, that neoclassical economics cannot cope with the dynamics of short-term and long-term business cycles.[89] Scholars answer with an evolutionary theory of economic development, drawing from Schumpeter, focusing on the sources of recurring "long waves" of economic growth and retraction caused by technology.[90] These long waves become evident as new technologies become increasingly inexpensive and ubiquitous such that that they fuel the rate of innovation and growth in new industries, and eventually the broader economy.

In this theory, a rapid diffusion of technologies inspires growth and profitability across newly emerging market segments. These developments often are not at first discernible given that said technologies are being developed by entrepreneurs without exposure, sometimes for decades. Paradigmatic shifts occur as small firms give way to larger firms and once novel technologies reform as technological commodities, finding relative market incumbency and becoming easily replicable. These systems-oriented views of economic and social change chart the course of long wave techno-economic development and impact across organizations, politics, and society.[91]

[88] Coccia (2015), Roland (1992).

[89] Schumpeter (1942).

[90] Kondratiev (1925), Schumpeter (1939).

[91] Perez (1983).

Finally, the growth of these new industries in turn catalyzes organizational innovation to serve the needs of new industries.

Long-wave theory generally defines four historical clusters: the first industrial revolution; steam power and iron; electricity and heavy engineering (the second industrial revolution); and oil, automobiles, and plastics, and finally information and communications technology, and biotechnology potentially indicative of a fifth paradigm.[92] Others segment the historical epochs slightly differently, beginning with the British Industrial Revolution (cotton, iron, and hydropower), followed by iron railways, steam power, and mechanization; steel, heavy engineering, and electrification; oil, automobiles, motorization, and mass production; and information and communication technology. In this and related theories, a paradigm emerges when the following process initiates and resolves to completion: A production factor or input benefitting from lowering costs and multi-use applications inspires new innovations that address unresolved problems within the extant paradigm.[93] Socio-institutional momentum and incumbent interests further the status quo of the marketspace slowing the breakthrough of paradigm disrupting innovations. However, once sufficient diffusion—innovation clustering that occurs across rather than within sectors—is accompanied by and perpetuates deep structural changes, a new paradigm emerges. These deep structural changes involve organizational forms in the firm and at plant level—a new skill profile in labor force, new product mix, wave of infrastructural investment, new pattern of consumption of goods and services and new types of distribution and consumer behavior—that define this paradigmatic shift.

[92] Freeman and Perez (1988).

[93] Freeman and Perez (1988), p. 58.

Other paradigmatic analyses of techno-economic revolution have explored major analytic categories or societal subsystems—science, technology, economy, politics, and culture—which long-wave theorists argue contain within them their own development lines.[94] With regard to major paradigm shifts or technological transitions, long-wave theorists argue that a mixed approach of both independent analysis of specific technological development, and reconciliation of interdependent developmental streams, as exemplified in the subsystems approach, yields a more robust picture. Said scholars make a distinction that their arguments are not arguments of technological determinism, but nevertheless perceive traditional economics as failing to account for science, technology, economics, politics, and cultural factors.

### *Narrative Economics, Adaptive Markets, and the Rise of the Web*

Signal innovations consciously introduce a linkage between factors, or utility factors, contributing directly to utility of the technology itself—for example, the superiority of a given technology's user interface, say, or the overall user experience—with business economic considerations. Utility in economics describes the overall satisfaction a consumer receives from the purchase and use or consumption of a product or service. Debates over how to measure utility—a close synonym in economics also being usefulness—are far outside the scope of this work. For our purposes, a tangible example of a utility factor intrinsic to a technology would be changeover from text-based, command-line computer operating systems to graphical user interfaces, represented in Apple Macintosh OS and Microsoft Windows, which inspired and accelerated the adoption and diffusion of personal computing platforms. The business economic

[94] Louçã and Freeman (2001).

considerations here can be understood as a signal innovation's activation of heretofore untapped macroeconomic potential, business investment potential, and consumer spending potential intrinsic to the more fundamental, general-purpose technology of the personal computer. These factors are best conceptualized through the prism of behavioral economics and behavioral finance. As described by economist Robert Shiller, academic finance has evolved long past efficient markets theory. Behavioral finance—finance that incorporates the full spectrum of social sciences, in particular psychology and sociology—is a vital research program that sharply refutes much of efficient markets theory and indeed the broader discipline of economics. (Shiller 2003)[95]

My purpose of introducing behavioral economics-adjacent theories of narrative economic and adaptive market theory is to illustrate the means by which the adoption and diffusion dynamics discussed extensively in the innovation literature finds resonance in contemporary economic theory. Namely, that no individual, household, or institution operates in a purely rational manner. As such, positive feedback loops based often on non-classical measures or phenomenon historically outside the discipline of mainstream economics bring to bear significant explanatory power on how transformational technologies can emerge. In this way, the theory of signal innovation builds a bridge between social science disciplines (e.g., sociology, economics) with the behavioral and cognitive sciences (e.g., neuroscience, psychology) to explain how technologies achieve general-purpose-level escape velocity.

Referencing the theory introduced earlier in this dissertation, the business economic factors intrinsic to a signal innovation include technology's release of untapped macroeconomic potential, business investment potential, and consumer spending potential, such that new value is created. The achievement of this value is explained by feedback models expressed in narrative economics

[95] Shiller (2003), p. 83.

and adaptive markets theories, both behavioral economics-adjacent theories. In this case, the signal innovation initiates Rogers' s-curve hype cycle diffusion model of the more fundamental general-purpose technology by mobilizing *financial incentive and economic gain*. As will be demonstrated in later chapters, consideration of commercial applications of the internet were consciously embedded in the development of Netscape's pioneering Navigator web browsing software. The combination of the effectiveness and utility of the web, and the potential for economic gain drove the exponential growth of the internet, and unlocked new macroeconomic, business investment, and individual potential. In practical terms, the web grew the overall U.S. economy by giving rise to new products and new services built by the explosion of new businesses who required new investment, all purchased, consumed, and fed back into the fundamental economy by consumers of said new products and services. The web as a signal innovation provisioned a new way of doing business and being in the world, which accelerated the strengthening and diffusion of the internet—the web's underlying technical infrastructure—with the web serving as the intermediary and gateway for personal computer users, and later smartphone users, to make the most of the globalized computer network of the internet.

The introduction of these theories explains the economics paradigm upon which signal innovation theory is based. Here, narrative economics and adaptive markets secure the multidisciplinary economics dimensions adjacent to the multidisciplinary technology dimensions of signal innovation theory. In concrete terms as best described by Shiller, the business-economic corollary to Rogers' technology-centric s-curve principles, as well as the various techno-economic development, adoption, and diffusion paradigms discussed in the previous section, is as follows:

> One of the oldest theories about financial markets, expressed long ago in newspapers and magazines rather than scholarly journals, is, if translated into academic words, a price-to-price feedback theory. When speculative prices go up, creating successes for some

> investors, this may attract public attention, promote word-of-mouth enthusiasm, and heighten expectations for further price increases. The talk attracts attention to "new era" theories and "popular models" that justify the price increases. This process in turn increases investor demand and thus generates another round of price increases. If the feedback is not interrupted, it may produce after many rounds a speculative "bubble," in which high expectations for further price increases support very high current prices. The high prices are ultimately not sustainable, since they are high only because of expectations of further price increases, and so the bubble eventually bursts, and prices come falling down. The feedback that propelled the bubble carries the seeds of its own destruction, and so the end of the bubble may be unrelated to news stories about fundamentals. The same feedback may also produce a negative bubble, downward price movements propelling further downward price movements, promoting word-of-mouth pessimism, until the market reaches an unsustainably low level.[96]

In this case, such a feedback model encapsulates the time period in question under analysis in this work. Moreover, in the case of the web and the ensuing enthusiasm for internet technologies, it certainly helped that said companies were led by visionary entrepreneurs who galvanized attention and unlocked all layers of potential. Behavioral economics' conscious introduction of psychology into broadening one's understanding of economic phenomena can account for the role individuals play in unlocking new economic value. While a thorough debate between enlightenment philosopher Thomas Carlyle's "great man" theory of history and the Tolstoy's determinism would require a reconciliation with modern neuroscience and the cognitive sciences (outside the scope of this work), nevertheless the psychology and capabilities of individuals do play a critical role in the advance of innovation. Specifically, the power of narratives and compelling storytelling advanced by persuasive, motivated, and often charismatic individuals

[96] Shiller (2003), p. 91.

leading great technical efforts can directly impact the adoption and diffusion of a new technical innovation.

Samo Burja's Great Founder theory is a revitalization of the Great Man theory, applied specifically to the role individuals play in the shaping of history, often through technical innovation. His theory provides an answer to the question of how social change co-occurs with the proliferation of transformational technologies. He argues that a small number of institutions founded by exceptional individuals occupy the core of society. These institutions are imperfectly fractalized and imitated, multiplying their effect. Ultimately the original institutions established by innovative thinkers and builders outperform the rest and are responsible for the creation and renewal of a society's goods. Across time, these functional institutions decay, paralleling the manner by which economic boom-bust cycles occur, often in tandem with the adoption-diffusion dynamics of technology proliferation, all very of a piece a Schumpeterian concept of creative destruction. Thus, as the landscape of founders and institutions changes, so does the landscape of society, and so does the landscape of technology.[97] This theory, taken in the context of narrative economics, with Great Founders operating as unifying storytellers who are often charismatic in nature, provides an interesting line of inquiry and intellectual platform for resurrecting more classical approaches to history.

In elucidating the case of the web, the theory of signal innovation serves as a causal story for its emergence and the realization of the internet as a general-purpose technology. The objective, material considerations of a truly path-breaking technology, embodied in the web, gave rise to a constellation of narratives that further propelled the web's development, growth, adoption, and

[97] Samo Burja has put forth a compelling theory in a draft manuscript, titled "Great Founder Theory," which is currently being turned into a book. The 2020 manuscript is available online at http://samoburja.com/gft.

diffusion. The goal of the history here is to elucidate these causal factors through diagnosis and detailing of the events and their construction into a broader narrative, in-line with the research and observations of Shiller for macro-level and household-level considerations, and the rise of narratives in VC-backed tech firms well described by finance scholar Aswath Damodaran.

To properly understand the role of narratives in economics, growth, and its contributions to this story, and, indeed, how this work can even lay claim to economic theory, it begins with the heterodox though increasingly mainstream argument made by Shiller. The narrative history that follows draws consciously from the field of behavioral and narrative economics in order to fully contextualize the events, the decision-making of actors, and impact of the web. It seeks to build bridges with the discipline of economics, and takes seriously Shiller's invocation in the preface to the 2020 paperback edition of *Narrative Economics:*

> This book argues that ideas from other disciplines need to be added to economics. High on the list of disciplines are the humanities, like history and literature. Humanists are well aware that the human mind is something far more complex and inscrutable than any machine that is programmed to compute optimal expectations for economic quantities.[98]

Shiller refers to this process as an "adventure in consilience," an attempt to unify academic disciplines, in particular across the sciences and the humanities, in order to gain a fuller and more comprehensive understanding of the world.[99] As it applies to this work, Shiller compares trying to understand major economic events by looking only at data on changes in economic aggregates—such as gross domestic product, wage rates, interest rates, and tax rates, etc.—risks missing the underlying motivations for change. This work attempts to address these underling motivations. AS

[98] Shiller (2020), p. xiii.

[99] Shiller (2020).

he writes, "doing so is like trying to understand a religious awakening by looking at the cost of printing religious tracts."[100] For example, though from 1994-2000 the stock market boomed, indicators of economic growth, gross domestic product, and corporate profits failed to demonstrate the same level of actual growth.[101] Errors of human judgment can infect even the smartest people due to hubris and the intrinsic infallibility of human nature. Things like overconfidence, lack of attention to details, excessive trust in the judgments of others, stem from a failure to understand that others are not making independent judgments, but rather simply following others and imitating their behaviors—the blind leading the blind.[102]

Shiller's concept of narrative economics, which builds upon his work with George Akerlof in *Animal Spirits*, brings import to the economic power of narratives. As he writes, we live our lives through stories, thus any complete understanding of economics must incorporate narrative into the forecasting process. Incorporating the contagion of narratives into economic theory is of urgent necessity. Narratives for Shiller are an important mechanism of economic change and crucial element for economic forecasting. Failing to understand the modern epidemic of popular narratives—increasingly referred to as memes, first introduced by evolutionary biologist Richard Dawkins—suggests that a full understanding of the economy and economic behavior shall remain elusive.[103] Whether by virtue of the cyclical emergence of "perennial" narratives have repeated throughout history, or entirely new narratives, the resulting public discussion of the fears emergent from a given narrative can impact individual investment, consumption, and voting behavior, all

[100] Shiller (2020), p. 74.

[101] Shiller (2015).

[102] Shiller, (2015), p. xxi.

[103] Shiller (2020), p. xvii.

casual factors in economic fluctuation.[104] Shiller has demonstrated through analysis and successfully predicted the dot-com bubble, the housing bubble, and, it would seem, at the time of this writing, the seeming cryptocurrency bubble.[105]

In concert with Shiller's observations, Aswath Damodaran shares in Shiller's view on the power of narrative. In his book *Narrative and Numbers*, he poses such questions as: How can a company that has never turned a profit have a multibillion-dollar valuation? Why do some start-ups attract large investments while others do not? He goes on to argue that the power of story drives corporate value, adding substance to numbers and persuading even cautious investors to take risks. He states that in business, there are the storytellers who spin compelling narratives and the number-crunchers who construct meaningful models and accounts. Both are essential to success, but only by combining the two, Damodaran argues, can a business deliver and sustain value. He argues that the irony of working with numbers is the more one becomes immersed in them, the greater the skepticism one adopts vis-à-vis purely number-driven arguments. In financial data, both accounting and market driven, noise in the data is endemic and accurate predictions prove to be incredibly difficult. He concludes, very much in line with Shiller:

> I believe in the scientific method, but I don't believe there are many pure scientists out there. All research is biased, with the only questions becoming about the direction and magnitude of the bias. Thus, it is my job when presented with a numbers-driven argument to probe for the biases of the person making the argument, and once I find them, to adjust the numbers to reflect that bias. Finally, I have learned that it takes hubris on my part to believe that just because I put a number on a process or variable, I control it or even understand it. Thus, I can offer you a dozen different numerical measures for risk, most

[104] Shiller (2020), p. 196.

[105] Shiller (2020), p. 11.

> with great academic pedigrees, but I struggle on a daily basis to understand what exactly risk is and how it affects us as investors.[106]

To close our discussion here, the adaptive market hypothesis, as proposed by Andrew Lo, seeks to reconcile economic theories based on the efficient market hypothesis with behavioral economics.[107] By applying the principles of evolution to financial interactions: competition, adaptation, and natural selection—he addresses Damodaran's observations regarding the difficulty of ascribing numerical measures to social phenomenon. In a publish or perish quantitative discipline, where measures may be difficult to come by, theoretical advance can often be limited due to the availability of indicators. It is much easier to model the number of buyers and sellers in a given market than it is to model the impact of stories on buying behavior. Lo argues that traditional models of modern financial economics can coexist with behavioral models. The biases often used to challenge purely rational conceptualizations of markets—loss aversion, overconfidence, overreaction, among others—reflect the behavior of individuals adapting to a changing environment using simple heuristics, consistent with evolutionary theories. Even the drivers of rampant speculation—fear and greed—when interpreted through Lo's theory are viewed as consistent with the complex adaptive systems frameworks Lo employs to explain behavior.

According to Lo, the adaptive market hypothesis represents an update to efficient market hypothesis derived from evolutionary principles. Prices-as-information reflect environmental market conditions operating at a given point in time, with the number and nature of distinct groups of market participants. In cases where members of a single group compete for scarce resources within a single market, then that market is likely to be highly efficient. In the converse, should a

[106] Damodaran (2017), p. 51. An excellent slide presentation of Damodaran's core arguments can be found at http://people.stern.nyu.edu/adamodar/pdfiles/country/narrative&numbers.pdf.

[107] Lo (2019), Lo (2004), Lo (2005).

small number of market participants compete for abundant resources, the market will operate inefficiently and be marked with speculation. Market efficiency is then a function of market ecology, including the number of market competitors, magnitude of profit opportunities available, and the adaptability of the market participants.

Lo from his argumentation derives a series of implications that contrast it with traditional economic models. He concludes with discussions concerning a relative absence of market stability over time, giving credence to heterodox economic theories, posting opportunities for arbitrage, the ecological market context dependency of any given investment strategy, the prime need of market participants to survive, with profit and utility maximization operant as secondary factors, which leads to Lo's final concluding implication. If survival is all that matters, then what ensures survival is innovation, wherein in a highly variable context, the best way of achieving returns is to adapt to changing market conditions. As we shall see, the web served to extrapolate the increasingly user-friendly graphical users interfaces that were growing commonplace in desktop computing to the still-command-line-based interfaces used to access and navigate the internet. Netscape and Microsoft's response to the adaptive demand of consumer preferences, who sought usability, helped unlock the series of business economic factors operant at all levels, that fostered the web-as-signal innovation and yielded the world the general-purpose technology of the internet.

### *The Fintech and Web Narratives of Digital Economy Origins*

The empirical section that follows finds resonance with several narrative economic throughlines. Per Shiller's argumentation, the constellation of narratives serves as to explain, within the structure of signal innovation theory, the business-economic dynamics driving the

adoption and diffusion of the web and describing the signal innovation inflection point of the development of the web, its own adoption and diffusion, and the resulting recognition of the internet as a general-purpose technology. The history evaluated here describing the innovation narratives of the web adheres to six identifiable narratives that will be called out in representation of the histories and yielding commentary on the event-based details covered in the subsequent chapters. These narratives, at the time elucidating the superiority, deterministic ascent, and the "end of history" finality of the internet, were as follows:

1. The narrative per Bill Gates' 1994 remark that banks were "dinosaurs," soon to be exiting the domain of financial services, which endured through the dot-com bubble. The narrative was sustained through a combination of investor exuberance for tech stocks and the government and banking industry's multi-year effort to repeal the Glass-Steagall Act, married with the celebrity association with Gates. The narrative remained potent through the final years of the decade, and caused banks to resist change amid partnership opportunities with Microsoft and other tech firms, spurring the frenzy of investment into competing new technologies and ushering in the Transaction Wars.
2. The narrative of the promise of e-commerce, buoyed by Netscape's early investment into SSL, validated in early partnerships with financial institutions coincident with Netscape Navigator's boom in adoption, and sustained amid lagging e-commerce growth behind overall web adoption. Though the idea of e-commerce did not originate with Netscape, the popularity of the web via Navigator helped perpetuate e-commerce as a renewing narrative despite regulatory, technical, and operational challenges. The narrative of e-commerce as an adoption driver benefited from the fact that the web was new and there was little data to forecast trends, which fostered speculation based on the promise rather than the

contemporaneous reality of e-commerce in the 1990s. It is worth noting that later entrants like eBay and Amazon later fulfilled this early promise, though several years behind the initial boom.

3. The narrative of home banking, spurred by the wild prices of tech stocks and the monumental acquisition price of Intuit, the software maker of Quicken, sustained despite the acknowledgment that only specific types of PC user became a Quicken users (as it was a software that required time to learn and navigate and one had to want or need to balance a checkbook and track expenses electronically). Paired with the banks' struggle against non-bank Microsoft, the lure of home banking drove banks to invest in jointly acquiring software and engaging in a yearslong tug of war with Intuit and Microsoft over supporting payments in both software and web-based transactions.
4. The narrative of tech progress as Schumpeterian creative destruction, encouraged by Alan Greenspan, the Chair of the Federal Reserve, who was described by Shiller at the time as a veritable "economic celebrity," which drove a positive outlook of technological innovation and overall market exuberance.
5. The narrative of America-first national economic competitiveness, predicated on tech companies looking for export-led growth opportunities, who lobbied the Clinton Administration to relax encryption export regulations. This was difficult for the White House to manage in the run-up to Al Gore's presidential run, especially given Gore's public reputation as tech champion.
6. The narrative of digital currency, which was centered on privacy thought never sticky enough as a narrative to challenge existing currencies or payment methods. The libertarian and tech-futurist narrative of Bitcoin later absorbed this mantle, inspired by genuinely

superior technological developments, which has remained in the popular imagination in recent years.

The large-scale economic narrative constellation traced here—the rise of the web and the financialization of the internet—consists of the aforementioned underpinning narratives that explain the adoption of the technological innovation of the world wide web. Shiller argues that economic narratives exhibit the same propensity for virality and contagion as bacteria and viruses, with the result being that narrative economic epidemics resemble disease epidemics.[108] This concept finds reflective corollary in the concept of virality well subscribed to in the technology innovation space. In economic narrative epidemics as in disease epidemics, contagion (i.e., technology adoption) must exceed recovery (i.e., technology abandonment) for an epidemic to get started. As the narrative spreads through social discourse—newspapers, television, social media, person-to-person—interest grows until a period of forgetting causes the narrative to decline and die off .[109] As reference, the concurrent precipitating factors that accompanied the broader dot com boom, of which the web's adoption and diffusion was of a piece, Shiller lists as follows: (1) the arrival of the internet at a time of solid earnings growth; (2) triumphalism and the decline of foreign economic rivals; (3) cultural and political changes favoring business success; (4) a Republican Congress and Capital Gains tax cuts; (5) the Baby Boom and its perceived effects on the markets; (6) an expansion in media reporting of business news; (7) analysts' increasingly optimistic forecasts; (8) the expansion of defined contribution pension plans; (9) the growth of mutual funds; (10) the decline of inflation and the effects of money illusion; (11) expansion of the volume of

[108] Shiller (2020), p. 94.

[109] Shiller (2020), p. 21.

trade: discount brokers, day traders, and twenty-four-hour trading; (12) the rise of gambling opportunities.[110]

Understanding economic and innovation narratives within a framework of consilience is key to the project we are all willingly or unwillingly a part of—building a more sustainable, prosperous, and equitable human experience for the world's population. The best way to make this happen is to maintain and continually improve capitalism—in this case, a truly robust global democratic financial system that takes account of the diversity of human motives and drives.[111] Implicit in this statement of a democratic financial system is a system that recognizes and encourages innovation, experimentation, intrapersonal and interpersonal growth. This work addresses the specific domain of innovation, and posits that without understanding innovation, humanity is doomed to replicate the same ideas, propelled by the same narratives, leading to the same results. Shiller and Akerlof argued that *animal spirits*—the thought patterns that animate people's ideas and feelings—are what drive the economy. Getting right and instilling in the fabric of our societies confidence, fairness, good faith, and the mitigation of corruption, taking into account the money illusion, and understanding the central role that stories play will help in designing and implementing policies that absorb the best and jettison the worst of capitalism.[112]

The theory offered here of signal innovations helps to open the black box of path-breaking general-purpose technologies—progress and prosperity are by no means assured. The web and its fintech capabilities took the internet from its underground of hackers and academics and made it mainstream, ultimately supplanting and driving out of business the panoply of balkanized online

[110] Shiller (2015).

[111] Shiller (2012).

[112] Akerlof and Shiller (2010), p. 6.

services, the prime gatekeepers to internet access at that time. The following narrative history is an attempt toward building a more comprehensive understanding of the mechanisms of innovation.

## Chapter 3 – Empirical Chronology and Summary

*Chronology of Major Events (1993-2001)—Empirical Summary—The Logic of Web as Historical Case*

*Chronology of Major Events (1993-2001)*

| | |
|---|---|
| January 1993 | Initial release of the Mosaic browser by the National Center for Supercomputing Applications (NCSA). |
| April 1993 | White House announces the controversial Clipper chip key escrow encryption initiative. |
| May 1993 | Bill Gates greenlights the Marvel project, a competitor online service to AOL. |
| April 1994 | Microsoft holds offsite internet strategy retreat. |
| May 1994 | David Chaum demos the first example of payment over the internet on Mosaic at W3C (World Wide Web Consortium) in Geneva. |
| July 1994 | *Newsweek* publishes article with Bill Gates quote calling banks "dinosaurs." |
| August 1994 | First e-commerce order made on Net Market Company via Mosaic. |
| October 1994 | DigiCash debuts "cyber bucks" trial.<br>Netscape Navigator public beta release.<br>Microsoft announces $1.5 billion acquisition of Intuit.<br>Microsoft and Visa sign letter of intent to develop internet transaction security protocol.<br>Microsoft and Mastercard sign letter of intent to co-develop Master Banking home banking program, using Microsoft Money technology. |
| November 1994 | Microsoft announces MSN (Microsoft Network). |
| December 1994 | Netscape Navigator 1.0 release. |

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| April 1995 | Justice Department opens probe into Microsoft-Intuit merger. |
| May 1995 | Bank of America and NationsBank jointly acquire Meca. |
| | Microsoft abandons Intuit acquisition; pays breakup fee of $46 million. |
| | Intuit announces 19 financial institutions to offer home banking services through Quicken. |
| | Wells Fargo becomes first bank to offer retail banking services via web. |
| | Gates distributes “The Internet Tidal Wave” internal memo. |
| | CyberCash becomes first electronic payment developer to gain export approval from US government for its encryption technology. |
| June 1995 | Microsoft holds executive offsite internet strategy retreat. |
| | Microsoft and Netscape meeting to discuss investment, partnership, and “splitting the market.” |
| | Visa and Mastercard announce partnership to develop single online transactions security protocol. |
| July 1995 | Checkfree Corp. licenses CyberCash encryption technology. |
| | Netscape announces Secure Courier, a transactions security protocol, in partnership with Mastercard and Intuit. |
| August 1995 | Netscape IPO. |
| | Consent Decree finalized, concluding Justice Department probe into Microsoft’s anticompetitive practices with OEMs. |
| | Windows 95 release. |
| | Checkfree and Compuserve announce H&R Block-owned online payment service. |

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| September 1995 | Microsoft and Visa jointly announce Secure Transaction Technology (STT). |
| December 1995 | Microsoft licenses Mosaic source code from Spyglass. |
| | Gates publicly announces Microsoft's new internet strategy. |
| January 1996 | Netscape and Verifone announce partnership to develop software for securing online transactions. |
| | Mark Twain lowers fees for DigiCash's Ecash pilot. |
| February 1996 | Netscape abandons its own protocol and endorses Microsoft and Visa's SET protocol with Mastercard and IBM. |
| | CyberCash IPO. |
| | Microsoft and Visa announce home banking partnership for Microsoft Money. |
| | Intuit experiences teething problems with Quicken transactions. |
| March 1996 | MSN exceeds 1 million subscribers. |
| | DigiCash debuts Ecash in Finland. |
| | Checkfree acquires Security APL, an online portfolio management software company. |
| April 1996 | Microsoft announces that MSN News would move to open web. |
| May 1996 | Deutsche Bank announces Ecash trial. |
| | Netscape announces LivePayment. |
| | Federal Reserve proposes amending Regulation E to limit consumer liability of credit card fraud to $50. |
| June 1996 | Netscape announces SSL 3.0. |

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| | Navigator exceeds 38 million users, overtaking Microsoft Office's 22 million users. |
| | Bank of America launches online banking site and AOL access point. |
| | Congressional hearing on The Future of Money regarding electronic payment systems. |
| July 1996 | Netscape granted permission to export software with 128-bit encryption for download by US citizens. |
| September 1996 | CyberCash partners with Mondex on CyberCash Wallet and smart cards; launches CyberCoin for micropayments. |
| | IBM and 15 banks form Integrion Financial Network to set transaction standards for online banking. |
| | Checkfree acquires Intuit's payments processing business. |
| October 1996 | Netscape incorporates CyberCoin into LivePayment. |
| November 1996 | Mastercard shuts down MasterBanking. |
| | White House transfers control of commercial encryption products from the State Department's US Munitions List (USML) to the Commerce Control List (CCL) of the Department of Commerce. |
| December 1996 | Netscape shuts down LivePayment. |
| April 1997 | CyberCash takes over LivePayment. |
| June 1997 | Microsoft and First Data announce MSFDC, an online bill payment venture. |
| July 1997 | White House releases global e-commerce framework. |

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| October 1997 | Checkfree takes over Visa Interactive through ten-year agreement with Integrion. |
| December 1997 | SET largely seen as a commercial failure.<br>Wells Fargo and KeyBank become first banks to pilot MSFDC's online payment service.<br>Microsoft barred from forcing OEMs to bundle Internet Explorer with PC shipments. |
| February 1998 | Netscape announces it will make browser source code public; creates the Mozilla.org project. |
| May 1998 | Justice Department files antitrust suit against Microsoft for monopolistic behavior in the browser and middleware space. |
| June 1998 | House passes legislation placing three-year moratorium on collecting taxes on internet purchases. |
| September 1998 | MSFDC renamed TransPoint.<br>Mark Twain closes down Ecash pilot program. |
| October 1998 | Justice Department files duality antitrust suit against Visa and Mastercard.<br>Senate passes legislation placing three-year moratorium on collecting taxes on internet purchases. |
| November 1998 | DigiCash files for Chapter 11 bankruptcy.<br>AOL acquires Netscape. |
| April 1999 | Senator John McCain withdraws support for key escrow legislation. |
| July 1999 | TransPoint integrated into MSN MoneyCentral. |

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| August 1999 | A Canadian mathematician discovers a Windows NT digital key labeled "NSA key," sparking rumors that Microsoft had a backdoor encryption alliance with the National Security Agency. |
| October 1999 | Amazon.com awarded 17-year patent for 1-Click payment. |
| November 1999 | Court finds Microsoft guilty of abusing its market power and begins mediation process. |
| January 2000 | White House relaxes encryption export controls. |
| February 2000 | Checkfree acquires TransPoint. |
| April 2000 | Settlement negotiations break down; Microsoft loses antitrust case. NASDAQ plunges 7.6% on April 3. |
| September 2001 | Justice Department announces it will not seek breakup of Microsoft. |
| March 2001 | CyberCash files for Chapter 11 bankruptcy. |
| April 2001 | VeriSign and First Data acquire CyberCash operating assets. |

*Empirical Summary*

The web's development, adoption, and diffusion can be understood through the narrative histories of three conflicts, each involving transformational technology firms operating amidst myriad forces, each engaged in building and distributing the signal innovation of personal desktop web browser, ultimately begetting the actualization of the internet-as-general-purpose technology. Taken in whole, the dynamics of these conflicts and the outcome of these struggles are foundational to our understanding of the signal innovation of the personal web browser, the topic of this work, and the broader general-purpose technology of the internet. The three conflicts to be discussed here are (1) the Browser Wars, (2) the Transactions Wars, and (3) the Encryption Wars, each of which demarcate overlapping eras between 1995 and 2001. These conflicts fostered the modern informational and communication technology (ICT) revolution, and set the stage for decentralized web3, a potential signal innovation unto itself, still nascent but nevertheless a potential catalytic point in the advance of the modern second machine age.

The Browser Wars began amidst the competitive environment marked by the National Center for Supercomputing Applications (NCSA) and its Mosaic personal browser, and Netscape and its Navigator personal browser in the pre-1995 era. In popular discussion, however, what individuals in the tech community generally meant with the "browser wars" referred to the subsequent battle between Netscape and Microsoft, and the personal web browsers of Netscape Navigator and Microsoft Internet Explorer. This conflict became a race to set the standards for web protocols, which led to innovation in what browsers and specifically webpages could offer users. The race to dominate user market share with the end goal of monetization of the web was the focus of both companies, but neither Netscape nor Microsoft—who pioneered the digital era's strategy toward market domination via standards setting—would emerge ultimately as winners of

the Browser Wars. Both Netscape and Microsoft underestimated both the size and complexity of the challenge that came with establishing security protocol standards for web-based financial transactions. The commercialization of the web both companies took as a priority: Even during the early years of the web, the concept of online malls began to gain traction, and investors were looking for ways to capitalize on usage. Critical to the web's growth was this new ability to facilitate commerce and financial transactions quickly and securely. However, both Microsoft and Netscape ceded ground in the payments space despite their distinct first-mover advantages. Both fell victim to some inability to translate a narrative of exploration and freedom with the practical necessities of establishing a viable and enduring business strategy predicated on what the tech community refers to as monetization. Additionally, both firms struggled to partner with banks and credit card companies (which are comprised of member banks), who were suspicious of the motives of tech companies.

Microsoft's Bill Gates in the 1990s articulated a vision of an interactive device running Windows—something akin to what the smartphone would become—that would cover everything from paying bills to consuming entertainment. He invested heavily in marketing Windows 95 and distributing its browser application, Microsoft Internet Explorer (MSIE or IE) at significant cost to the firm, and thus igniting the Netscape vs. Microsoft battle for web browsing market share. Though Microsoft was decisive in its 1995 pivot to focus on the internet, its strategy to monetize the web space fell victim to fragmentation and inconsistent implementation. Separately, Netscape, founded with the tech-libertarian story of producing Netscape Mozilla, positioned and ultimately successful as NSCA Mosaic's replacement, struggled to reconcile its corporate ethos of building a free and open internet with its worries of turning into another Microsoft. Microsoft at that time represented all that was wrong with the then hobbyist, academic, and hacker-dominated online

ethos—the existing community sought to gatekeep access from outsiders like Microsoft who sought to monetize the internet. Netscape, uneasy with that identity, followed in the footsteps of Novell and Sun Microsystems, both technology market competitors, in its appeal to the Justice Department requesting investigation of Microsoft's anticompetitive activities as it ceded market share to its Redmond-based foe. Microsoft's lead in users seemed to spell victory, but said victory was short-lived as the web proved too diverse, too decentralized, and too creatively destructive to bring under singular corporate control.

The Transactions Wars arose as the vast and well-documented struggle between financial services companies and technology firms, but especially Microsoft. Though it took place concurrently with and was intricately tied to the race to set web standards, the saga went beyond this battle of preferences and ultimately encapsulated a range of innovative services and products, including home banking, online banking, e-commerce, and e-money (then a blanket term for both stored value currency on smart cards and novel digital currencies). The reluctance of financial services firms to work with early-incumbent Microsoft and its competitors slowed the growth of the e-commerce market. The battle over for financial transactions standards began with the profit opportunity recognized in internet-based transactions fees available to be integrated within desktop financial accounting programs like Quicken. As the web matured and competition between Netscape and Microsoft intensified, however, new and more interactive features were built into each new release of Navigator and Internet Explorer. Desktop software soon began to be replaced by dynamic websites and webpages, where home banking through an interface like Quicken ceded ground to entirely web-based banking services. The earliest pioneers of web technologies recognized the commercial potential of the web and its capacity for user-friendly secure information and data transfer. Netscape's ambitions to set the security protocols standard for credit

card transactions, for example, was not a secret, as it established a partnership with MasterCard early on in 1995.

On the heels of the race to set billing and payment standards and capture existing financial products and market share from financial services firms, transactions standards race had to account for another development—the advent of electronic cash, or digital currency. The broader consumer world was facing the question of the future of paper-based money in the digital age as the world grew more comfortable with an increasingly digital, increasing virtualized environment. Before Navigator popularized the web, financial institutions were primarily concerned with open system stored value cards, or smart cards, which built upon the logic of the then-new debit card, which was quickly replacing paper-based checking. Both the Mosaic and Navigator web browsers offered an early platform for e-commerce businesses. Digital payments startups, several of them backed by big name financial institutions, then joined the fraught struggle over internet-based payments and transactions. The home banking and digital payments battles would converge and then diverge: Visa and MasterCard, the two dominant credit card companies, would exit the home banking stage and ultimately work with Microsoft on its SET standard. Netscape would exit the race entirely in 1997. From 1995 to 1997, Microsoft would spend considerable effort wooing banks as it sought to make in-roads into the web, with Gates involved in an apology tour of sorts in late 1995 for his criticisms of the banking sector, resulting ultimately in a joint venture with First Data, TransPoint, in setting the standard for online bill payments (in this case, the OFX). Integrion and IBM would lead a competitor standard, called the GOLD standard. The two standards would ultimately merge and TransPoint would be acquired by CheckFree.

The web would never achieve a universal standard for browser-embedded micropayments, and certainly not one that was an unregulated momentum-based digital currency (i.e., Bitcoin and

cryptocurrencies in 2021). Microsoft's antitrust trial may have ultimately slowed down the company's pursuit of a transactions standard that it could collect fees from. Visa and MasterCard's own antitrust suit around the same time may also have had the "police at the elbow" effect, putting on notice other organizations who might have sought to knowingly breach certain regulations. Neither credit card company settled with any tech firm or consortium on a single secured transactions protocol, which led to the modern ad-based "attention economy" revenue model for online usage monetization.

Central to the Transactions Wars was the issue of security, which largely fell under the umbrella of the greater US regulatory struggles between the government and tech firms over the export of encryption technology—hence what is referred to here the Encryption Wars. American companies were prohibited from exporting American encryption technology, but Netscape and other firms could still obtain clearance exporting less sophisticated encryption programs in order to sell their products abroad. In the case of Netscape, this meant European and Asian markets did not enjoy the same level of security in their respective regional editions of Navigator. For encryption firms, American companies keep a close watch on potential European competitor firms. While tech firms lobbied the Clinton administration for the loosening of these data encryption export laws, banks—under threat from firms like Microsoft—banded together to prevent sustained and potentially unrecoverable disruption from technology companies. The Clinton administration was evaluated the growing digital economy against the backdrop of universal backlash against its campaign for governments to adopt the NSA-developed Clipper chip encryption technology. Infamously, the chip technology that would allow the US government backdoor access to communications for law enforcement purposes. The White House chose to ease off its push for Clipper adoption, and allowed the export of 56-bit encryption software developed by Netscape,

Microsoft, and others, with the controversial caveat that software firms were to provide a key-recovery system for law enforcement back door decryption purposes. The administration would later put forth an e-commerce framework in 1997 advocating for minimal regulation. With Al Gore's presidential bid in mind in 2000, the White House finally dropped its export ban and allowed Netscape to export Navigator with 128-bit encryption to the rest of the world.

These three battles in the early years of web adoption ultimately shaped the forthcoming digital economy. Both Netscape and Microsoft lost the browser wars in the end with Google Chrome, Mozilla Firefox, and Apple Safari absorbing the vast majority of web users into the 2000s and beyond. As more and more individuals and entities published content to the web, search became the necessary intermediary to navigate the web. Google, with its dominant search engine, became the greatest beneficiary of the Browser Wars, both in terms of overall web traffic and its ability to lock in market share for its products and services. In linking users to their destination online, Google established itself as the attention broker of the online world, paving the way for the rise of what up Big Tech—Meta (previously Facebook), Apple, Amazon, Netflix, and Alphabet (previously Google), who would emerge as the prime players in an ad-driven multi-sided platform economy.

The Transactions Wars may, interestingly enough, have been the conflict that most benefited consumers. It drove financial services firms to develop consumer-friendly interfaces for what were complex transactions and protocols on the backend. The earliest and most prominent beneficiary of the highly publicized struggles between banks, credit card companies, and Microsoft, was PayPal. PayPal would, after years of consumer distrust of online security for credit card transactions, achieve notoriety as a trusted payments facilitator, and in tandem popularize peer-to-peer (i.e., user-to-user) payments technology. In the complex financial regulatory

environment of the U.S., PayPal would never see the kind of market dominance occupied by China's Alipay, who used similar technology and user logic to its payment services. In the U.S., the lack of a single dominant financial or tech firm in payments and banking bolstered competition in the fintech domain, which as the time of this writing is one of the most aggressive and fastest growth tech-related sectors, further buoyed by ambitious web3 technologies such as Blockchain.

With the end of the Encryption Wars, every tech firm seeking to grow its market share globally benefitted from the U.S. government's substantive policy change and shift toward deregulation. Facing a lucrative emerging market in China, and the whiplash from the Clinton administration's Clipper chip years, Microsoft agreed in July 2001 to ship its Windows software with a native Chinese encryption software written by a Chinese state-owned security company, a response to rumors circulating amongst Chinese netizens that Windows made computer users vulnerable to spying. Rising geopolitical tensions in 2022 as geopolitics resettled and realigned following the Trump era have since further cooled U.S.-China relations amid renewed conflict in the Balkans and enduring questions of state sovereignty. Amid a massive market downturn in tech and the broader economy, and major questions marks hanging over ambitious libertarian futures, the relevance and reach of governments, and their role in innovation, technological advance, and regulation seems as present as it ever has been.

### *The Logic of Web as Historical Case*

The work develops a historical chronology of the desktop web browsing sector through exploration of the Netscape and Microsoft corporations. By examining these companies and their web products between the years 1995 and 2001, the work details those factors that galvanized the

dissemination and usage of digital network platforms at their origin moment. As a work of analytical history, this work goes beyond the limitations of what otherwise might be considered a case study. It aspires to make an argument about the causal factors behind transformational innovation by leveraging a bottom-up approach to the research in order to arrive at an explanatory theory. The construction of a generalizable theory would thus seek to explain the factors necessary and sufficient to qualify an innovation as a transformative technological innovation. To understand what the future of a digital network platform technology like blockchain—"the world wide ledger"—might hold, the case of the web makes for an ideal starting point provided the range of similarities.[113]

As a reminding reference definition, signal innovations are at once a layer of technological utility built upon a yet-to-be classified general-purpose technology, while also the operant catalyst for the broader innovation system the general-purpose technology underpins as described in Chapter 2. The signal innovation under investigation in this work is the development, adoption, and diffusion of the world wide web and personal web browser as a unified digital platform, detailed via historical narrative, while the general-purpose technology antecedent to the signal innovation of the web is in this case the internet and its proliferation as mobilized by the web.

The internet existed prior to unified platform of personal web browser and world wide web, but it was not until the advent of the paired technologies of the web browser and underlying essential web technologies (universal resource locator (URL), hypertext markup language (HTML), and hypertext transfer protocol (HTTP), incorporated into an easily accessible, user-friendly personal web browser, that the innate potential of the internet as a technology grew evident. The emergence of the web signaled the arrival of the internet as a transformational

[113] Greenstein (2012).

catalyst, which subsequently inspired the development of countless spillover internet technology innovations. The resulting cascade of national and global geopolitical and social-economic effects are still being felt today, such that the internet is rightfully classified as a general-purpose technology as described in Chapter 2.

The adoption and diffusion of the world wide web, investigated through the activities, strategies, innovations, and growth of Netscape and Microsoft, meets three general thresholds introduced here that parallel what the world seems likely to experience singularly or collectively with blockchain—or any other number of second machine age technologies, including artificial intelligence, quantum computing, robotics, internet of things, and cloud computing. These thresholds, which the web crossed, include an economic and financial threshold, a socio-cultural threshold, and a geopolitical and regulatory threshold. Rather than introducing another layer of restriction within the theoretical structure of signal innovation, and thus subject to further debate, these thresholds should be considered directional for the purposes of the web-as-case-selected. As discussed in the prior chapter, cases worth examining will fit two dimensions of being at once highly accessible and intuitively comprehensible, as well as historically relevant and of high-yield for insight and intellectual inquiry—thus likely to amend, update, or further detail signal innovation theory. With that caveat, the thresholds considered are as follows, aligning with the encompassing systems-level effects described in the concept of general-purpose technologies.

First, the general economic and financial impact threshold: The release of the free for personal use Netscape Navigator web browser brought an entirely new group of users to the internet by helping transition internet navigation away from text-based user interfaces and toward graphical user interfaces similar to those found in contemporaneous online services (i.e., America

Online) or desktop operating systems (MS Windows, MacOS) via the web.[114] The early success of internet companies like Netscape led to rampant internet technology speculation and the venture capital boom, which drove rapid growth both in what is now termed the digital economy as well as across global financial markets between 1995 and 2001. Between 1995 and March 2000, the Nasdaq Composite stock market index rose 400 percent.[115]

Second, the general socio-cultural impact threshold: Whether we can accurately inscribe the present moment as the dawn of the second machine age, there is not doubt that the latticework of network infrastructure and digital technologies have transformed global society over the past three decades. The basic firmament of where and how human beings interact and acquire resources can be traced back to the genesis of the popular internet, first activated by the web. In 1995, some 13 percent of households had adopted use of the internet. By 2001, that number had risen to 52 percent, representing 300 percent growth over just a few short years.[116] While these numbers bear similarity to adoption rates of both the radio and color television, critically, the web is not merely a device for passive consumption. It has instead contributed to a truly globalized society, enabled and reliant upon the planetary spread of networked, digital information and communications technologies.

Third, and finally, the general geopolitical and regulatory impact threshold: Regardless of whether the internet has reaffirmed and galvanized state control and power, or has effectively eroded government control in favor of markets and individuals, unquestioningly, the internet has reshaped human relations and the capabilities and mechanisms by which governments can or

[114] Clark and Edwards (1999), Yoffie and Cusumano (1998).

[115] Data gathered from the NASDAQ website at https://www.nasdaq.com/market-activity/quotes/historical.

[116] Data gathered from World Bank at https://datacatalog.worldbank.org/dataset/world-development-indicators.

cannot exert control and influence over human affairs.[117] Amid previous industrial revolutions, other general-purpose technologies have so too reconfigured the balance of power between governments and the populaces or societies over which they reign, or with which they interact.[118] Consider the impact of the printing press and its ushering in of the Protestant Reformation, concluding in the Peace of Westphalia, marking the transition away from feudal rule and toward the modern nation-state system. Major questions will need to be answered over the coming decades concerning the purview of governments in a hyper-networked, digital-first world.

This work seeks to build a bridge to the future by extracting patterns from the history of the web's adoption and diffusion and apply new understandings to emerging technologies. Prior treatments of the web have focused on the interplay between public and private interests, the actions of individuals or individual firms, the confluence of technological factors, the role of government, legal-regulatory environments, and international affairs, or the all-encompassing human instinct to find new ways and means to connect.[119] This work treats the web as the result of a constellation and convergence of narrative economic forces, both technological and business economic, built upon the resultant general-purpose technology of the internet, while also operating in of itself as an innovation systems catalyst—a signal innovation—that helped transform the world.

[117] Wu and Goldsmith (2020), Friedman (2006).

[118] Ferguson (2017).

[119] Greenstein (2020), Greenstein (2019), Greenstein (2015), Berners-Lee and Fischetti (1999), Clark and Edwards (1999), Yoffie and Cusumano (1998), Isaacson (2014), Wu and Goldsmith (2020), Brynjolfsson and McAfee (2014), Gates (1995).

## Chapter 4 – Netscape, Microsoft, and the Browser Wars

*The Browser Wars: Overview—Signal Innovation Theory Application—The PC Revolution and the Ascendence of Windows—The Nascent Commercial Browser Industry—Netscape Races to Set Standards—Microsoft's Internet Dilemma: MSN, Netscape, and Windows 95*

*The Browser Wars: Overview*

In 1993, CERN, the European Organization for Nuclear Research, released Tim Berners-Lee's protocol for the web into the public domain and made its use royalty free. The same year marked the beginning of the web boom, when the National Center for Supercomputing Applications (NCSA) released Mosaic, the first popular graphical web browser. When one of Mosaic's original inventors, Marc Andreessen, co-founded a rival browser company in spring of 1994, the move marked the beginning of what is commonly known as the Browser Wars. While the first major rivalry was between Mosaic and Netscape Navigator, the second and more consequential rivalry was the one between Microsoft and Netscape between 1995 and 1999. In a race to procure greater market share, the Browser Wars resulted in not only the meteoric rise in popularity of the web, but also demonstrable evidence of rapid innovation from the entities involved in enhancing the user experience (UX) of the web.

The industry and market dynamics that gave way to the Browser Wars are best understood through evaluation of the landmark antitrust cases that took place prior to and nearing the conclusion of the Browser Wars as examined in this paper. The first case, an antitrust suit against IBM, ended in January 1982 after thirteen years when it was summarily dismissed as "without merit." The case coincided with change internally at IBM as the company developed the unbundled IBM PC in partnership with Microsoft, sharing original equipment manufacturer (OEM) responsibilities by partnering with software providers. In decoupling hardware from software, the IBM PC's success gave way to the PC Revolution, resulting in the proliferation of hardware manufacturers and the dominance of Windows as the standard-setting operating system. This decoupling led to a rapidly maturing software industry dominated by Microsoft by the time the web gained traction in 1993.

The second antitrust case is the infamous suit against Microsoft beginning in 1998 and decided in 2000. *United Stats v. Microsoft Corporation* was in fact the culmination of the Federal Trade Commission (FTC) and Justice Department's resolute efforts to prosecute Microsoft since 1990. The court's findings revealed not only Microsoft's anticompetitive behavior in the software market, but more importantly the leverage the company had enjoyed as the maker of Windows, the dominant OS of the PC and software industries. While software companies relied entirely on a dual-pricing revenue model—one price for the private user and one price for educators or companies—Microsoft's position in the market led to the development of multisided economics. Microsoft earned revenues from selling shrink-wrapped software to individuals and organizations alike while also receiving fees from hardware manufacturers, content providers, and internet service providers. This unique multisided revenue model mapped directly to Microsoft's anticompetitive practices, which included pressuring partner companies into exclusionary or prohibitive agreements as it sustained its dominance in the personal computing software industry.

The rise of the web produced in turn a nascent commercial browser industry that seemingly sat apart from the broader software industry. The popularity of Navigator quickly resulted in a wildly successful market debut for Netscape in August 1995, which helped encourage an investment frenzy for all things internet related. While the Browser Wars yielded more and better features for webpages and applications with each browser release, the forces driving the rapid innovation that defined the narrative of the web boom are best understood through the business economic factors driving decision-making at each of these companies. Between late 1994 and mid-1995, Netscape made a slew of announcements relating to browser and server software products and partnerships focused on securing transactions online. This future-oriented attitude was based on a belief that the e-commerce boom would soon occur, and Netscape Navigator would be the

gateway to online shopping. Netscape, like Microsoft in the PC and software industry, had a head start in a race to set standards for both browsing and spending on the web. Yet, despite its overnight success and browser market dominance, Netscape, like its original nemesis behind Mosaic (or rather, Spyglass, the private company formed to help the NCSA profit from its research institution-backed invention), relied on a dual-pricing business model. Spyglass would eventually secure a lucrative deal with Microsoft, which licensed the source code of Mosaic to quickly build Internet Explorer to ship with Windows 95.

During the time that Andreessen helped invent Mosaic and later Navigator, Microsoft devoted significant time and resources to internet-enabled TV software, known as WebTV. The company's fixation with WebTV led to a venture called the Microsoft Network, which would remain the thorn in Microsoft's internet dilemma for years to come. Code-named Marvel, and later launched (or relaunched) as MSN, the interactive television plan would be scrapped in favor of a closed-internet content product and service positioned to rival America Online (AOL) on other online services then dominant in the 1990s. By 1995, it became clear to industry professionals and investors alike that the web—now synonymous with the internet—would be an open platform. The gated institutional dynamics of online services could not forestall what would be dubbed the internet tidal wave. This point would be argued internally by younger developers at Microsoft and lead efforts at the highest corporate level to formulate an internet strategy, beginning in 1994. Toward the end of 1994, Microsoft had by then already made an unsuccessful bid for a browser company and was deep in negotiations with Spyglass.

By spring of 1995, the team building Internet Explorer (IE) would argue to the rest of the company that the open web, in the most extreme case, would likely topple Windows as the platform of choice for PC users—and MSN would likely play a role in working against Microsoft's efforts

to commercialize the web. While executives and managers at Microsoft continued to tussle over the problem that was MSN, the company's leadership continued to fumble the task of forming a coherent internet strategy. By mid-1995, it was clear to Microsoft executives that they could no longer ignore the rise of Netscape, and the internet strategy conversation would seemingly be sidelined again as the Redmond company sought to reign in Netscape's ambitions and influence.

*Signal Innovation Theory Application – Browser Wars Assessment*

The origins of the web and the development of the commercial browser meet several of the identifying conditions and characteristics that make the web a signal innovation. The web was built upon the fundamental technology of the internet, drove the adoption of the internet through its popularity, and ultimately formed the bridge between the non-specialized user of the internet with the internet itself. Accessed through the graphical web browser, the web unlocked the usability of the internet through an enhanced user experience. This made what was previously a niche technological with incredible complexity in its back-end makeup usable through a simplified front-end design.

*Table 4.1 – Signal Innovation – Foundational Principles – Browser Wars*

| Condition | Evidence |
|---|---|
| 1. **Evolve emerging technology.** Build upon and advance the evolution of a more fundamental technology later characterized as general-purpose. | • The web's success was made possible by the pluralist approach to internet regulation on the part of businesses, research institutions, and the government. This deregulation attitude drove both the web's popular emergence in 1995, and the privatization of the internet backbone, |

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| | known as National Science Foundation Network (NSFNET) backbone, in the same year. |
| **2. Accelerate user adoption.** Accelerate the adoption and diffusion of said underlying general-purpose technology. | • The web's popularity reportedly led to "data traffic jams" on the internet and was hailed by tech enthusiasts as network computing's first *killer app*, "an applications program so different and so obviously useful that it can create a new industry from scratch." A 1993 *New York Times* article claimed that Mosaic had been downloaded by "several hundred thousand computer networkers in less than a year."<br>• In 1995, coincident with Netscape's release, some 40 million people had access to the internet. |
| **3. Catalyze innovation ecosystems.** Catalyze the growth of an economic ecosystem around the general-purpose technology. | • Bill Gates in discussing the market anticipation of internet products and services from Microsoft and what would ultimately lead to Internet Explorer and the Microsoft Network (MSN): "People want to know when we will provide support services on the internet, they want to know when we will release internet software such as Mosaic, and they want to know how our future information products (and our information at your fingertips vision) relate to the internet. Many people feel that the internet is the real-live digital highway..." |
| **4. Intermediate with technology forerunners.** Function as an abstract or concrete technological intermediary | • In early June 1995, Netscape announced Navigator Personal Edition, a "one button access to the |

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|---|---|
| between it and the general-purpose technology. | Internet" solution made available through various Internet Service Providers (ISPs) where users were walked through an internet service registration process included in the Navigator software. |
| **5. Enhance user experience.** Unlock the usability or value of a general-purpose technology through an enhanced user experience (i.e., usability). | • The web and internet privatization opened new worlds of possibility for non-technologists, and dramatically reduced the technical barriers to entry for lay users. Prior to the release of Netscape, activity online was limited either to closed private networks, like America On Line (AOL), which featured a graphical user interface that allowed non-specialists to find exposure to information communication technologies. The web began to offer a more compelling (and consequentially free) alternative to pricey online services, who initially charge per-hour of use. |
| **6. Drive market growth.** Unlock the financial, commercial, or broader business economic potential of the general-purpose technology. | • Netscape, the first commercial internet company, debuted on the NASDAQ on August 9, opening at $70 per share after having set the stock price at $28. The Netscape IPO was so hotly anticipated that both underwriters, Morgan Stanley and Hambrecht & Quist, increased the number of shares issued (five million) and more than doubled the price.. . The *Wall Street Journal* described the demand for the stock as "nutty." . . . *Wired* would describe the 1995 multibillion-dollar |

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|---|---|
| | IPO of Netscape as “Phase One” of the Internet IPO fever. |
| **7. Unlock new value.** Unlock the consumer-relevance and value competitiveness of the general-purpose technology. | • Andreessen hoped that Mosaic would become “the standard front end to the Net” and that the momentum behind the web's becoming an increasingly rich data environment would drive consumer demand for his company's proprietary browser.<br>• On the topic of Netscape's market strategy, Andreessen appeared unwilling to divulge details of his company’s business model: “one way or another” his browser application would wind up “on every computer in the world.” |
| **8. Inspire new narratives.** Build upon existing or inspire new economic or innovation narratives surrounding the general-purpose technology. | • The web extended the PC revolution narrative of the 1980s, which saw via anti-trust intervention the decoupling of personal computing hardware from software. IBM dominated the hardware market, which soon became open to third-party competitors. Similarly, Microsoft monopolized the PC operating system market, where it controlled standards. The web and internet threatened Microsoft’s strong market position in software, which the web could conceivably supplant, hence it’s turn toward the internet in 1995, with Windows and IBM PC compatibles serving as the dominant platform for internet access. |

*Table 4.2 – Signal Innovation – Pre-Incident Indicators – Browser Wars*

| Condition | Evidence |
|---|---|
| **1. Underutilized disruptive technology.** A significant, disruptive, but niche technological artifact or development limited by technical complexity, usability and interfacing capabilities, and product and service use case application. *This the fundamental technology that has the potential to emerge as general-purpose, which often has existed for some time but never achieved general-purpose "escape velocity."* | • The web and internet privatization opened new worlds of possibility for non-technologists, and dramatically reduced the technical barriers to entry for lay users. Prior to the release of Netscape, activity online was limited either to closed private networks, like America On Line (AOL), which featured a graphical user interface that allowed non-specialists to find exposure to information communication technologies. The web began to offer a more compelling (and consequentially free) alternative to pricey online services, who initially charge per-hour of use. Before the web and before Netscape, non-online service internet users were restricted to unwieldy text-only command shells. A certain degree of familiarity with basic UNIX or UNIX-like command functions were necessary to gain access to tools like email, telnet, gopher, usenet, and the like, all predecessors to the world wide web. Netscape and the web changed access to the internet. |
| **2. Competitive innovation ecosystem.** An emerging and highly rivalrous series of complementary technical innovations, built upon said artifact and demarcating a new market ecosystem of no clear winners and aggressive competition. *These are the* | • A year after the first release of Navigator, Netscape claimed that more than 70 percent of global Fortune 100 companies were using Netscape software. The IPOs of both Netscape and Spyglass indicated there |

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| *innovations advancing the fundamental technology and competing for signal innovation status, drawing focus to the underutilized disruptive technology.* | was potential in the commercial browser market. The notion of what the internet was and who could access it had completely changed with the popularity of Mosaic and Navigator. In its October 16, 1995 review of the beta release of Navigator 2.0, the *New York Times*, "The introduction of the "beta," or test, version of Netscape Navigator 2.0 places Netscape on a direct collision course with Microsoft and the rest of the software industry, while at the same time signaling that Netscape may be preparing to veer off in a radically new and uncharted direction that could overturn the balance of power in the software industry." |
| **3. Compelling narratives.** An explosion of economic narratives surrounding said technical market ecosystem, covered more favorably in new media outlets, less favorably in established media outlets, and inspiring new terms and new uses of existing terms. *This circulation of narratives around a singular disruptive technology, amplified by the influx of technical innovations, suggests a higher probability of a signal innovation-general-purpose technology pairing.* | • At the end of the week, the *New York Times* would describe "Netscape fever" as a sign of a speculative bubble: "Given that Netscape has no earnings, hardly any sales and looming competition from big boys like Microsoft, such enthusiasm seems a little, well, juvenile. And while many analysts insist Netscape is an anomaly, some see it as a dangerous sign of the speculation that tends to mark market tops." By fall of the same year, the press would recognize that the internet's effect on Wall Street was here to stay, with Netscape's IPO signaling the beginning of a new era in computing. "Why did the stock market |

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| | go bonkers for Netscape, a year-old company that not only operated deep in the red but also warned in its prospectus that it did not intend to make any profits "in the foreseeable future?" Only one reason: the Internet." |
| **4. Incumbent investment.** Major investment by incumbent institutions into the productization of a technical innovation, unlocking the business economics and user experience factors of a more fundamental technology, often in competition with smaller, disruptive entrants. *Investment activity by large and established market incumbents drives additional focus and increases market speculation.* | • "Microsoft's Potential for Leadership in the Internet.": The memo outlined gaps in Microsoft's "fragmented" offerings, as well as a prioritized list of threats. At the top of the list was: "Threat of another company evolving the client and server using non-Microsoft protocols"—and specifically pointed to Netscape as the key competitor in the race to "control the client evolution." On this particular point, Rosen wrote that Microsoft's strategy was "currently a matter of some dispute." . . The final recommendation in the list reads, "We should try to strike a close relationship with Netscape. In this relationship our goal should be to wrest leadership of the client evolution from them. We should try to win them to a position where they are a "solution provider" of Internet merchant services on NT and back Office. . . We should also contemplate an investment if that helps bring about alignment." |

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| **5. Business model transformation.** Accelerated repurposing of how large institutions carry out business and profit-making activities, coincident with the adoption of said complementary technical innovation. *The emergence of new business models is the last step in the temporal transition from underutilized to general-purpose technology via the instantiation of a signal innovation and general-purpose technology pairing.* | • A later 1997 internal report of Microsoft's interactive TV efforts, which lasted from 1993 to March 1996, states that Microsoft, Oracle, and Silicon Graphics all saw interactive tv "as a new kind of software platform, potentially outnumbering the PC if successful." The system Microsoft spent years developing included subscriber services and financial transaction services, what eventually became known as WebTV. Throughout 1993, as Gates self-admittedly devoted much of his waking hours to figuring out how to monetize interactive television, the company was said to be in advanced talks with Tele-Communications Inc. (TCI) and Time Warner. |

*The PC Revolution and the Ascendance of Windows (1981-1990)*

The history of the rapid innovation and adoption of the web begins with the rise of Microsoft and the growing consumer interest in personal computers (PC), both of which took place a decade prior to the invention of the graphical web browser. The 1980s saw a diverse market of PC manufacturers, or original equipment manufacturers (OEM), and makers of PC operating systems (OS) come to occupy significant market share. The PC brought to the average household both the futuristic quality of powerful and unwieldy mainstream machines, such as the early

computer featured in the 1957 film *Desk Set*, and the immediacy of feedback designed for a non-specialist end user. At the end of 1982, in accordance with the magazine's tradition of naming a Man of the Year, Time magazine announced on its Jan 3, 1983, cover the personal computer as the Machine of the Year. An estimated 1.4 million PCs were shipped around the world that year, with over a million units sold in the United States, accounting for a 70% increase from the previous year when signs of the PC revolution gained momentum. [120] 1981 saw the continued success of the Apple II, the launch of the IBM PC, which featured the debut of Microsoft's MS-DOS operating system, and the launch of the Xerox 8010 Information System, the first commercial graphical user interface (GUI). The wildly successful Commodore 64 launched in August 1982. The dawn of the Information Age was felt in the realm of geopolitics as Japan inaugurated the ill-fated Fifth Generation Computer Systems initiative of the Ministry of International Trade and Industry (MITI).[121] While the computer industry in the United States raced toward the PC, the Japanese government placed its big bets for tech dominance on the hopeful creation of a large frame supercomputer in ten years' time.

The introduction of the Xerox 8010 Information System, commonly referred to as the Xerox Star, spurred the shift to graphic user interfaces (GUI) in personal computing.[122] Xerox Star's graphical interface introduced lasting interface concepts and functions such as computer icons, the desktop, object integration, and the What You See Is What You Get (WYSIWYG) interface in editing software.[123] The anecdote of Steve Jobs and Apple engineers visiting Xerox

[120] See *Byte* magazine 8, issue no.1 at https://archive.org/details/byte-magazine-1983-01. The magazine *Byte*, a publication at the center of the 1970s and 1980s microcomputing revolution, titled its inaugural 1983 issue "Looking Ahead" and covered the personal computer across 544 pages.

[121] "5th Generation' Spurs A Global Computer Race," by Michael Schrage, *The Washington Post*, July 12, 1984.

[122] "Xerox Offering New 8010 Star System," in *Communications News* 22, no. 4 (1985).

[123] WYSIWYG is a user interface system where what the user is editing resembles the content's appearance as an end product (ex. printed document)

PARC to examine Xerox's GUI developments and its impact on Apple's development of the Lisa and Macintosh is an oft-told business narrative.[124] Though the cost-prohibitive Lisa of 1983 was a commercial failure, its features set the technical direction for mass-market PC design. The commercial impact of the GUI on the PC market was realized first by the success of the Apple Macintosh, launched in January 1984, two days after Apple's famous Ridley Scott "1984" Super Bowl ad.[125]

The Macintosh figured significantly in Microsoft's shift to GUI. Microsoft had worked closely with Apple to develop Word and Excel for the Macintosh. But Microsoft's own response to the GUI revolution, a graphical operating environment that ran on DOS (also known as a graphical shell) called Windows was announced in November 1983. One of the first builds of Windows appeared in BYTE magazine.[126] BYTE highlighted in its article the need in the market for a more affordable PC with a GUI, as well as the challenges in meeting the hardware specifications to run all of Windows's graphical features smoothly. Windows 1.0 launched in November 1985 as a GUI operating environment, or graphical shell, that ran on MS-DOS.

Between 1981 and 1985, the PC market not only took shape in structure, but it witnessed rapid adoption as the number of units shipped globally crossed into the millions.[127] These years also spanned both the 8-bit and 16-bit processor eras. Microprocessor technology advanced rapidly during this period, with technical production efficiencies increasing and costs decreasing, spurred by consumer demand of the growing personal computing market. Personal computing processing power was rising to a level that enabled the absorption of computing capabilities previously the

[124] "Creation Myth," by Malcolm Gladwell, *The New Yorker* 87, no. 13 (2011).

[125] "Who really invented the personal computer?" by James Ellis, *Newsweek*, March 3, 2016.

[126] "Windows in 1983," at http://toastytech.com/guis/win1983.html. The site is an astonishing blast from the past, both stylistically and with its content pertaining to the early days of the web.

[127] "Looking Ahead," *Byte*, https://archive.org/details/byte-magazine-1983-01/page/n175,

exclusive purview large commercial or academic technology implementations. The Aldus Pagemaker, the first application of what would later become the Adobe desktop publishing suite, debuted on the Macintosh in July 1985, signaling the launch of the desktop publishing segment of the newly independent software industry. 1985 also saw the beginning of the fateful partnership between Microsoft and IBM in co-developing the OS/2 operating system, intended as the graphical successor to DOS, and further opening possibilities for personal end-users.

Amidst the bustle of the PC's arrival, 1982 also saw the end to the Justice Department's antitrust case against IBM, which sought to prove IBM's violation of Section 2 of the Sherman Act. Described by antitrust law scholar Robert Bork as "the antitrust division's Vietnam," *US v. IBM* spanned thirteen years and four administrations, produced over 66 million pages of documents, and cost tens of millions of dollars in legal fees a year on the defendant's side alone.[128] In January 1982, months before the case was due to go to judgement—and a year into Ronald Reagan's first term—the Justice Department dismissed the case as "without merit." The IBM suit would serve as a caution against big antitrust cases, a freeze that would only be broken in the Clinton years by the suit brought against Microsoft.[129]

The long duration and exorbitant cost of the investigation and trial may have influenced the shift in IBM's internal design philosophy as it developed the IBM PC. For the first time, IBM embraced an unbundled, decentralized, open architecture, partnering with Microsoft and Intel. Reconstitutions of this time period typically explain the rise of the PC market as either break-neck innovation of a single team at IBM or a product the boy wonder (Bill Gates) who outsmarts the "myopic and foolish IBM." But, as legal scholar Tim Wu argues, the effect of the "policeman at

[128] "Law Firm Waged 13-Year War for IBM: An Antitrust Relic?" by Paul Taylor, *The Washington Post*, January 24, 1982.

[129] Oliver (2021).

the elbow" may have curbed IBM's appetite for appearing to monopolize yet another computer market coming so shortly after resolution of its anti-trust case.[130] It was precisely the practice of bundling hardware with software for mainframe computers that formed the basis of the Justice Department's investigation of IBM beginning in 1969. No doubt executives were looking to prevent a repeat of those events.

IBM's choice to decouple hardware and software established the platform and applications structure for the PC market going forward, in which the Wintel environment (e.g., Microsoft operating systems beginning with DOS and continuing with Windows running on Intel chipsets and hardware architecture) became the standard-setting PC platform for which applications were developed, and thus making the birth of an independent software industry possible. The Wintel-led market with its platform-based innovation spurred product and technological advancement in the industry and quickly became the home computing standard. Platforms—specifically digital platforms—rely on standards and in turn lower the cost of entry into a market for prospective entrants looking to offer products or services based on said standards, and thus giving rise to product or service ecosystems built upon the compounding returns of technical innovation. The IBM PC's open architecture also allowed, in due time its hardware to be reverse engineered and copied, leading to the rise of IBM PC "compatibles" or clones that came to dominate the space. This arrangement set the stage for the modern day PC (personal computing) market, which continues to operate under the same standards are these decades later. This move produced a number of competitor hardware companies in the PC market—with Dell being perhaps the best known—who consequently pioneered online personal computing configuration and purchase. This

[130] Wu (2020).

formed what would become the OEM channel reliant upon Microsoft's Windows OS as Windows quickly became the consumer OS of choice.

With the launch of the Windows 3.0 operating system in 1990, Microsoft brought to market a graphical operating system to compete with GUI environments as seen in the Macintosh. At this time, Windows was a graphical shell that ran atop DOS—it was not yet a fully standalone operating system—but nevertheless represented significant enough of advances in features and capabilities to compete with the Macintosh. Windows 3.0 was both a critical and commercial success, selling three million copies in its first years and setting the stage for the standalone Windows 95 OS yet to come.[131] The success of Windows 3.0 marked the turning point in Microsoft's strategy in the market as it shifted from being an applications player to being a single entity (albeit still a software company) established the standards of the emerging personal computing platform, releasing alongside its OS a suite of productivity applications popular with PC users. Third-party programmers began to write applications for Windows, and Microsoft gained market share quickly as Windows 3.0 started to come bundled standard with most non-Macintosh PCs in the early-1990s.

The software development relationship between IBM and Microsoft for an IBM-released Windows competitor known as OS/2 would break down in 1990 over features and market positioning of the future releases of the jointly developed OS/2. It also coincided with the first Federal Trade Commission (FTC) probe into possible collusion between IBM and Microsoft to corner the PC market by privileging the OS/2 for high-end computing needs while sandbagging features on Windows, which would target the lower end of the market.[132] Importantly, OS/2 was

[131] "Microsoft Windows Turns 30: A Brief Retrospective," at *ExtremeTech*, November 20, 2015. http://www.extremetech.com/computing/218336-microsoft-windows-turns-30-a-brief-retrospective.

[132] Wu (2018).

designed around an IBM-based competitor chipset known as the PowerPC chip set to compete with Intel's Pentium processors in the home computing market. When the agreement fell apart, IBM sold the architecture to Apple, which became the basis for its post-Motorola processor line of Macintosh computers, before later adopting Intel-based architecture in the 2000s.

The basis for the FTC probe was a joint announcement made by the two companies at the Comdex trade show in November 1989.[133] The FTC investigation would only be made public in early 1991 and result two years later in a deadlock, which spurred the Justice Department to launch an antitrust investigation into Microsoft's operating system and applications bundling practices.[134] While the FTC began by looking into collusion between Microsoft and an OEM, the Justice Department's investigation investigated more broadly the full scope of Microsoft's practices within the software industry. But it was by focusing narrowly on Microsoft's licensing practices for MS-DOS in the computer industry that the Justice Department ultimately compelled Microsoft to settle the case out of court.[135]

The antitrust suit led to the heavily criticized July 1994 final judgment, a consent decree noted for its vague language. The settlement agreement came about because the Justice Department, like the FTC, spent years mired in "arcane disputes between competitive high-tech companies." The *New York Times* reported, "[U.S. government officials] were overwhelmed by the volume of information that came pouring down on them. In the end, they retreated to a fairly narrow set of licensing practices that they felt were clearly illegal. By default, the Government decided to avoid the larger and more difficult questions raised by Microsoft's angriest critics."[136]

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[133] "I.B.M. and Microsoft Promote OS/2," by Andrew Pollack, *The New York Times*, November 14, 1989.

[134] Wu (2018).

[135] "Judge in the Microsoft Case Is Willing to Test the Limits," by Edmund L. Andrews, *The New York Times*, February 21, 1995.

[136] "Microsoft Dilemma for Justice Dept," by Edmund L. Andrews, *The New York Times*, February 16, 1995.

The computing industry was so new that even basic knowledge or understanding of how a personal computer worked, let alone a deeper understanding of its technical capabilities, remained out of reach for most individuals uninitiated with the industry. The consent decree's approval process would be drawn out when Judge Stanley Sporkin refused to approve the agreement. Sporkin argued that the consent decree would be ineffective in reining in Microsoft's behavior going forward because not only did the agreement not cover all of Microsoft's operating systems, it also had no provision for an independent compliance officer to monitor Microsoft's behavior.[137] The consent decree would be finalized only in August 1995.[138] By that point, Microsoft had established its preeminence in the personal computing sector. To succeed, third parties were forced to work with Microsoft. The software company's early dealings with the Justice Department revealed the changing economics of the PC industry, which would ultimately inspire the growth of the software industry. The pace of change in both the technology innovation and the ways in which Microsoft made money was unprecedented and difficult for antitrust enforcers to grasp and police.

*The Nascent Commercial Browser Industry (1993-1995)*

Though the Mosaic-Navigator and Navigator-Internet Explorer browser wars marked two distinct periods of rapid innovation in browser technology, both rivalries shared a common pivotal character—Marc Andreessen. The creation of a commercial browser industry began with Andreessen's time at the National Center for Supercomputing Applications (NCSA), one of the many entities that benefitted from legislation to build the "Information Superhighway," a term

[137] "Microsoft Dilemma," by Edmund L. Andrews, *The New York Times.*

[138] "Long antitrust saga ends for Microsoft," by Sharon Pian Chan, *The Seattle Times,* May 11, 2011.

originating in the late 1970s and popularized in the early 1990s by then-Senator Al Gore. A variation of the coined term *infobahn*, the Information Superhighway encompassed internet, cable, and broadband access for all Americans. On December 9, 1991, President George H.W. Bush signed into law the High Performance Computing Act (HPCA), commonly referred to as the Gore Bill in reference to Senator Gore, who created and championed the legislation.[139] The Gore Bill was intended for national security purposes to support American competitiveness in technology and science by building on government-backed programs that created innovative technologies like the ARPANET, the precursor to the Internet.

One of the recipients of HPCA funding was the NCSA at the University of Illinois at Urbana-Champaign (UIUC). A small team of programmers at NCSA led by Andreessen, then a student and Unix coder at NCSA, and Eric Bina began development on a graphical web browser that came to be the Mosaic browser, originally written for Unix.[140] Soon, a few others at NCSA joined the Mosaic project, quickly turning out versions for Mac OS and Windows. Tim Berners-Lee, the inventor of the web, described in his writings that Andreessen was motivated by Mosaic's fast user adoption, and was spending a good majority of his time responding to feedback and bug reports. Andreessen also enthusiastically marketed Mosaic to the highly specialized Internet-minded community.[141] Mosaic's popularity reportedly led to "data traffic jams" on the internet and was hailed by tech enthusiasts as network computing's first *killer app*, "an applications program so different and so obviously useful that it can create a new industry from scratch."[142] A 1993 *New*

[139] See "S.272 - 102nd Congress (1991-1992): High-Performance Computing Act of 1991," accessible at https://www.congress.gov/bill/102nd-congress/senate-bill/272.

[140] Pavel (1982).

[141] "A Brief History of the Web," on Tim Berners-Lee personal website, accessible at https://www.w3.org/DesignIssues/TimBook-old/History.html.

[142] "A Free and Simple Computer Link," by John Markoff, *The New York Times*, December 8, 1993.

*York Times* article claimed that Mosaic had been downloaded by "several hundred thousand computer networkers in less than a year."[143] This sudden popularity of a free software that connected the user to the web was attributed to its clickable, graphical interface. Berners-Lee, on the other hand, has suggested that it was the ease of download and installation (especially when compared to ViolaWWW, an early web browser) that made Mosaic so popular.[144]

While Mosaic was free for individual non-commercial use, NCSA's small software team soon experienced overwhelming commercial interest in Mosaic. UIUC retained the rights to the software and the NCSA's mission included the commercial licensing of its inventions; in 1994 several licensees planned to capitalize on Mosaic's commercial potential. In July 1994, the NCSA priced commercial licenses at an initial fee of $100,000 and $5 for each copy of the software. This pricing strategy is, in retrospect, interesting as it reflected an "accepted belief" within the software industry that an initial licensing deal offer from Microsoft was always set at $100,000.[145]

In 1993, the NCSA approached Spyglass Inc., founded by a former NCSA engineer who helped create Telnet—a text console-based networking application that in many respects served as an early forerunner to the web—to help commercialize Mosaic.[146] NCSA and Spyglass entered into a master commercial licensing agreement in March 1994. This agreement led to the Enhanced Mosaic commercial browser. In August 1994, Microsoft made an initial offer of $100,000 to Spyglass to license the Mosaic source code. A deal was reached between the two companies in December for $2 million for Microsoft to use the Mosaic code in Windows 95.[147] By January 1995,

[143] "A Free and Simple Computer Link," by John Markoff, *The New York Times.*

[144] Berners-Lee and Fischetti (2000).

[145] "Spyglass, a Pioneer, Learns Hard Lessons About Microsoft," by Steve Lohr, *The New York Times*, March 2, 1998.

[146] "The (Second Phase of the) Revolution Has Begun," by Gary Wolfe, *Wired*, October 1, 1994.

[147] "Spyglass," by Steve Lohr, *The New York Times.*

Spyglass had licensed 15 million copies of the Enhanced Mosaic browser. SPRY, Inc. licensed the Mosaic source code from Spyglass for its Air Mosaic browser as part of the IBox, one of the first Internet-in-a-box products for the consumer market.[148]

After the initial success of Mosaic, developers working at the NCSA soon grew discontent with the rapid influx of reports and requests from new users and increasingly bureaucratic response within the NCSA to the urgency of making money from Mosaic.[149] With scarce pay to support the increasing complexities of the project, by the end of 1993 Andreessen graduated and had moved to California to work at Enterprise Integration Technologies, an Internet security software firm. He was soon recruited by Jim Clark, one of the co-founders of Silicon Graphics, Inc. Among their initial business ideas for their newfound partnership was an online virtual gaming network, which they pitched to Nintendo.[150] Instead, the pair elected to recruit several members of Andreessen's Mosaic team at NCSA and in April 1994 and founded Mosaic Communications Corporation, where Andreessen led his team of developers in creating a new Mosaic web browser to supersede the one he had created at UIUC. The browser was code named Mozilla, the Mosaic Killer, a riff on the fictional monster Godzilla.[151] After trademark disputes with the NCSA over use of the Mosaic name, the company would come to rename as Netscape Communications Corporation in November 1994.[152]

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[148] "Shining Time for Spyglass," by Ronald E. Yates and Tribune Staff Writer, *The Chicago Tribune*, January 22, 1995.

[149] "The (Second Phase of the)," by Gary Wolfe, *Wired.*

[150] "The (Second Phase of the)," by Gary Wolfe, *Wired.*

[151] "The Curious Case of Web Browser Names," by Scott Gilbertson, *Wired*, January 13, 2012.

[152] "Mosaic Communications changes name to 'Netscape Communications Corporation'," by Rosanne Siino, *PR Newswire*, November 14, 1994.
https://web.archive.org/web/20030201174633/http://wp.netscape.com/newsref/pr/newsrelease5.html.

An early Netscape press release indicated that Netscape did not need to license the Mosaic source code, meaning that Andreessen's team went on to build an entirely new graphical browser, as he had done previously at the NCSA.[153] While the commercial licensees of Mosaic primarily sold altered or shrink-wrapped versions of Mosaic, Netscape built Mozilla—later, Navigator—from the ground up as the center of a suite of web-centric offerings. An article by Gary Wolf in the October 1994 issue of *Wired* magazine provided an early glimpse into the driving force behind product development at Netscape, as well as a certain degree of ambiguity in its business model and market strategy. Andreessen hoped that Mosaic would become "the standard front end to the Net" and that the momentum behind the web's becoming an increasingly rich data environment would drive consumer demand for his company's proprietary browser.[154] On the issue of standards setting, Andreessen acknowledged the unlikelihood of the web remaining an open environment: commercial players in the space would push the web towards fragmentation. He emphasized that his company was product-driven, that they were "competing on the basis of quality."[155] Of the seemingly inevitable effect of this commitment to building a superior Mosaic browser—and building it fast—Wolf predicted that Mosaic would possibly become the leading browser and be in a position to set the standards. On the topic of Netscape's market strategy, Andreessen appeared unwilling to divulge details of his company's business model, only stating ambitiously that "one way or another" his browser application would wind up "on every computer in the world." But on the importance of maintaining open standards in browser technology, Andreessen said, "The overriding danger to an open standard is Microsoft."[156]

[153] "Mosaic Communications," by Rosanne Siino, *PR Newswire.*

[154] "The (Second Phase of the)," by Gary Wolfe, *Wired.*

[155] "The (Second Phase of the)," by Gary Wolfe, *Wired.*

[156] "The (Second Phase of the)," by Gary Wolfe, *Wired.*

On October 13, 1994, Netscape announced that the public beta version of its browser, Netscape Navigator, released the same day, would be free to individuals for personal use and that the official version slated for launch in November would also be free to download. The 1.0 release would have [BIT] encryption and server authentication, and when paired with the forthcoming Netsite Commerce Server, would allow Netscape users to "take advantage of such commercial services as online publications, financial services and interactive shopping." Commercial licenses were priced at $99 per user.[157] Netscape's ambitions for its software products serving as the linchpin of e-commerce became evident in its initial product lineup.

On December 15, 1994, Netscape's press release for the 1.0 launch stated that the browser would continue to be free for academic and non-profit use, as well as free for evaluation use. Commercial single user license fees were lowered to $39. Navigator shipped cross-platform for Windows, Macintosh, and X Windows System. It was touted as the fastest commercial browser on the market, and featured continuous document loading, simultaneous downloads, and native support for JPEG image format, a meaningful step forward from previous Bitmap or GIF image files.[158] The 1.1 release came with a significant new feature, underappreciated at the time, called the Netscape Client Application Programming Interface (NCAPI) for third-party applications integration and dynamic document updating.[159] In June, Netscape announced the integration of Macromedia, Inc.'s Director multimedia playback software into Navigator, bringing sound and

[157] "Mosaic Communications Offers New Network Navigator Free on the Internet," *PR Newswire,* October 13, 1994. https://web.archive.org/web/20030201174633/http://wp.netscape.com/newsref/pr/newsrelease1.html.

[158] "Netscape Communications Ships Release 1.0 of Netscape Navigator and Netsite Servers," *PR Newswire,* December 15, 1994.
https://web.archive.org/web/20030201191405/http://wp.netscape.com/newsref/pr/newsrelease8.html.

[159] "Netscape Unveils Netscape Navigator 1.1.," *PR Newswire,* March 6, 1995.
https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease16.html.

video to web pages, and laying the foundation for first streaming audio then video.[160] The beta release of Navigator 1.2, designed for Windows 95, arrived June 20, featured only some of the many new features to be included with the official release of 1.2 in September that leveraged the new interface and features of Windows 95.

Prior to the official 1.0 release of Navigator, Digital Equipment Corporation was announced as the first Netscape server software reseller. Prior to modern day cloud computing, web servers were tied to specific computer servers, designated via IP addresses that mapped to physical networked computing locations, accessible via the web through URLs, Universal Resource Locators, commonly known as web addresses, running a web server package such as Netscape.[161]

While Netscape marketed Andreessen as the new wunderkind of the internet age, the company quickly moved away from the founder-CEO leadership model. James Barksdale was announced on January 11, 1995, as the new president and CEO of Netscape, alongside several other senior management hires.[162] In February, Novell, Inc. and Netscape announced a licensing agreement to bundle Navigator with Novell products. Later in March, Netscape expanded its product offerings, adding the Netscape Proxy Server alongside new applications for businesses to create online stores.[163] In April 1995, Morgan Stanley conducted a Series C round that placed

[160] "Macromedia and Netscape Combine Technologies to Bring True Multimedia to the Internet," *PR Newswire*, June 5, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease28.html.

[161] "Digital and Netscape Communications Announce Partnership Agreement," *PR Newswire*, November 29, 1994. https://web.archive.org/web/20030201174633/http://wp.netscape.com/newsref/pr/newsrelease6.html.

[162] "James Barksdale Joins Netscape Communications as President and CEO," *PR Newswire*, January 11, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease11.html.

[163] "Netscape and Novell Announce Strategic Agreement To Deliver Intranet Solutions," originally in Novell AppNotes, May 1, 1997. Accessible at https://support.novell.com/techcenter/articles/dnd19970506.html.

preferred Netscape stock with publishing and technology companies, including Adobe Systems Incorporated and Hearst Corporation.[164]

On May 23, Netscape and Sun Microsystems, Inc., then the leader in the internet server market, jointly announced a partnership based on "a pact" the two companies had made earlier in fall of 1994.[165] Netscape would license Sun's Java programming language in an effort to "integrate the Java language into future versions of Netscape Navigator."[166] At the time of the announcement, Sun had already been offering Netscape Navigator bundled with its own software. By December, Netscape and Sun would announce an open, cross-platform object scripting language called JavaScript, made available with the beta release of Navigator 2.0.[167] In the first half of 1995, Netscape claimed that Navigator accounted for "more than 75 percent of browser traffic on the Internet, according to statistics from popular Web sites."[168]

In early June 1995, Netscape announced Navigator Personal Edition, a "one button access to the Internet" solution made available through various Internet Service Providers (ISPs) where users were walked through an internet service registration process included in the Navigator software.[169] This release of Navigator was significant because it marked another shift in Netscape's

[164] "Netscape Communications Announces Investment by Publishing and Technology Companies," *PR Newswire,* April 7, 1995.
https://web.archive.org/web/20030403225148/http://wp.netscape.com/newsref/pr/newsrelease22.html.

[165] "Netscape and Sun," *PR Newswire,* April 11, 1995.
https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease23.html.

[166] Specifically, Java Runtime Interpreter, the Java Foundation Classes, and Java Compiler and Development Tools.

[167] "Netscape and Sun Announce JavaScript, the Open, Cross-Platform Object Scripting Language for Enterprise Networks and the Internet," *PR Newswire,* December 4, 1995.
https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease67.html.

[168] "Developers weigh Navigator against Explorer," by Nick Wingfield, *InfoWorld*, January 29, 1996. Full issue available at https://books.google.com/books/about/InfoWorld.html?id=zD4EAAAAMBAJ.

[169] "Netscape Unveils Netscape Navigator Personal Edition," *PR Newswire*, June 5, 1995.
https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease27.html.

business strategy concerning distribution and market share. Previously the web was considered but one of a host of internet navigability options, alongside protocols like gopher, telnet, usenet, and email. By means of inclusion of internet service options, Netscape's partnership with ISPs prefigured the shape of digital things to come, with the web increasingly serving as the preferred portal for the internet and use cases from alternative protocols now being replicated on the web (e.g., bulletin board systems beget usenet, which beget online forums, of most notable contemporary relevance, reddit). The one button access also demonstrated the important of user interface (UI) design beyond the graphical interface function of browsers like Mosaic and Navigator. A UI design feature was now tied to a business imperative to sign users up for internet service. Netscape planned to sell the Personal Edition in stores for around $40 instead of distributing it solely online for free. Its one-button internet access feature was also notable in that it allowed immediate sign-up to four ISP gateways: MCI, Netcom, Portal, or UUNet, predating Microsoft's subsequent MSN one-button sign-up feature in Windows 95.[170]

Beginning in late October, Intuit's release of Quicken for 96 for Windows not only bundled Navigator, but also provided free access to Intuit's new website, the Quicken Financial Network, and internet access through ISP Concentric Network Corp.[171]As Netscape products gained momentum rapidly between the 0.9 and 1.2 releases of Navigator, the company signaled investment into new categories of commercial users of Navigator: the enterprise customer and US government. On September 21, 1995, Netscape announced its first acquisition—Collabra Software, Inc., the maker of Collabra Share, a group conferencing and collaboration software.[172]

[170] "Netscape to Sell Internet Browsers," by Bloomberg News, *The New York Times,* June 6, 1995.

[171] "Intuit to Provide Internet Access Directly From Quicken," *PR Newswire,* October 19, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease55.html.

[172] "Netscape to Acquire Collabra Software," *PR Newswire,* September 21, 1995, https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease45.html.

Netscape then announced on October 10 its intent to support the Fortezza security card, a PC card technology developed by the National Security Agency (NSA) utilizing U.S. government standard cryptography.[173] At the end of the same month, Netscape slashed its prices for Netscape Commerce Server and Netscape Communications Server software, and announced a reseller agreement with IBM.[174]

Navigator's success reads like many tech startup beginnings, but to understand the novelty of the web conferred onto the average PC user it is worth revisiting the browser's installation message. Upon downloading Netscape, new users were greeted with the following message in the software's product manual:

> You're about to embark on a journey across the Internet, and Netscape is your vehicle. Netscape Navigator opens a world of new media applications, such as online publishing and information access, interactive shopping, and distance learning. It also allows organizations to communicate more efficiently with customers, suppliers, partners and employees.[175]

What Netscape and the emergence of the web into popular consciousness signaled that, for the first time, through telecommunications and information technology, recorded information was freed from the domain of atoms (books and other printed literature) and replaced with bits (digital files hosted on the web).[176] At the time, no payment was expected in exchange for information-

[173] "Netscape to Offer Fortezza Cryptographic Capability for Its Software Products," *PR Newswire*, October 10, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease49.html.

[174] "Netscape and IBM Sign Agreement, " *PR Newswire*, October 31, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease59.html. Also see "Netscape Cuts Prices on Netscape Server Software," *PR Newswire*, October 30, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease58.html.

[175] "Netscape 1.x," *WinWorld.* Available at https://winworldpc.com/product/netscape-navigator/1x.

[176] "Anthropic Capitalism And The New Gimmick Economy," by Eric Weinstein, *Edge.org*, 2016. https://www.edge.org/response-detail/26756.

based products or goods distributed online. In 1995, coincident with Netscape's release, some 40 million people had access to the internet. All content could be accessed in large part free of charge in emerging digital economy, where advertising or subscription models had yet to take hold.

Both Mosaic and Navigator's success were made possible by the pluralist approach to internet regulation on the part of businesses, research institutions, and the government. This deregulation attitude drove both the web's popular emergence in 1995, and the privatization of the internet backbone, known as National Science Foundation Network (NSFNET) backbone, in the same year. Prior to 1995, commercial internet service providers had to hook their networks into the NSFNET backbone infrastructure. Originally NSFNET served only academic, research, and governmental users, but in 1991 it enabled commercial internet service providers to link their regional networks into NSFNET for internet access. In 1995, NSFNET reverted to its research-only functions as U.S. internet traffic necessitating backbone transport rerouted through private internet service providers' infrastructure. Commercial internet service providers had been rapidly establishing their own architecture, such that by 1995, NSFNET was no longer necessary to interconnect servers. This privatization transformed the internet into a commercial enterprise spanning the globe, with 6.6 million hosts spread over 61,000 networks with 23,500 web sites in 1995, that, already at that time, was growing at exponential rates.[177]

The web and internet privatization opened new worlds of possibility for non-technologists, and dramatically reduced the technical barriers to entry for lay users. Prior to the release of Netscape, activity online was limited either to closed private networks, like America On Line (AOL), which featured a graphical user interface that allowed non-specialists to find exposure to information communication technologies. The web began to offer a more compelling (and

[177] Cave and Mason (2001), p. 190.

consequentially free) alternative to pricey online services, who initially charge per-hour of use. Before the web and before Netscape, non-online service internet users were restricted to unwieldy text-only command shells. A certain degree of familiarity with basic UNIX or UNIX-like command functions were necessary to gain access to tools like email, telnet, gopher, usenet, and the like, all predecessors to the world wide web. Netscape and the web changed access to the internet.

First, the web was searchable and integrated. The web introduced the concept of sites into the architecture of the internet and eventually our daily lexicon. Using hypertext transfer protocol (HTTP), sites then (and still now) could be searched and networked, both internally within a given server or domain, and externally, to any other site available via the web. HTTP simplified the mechanism by which internet addresses were created and accessed, abandoning port designations, for example. Once a site name was entered within a browser's URL field, a user's web browser automatically searched the internet for said address and retrieved the document or file in question. This was a huge step forward from other internet protocols, which required several additional steps and more insider knowledge to uncover information online. This protocol continues through to present day, with minimal change.

The web, via Netscape, represented a new articulation of the motto "information wants to be free." The iconic phrase drove much online activity and was representative of the early ethos of the internet. Stewart Brand, an early technology activist, is largely credited for the expression, which he communicated reportedly to Steve Wozniak first in 1984: "On the one hand information wants to be expensive, because it's so valuable. The right information in the right place just changes your life. On the other hand, information wants to be free, because the cost of getting it out is

getting lower and lower all the time. So you have these two fighting against each other."[178] Most technologists and technology activists promoted an interpretation that anchored on the latter: all people should have access to all information at no cost. It was in this open environment and with this ethos that Netscape helped transform Berners-Lee's niche portal to the internet into one of the century's most transformational technologies.

*Netscape Races to Set Standards (1994-1995)*

In a December 1995 *New York Times* profile of Tim Berners-Lee, it was noted that though the World Wide Web Consortium (W3C) had more than 100 members—including the biggest names in the tech industry like Microsoft, Netscape, IBM, and Oracle—that formed working groups and committees making recommendations about standards, ultimately the decision sat with Berners-Lee.[179] In fact, for Berners-Lee, the need for the web to remain global and open outweighed the threats of proprietary standards, especially as Navigator was the dominant browser. Berners-Lee told the *New York Times*, "Companies will promote the proprietary aspects of their browsers and applications, and they should. But the navigation of the Web has to be open. If the day comes when you need six browsers on your machine, the World Wide Web will no longer be the World Wide Web."

Among the standards Netscape raced to set was the security protocol for credit card transactions. Netscape's vision of a flourishing e-commerce market enabled by its server software

[178] "Hackers at 30: 'Hackers' and 'Information Wants to Be Free,'" by Steven Levy, *Wired*, November 21, 2014.

[179] Situated at the Massachusetts Institute of Technology (MIT), the consortium's mission was to establish international standards for client and server protocols that enable online transactions and communications. See Brooks (2009). Also see "His Goal: Keeping the Web Worldwide," by Steve Lohr, *The New York Times*, December 18th, 1995.

and booming user market share was clear from the 1.0 release. This strategy indicated that Andreessen had a strong grasp of Berners-Lee's commercial considerations in building the web, namely that the commercialization of the open web was inevitable. Berners-Lee had built in Error 402, a placeholder for browser-embedded digital payments that continues through to today, indicative of his anticipation that users would pay to access certain pages.[180] For browser developers, Berners-Lee's Error 402 was unmissable, and Netscape (and soon Microsoft) saw embedded payments as a crucial component to making browser technology the interface for e-commerce. An embedded payments function would require security protocols that satisfied financial services entities like banks and credit card companies. Between the beta release and the official 1.0 launch of Navigator, Netscape made a series of announcements indicating that setting the security protocol standards on the web would play a key role in its business strategy for Navigator. The first of these announcement's was Netscape's new role as founding member of the W3C.[181] In late October 1994, Netscape first submitted its Secure Sockets Layer (SSL) security protocol as a proposal to the W3 online security working group in an effort to standardize security protocols for e-commerce**.**

The original SSL protocols were developed by Netscape's lead scientist Taher Elgamal.[182] SSL provided a secure channel between two machines or devices operating over the internet or an internal network, for example, between a web browser and web server. This made it the standard security technology for establishing an encrypted link between a web server and a browser,

[180] The developer specification notes for Error 402 read, "The 402 (Payment Required) status code is reserved for future use." See "Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content," at https://datatracker.ietf.org/doc/html/rfc7231#section-6.5.2.

[181] "Mosaic Communications Becomes Founding Member of W3 Consortium for Internet," *PR Newswire*, October 25, 1994. https://techmonitor.ai/technology/mosaic_becomes_founder_member_of_internet_body_w3.

ensuring that all data passed between the web server and browser remained private. In lay terms, this means that when a user accesses a webpage with a form, information entered the form and submitted, absent SSL, opens the unencrypted information to interception by a hacker. This information could be anything from bank transaction details to personal-identifying data. Such data interception is referred to as a "man-in-the-middle attack" by cybersecurity professionals, whereupon an adversarial party deploys a listening program on a web hosting server to execute the attack. Once a visitor accesses the site and enters information, the program activates and begins transmitting the information back to the hacking, who goes undetected in the process.

Contrast this with SSL encryption: a user browser in this scenario forms a connection with the web server and immediately forms a connection with what is known as an SSL certificate. This binds the browser and the server and secures the connection so that the information transferred occurs only between the client web browser and the web server host. This is accomplished by the following process: A browser or server attempts to connect to a website (i.e. a web server) secured with SSL. The browser/server requests that the web server identify itself. The web server sends the browser/server a copy of its SSL certificate. The browser/server checks to see whether or not it trusts the SSL certificate. If so, it sends a message to the web server. The web server sends back a digitally signed acknowledgement to start an SSL encrypted session. Encrypted data is shared in this case only between the browser/server and the web server, making hacking by intercept means far more difficult, if not impossible.

SSL-enabled products were operational beginning December 1994. In early February 1995, Netscape made its SSL source code or reference implementation (SSLRef) public for non-commercial use, announcing that it would license the protocol to partners for commercial purposes. According to the same press release, Netscape joined CommerceNet, another non-profit

consortium focused on open online infrastructure for e-commerce.[183] On November 11, 1994, Netscape announced that the world's largest credit card payment processor, First Data Card Services Group's Electronic Funds Services (EFS), would provide real-time online credit card authorizations for e-commerce starting that December running Netsite Commerce Server software. Three banks were listed as the first client banks to agree to offer online transaction services to businesses looking to accept payments online. To use the service, businesses would create online stores using Netsite software and enroll in the First Data service through their bank.

Ten days later, on November 21, 1994 Netscape announced that MCI Communications Corporation, then one of the largest telecommunications companies, was selecting Netscape Netsite Commerce Server software for a "secure online shopping mall called marketplaceMCI that [would] include electronic newsstands and storefronts."[184] Not only would MCI begin offering its internetMCI service and the marketplaceMCI by the end of the year, it at the same time was set to serve as a distribution channel for Navigator. Less than a month later, on December 5, Netscape announced that Bank of America would provide merchants with secure online transactions on Netscape's server software beginning the following month.[185] On January 9, 1995, Netscape announced an "agreement in principal" with MasterCard to co-develop an interface for secure transactions online, anticipated for launch by mid-1995.[186] On March 20, Netscape published a

[183] "Netscape Continues Push for Open Internet Standards," *PR Newswire,* February 7, 1995.

[184] "MCI Selects Netscape Communications' Secure Software for New internetMCI Service," *PR Newswire*, November 21, 1994.
https://web.archive.org/web/20030201174633/http://wp.netscape.com/newsref/pr/newsrelease4.html.

[185] "Bank of America to Provide Secure Payment System Over Internet Using Netscape Communications Software," *PR Newswire*, December 5, 1994.
https://web.archive.org/web/20030201174633/http://wp.netscape.com/newsref/pr/newsrelease7.html.

[186] "Mastercard and Netscape to Offer Secure Transaction Processing for Purchases on the Internet," *PR Newswire,* January 9, 1995.
https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease10.html.

press release claiming that "a number of industry-leading companies and organizations" were showing their support for the SSL protocol. Among the companies named were major PC market players such as Apple, IBM, and Microsoft, as well as Visa International and Wells Fargo.[187] A week later, Netscape debuted the Netscape IStore, an application priced at $20,000 and marketed to individual business owners to create online stores that integrated "data management, online credit card authorization, billing and order processing capabilities."[188] On June 2, in an effort to drive web publishing adoption, Netscape made its server software products available for free evaluation for users in the United States, similar to the 60-day trial period for Navigator.[189] By the end of the month, Netscape had extended the same trial program to enterprise and education users. Netscape's payments or transactions standards-setting ambitions manifested in a multisided strategy. The company built products and protocols to satisfy the security needs of banks and credit card companies, while simultaneously driving user adoption among shoppers and merchants through ease of use of its software's UI and accessibility.

Cumulatively these events set the stage for Netscape's decision to go public, and on June 23, Netscape filed for initial public offering (IPO).[190] Netscape debuted on the NASDAQ on August 9, opening at $70 per share after having set the stock price at $28.[191] The Netscape IPO

[187] "Netscape: Industry Leaders Support Secure Sockets Layer for Internet Security," *PR Newswire,* October 30, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease17.html.

[188] "Netscape Communications Unveils Netscape IStore," *PR Newswire,* March 27, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease20.html.

[189] "Netscape Places Server Software Products on the Internet for Free Evaluation," *PR Newswire,* May 31, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease26.html.

[190] "Netscape Communications Corporation Files for Initial Public Offering of 3,5000,000 Shares of Common Stock," *PR Newswire,* June 23, 1995. https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease31.html.

[191] "Technology Investors Fall Head Over Heels for Their New Love" by Molly Baker, *The Wall Street Journal,* August 10, 1995.

was so hotly anticipated that both underwriters, Morgan Stanley and Hambrecht & Quist, increased the number of shares issued (five million) and more than doubled the price. After climbing to nearly $75, the stock closed at $58.28 on its first day and then down to $52 at the end of the week.[192] The *Wall Street Journal* described the demand for the stock as "nutty." Spyglass, which went public in June 1995, issuing two million shares at $17 per share, closed at $43.25 on the day of Netscape's IPO, down $6. *Wired* would describe the 1995 multibillion-dollar IPO of Netscape as "Phase One" of the Internet IPO fever.[193] In describing the business strategy of Wall Street's new "darling" tech stock, the *New York Times* wrote, "By giving away its Netscape Navigator for free to individual users, but charging companies who use the software to set up and operate Web sites, Netscape has moved aggressively to establish itself as the industry standard. If it succeeds, investors hope that some day it will be able to command near-monopoly profits, much as Microsoft dominates the market for operating software."[194] In giving a product or service away for free to one channel, while providing services linking merchants and financial institutions to consumers via web server software, Netscape in 1995 set the stage for the multisided platform economy that would come to dominate the tech industry a decade later.

At the end of the week, the *New York Times* would describe "Netscape fever" as a sign of a speculative bubble: "Given that Netscape has no earnings, hardly any sales and looming competition from big boys like Microsoft, such enthusiasm seems a little, well, juvenile. And while many analysts insist Netscape is an anomaly, some see it as a dangerous sign of the speculation that tends to mark market tops."[195] By fall of the same year, the press would recognize that the

[192] "With Internet Cachet, Not Profit, A New Stock Is Wall St.'s Darling," by Laurence Zuckerman, *The New York Times,* August 10, 1995.

[193] "Son of IPO Fever," by Ned Brainard, *Wired,* March 1, 1996.

[194] "Son of IPO Febver," by Ned Brainard, *Wired.*

[195] "Netscape Fever: Will It Spread?" by Leslie Eaton, *The New York Times,* August 13, 1995.

internet's effect on Wall Street was here to stay, with Netscape's IPO signaling the beginning of a new era in computing. "Why did the stock market go bonkers for Netscape, a year-old company that not only operated deep in the red but also warned in its prospectus that it did not intend to make any profits "in the foreseeable future?" Only one reason: the Internet."[196]

A year after the first release of Navigator, Netscape claimed that more than 70 percent of global Fortune 100 companies were using Netscape software.[197] The IPOs of both Netscape and Spyglass indicated there was potential in the commercial browser market. The notion of what the internet was and who could access it had completely changed with the popularity of Mosaic and Navigator. In its October 16, 1995 review of the beta release of Navigator 2.0, the *New York Times*, "The introduction of the "beta," or test, version of Netscape Navigator 2.0 places Netscape on a direct collision course with Microsoft and the rest of the software industry, while at the same time signaling that Netscape may be preparing to veer off in a radically new and uncharted direction that could overturn the balance of power in the software industry."[198]

The reason for this thinking was the introduction of Sun Microsystem's Java applets, which enabled dynamic, interactive features on websites—replacing the "static electronic pages" of yesterday's internet. The *New York Times* article described these new Java-enabled features colorfully: "Stock prices and sports scores could be updated on screen automatically. Colorful, moving advertisements could be anchored in a fixed "frame" on each Web page, while the user browses information in another frame. Eventually, Java could be the foundation for a new software

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[196] "How the Propeller Heads Stole the Electronic Future," by Steven Levy, *The New York Times Magazine,* September 24, 1995.

[197] "Netscape's First Year of Product Shipments Establishes Broad Internet Market Leadership," *PR Newswire,* December 13, 1995.
https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease69.html.

[198] "Will Netscape be the next Microsoft, or the next victim of Microsoft?" by Peter H. Lewis, *The New York Times,* October 16, 1995.

industry, based on the Web, in which programs are created for networks rather than for individual Windows, Macintosh or Unix machines."[199] The same article highlights the message that Netscape was now communicating to the technology industry via Navigator 2.0: "On a political level, all these new features send a clear notice to the industry that Netscape has no interest in bowing to the traditional Internet procedures for setting software standards by academic and scientific committee. The Internet has become primarily a commercial medium, where standards are set by whoever has the highest market share. It is a concept Microsoft knows well, and one that Netscape has grasped."[200] With the creator of the first graphical browser at the helm of its technical development, Netscape was the clear first mover in setting commercial web standards.

In a November 1995, *American Banker*, the financial services industry's trade news publication, reported that central to Netscape's business strategy was the company's belief that its browser will be Netscape's "ticket to an integral role in electronic commerce." Netscape's business model relied on server software marketed at enterprise clients, allowing the company to give the personal browser away for free.[201] The stream of announcements Netscape made in 1995 reflected the standard software provider's dual revenue stream model, where software prices were set differently for enterprise users and educators. The announcements also revealed the company's urgency in providing the necessary software infrastructure to banks and retailers in anticipation of an imminent e-commerce boom on the web, made possible primarily by Navigator. Owning the secure transactions protocol was key to Netscape's strategy for dominating the browser market in a future of mass internet adoption accompanied by an e-commerce boom.

[199] "Will Netscape be the next Microsoft, or the next victim of Microsoft?" by Peter H. Lewis, *The New York Times.*

[200] "Will Netscape be the next Microsoft, or the next victim of Microsoft?" by Peter H. Lewis, *The New York Times.*

[201] "Netscape's Bank Liaison: Point Man in the Middle," *American Banker,* November 3, 1995.

A year after the first release of Navigator, Netscape claimed more than 70 percent of global Fortune 100 companies were using Netscape software, an indication of strong enterprise sales.[202] By its 2.0 release Navigator had succeeded in fulfilling the destiny of its Mozilla nickname: the browser war between Mosaic and Navigator had been fought and won by the Silicon Valley upstart. Netscape was now synonymous with the internet; its browser was more than just a gateway to the web—to investors and newcomers to the internet it *was* the web. By fulfilling the narrative of its founding, it now faced a greater question: does it become the Microsoft of a new era?

### *Microsoft's Internet Dilemma: MSN, Netscape, and Windows 95 (1993-1994)*

Before the invention and subsequent popularity of Mosaic and Navigator, Al Gore's public campaigning for an Information Superhighway had directed media attention and generated public interest in the internet. *Fortune* magazine called 1993 the year of the announcement, referring to the slew of major organizations all making internet-related declarations.[203] The popular notion that Microsoft was slow to recognize the potential of the internet is an imperfect one. During the time that Netscape designed and coded Navigator, Microsoft was internally, amongst a group of senior executives, struggling to define a corporate-wide internet strategy with an understanding that it was a crucial step to take in maintaining Microsoft's dominance in the software industry. Its activities on this front during 1994 would be used by the company's legal team in 1999 to argue that Microsoft attempted to address the explosion of the internet prior to the founding of Netscape.

[202] "Netscape's First Year of Product Shipments Establishes Broader Internet Market Leadership," *PR Newswire*, December 13, 1995.

[203] "The Internet and Your Business," by Rick Tetzeli, *Fortune*, March 7, 1994.

In 1993, Bill Gates was under the impression there was no money to be made on the internet as the internet itself was free. Instead, he—and an influential team inside the company—were focused on bringing interactive television (ITV) to the market.[204] Prior to the rise of the web, "interactive" meant internet-enabled. A later 1997 internal report of Microsoft's interactive TV efforts, which lasted from 1993 to March 1996, states that Microsoft, Oracle, and Silicon Graphics all saw interactive tv "as a new kind of software platform, potentially outnumbering the PC if successful."[205] The system Microsoft spent years developing included subscriber services and financial transaction services, what eventually became known as WebTV. Throughout 1993, as Gates self-admittedly devoted much of his waking hours to figuring out how to monetize interactive television, the company was said to be in advanced talks with Tele-Communications Inc. (TCI) and Time Warner.[206] The *Washington Post* described the software company's ambitions with interactive tv: "In Microsoft's vision of the coming interactive world, viewers will be able to call up statistics in the middle of a baseball game, order a compact disc after seeing a music video, shop in a "virtual" mall tailored to individual tastes or call up a movie."[207] Microsoft and TCI formed an interactive TV joint venture in spring of 1994.[208] In December 1994, TCI agreed to pay $125 million for a 20 percent stake in a joint venture named Microsoft Network.[209] Analysts expected access to their interactive television offering to be shipped with Windows 95, but

[204] "Microsoft Morphs into a Media Company," by Denise Caruso, *Wired*, June 1, 1996.

[205] "The Microsoft Interactive TV System: An Experience Report," by Michael B. Jones, *Microsoft Research*, July 1997. Available for download at https://www.microsoft.com/en-us/research/wp-content/uploads/2016/02/tr-97-18.doc.

[206] "A New Joint Test of Interactive TV," by Lawrence M. Fisher, *The New York Times*, March 4, 1994.

[207] "Microsoft Hopes to Lead Interactive Revolution," by Martin Wolk, *The Washington Post*, September 20, 1993.

[208] "A New Joint Test of Interactive TV," by Lawrence M. Fisher, *The New York Times.*

[209] "TCI Joins Microsoft In Venture Cable TV Firm Invests In On-Line Service," by Paul Farhi, *The Washington Post*, December 22, 1994.

representatives from Microsoft indicated that TCI's involvement with the upcoming Microsoft Network would be "essentially passive." The 1997 internal Microsoft report summed up the fate of interactive television at Microsoft succinctly, "ITV was a technical success, both in Microsoft's and our competitor's trials, but it was a business failure." The company's efforts in developing interactive television software to capitalize on high-speed fiber optic networks revealed that Microsoft in 1993 was heavily invested in an internet product. As early as 1993, Microsoft saw its Windows software as the interface or gateway to the internet, with the television joining the PC as the primary hardware of choice. Years later, this would evolve into an internet content strategy alongside Microsoft's browser product push when adoption of both Mosaic and Navigator proved the web to be the true gateway to the internet.

In May 1993, Gates greenlit an internal project codenamed Marvel, a competitor online service to America Online (AOL). Russ Siegelman, who had initially interviewed in 1992 to be one of Gates' Technical Assistants, led the development of Marvel, which Gates ordered the company to ship with Chicago, the internal designation for the operating system that would come to be known as Windows 95.[210] The decision to create a proprietary, AOL-style service was met with pushback as early as 1993 when Rob Glaser, another Microsoft executive, argued for Microsoft to "radically change" direction and make Marvel part of the internet rather than a balkanized online service. Siegelman in November 1993 suffered a brain hemorrhage and, in Siegelman's temporary absence from the Marvel team, Glaser eased off his internal campaign against Marvel.[211] Thus, Microsoft's efforts to define some kind of internet strategy had begun with interactive television and the hiring of Siegelman, but the need to tie internet strategy with its

[210] "Inside Microsoft," by Kathy Rebello, *Bloomberg,* July 14, 1996.

[211] "Inside Microsoft," by Kathy Rebello, *Bloomberg.*

flagship product, Windows, and the subsequent delays in shipping Windows 95, would prevent any pivoting of a broader Microsoft business strategy that would indicate the company's early commitment to addressing the internet as a competitive space. This was also the beginning of Microsoft's fraught internal efforts to define the scope of Marvel and align the service with the rest of Microsoft's product lineup. Eventually Microsoft would abandon its WebTV ambitions and Marvel would launch as MSN, a thorny and persistent problem at the heart of Microsoft's internet strategy for years to come.

Microsoft's broader internet strategy began to take shape and gain momentum in early 1994. During a February 1994 recruiting trip to his alma mater, Steven Sinofsky, a Technical Assistant to Bill Gates,[212] discovered that students and faculty at Cornell University were active users of the internet. This led to his famous e-mail to Gates proclaiming in the subject line, "Cornell is WIRED!"[213] Sinofsky penned an internal memo to Gates detailing the use of the internet at Cornell.[214] John Ludwig of the Chicago team suggested that Sinofsky connect with a "guy over in NT," and sent along a memo the colleague had written and circulated two weeks prior. James "J." Allard, a Program Manager for Microsoft's Business Systems Division, circulated an internal memo in late January 1994 titled "Windows: The Next Killer Application on the Internet," which is credited with capturing Gates' attention and eventually shifting Microsoft corporate-wide to an internet-first strategy.[215] Allard addressed the sudden popularity of the web and Mosaic, noting

[212] Sinofsky was one of the few employees at Microsoft with the formal designation of Technical Assistant to Bill Gates. Technical Assistants served to inform Gates of the latest in technological developments and would come to be known as potential successors to Gates—or "Baby Bills."

[213] "025. Trapped," by Steven Sinofsky, *Hardcore Software by Steven Sinofsky*, May 11, 2021. https://hardcoresoftware.learningbyshipping.com/p/025-trapped.

[214] "Computing at Cornell and the Internet," by Steven Sinofsky, an internal Microsoft memo sent to CEO Bill Gates. February 13, 1994.

[215] *US v. Microsoft Corp*, 253 F. 3d 34, No. No. 00-5212 (Court of Appeals, Dist. of Columbia Circuit 2001). (Defendant's exhibit 350).

that though at the time there was a version of Mosaic for Windows, "the current implementation is considerably weaker than its Unix counterpart."[216] The memo's tone is one of urgency. Allard emphasizes in italics that "*Today, it is probably fair to consider Internet connectivity a competitive advantage in the software industry. Tomorrow it will be a measurable disadvantage if we're not wired.*" Allard characterizes the internet as such:

> Although Al Gore and Company's NII (National Information Infrastructure) efforts appear to be making some initial headway, the Internet provides an incredible opportunity for Microsoft to effectively explore large scale public networks from many levels: customer needs, technical challenges, quality of service issues, electronic commerce and information browsing technologies. *The Internet is version 1.0 of the National Information Infrastructure.*[217]

Allard's memo was methodical in providing the context for understanding the internet and its potential in the consumer space. The memo proposed a three-phase process to establish Windows as "*the next-generation Internet tool of the future*." Phase 3, "Innovate," set forth the concept of Windows as the "Global Infostructure Explorer." Of the potential downsides of Microsoft competing in the consumer internet technologies domain, Allard mentioned the sensitivity around the online community's attitude towards Microsoft:

> One of the biggest challenges facing Microsoft's success in the Internet community is acceptance and respect. Although we have an incredible amount of respect in the commercial software business, the Internet has been founded on public domain protocols and products which generally included source availability at no charge. It has been only recently that vendors have suggested profiting from the Internet by selling the browsing tools and technologies, and offering commercial services on the Internet itself. The

[216] "Computing at Cornell and the Internet," by Steven Sinofsky, an internal Microsoft memo.

[217] "Computing at Cornell and the Internet," by Steven Sinofsky, an internal Microsoft memo.

information and software has been free for 15 years, we need to be careful to embrace the current technologies and community before we attempt to reshape it. [218]

The memo posited that the introduction of commercial services, first in publishing and in e-commerce, will be the "biggest change facing the Internet in the next two years" and that commercial servers based on the web were "inevitable." Under Phase 3, Marvel would emerge as the "hottest content server" on the internet shipping integrated with directory, email, messaging, and e-commerce services.[219] "Perhaps most importantly, *Marvel solves the difficult electronic commerce problem well ahead of the Internet: the ability to securely purchase goods in a networked environment.*" This was one of the earliest indications that securing financial transactions on the internet would be a key component to Microsoft's long-term Windows strategy, one that began to heavily orient towards the consumer PC market and setting the stage for the payments boom still to come.

Allard's opinions largely reflect the outlook shared by the younger developers at Microsoft who were early adopters of both the internet and the web. The following day in February, a product manager from the Connectivity Business Unit named Dave Pollon circulated another internal memo advocating for an internet strategy titled, "Microsoft and The Internet: Strategic Direction."[220] The document identified areas of opportunity for internet extensions within the delivery timeframe for Windows 95. More broadly, it suggested that Microsoft could also capture the market for a "standardized commercial server platform for organizing and distributing Internet content."[221] Following the circulation of these memos, Sinofsky met with members from the

[218] "Computing at Cornell and the Internet," by Steven Sinofsky, an internal Microsoft memo.

[219] "Computing at Cornell and the Internet," by Steven Sinofsky, an internal Microsoft memo.

[220] *US v. Microsoft Corp*, 253. (Defendant's exhibit 302).

[221] *US v. Microsoft Corp*, 253. (Defendant's exhibit 302).

Chicago project's networking protocols team. Sinofsky's first internal demo of various internet user features was a two-hour session with Gates. He recalls:

> One of the things I concluded was that as I showed different aspects of the internet to Bill (gopher, WWW, ftp, telnet, HTML, etc.) he was quick to map those to existing or envisioned capabilities in Windows or in Information At Your Fingertips. I was struck by this because, well, I did not see that at all. I saw everything on the internet as totally new and different. I saw everything we had as kind of clunky and unrelated, or at least different. As I reflect on this and now have the benefit of the vocabulary of disruptive technologies, I can see how I had an insurgent view of the technology whereas Bill had the incumbent view. As the insurgent I had nothing to lose and everything to gain by embracing the new and seeing it as different. As the incumbent, the natural inclination is to see new things from the perspective of the existing work.[222]

Over the course of the few months leading up to an early April offsite retreat for Microsoft's top executives to formulate an internet strategy, Sinofsky proceeded to demo the internet's various features internally across the organization. On April 6, 1994, Microsoft held a daylong offsite retreat at the historic Shumway Mansion in Kirkland, Washington, for a small group of senior executives and younger engineers advocating for a corporate-level internet strategy, including J. Allard. For a company with a headcount total of over 15,000 during the fiscal year of 1994, only twenty employees participated in the internet offsite. Sinofsky provided the attending executives each with a packet of briefing materials on the internet. Included in the packet were Allard's memo, press clippings on the internet, a section titled "Transactions on the Internet," and CERN's guide to HTML.[223]

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[222] "027. Internet Evangelist," by Steven Sinofksy, *Hardcore Software by Steven Sinofsky*, May 23, 2021. https://hardcoresoftware.learningbyshipping.com/p/027-internet-evangelist.

[223] "028. Pivotal Offsite," by Steven Sinofksy, *Hardcore Software by Steven Sinofsky*, May 25, 2021. https://hardcoresoftware.learningbyshipping.com/p/028-pivotal-offsite.

In an April 15 summary memo of the offsite event, Sinofsky included an overview of Gates' opening remarks in which Gates described the growth in internet use as a "mania": "Embrace and Extend are the two key words for how Microsoft will inter-operate with the internet. This retreat is about how Microsoft will embrace the current internet *mania* and extend Internet Protocols, Applications, and Tools… At each step of this strategy we need to be aware of the business implications of what we are doin [sic]."[224] Gates also noted market anticipation of internet products and services from Microsoft: "People want to know when we will provide support services on the internet, they want to know when we will release internet software such as Mosaic, and they want to know how our future information products (and our information at your fingertips vision) relate to the internet. Many people feel that the internet is the real-live digital highway. In many ways, what we are seeing on the internet is a narrow band version of the highway."[225]

Following Gates' opening remarks, the executives split into three breakout groups: Systems, Tools and Services, and Online Strategy. After about four hours of preparation, each group was given an hour for a presentation to respond to a designated set of questions. Sinofsky's recollection of the retreat offers a glimpse into the early ambiguity at Microsoft over its Marvel strategy. The overlaps between applications like email and the Marvel online service were not yet reconciled. The attitude in the group towards an internet-driven product strategy was split between those who faced schedule constraints (shipping their division's product soon) and those whose products were due to ship much later. The most internet-friendly group was Systems, given that Windows NT team was already incorporating internet features into a future build. In Sinofsky's summary of the preliminary proposed action items, Marvel figured in several of the items, often

[224] *US v. Microsoft Corp*, 253. (Defendant's exhibit 400).

[225] "028. Pivotal Offsite," by Steven Sinofksy.

indicating a product overlap with another Microsoft product. The ambition to tie Microsoft Word to web use was an early strategic priority; the list included action items to explore making Word both a web authoring and viewing tool. In addressing the wide-ranging potential business implications of the internet, item number 19 on the list may have been the most ambitious of the group's initial internet strategy for Microsoft: "Pursue a standard for internet money, perhaps working with the IETF on the Internet Mercantile Protocol."[226] This is one of the earliest documented indications that Microsoft shared Netscape's ambition in setting standards for online transactions.

A July 1996 *BusinessWeek* cover story on Microsoft's sweeping 1995 internet pivot details, from the perspectives of Sinofsky, Allard, and Ben Slivka (head of the browser team), the evolution of internet-related investment and product strategy at Microsoft between 1994 and 1995. Though still not well defined in 1994, Microsoft's strategy for Marvel was cemented in one of the breakout sessions at the corporate retreat: "In one breakout group, Allard tangled with Russell Siegelman... Allard argued that instead of being proprietary, Marvel should be based on Web standards. Siegelman held his ground and won. It was a decision that would later cost millions to reverse."[227] Microsoft's positioning of Marvel reflected a preoccupation with the firm's existing business model, where distinct partner channels, such as OEMs, could be leveraged to sell software given the stature Windows enjoyed as the preferred OS in the market. Rather than responding to the nature of internet and what may come, Microsoft invested in an internet service strategy that could serve its platform business.

[226] "028. Pivotal Offsite," by Steven Sinofksy.

[227] "Inside Microsoft," by Kathy Rebello, *Bloomberg.*

At Comdex in April 1994, Sinofsky discovered the Internetworks browser by a company called BookLink, which led to an unsuccessful attempt to license the technology for Chicago. This is the earliest indication that Microsoft sought to market its own web browser, albeit to serve as a closed network competitor to AOL's graphical interface. In November 1994, AOL acquired BookLink for $30 million.[228] In late October 1994, Microsoft publicly acknowledged that it was developing an internet service.[229] The company officially announces in November the Microsoft Network (MSN), a low-cost online service focused on email, news, personal finance, and entertainment content. MSN was slated to ship with Windows 95 the following year.[230] At the time, the ship date for Windows 95 was pushed further down the road, once again, to August 1995.[231] By January 1995, the *New York Times* reported that with its MSN plans and a recent deal to license the Mosaic browser technology, Microsoft's strategy was shifting toward an online strategy.[232]

Internal emails also show that by early November 1994 the company had crafted an initial draft of the messaging narrative in a product strategy document around the forthcoming Windows 95 platform (originally slated for a December 1994 release) as "The Communicating PC": "Our objective is to increase the overall success of Windows 95 by establishing it as the leading OS platform for communications… We want to leverage the array of communications technologies in Windows 95 and maximize the perception that Windows 95 is the premier platform for communications and the portal to the outside world. At the same time, we can capitalize on the

[228] "America Online Buys 2 Internet Companies," by Peter H. Lewis, *The New York Times*, November 10, 1994.

[229] "On-Line Plans at Microsoft," by Reuters, *The New York Times*, October 24, 1994.

[230] "Microsoft Seen Disclosing On-Line Network Plan," by Peter H. Lewis, *The New York Times*, November 11, 1994.

[231] "Microsoft Venture With Cable Giant," by Bloomberg News, *The New York Times*, December 22, 1994.

[232] "Microsoft's Next Move Is On Line," by Peter H. Lewis, *The New York Times*, January 13, 1995.

interest in the "information highway."[233] The Internet Ready feature of Windows 95 was one of the primary selling points for the new operating system, which was equipped with an integrated online services capability (MSN), but also could support "popular Internet applications, such as Mosaic, WinWAIS or WinGopher."[234] The product strategy document did not address web browsers or even the web as a value proposition for Windows 95. In its evaluation of the competition, under OS/2 Warp the author notes, "Getting good press for their Internet browser – not clear what exactly this is (News, Mail?)."[235] It may be more accurate to say that Microsoft played catch-up to the popularity of the web, rather than the internet, because it was wholly invested in the internet-ready Windows 95. Applications, features, or services related to the internet were all filtered through the product and market strategy for Windows 95. From a marketing perspective, not only did the principals formulating the structure of Microsoft's messaging for promoting Windows 95 lack an understanding of the web browser boom already underway, but they also failed to tell the story of the internet in a compelling manner despite the internet already receiving significant attention in the mainstream press. The commercial browser industry at the time of the launch of Navigator, though nascent, was not new. That the marketing leads for the most hotly anticipated consumer-oriented operating system at the world's largest software company could not formulate a sophisticated and compelling narrative tying Windows 95 together with internet use is astonishing. This further illustrates the gap between individuals like Allard and Sinofsky and other Microsoft executives and managers in grasping internet trends.

On November 10, 1994, Russell Siegelman wrote to fellow senior executives at Microsoft about a tip he received regarding Netscape and AT&T "creating a private TCP/IP over the

[233] *US v. Microsoft Corp*, 253. (Exhibit 150, p. 2).

[234] *US v. Microsoft Corp*, 253. (Exhibit 150, p. 2-3).

[235] *US v. Microsoft Corp*, 253. (Exhibit 150, p. 3).

Internet."[236] As a result, Dan Rosen, Senior Director of Strategic Relationships for the Consumer Systems Division at Microsoft, spoke to Netscape's Jim Clark to explore partnership opportunities and informed the group on November 15 that Netscape was likely in serious discussion with both AT&T and MCI. The following day, Microsoft's Peter Neupert stressed that there was likely a conflict of interest between Microsoft and Netscape on multiple fronts, "such as secure transaction tech. (deal with FDR) and they are going into the merchant server business."[237] On November 22, Siegelman asked which executive was driving the agenda for Microsoft so as to be internally aligned on its Netscape approach. Rosen responded on November 30 that he was happy to drive the conversation but that there appeared internally to be disagreement over what Microsoft hoped to achieve with Netscape. Siegelman responded the same afternoon stating that he believed Microsoft was not interested in Netscape's server technology but that "the best outcome" would be securing a Navigator licensing deal. During the time that spanned Siegelman's initial email and his conclusion that Microsoft should seek a licensing deal for the Navigator source code, Netscape announced its SSL partnership with First Data, its commerce server deal with MCI, and a reseller partnership with Digital Equipment Corp.

On December 9, Rosen emailed several Microsoft executives for feedback regarding what sort of relationship Microsoft wanted to pursue with Netscape. He noted that the clear area of competition would be in security standards and that in the realm of internet clients and servers there would likely be more than one winner in that market (Netscape and Microsoft). He asked those on the thread if there were areas of cooperation in e-commerce, and whether Microsoft would be interested in licensing the Netscape client as a backup to their "NCSA activity."[238] Rosen's

[236] *US v. Microsoft Corp*, 253. (Exhibit 133, p. 2).

[237] *US v. Microsoft Corp*, 253. (Exhibit 133, p. 1).

[238] *US v. Microsoft Corp*, 253. (Exhibit 134, p. 1).

questions to his colleagues betrayed both a lack of coherent web strategy at Microsoft and a simplistic understanding of where Microsoft and Netscape would compete given Microsoft's existing product strategy. On the morning of December 12, Siegelman responded with a single line e-mail that it was unlikely Microsoft would license Netscape's client given that Microsoft was licensing from Spyglass. In fact, Microsoft would explain internally to its Windows 95 team that the choice to license Mosaic was born from a feeling "that NCSA Mosaic is the de facto standard for the Internet" and that Microsoft planned to "extend and enhance." The official line on licensing from Spyglass and NCSA was that it "better fit our technology model because it is the de facto standard, with the most mileage and most openness going forward. (do NOT discuss security architectures)."[239] Microsoft spent months negotiating a licensing deal with Spyglass. It is possible that the sunk cost of the prolonged negotiations with Spyglass, combined with AOL's acquisition of BookLink, deterred Microsoft from pursuing a deal with Netscape despite Siegelman's initial suggestion in November 1994. By the time of the public announcement of the Mosaic licensing deal in early 1995, Navigator was considered the superior and more sophisticated browser by web users. Mosaic was the de facto standard primarily because of the licensing deals that NCSA sought via Spyglass in order to profit from the technology.[240]

The same morning, J Allard responded in detail to Rosen's original email, adding Jim Allchin, Microsoft's head of Platforms, to the thread. Allard addressed each of Rosen's questions sequentially, first emphasizing that from a platforms (Windows) perspective the company had two strategic targets: "standards (specifically, commerce and security)" and "the internet server

[239] *US v. Visa USA, Inc,* 163 F. Supp. 2d 322, No. No. 98 CIV. 7076 (BSJ) (Dist. Court, SD New York 2001). Also see *US v. Microsoft Corp*, 253. (Exhibit 154).

[240] "Netscape Knows Fame And Aspires to Fortune," by Peter H. Lewis, *The New York Times,* March 1, 1995.

market."[241] Allard explained to Rosen that licensing Navigator would only legitimize Netscape's SSL standards, which was likely the strategy behind Netscape giving the browser away for free. He continued, explaining Netscape's recent product and partnership announcements indicating that Netscape was oriented toward "a high flat-fee model" and that the partnerships with First Data and Bank of America suggested that there was a revenue percentage opportunity for Netscape. Allard asked where Netscape's server strategy fit with Microsoft's own e-commerce goals. He explained that based on Netscape's SSL recommendation to the W3 consortium, SSL was limited and "backward." On security features, Allard wrote that Microsoft would be recommending "encrypted rpc (and future, dcom) to the w3c community [that] week to counter their ssl (secure sockets layer) recommendation. i don't see them embracing ecom given that its ole based and they are targeting cross-platform and stand to lose their[sic] % of rev opt by embracing our mechanism." Pushing back on Rosen's assumption that the client server market would be split between Microsoft and Netscape, Allard explained that the technical and interoperability aspects need to be worked out through the W3 consortium. He concludes "…i don't see why they'd want to legitimize our server by doing this." In his explanations of both the business implications and technical considerations, Allard demonstrated a multisided thinking regarding the monetization of the internet for Microsoft involving the typical PC user, enterprise customers, and the W3C community that safeguarded web standards.

Allard's response to Rosen revealed a split in understanding concerning the Netscape threat; Rosen's was one from a dealmaking perspective, instigated primarily from Siegelman's original tip about a Netscape-AT&T partnership. In contrast, Allard's point of view was one backed by a strong technical understanding of the internet, but now bolstered by a platform-driven

[241] *US v. Microsoft Corp*, 253, *US v. Visa USA, Inc*, 163. (Exhibit 134, p. 2).

business strategy. The most glaring strategic miss was the lack of participation from Siegelman, given that Microsoft by this point understood that it needed to compete with point-and-click internet access as featured on OS/2 Warp.[242] It would not be until early January that Siegelman would inform Brad Chase, the head of marketing for Windows 95, after going over Windows 95 internet plans with Gates that Microsoft finally made the decision to converge "Ohare and MSN Internet plans," resulting in the message that "The way for Win 95 users to get on the Internet is to sign up for MSN."[243] The inconsistency in understanding the internet and the protracted problem of positioning MSN highlight MSN's beleaguered status within the Microsoft line of products designed to launch with Windows 95. In 1994, MSN appeared to still exist as a product of Microsoft's significant internal efforts to develop WebTV. Even as a distinct internet service product strategically developed around the internet-ready Windows 95, MSN still suffered from lack of internal product strategy consensus and executive sponsorship.

By January 22, the Windows 95 marketing narrative included an emphasis on MSN as the future of online services and OS integration, "seamlessly melding remote information with local."[244] On January 11, it had been announced that Jim Barksdale would depart AT&T to become the CEO of Netscape, Rosen forwarded the news along to his colleagues, adding, "Barksdale is a smart, good manager. I would anticipate that this move will presage Netscape getting its act together (especially from a business model perspective). They could become a bigger competitive threat than we had anticipated."[245] Rosen's language reflects an understanding that giving away software for free was not a sustainable business model. Nathan Myhrvold, a scientist and

[242] *US v. Microsoft Corp*, 253. (Exhibit 154, p. 1).

[243] *US v. Microsoft Corp*, 253. (Exhibit 136).

[244] *US v. Microsoft Corp*, 253. (Exhibit 141, p. 4).

[245] *US v. Microsoft Corp*, 253. (Exhibit 1118, p. 1).

technologist who would become Microsoft's Chief Technology Officer in 1996, forwarded Rosen's email to Gates. Gates' response read, "I am really surprised. Barksadale[sic] is a very good manager and very experienced. Netscape is getting to be more and more important [sic] us to watch!!" Gates' phrasing suggests that he was certainly aware of Netscape but did not consider the browser company to be a threat despite its having made announcements between November 1994 and early January 1995 that indicated significant momentum in Netscape working to set standards in financial transaction protocols. Internally at Microsoft, software was considered king, and everything else secondary to getting all computers running Microsoft software.

In late February 1995, Siegelman was profiled by the *New York Times*, then promoting MSN's M8 beta program for volunteers around the world. He articulated an internet-first strategy for the MSN service: "As a commercial on-line service provider, we plan to harness and embrace the Internet in a way people don't envision today. Our goal is to create a managed community, with customer support, billing and an added level of editorial value. And in doing so, we'll combine the best of the Internet and the best of the on-line services."[246] By this time, it seemed clear that MSN was the content-first arm of Microsoft's internet strategy. The Windows PC remained the anchor to this orientation. At the time, the internet was still considered an underground and hacker and hobbyist-oriented entity. Online services had yet to start offering access to the internet, which would only come later, given the heavy role online services such as AOL played in censoring content online. In this MSN, was unique in its paradigm of integrating with the internet.

The thinking of individuals like Allard and Sinofsky certainly influenced Gates' own urgency in addressing open web trends while his direct reports continued to merely observe

[246] "Profile; A Physicist Is Propelling Microsoft Into Cyberspace," by Peter H. Lewis, *The New York Times* February 26, 1995.

developments in this space. “I know I am a broken record on this but I think our plans continue to underestimate the importance of an OPEN unified tools approach for the internet,” reads the opening sentence of an internal email sent on the afternoon of April 6, 1995 from Gates to several Microsoft executives.[247] He described a Windows 95 internet capability demo he saw earlier that day that involved opening the FedEx homepage online and entering in the tracking number of a package to retrieve its status. Gates pointed out the disparity between how much easier it was for a business to set up its own website to reach customers and how complicated it would have been had FedEx reached out to Microsoft directly to run the same tracking service on MSN. Gates writes, “The continued enhancement of the browser standards is amazing to me. Now its [sic] security and 3d and tables – what will it be within the next several years? Intelligent controls, directory – everything we are trying to define as standards.” An hour later, Paul Maritz, the Senior Vice President for the Consumer Systems Division, responded that he and his colleagues likely needed to reach a “concensus [sic] on our basic approach to the Internet.” Siegelman indicated in response on the thread that he was “watching Netscape very closely,” sending along Netscape’s server product lineup information. On Microsoft’s internet strategy, Siegelman suggested that the Internet-ready strategy (with MSN) and a “better Web browser” were not enough to prevent Netscape from creating a new platform for ISVs, merchants, and content providers. “We need to have the toolkits + servers to fight on the publishing, e-commerce, etc part as well. And there are some interesting questions about the viewer/client side, integration with Ohare, Office and Blackbird that need to be worked out.”[248] These responses from Microsoft’s top executives can be interpreted as message intended to assuage Gates’ frustrations and worries. They also betray a

[247] *US v. Microsoft Corp*, 253, *US v. Visa USA, Inc*, 163. (Exhibit 16, p. 6).

[248] *US v. Microsoft Corp*, 253. *US v. Visa USA, Inc*, 163. (Exhibit 16, p. 2).

culture of executives continually declaring that the company needed a internet strategy, while any detailed proposal to this dilemma took a kitchen sink approach.

The following week, Rosen initiated a new thread with the subject line "Netscape as a merchant channel" following a discussion with Ben Slivka and Thomas Reardon, who were both leading the web browser project codenamed O'Hare. In his email Rosen addresses the important issue of setting the standard for securing online transactions as Microsoft is in the midst of formulating a strategy for approaching merchants. Of Microsoft's forthcoming transactions standard STT, Rosen writes,

> Microsoft will include STT into the O'Hare client, along with SSL in order to support electronic commerce transactions. We (Warren) will aggressively market this to the acquirers as a part of our relationship with Visa. This missing link is in the middle – the merchants, where our plans are still evolving. In this area we are well behind the market and the pace is being set by Netscape. Microsoft should actively pursue a relationship with Netscape to incorporate STT into their server products and adopt our affidavit formats, viewing them as either an important or primary channel to merchants for our server technology (including STT). We will directly license the NT version of this product to Spyglass and others, and work with Netscape to do the many varieties of UNIX versions.[249]

Rosen also mentions that IBM, AT&T, MCI, and AOL were identified as major competitors in this market space. On April 17, Siegelman responded, having removed most of the original recipients from the thread, that there was a "growing feeling that we need to compete with Netscape." He pinpointed the strategic conundrum behind the strategy Rosen articulated:

> This is one of those decisions that are hard to make: is the technology so key and value add that you want to keep it yourself? Is it such that there will be enough momentum for

[249] *US v. Microsoft Corp*, 253. (Exhibit 18, p. 2).

> alternative solutions that you don't think that you can keep it to yourself as your proprietary solutions? Before we do anything we should think carefully about the situation and need to think it through as if we want to sell a complete merchant kit and server that will compete with Netscape. We may not want to do this, but we should understand the implications in case we do.[250]

As an executive who interviewed with Microsoft initially to serve as one of Gates' technical assistants, Siegelman understood at a high level the advantages of setting technology standards, as well as the risk of competing with Netscape, which at the time enjoyed overwhelming popularity with web users. But his response betrays a weariness in debating and fighting yet another internal battle that would draw focus away from MSN.

In his response to Siegelman the same afternoon, Rosen removed any doubt that Microsoft would not be competing with Netscape. There was an urgent need to establish a plan of action: "The acceleration of Internet related activities makes it critical that we begin to make these choices ASAP, or they will be made for us." A single top-line strategy was non-negotiable—Microsoft was being forced into becoming the market leader in e-commerce. Rosen proceeded to articulate his assumptions, that Netscape was "a small, aggressive, FOCUSED competitor or ally," and that competing with Netscape would yield two outcomes—a split market or Netscape's alliance with Lotus or AT&T. Peter Neupert, the Microsoft lead for its MSNBC online partnership, responded that the newly formed Microsoft-Visa payments alliance would increase the adoption of STT, and "with Netscape supporting and distributing this, it increases the value of our payment servers and may increase the volume of transactions coming through VISA for which we get paid."[251] Neupert calls out Microsoft's preoccupation with profiting from online transactions fees in addition to its

[250] *US v. Microsoft Corp*, 253. (Exhibit 18, p. 2).

[251] *US v. Microsoft Corp*, 253. (Exhibit 18, p. 1).

hopes of competing with Netscape on client servers for e-commerce. Though Rosen echoed Siegelman's sentiment that Microsoft still did not have an articulated internet strategy, his email conflated the organization's overarching internet strategy (as it was considered at the offsite retreat a year prior) with a browser and web standards strategy. The discussion is a telling portrait of decision making among top Microsoft executives; while only twenty executives participated in the internet strategy offsite retreat in 1994, the centralized decision-making culture had yet to yield a coherent corporate-wide strategy despite the recognition among the executives that internet features needed to be built into nearly every Microsoft product category. A month later, on May 16, Maritz emailed the same group of senior executives with a list of good news and bad news regarding the status of internet strategies at Microsoft. The concerns and goals were still the same, except with MSN's role slightly better articulated ("…MSN needs to be, and be perceived to be, a "value-added" Internet service leveraging widely used-protocols[sic]").[252]

In mid-April 1995, Ben Slivka, gave an internal presentation called "Platform Shift: The Web," which he admitted over email was a "slightly extreme view of the ability of the Web to make Windows irrelevant."[253] Slivka's presentation explained that the web as a networked platform that could host applications, and listed five bullet points under "The Ferment on The Web": Internet Phone, Virtual Reality Markup Language (VRML), RealAudio, HTML 3.0 tables, and "FirstVirtual, CyberCash, SSL, S-HTTP."[254] Slivka's slide makes this the earliest documented mention of two secured transactions startups (FirstVirtual and CyberCash) looking to set standards for e-commerce in the early days of the web. Of Microsoft's then current web efforts, Slivka included O'Hare ("Win95 web browser, internet shortcuts, install wizard, Lycos") and Secure

[252] *US v. Microsoft Corp*, 253. (Exhibit 146, p. 1).

[253] *US v. Microsoft Corp*, 253. (Exhibit 399, p. 1).

[254] *US v. Microsoft Corp*, 253. (Exhibit 399, p. 3).

Transaction Technology (STT).[255] Among the bullet points of "Microsoft Anti-Web Efforts," MSN topped the list.[256] MSN, in Slivka's view, worked against the very product his team was developing to ship with Windows 95.

In an email exchange on April 25 with J Allard, Barbara Fox, Director of Advanced Product Development at Microsoft, indicated that the Microsoft team had deferred Netscape discussions into that week to focus on closing a deal with Visa. The transactions fees partnership with Visa appeared to cement Microsoft's ambitions in internet-enabled payments from 1994 (see Chapter 5). Fox pointed to the difficulty in reigning in both Visa and Mastercard to adopt Microsoft's STT standard:

> We DID get the per/transaction revenue deal we wanted, but they (Visa) are now tasked with bringing in MasterCard which has an existing deal with Netscape. SO…Netscape is back on my list. It certainly looks like getting STT adopted by both bankcards is going to take some deal with Netscape – the solace here is that the more transactions we generate, the more revenue we see. I don't, however, want to be shortsighted on this.[257]

Rosen responded to Fox's questions about the commercial strategy with Netscape, "I believe that we must view Netscape as a channel for our "stuff" including NT and Internet extensions… and work to find a way to position them as a solution provider on top of our platform." While Fox's email showed Microsoft's desire to profit from online credit card transactions, Rosen's take on competing with Netscape was that it would be better to make Netscape a mere part of the Windows ecosystem like any other software provider. Rosen expressed that Microsoft could not afford to "declare war in the near term" due to Netscape's market lead and that Microsoft needed to

[255] *US v. Microsoft Corp*, 253. (Exhibit 399, p. 6).

[256] *US v. Visa USA, Inc*, 163; *US v. Microsoft Corp*, 253. (Exhibit 399, p. 7).

[257] *US v. Microsoft Corp*, 253. (Exhibit 949, p. 1).

"aggressively sign them up for STT, and then work to get other merchant platform providers signed up too." Warren Dent, a business development lead, indicated in his response that Microsoft and Visa both sensed "a great willingness from MasterCard to set one standard and one bindery."[258]

Dent's thoughts on establishing STT as the standard for secure financial transactions echoed what several executives, including Rosen, had repeatedly expressed amongst one another on email that spring. However, by this time the setting of standards for securing online financial transactions, a top internet strategy priority, had seemingly become divorced from the goal of profiting from fees via agreements with Visa and MasterCard. In fact, Rosen repeatedly failed to provide strategy whenever his colleagues asked for clarification on what Microsoft's plans were for competing with Netscape. The echo chamber of internet and browser strategies amongst senior executives at Microsoft suggested that despite the twenty executives invited to the internet offsite in spring 1994, the final arbiter for any top-level strategy was still Gates. The issue of overlapping internet strategies with MSN only ceased after Gates took the decision to market MSN as the vehicle through which a Windows 95 user would access the internet. Siegelman told *Fortune* magazine in spring that MSN would link directly to the web by the end of 1995.[259]

In mid-May, Rosen circulated to members of the same group of executives his draft memo on Microsoft's internet strategy, titled "Microsoft's Potential for Leadership in the Internet."[260] The memo outlined gaps in Microsoft's "fragmented" offerings, as well as a prioritized list of threats. At the top of the list was: "Threat of another company evolving the client and server using non-Microsoft protocols"—and specifically pointed to Netscape as the key competitor in the race to "control the client evolution." On this particular point, Rosen wrote that Microsoft's strategy

[258] *US v. Microsoft Corp*, 253. (Exhibit 949, p. 1).

[259] "As the Internet Sizzles, Online Services Battle for Stakes," by David Kirkpatrick, *Fortune,* May 1, 1995.

[260] *US v. Microsoft Corp*, 253. (Exhibit 331).

was “currently a matter of some dispute.” The memo highlighted the firm’s failure to identify customer segments for MSN and a general lack of focus on internet initiatives within the organization.[261] In his recommendations, Rosen listed coordinated marketing efforts, consistent messaging, rights to content, and a coherent tools/platform strategy as his top suggestions. The final recommendation in the list reads:

> We should try to strike a close relationship with Netscape. In this relationship our goal should be to wrest leadership of the client evolution from them. We should try to win them to a position where they are a “solution provider” of Internet merchant services on NT and back Office. We should license them STT, authoring tools, and other platform technologies to alight them with our direction. We should also contemplate an investment if that helps bring about alignment.[262]

It is difficult not to read Rosen’s persistent belief in bringing Netscape round to a partnership in which Netscape cedes standards and tools to Microsoft as a kind of magical thinking. By that time, Netscape had already solidified its senior leadership team, replacing Jim Clark with James Barksdale as CEO. Netscape and its flagship browser were synonymous with the web and the internet. Furthermore, any intent to acquire Netscape would have likely been regarded as problematic given the ongoing legal issues Microsoft faced on both the MS-DOS consent decree and the Intuit acquisition. There is a sense in Rosen’s interpretations of his conversations with the leaders of Netscape that he believed Netscape would be won over. In the coming months, Rosen would lead Microsoft’s unsuccessful partnership discussions with Netscape’s Barksdale.

[261] *US v. Microsoft Corp*, 253. (Exhibit 331, p. 5).

[262] *US v. Microsoft Corp*, 253. (Exhibit 331, p. 7).

## Chapter 5 – The Digital Economy and the Browser War Boom

*The Digital Economy: Overview—Signal Innovation Theory Application—Microsoft stokes the Transactions Wars—Microsoft's Tidal Wave—The Browser War and Boom—Windows 95 and Resolving the MSN Problem—The Rapid Browser Innovation Years*

*The Digital Economy: Overview*

In the spring of 1994, a *Newsweek* reporter shadowed Bill Gates throughout a day's meetings at the Microsoft campus in Redmond, Washington. What the subsequent article that appeared later in July gave the world as a clear glimpse into both Gates' abrasive leadership style and the big picture thinking that drove the economics of his business. In trying to figure out how to improve the market share of Microsoft Money, the company's home banking software application, Gates described a vision of a Microsoft-led banking future. Gates is quoted as saying "Banks are dinosaurs," and that Microsoft can "bypass" banks by owning the transaction fee on every retail banking transaction taking place within its software. Gates envisioned a world where every bill payment and transfer of funds would take place within the Windows 95 platform—and thereby Microsoft would stand to profit from transactions fees. Gates' mere words had stoked the Transactions Wars.

Several months later, in October 1994, Microsoft announced its acquisition of software company Intuit, valued at $1.5 billion at the time. Intuit was the maker of Quicken, then the most popular personal finance software program. Microsoft publicly spoke of Quicken not as a software, but rather as an interface. The industry understood that Microsoft intended to make Quicken the online gateway to financial services features on its upcoming internet service and portal MSN. Despite Microsoft's move to offload its own competing software Microsoft Money by selling it to another competitor, the software giant could not avoid antitrust scrutiny from the Department of Justice. By November 1994, the Justice Department's probe was magnified with the lobbying efforts of Microsoft's competitors. Among these competitors was the brokerage firm Charles Schwab. For the first time, Microsoft's enemies included a financial services firm.

By early 1995, the banking industry's indignant and fearful reaction to the "dinosaur" quote made its way into financial services industry media coverage. Checkfree Corp. would sue an Intuit-owned payments processor, positioning itself as a payments company allied with the financial services community rather than with the software industry. One of the earliest moves from banks responding to Microsoft's seemingly imminent encroachment on their transactions fees territory came when H&R Block put up its software company Meca for sale following the Intuit acquisition announcement. The tax preparation company did not see a future in competing with Microsoft. In May, Bank of America and NationsBank jointly acquired from H&R Block the software company behind the Manage Your Money application. On April 27, 1995, the Justice Department filed suit against Microsoft to stop the Microsoft-Intuit merger. After having publicly announced that the company would seek a speedy trial, Microsoft abandoned the merger on May 19, paying Intuit a breakup fee of $46 million. Following the aborted merger, Intuit moved quickly to secure partnerships with banks to provide Quicken users with home banking features. Even so, Intuit CEO Scott Cook told the press that Gate's dinosaur quote had already hindered Intuit's progress in negotiating in-application services and fees with banks.

Thus, May 1995 marked a turning point in the entanglement of the software and financial services industries, as well as the imminent Browser War between Microsoft and Netscape. Not only did banks join forces to invest in home banking software (Meca) and Microsoft abandon its Intuit acquisition, but Wells Fargo also became the first retail bank to put banking services on the web with the launch of its website on May 18. A week later, Gates distributed his now famous internal memo, "The Internet Tidal Wave," in which he details the reasons why the internet was now critical to every part of Microsoft's business. The memo came with the announcement of a

new Platform group headed by Paul Maritz, effectively designating Maritz as the executor of Microsoft's internet strategy.

The memo was followed by another corporate executive internet strategy retreat. As with the previous retreat in 1994, younger developers argued for a product strategy for the open web. Ben Slivka, the head of the Internet Explorer team, gave a talk based on his internal memo, "The Web is the Next Platform," which ran over an hour from its schedule 15-minute allotment. It is during this talk that Slivka suggested that Microsoft give away software online for free, to which Gates responded by calling Slivka a communist. Executives left the retreat, yet again, without a coherent internet strategy. A week later, Gates asked several executives about a potential partnership with Netscape, believing that there had to be a mutually beneficial path forward given his belief that the commercial browser business was not profitable. This prompted two concurrent efforts by Microsoft to leapfrog Netscape in terms of strategy. Barbara Fox and Thomas Reardon would lead efforts in securing a security protocol development deal with Visa, while Dan Rosen led internal efforts towards persuading Netscape to a partnership deal.

June 1995 saw Microsoft and Netscape engage on the topic of partnership and quickly leave the formal meeting as rivals. Rosen would push for a partnership strategy in which Microsoft would somehow co-opt Netscape, despite Maritz's reservations. Netscape, on the other hand, was primarily interested in understanding the exact cost of doing business with Microsoft, which was soon shipping the long-awaited Windows 95. Court documents also show that AOL showed an interest in investing in Netscape as early as summer 1995. After the unsuccessful meeting between Netscape and Microsoft, Netscape would go on to make several announcements indicating progress in setting security standards for online transactions protocols. The company would also enjoy a widely reported and heady initial public offering in August 1995.

After the splashy worldwide launch of Windows 95 in August, Microsoft would publicly announce in December 1995 a corporate-wide pivot to being an internet-first company. At the same time, the company now faced a new Justice Department inquiry. This time, the DoJ was probing the dangers of Microsoft's bundling of MSN with Windows. Yet, since the project's inception in 1994, Microsoft failed again and again in reaching any internal consensus regarding MSN's strategy and direction. But over the course of 1996 the company would resolve the MSN problem. WebTV efforts, which gave birth to the MSN project, would be shuttered in March 1996. A month later, Microsoft reneged on its deals with content providers—all participating in a subscription-based strategy with MSN—by shifting MSN to the open web. Russell Siegelman, who spearheaded the doomed MSN project, would be replaced and go on to help Microsoft found Slate.com.

By the end of 1996, MSN was on the web but remained behind a paywall. In other words, Microsoft spent 1996 dismantling MSN, which encompassed its pre-web boom internet strategy. What followed Microsoft's course correction and entry into the commercial browser market are the rapid browser innovation years that spanned 1996 to 1998. Netscape and Microsoft tirelessly put forth more innovative features and functionalities for building and consuming web pages at a breathtaking pace until the Justice Department formally sues Microsoft in 1998. By then, Netscape was struggling to survive as Microsoft's anticompetitive tactics—leaning largely on Windows' market dominance—made it increasingly difficult for Netscape to partner with other firms or ink enterprise deals to large businesses. Microsoft's zero-sum strategy in gaining browser market dominance drove both companies to deliver a dynamic and appealing user experience for browsing the web. The rivalry and the challenges software firms faced in working with the financial services

industry ultimately prevented Netscape and Microsoft from delivering an in-browser payment system.

*Signal Innovation Theory Application – Digital Economy Assessment*

The emergence of a digital economy made possible by the web formed an internet-centric economic ecosystem. The digital economy introduced new products and services and often created entirely new markets. This identifying characteristic of the web then gave way to other signal innovation characteristics. Enhanced user experience of new web-based products (other than the browser) further unlocked the usability and value of the internet. These new products and markets then unlocked the broader business economics potential for internet-related products and services. Made possible by the simplified front-end interface of the web but simultaneously bolstered by the complex back-end foundations of the internet, the nascent digital economy was a highly competitive new market ecosystem.

*Table 5.1 – Signal Innovation – Foundational Principles – Digital Economy*

| Condition | Evidence |
|---|---|
| 1. **Evolve emerging technology.** Build upon and advance the evolution of a more fundamental technology later characterized as general-purpose. | • Slivka circulated his memo "The Web is the Next Platform" on the Saturday before the offsite. He described his vision of the Microsoft SuperWeb architecture and monetization opportunities, as well as recommendations for various Microsoft teams to integrate this vision of the web into the core objectives and activities of the |

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| | respective teams. Emphasizing the importance of setting standards for the web, Slivka wrote that Microsoft needed to avoid repeating the errors of MSN . . .” |
| **2. Accelerate user adoption.** Accelerate the adoption and diffusion of said underlying general-purpose technology. | • *The Seattle Times* . . . considered the growing popularity of the web as it was taking place: “Yet another explanation. . . is that the continuing growth of the Internet, largely the consequence of the astonishing popularity of the World Wide Web, may have caused Microsoft to question the assumptions it had been making all along about the Intuit purchase.” The *Washington Post* reported that, in fact, Quicken was “widely seen as an interim step toward electronic banking,” referring to web-based retail banking. A week prior to the breakup of the [Microsoft and Intuit] merger, Wells Fargo announced that its new website would be a platform for customer account access. On May 18, Wells Fargo became the first retail bank to provide customers with online banking features. Unlike home banking software, online banking was made possible via a webpage, enabled by browser technology innovations. |
| **3. Catalyze innovation ecosystems.** Catalyze the growth of an economic ecosystem around the general-purpose technology. | • During August 1996, Netscape announced a slew of deals expanding its browser reach in terms of both content and future functionalities. The |

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| | race for partnerships with Internet Content Providers (ICPs) heated up as Netscape signed deals with 26 content providers, including the New York Times and Sony Music. Microsoft signed with the likes of the Wall Street Journal, MTV Online, and ESPNet Sports Zone. Netscape acquired Navio Communications, a software company focused on bringing internet technologies to non-PC products. Apple and Netscape announced on August 27 that Netscape would develop a new version of Navigator for Cyberdog, Apple's internet suite. The following day, IBM and Netscape announced the development of a native OS/2 speech-enabled version of Navigator. |
| **4. Intermediate with technology forerunners.** Function as an abstract or concrete technological intermediary between it and the general-purpose technology. | • Though MSN signed up over a million subscribers in the first seven months of service, the figure paled in comparison to the 15 million web users in North America. When Siegelman's departure from Microsoft was announced in July, the *Seattle Times* observed that Siegelman had been given an impossible task as the nature of internet access was changing rapidly, "What is known is that Siegelman sat in a hot seat during at least the past two years, trying to head MSN as a private online service during a time when the company - and the world - was directing itself more |

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| | toward the global, largely free Internet computer network. Microsoft recently began switching much of MSN's content toward the Internet and giving it away for free, abandoning many of the partners who had signed on to provide information for the private service for a fee." The way that PC users relied on browsers to access the web became an undeniable and lasting trend that Microsoft could not afford to ignore. In responding to the web boom, Microsoft focused much of its efforts on achieving greater market share for Internet Explorer. This conflict is noted in the *Court's Findings of Fact* regarding the ambivalence over its MSN strategy that figured into how Microsoft approached ISPs to privilege Internet Explorer in product bundling practices. |
| 5. **Enhance user experience.** Unlock the usability or value of a general-purpose technology through an enhanced user experience (i.e., usability). | • By 1998, Netscape and Microsoft both boasted feature-laden browsers. In this short span of time, the two companies advanced the build and functionality of webpages, changing how end users could consume and publish content on the web. These innovations in web features contributed directly to how the web looks today. Netscape also quietly gave the world built-in tracking cookies with its first browser in 1994. Both Navigator and Internet Explorer established the ever-present |

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| | features of today's web experience, including plug-ins, built-in messaging, video and audio streaming, and POP3 mail server protocols. The rapid innovation years that saw constant one-upmanship between Netscape and Microsoft with each release of their respective browsers gave users an increasingly appealing, entertaining, and dynamic web experience. |
| **6. Drive market growth.** Unlock the financial, commercial, or broader business economic potential of the general-purpose technology. | • In 1996, Netscape capitalized on its early mover dominance in the browser market, promoting its products for e-commerce and furthering its partnerships with Microsoft's rivals. On April 30, 1996 Netscape adopted the QuickTime plug-in for Navigator 3.0 as browsers became more multimedia content-driven, thereby allowing audio and video integrationOn June 17, Netscape announced SSL 3.0, providing a list of clients adopting the technology: "Among the companies supporting the SSL 3.0 open protocol for Internet security are @Home Network, Citibank, First Data Corporation, Hypercom, Inc., IBM, Intuit, Inc., KeyWitness Canada, Inc., Lockheed Martin Federal Systems, Motorola Government and Space Technology Group, Northern Telecom (Nortel) Secure Networks, Novell, Inc., Premenos Corp., Security First Network Bank, Siemens Nixdorf, |

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| | Silicon Graphics, Inc., Sun Microsystems, Inc., and Verisign, Inc." Further enhancing its reputation in encryption technologies, Netscape announces on July 8 that the company was now working with the public sector through the technology arm of the DoD, the Defense Information Systems Agency (DISA), which was using Netscape for its military intranets. Netscape appeared to be in the right time and place with the necessary partnerships to capitalize on an e-commerce boom. |
| 7. **Unlock new value.** Unlock the consumer-relevance and value competitiveness of the general-purpose technology. | • Shortly before the acquisition was announced, Microsoft and Mastercard signed a letter of intent that would use Microsoft Money as part of a "Master Banking" software program co-developed by the two companies. In early November, Microsoft and Visa announced a planned joint venture to develop encryption software on Visa's payment network with an anticipated launch the following year in 1995, a deal that Microsoft claims predated the Intuit acquisition. The original letter of intent between Microsoft and Visa was dated October 24, 1994, coinciding with Netscape's submission of its SSL source code to the W3 consortium. *American Banker* cited statistics from Visa: "30 million consumers and three million merchants participate in the Internet, |

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| | and transactions from these rise by an average of 1% per day… Consumer participation in the global computer network leapt 200% last year, and the number of merchants on-line grew 150%." |
| **8. Inspire new narratives.** Build upon existing or inspire new economic or innovation narratives surrounding the general-purpose technology. | • On the following day, May 26, 1995, a mere week after his company announced the forfeited Intuit acquisition, Gates distributed the now iconic internal memo to Microsoft executives and their direct reports titled, "The Internet Tidal Wave." Penned by Gates himself, the memo is considered the official moment when Microsoft shifted to a company-wide internet-first strategy (this in contrast to the activities of the MSN team). Of the government exhibits entered into public record for the browser and middleware antitrust suit brough forth in 1998, Gate's memo—Exhibit 20—would become the oft-cited moment when Gates switched gears to play catch-up with other internet-minded competitors. |

*Table 5.2 – Signal Innovation – Pre-Incident Indicators – Digital Economy*

| **Condition** | **Evidence** |
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| **1. Underutilized disruptive technology.** A significant, disruptive, but niche technological artifact or development limited by technical complexity, usability and interfacing capabilities, and product | • On Microsoft's existing commitment since 1994 to "extend the Web," Slivka argued, "We should support all of the key internet standards and become key suppliers of Internet |

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| and service use case application. *This the fundamental technology that has the potential to emerge as general-purpose, which often has existed for some time but never achieved general-purpose "escape velocity."* | technology to all comers." Of these standards, Slivka placed emphasis on the need to enable electronic billing for Microsoft's STT standard such that they became "pervasive." This is the first concrete indication that for Microsoft the protocols for securing transactions in home banking instances and web e-commerce instances had finally converged into a single standard. Adding to his argument from his prior internal presentation on the web from April, Slivka explained part of the attractiveness of the web for users is its usability, "UI [user interface] consistency is easier to achieve because there is less code to write for UI. UI also looks better, because the layout of text, graphics, and controls is automatic…and richer (background bitmaps, sounds, etc.)" It would seem that throughout most of 1994 and the first half of 1995, younger developers like Slivka and Allard had continued to provide other Microsoft executives with a crash course in why the web (and more broadly, the internet) would only continue to grow in popularity. |
| 2. **Competitive innovation ecosystem.** An emerging and highly rivalrous series of complementary technical innovations, built upon said artifact and demarcating a new market ecosystem of no clear winners and aggressive competition. *These are the innovations advancing the fundamental* | • In the Tidal Wave memo, Gates explained the then contemporary mid-1990s internet landscape, what the internet enabled, and what the future would look like with internet-enabled communications. His intent in writing |

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| *technology and competing for signal innovation status, drawing focus to the underutilized disruptive technology.* | the memo was as follows: "In this memo I want to make clear that our focus on the Internet is critical to every part of our business. The Internet is the most important single development to come along since the IBM PC was introduced in 1981. It is even more important than the arrival of graphical user interface (GUI)." He posited that the internet "will set the course of our industry for a long time to come," and "that virtually every PC will be used to connect to the Internet and that the Internet will help keep PC purchasing very healthy for many years to come." The Tidal Wave memo is the most comprehensive look into Gates' expansive considerations of how the internet would impact the PC and software industries. The document is a forthright recognition of an unmissable development in the PC and software industries.. . . The memo is galvanizing in the sense that Gates declared a sweeping, full reorientation of his company's various product strategies, resulting in a new Platform group headed by Paul Maritz. |
| 3. **Compelling narratives.** An explosion of economic narratives surrounding said technical market ecosystem, covered more favorably in new media outlets, less favorably in established media outlets, and inspiring new terms and new uses of existing terms. *This circulation of narratives around a singular disruptive* | • By the fall, the press would reflect on the summer of Windows 95 as an inflection point in the tech industry and overall markets: "This summer, during the orchestrated build-up for Windows 95, Wall Street found that Microsoft is the company that drives |

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| *technology, amplified by the influx of technical innovations, suggests a higher probability of a signal innovation-general-purpose technology pairing.* | the American financial markets as only I.B.M. and General Motors could in previous eras. The closing months of 1995 see competitors and potential competitors -- I.B.M., Apple, Lotus Development, Wordperfect, Novell -- fading back from Microsoft's businesses or bracing fatalistically for the next onslaught." While the investment frenzy surrounding software firms developing applications anticipated for the Windows 95 launch, the *New York Times* observed that the Windows 95 effect was not actually a result of a massive marketing effort. "The fascination, hype and controversy surrounding Windows 95 stems largely from the fact that PC's[sic] are now ubiquitous in the workplace and are fast becoming a mainstream consumer product. The $85- billion-a-year personal computer industry is recognized as a pillar of the American economy. And as a gateway to the Internet, cyberspace and multimedia, the personal computer affects everything from how people communicate with each other to how children are educated." PCs were now essential to consumers accessing something much more exciting than what computers previously offered users—the web. |

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| **4. Incumbent investment.** Major investment by incumbent institutions into the productization of a technical innovation, unlocking the business economics and user experience factors of a more fundamental technology, often in competition with smaller, disruptive entrants. *Investment activity by large and established market incumbents drives additional focus and increases market speculation.* | • By early 1995, the banking industry's indignant and fearful reaction to the "dinosaur" quote made its way into financial services industry media coverage. Checkfree Corp. would sue an Intuit-owned payments processor, positioning itself as a payments company allied with the financial services community rather than with the software industry. One of the earliest moves from banks responding to Microsoft's seemingly imminent encroachment on their transactions fees territory came when H&R Block put up its software company Meca for sale following the Intuit acquisition announcement. The tax preparation company did not see a future in competing with Microsoft. In May, Bank of America and NationsBank jointly acquired from H&R Block the software company behind the Manage Your Money application. On April 27, 1995, the Justice Department filed suit against Microsoft to stop the Microsoft-Intuit merger. After having publicly announced that the company would seek a speedy trial, Microsoft abandoned the merger on May 19, paying Intuit a breakup fee of $46 million. Following the aborted merger, Intuit moved quickly to secure partnerships with banks to provide Quicken users with home banking features. Even so, Intuit CEO Scott Cook told the press that Gate's |

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| | dinosaur quote had already hindered Intuit's progress in negotiating in-application services and fees with banks.<br>• Thus, May 1995 marked a turning point in the entanglement of the software and financial services industries, as well as the imminent Browser War between Microsoft and Netscape. Not only did banks join forces to invest in home banking software (Meca) and Microsoft abandon its Intuit acquisition, but Wells Fargo also became the first retail bank to put banking services on the web with the launch of its website on May 18. |
| **5. Business model transformation.** Accelerated repurposing of how large institutions carry out business and profit-making activities, coincident with the adoption of said complementary technical innovation. *The emergence of new business models is the last step in the temporal transition from underutilized to general-purpose technology via the instantiation of a signal innovation and general-purpose technology pairing.* | • By then, the industry understood that Microsoft was indeed shifting MSN from a proprietary online service to the open web. This change in strategy required hundreds of content providers—which included big names like NBC—to abandon MSN development efforts and shift to developing to web-based content. But MSN's fate was marred from the start when it was formed initially as an interactive television joint venture with TCI. *Wired* magazine characterized the fixation of Gates and his company's efforts in interactive tv in the spring of 1994 as "a consensual hallucination of magnificent proportions." Interactive television |

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| | efforts at Microsoft would be closed down in March 1996, and TCI withdrew its $125 million investment in the original venture known as MSN in November 1996. Myhrvold, then head of Applications and Content, told *Wired*, "Yes, we are becoming a media company." As *Wired* described, "This model is a counterculture move for Microsoft, which is being forced to do something it has never had to do before: act like a broadcaster and fill its channel with interactive media that it believes will drive consumers to the MSN channel. . ." |

*Microsoft stokes the Transactions Wars (1994-1995)*

*"Banking is essential, banks are not." Attributed to Bill Gates, 1994.*

As Bill Gates worked with Sinofsky and others to define an internet strategy for his firm, Microsoft remained in negotiations with the Justice Department over the language and scope of a consent decree that would put an end to the ongoing antitrust scrutiny the company faced since 1990. Concurrently, Gates devised in May 1994 a grand scheme to upend the global financial system via software—hopefully profiting handsomely along the way. This naked ambition to displace banks would germinate from a single quote in a throwaway article in *Newsweek* into one

of the most persistent narratives at the heart of the relationship between finance and technology for years to come.

A July 1994 *Newsweek* article gave readers a glimpse into the aggressively competitive culture at Microsoft and Gates' abrasive leadership style. The article, based on the journalist's day shadowing Gates in May 1994, detailed Gates' impatience with the lagging market performance of his company's personal finance software, Microsoft Money. More consequentially, a single paragraph in the article provided the fodder that made the financial services industry wary of Microsoft for the next several years, consequently creating challenges for both Microsoft and Netscape in setting standards for online financial transactions:

> Then comes a strange moment, the sort of thing that happens often at Microsoft, which seemingly within moments turns disaster into salvation. Talk has turned to broader trends in banking. Where's it going, what's in it for us. Banks are dinosaurs, says Gates. We can "bypass" them. The Raptor is unhappy with an alliance involving a big bank-card company. "Too slow." Instead he proposes a deal with a small-and more easily controllable-check-clearing outfit. "Why don't we buy them?" Gates asks, thinking bigger. It occurs to him that people banking from home will cut checks using Microsoft's software. Microsoft can then push all those transactions through its new affiliate, taking a fee on every one. Abruptly, Gates sheds his disappointment with Money. He's caught up in a vision of Microsoft at the center of the "transformation of the world financial system." It's a "pot of gold," he declares, pounding the conference table with his fists, triumphant and hungry and wired. "Get me into that and goddamn, we'll make so much money![263]

This anecdote marks Microsoft's entry into the Transaction Wars and foment rumors in the financial services industry that Microsoft sought to encroach on the domain of banks and credit card companies by selling software that allowed customers to bank on their PCs and profiting from

[263] "Culture Club," *Newsweek*, July 10, 1994.

each transaction taking place through Microsoft Money. The passage from the article would be truncated into a simple and catchy "banks are dinosaurs" quote attributed to Gates, ricocheting through the banking industry just as Gates acquired increasing recognition as a self-made billionaire. In July 1995, *Forbes* would declare Gates as the world's richest man, cementing his status as a celebrity.

It came as no surprise for the banking industry when on October 14, 1994, Microsoft announced a stock swap acquisition of Intuit, valuing the maker of Quicken at $1.5 billion. If completed, the deal was slated to become the largest ever acquisition in the software industry.[264] Intuit's personal finance application Quicken boasted six million users, which made it the leading software in the then growing segment of home banking. Not to be confused with online banking, home banking was software-based, requiring users to install and learn how to use an application like Quicken or Microsoft Money to manage household finances and make transactions (primarily transferring money between accounts or paying bills). The personal and household finances application was uniquely popular for its ability to "hide" the technology behind a checkbook metaphor user interface, which made the design intuitive after users learned how to use the various functions.[265] Intuit also offered a personal digital assistant (PDA) version of the software called Pocket Quicken, and in 1994 launched an online link to a webpage for updates on mutual funds and other investments. An executive from Microsoft told the *New York Times* that Quicken users spend more time with Quicken than they did with their banks, brokers, or insurance companies.

[264] "Microsoft in $1.5 Billion Deal to Acquire Intuit," by Lawrence M. Fisher, *The New York Times*, October 14, 1995.

[265] "Microsoft May Make Quicken the Home Banking Standard," by Lawrence M. Fisher, *The New York Times*, October 16, 1994.

In hopes of avoiding an antitrust probe, Microsoft sought to sell its own competitor to Quicken, Microsoft Money, to the beleaguered software company Novell. Intuit's internet-enabled features in its applications were seen as attractive complements to Microsoft's software strategy, especially as Microsoft was developing MSN. Announced the day after Netscape Navigator 0.9's beta release, the Intuit acquisition reflected the recognition of the internet as a potentially transformative technology for home banking, but neither the browser nor the web had yet to factor into this equation. The web was seen as but a part of the internet and had yet to achieve primacy as the dominant portal for access. Microsoft was careful to refer to Quicken not as a software application, but as an interface, signaling its plans to make Quicken the financial services interface within the MSN service. Based on Gates' very public ambitions to achieve an internet-enabled, Windows-based interactive PC and TV experience, the natural outcome of a Microsoft Quicken UI standard would lead to PC-based, internet-enabled retail investment and insurance services.[266]

However, on October 26 it was reported that the Justice Department had subpoenaed records from Novell as part of an antitrust review of the proposed Microsoft-Intuit merger (separate from Microsoft's existing troubles with its consent decree).[267] By late November 1994, the Justice Department requested more information from not only Microsoft and Intuit, but also from a Palo Alto law firm. Gary Reback of Wilson, Sonsini, Goodrich & Rosati submitted to the Justice Department a whitepaper arguing that network effects would spur a Microsoft-owned Quicken to dominate the market in years to come.[268] The cost of producing the whitepaper (over $150,000) was billed against Reback's anonymous clients.[269] Later, at least one client represented by Reback

[266] "Microsoft May Make Quicken the Home Banking Standard," by Lawrence M. Fisher, *The New York Times.*

[267] "Novell in Antitrust Review," by Bloomberg News, *The New York Times*, October 26, 1994.

[268] "A Legal High-Wire Artist Takes On Silicon Valley Giants," by Lawrence M. Fisher, *The New York Times,* April 5, 1995.

[269] "Microsoft Deal Facing Intense New Scrutiny," by Martha Groves, *The Los Angeles Times,* November 23, 1994.

that opposed the merger was revealed to be the brokerage firm Charles Schwab.[270] This is one of the earliest indications that the financial services industry was willing to invest in lobbying against Microsoft's interests, challenging the software giant's ambitions in the personal finance space.

Shortly before the acquisition was announced, Microsoft and Mastercard signed a letter of intent that would use Microsoft Money as part of a "Master Banking" software program co-developed by the two companies.[271] In early November, Microsoft and Visa announced a planned joint venture to develop encryption software on Visa's payment network with an anticipated launch the following year in 1995, a deal that Microsoft claims predated the Intuit acquisition.[272] The original letter of intent between Microsoft and Visa was dated October 24, 1994, coinciding with Netscape's submission of its SSL source code to the W3 consortium.[273] *American Banker* cited statistics from Visa: "30 million consumers and three million merchants participate in the Internet, and transactions from these rise by an average of 1% per day… Consumer participation in the global computer network leapt 200% last year, and the number of merchants on-line grew 150%."[274] From the partnerships Microsoft struck with Visa and Mastercard in 1994 and 1995, it appears that within Microsoft internet-enabled home banking transactions were entirely separate from web-based e-commerce transactions. Microsoft sought to set standards and profit from both types of transactions, but Netscape's activities in setting web standards took place as Microsoft was heavily invested in acquiring Intuit.

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[270] "Microsoft Calls Off Deal to Purchase Intuit Merger," by Julie Pitta, *The Los Angeles Times*, May 21, 1995.

[271] *US v Microsoft Complaint*, (CA No. 98-1232). Filed May 18, 1998.

[272] "Microsoft and Visa in Software Deal," by Lawrence M. Fisher, *The New York Times*, November 9, 1994.

[273] Exhibit from DOJ antitrust suit against Visa and MasterCard. *US v. Visa USA, Inc*, 163.

[274] "Microsoft, Visa are planning joint venture to shield card users from cyber-fraud," *American Banker*, November 9, 1994. https://www.americanbanker.com/miscellaneous/-49361-1.html.

By early 1995, Gates' supposed "dinosaur" and transactions fees grand strategy received coverage in *American Banker* when industry leaders were asked to comment on the banking industry's challenges in catching up with technological advances.[275] The dinosaur quote evidently made its way through the banking industry and planted the seeds of a narrative that would plague both Microsoft and Netscape's future efforts in working with financial institutions. In late January 1995, Checkfree Corp., a bill payment processor, sued National Payment Clearinghouse Inc., which was owned by Intuit at the time, for patent infringement. National Clearing House also handled Microsoft Money's PC-based transactions. The move was seen as "taking on the demonized software company," one that would make Checkfree more friendly to the financial services community.[276] In a few years' time, this move would benefit Checkfree as it competed with Microsoft in winning banks over to a single online bill payment security standard.

In mid-March, *American Banker* covered the publication of a study by a Silicon Valley consulting firm on Microsoft's potential market penetration in financial services. The study projected that by the year 2000 "Microsoft will be earning upwards of $2 billion in annual revenues from its electronic funds services alone."[277] Big banks were described as "fearful" of Microsoft's acquisitions and partnerships, and the financial industry was described by a banker as having "no strategy" to compete. Months after *Newsweek* first printed Gates' dinosaur anecdote, the financial services industry was undeniably hostile towards the perceived encroachment of technology firms on the territory of retail transactions.

An email from Gates sent on April 10, 1995, timestamped 3:00 am provides some indication that he may have felt the strain of the Justice Department's "policemen at the elbow"

[275] "Is Microsoft's Bill Gates right when he says banks are technology," *American Banker,* January 9, 1995.

[276] "Suit Suggests Home Banking Race May Ultimately Be Won In," *American Banker,* January 26, 1995.

[277] "Microsoft Looms as Potent Foe, Study Warns," *American Banker,* March 14, 1995.

effect after years of antitrust dealings. Gates wrote, "I admit I find it hard to focus lots of resources on trials and things when the Ineternet [sic] is taking away our power every day and will have eroded it irretrievably by the time broadband is pervasive on the course we are on right now."[278] Of the internal emails selected by the Justice Department for the antitrust trial, this is the only indication that Gates felt the strain of both antitrust probes plaguing his company at the time. As Microsoft executives continued to fret over STT and their inability to articulate a coherent internet strategy, the Justice Department filed an antitrust suit on April 27 opposing the Microsoft-Intuit merger, citing the likelihood of "higher prices and lessened innovation" in the personal finance software market.[279] Microsoft and Intuit stated that they would go after a speedy trial.[280] It was an unsurprising move for Microsoft, as the May 11 announcement of Bank of America and NationsBank jointly acquiring Meca, maker of the Manage Your Money software, from H&R Block for $35 million, was seen as a development in the merger's favor.[281] H&R Block had reportedly put up the software unit for sale in April under assumptions that the Microsoft-Intuit merger would go through, thereby making it impossible for H&R Block to compete with the software giant.[282] Bank of America and NationsBank explained the joint acquisition as "acting to preserve a role for their industry in the hotly contested market for interactive services, and they are inviting other banks to take ownership positions." The Justice Department's announcement did not escape industry scrutiny; the blocking of the merger was regarded as an about face following

[278] *US v. Microsoft Corp*, 253. (Exhibit 17, p. 2).

[279] *Findings of fact: US v. Microsoft Corp,* (CA 98-1232*), State of New York, ex rel. Eliot Spitzer, el al., v. Microsoft Corp* (CA 98-1233).

[280] "U.S. Sues to Block $2 Billion Merger Microsoft Seeks," by Lawrence M. Fisher, *The New York Times,* April 28, 1995.

[281] "Home Banking: NationsBank, B of A Buying A Rival to Quicken Software," *American Banker*, May 11, 1995.

[282] "News Analysis: Block's Exit from Personal Finance Software Underscores Intense Competition in the Field," *American Banker*, April 6, 1995.

industry criticism of the loosely worded consent decree that finally concluded the yearslong antitrust scrutiny of Microsoft's dealings with OEMs.[283] The inconsistencies in the DoJ's probing of Microsoft's activities further revealed the government's difficulties in keeping up with the pace of innovation brought on by the internet.

On May 19, 1995, after the Justice Department filed a memo requesting a trial postponement of two or three weeks,[284] Microsoft immediately aborted the merger. As a result, Microsoft paid Intuit a breakup fee of $46 million.[285] By this time, the public narrative surrounding Microsoft's intentions with financial transaction services was clear. The *Washington Post* reported, "By teaming up with Intuit, which has been focusing on this emerging market, Microsoft had hoped to leapfrog over a host of other organizations, principally banks, that it believed would become important players in the market."[286] The coverage of the sale of Meca to Bank of America and NationsBank indicated the prevailing wariness of banks to allow software makers to emerge as a broker between users and banks. The industry and media consensus by spring 1995 that Microsoft sought to use Quicken as the home banking interface for its upcoming MSN service. On the sudden investments banks made in home banking software, the *New York Times* explained:

> What stokes the industry's passion to get into this market has much less to do with software sales than with financial services. Companies like Microsoft and Intuit own one crucial piece of this business: the user interface. Banks own customer accounts, arguably a more vital asset. For the third piece, the communications links between the first two, look for a shootout between on-line service providers, like America Online, and the telephone companies.

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[283] "Microsoft's Next Move Is On Line," by Peter H. Lewis, *The New York Times,* April 29, 1995.

[284] "Microsoft Halts Merger With Intuit," by Elizabeth Corcoran, *The Washington Post*, May 21, 1995.

[285] Notes to financial statements for the Microsoft Annual Report, 1996 Fiscal Year. https://www.microsoft.com/investor/reports/ar96/financials/ns.htm.

[286] "Microsoft Halts Merger With Intuit," by Elizabeth Corcoran, *The Washington Post.*

In the same article, Scott Cook, the CEO of Intuit, said that the banks' fear of Microsoft was understandable and "palpable." Crucially, he noted, "I had to constantly explain away that dinosaur quote."[287] In the following years, Gate's dinosaur quote would serve as the source of most of the challenges Intuit, Microsoft, and other technology firms faced in working with the financial services industry.

Coverage of the abandoned deal in the *Seattle Times* offered a different take, one that considered the growing popularity of the web as it was taking place: "Yet another explanation for the retreat is that the continuing growth of the Internet, largely the consequence of the astonishing popularity of the World Wide Web, may have caused Microsoft to question the assumptions it had been making all along about the Intuit purchase."[288] The *Washington Post* reported that, in fact, Quicken was "widely seen as an interim step toward electronic banking," referring to web-based retail banking.[289] A week prior to the breakup of the merger, Wells Fargo announced that its new website would be a platform for customer account access. On May 18, Wells Fargo became the first retail bank to provide customers with online banking features.[290] Unlike home banking software, online banking was made possible via a webpage, enabled by browser technology innovations. This early move by Wells Fargo into online banking did not spur fellow banks to capitalize on the growing popularity of the web. Rather, it signaled the challenges banks would face in determining whether to invest in home banking software services or web-based online banking services, or both.

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[287] "And Now, a Scramble in Finance Software," by Lawrence M. Fisher, *The New York Times*, May 22, 1995.

[288] "Why Did Microsoft Abandon Intuit?" by Lee Gomes, *The Seattle Times*, May 22, 1995.

[289] "Intuit Deal Fears Center On Banking," by Elizabeth Cocoran, *The Washington Post*, May 2, 1995.

[290] "Wow! 20 years of internet banking," *Wells Fargo Stories*, May 18, 2015. https://stories.wf.com/wow-two-decades-of-banking-online/

On May 25, 1995, Thomas Reardon, one of the lead programmers for Internet Explorer, provided an email summary of the May 22 W3C advisory committee meeting in San Francisco to Microsoft executives. IBM, HP, and Digicash presented their respective payment protocols. At the W3C meeting, fellow members expressed strong interest in what Microsoft's payment protocol proposal would be.[291] Reardon spent several hours with Tom Paquin, Director of Client Development at Netscape, and Taher Elgamal (who in Reardon's words, was "crypto god"). On the topic of STT, Reardon found it "odd" that Elgamal did not take Microsoft's STT proposal seriously and that an STT pitch Fox had by then made to Netscape (in which Netscape would "handle server-side rollout of STT, at least in the Unix environment") was "probably at the wrong level."[292] He wrote that Elgamal was "absolutely interested in doing STT, assuming the crypto is assuredly strong, but he can't move it forward… He is convinced that a deal between MS+Netscape would force Mastercard+VISA into line immediately." For reasons unexplained, Reardon urged Microsoft executives to move quickly to get Netscape to commit to STT, stating that he gauged only a window of four weeks for Microsoft to "open their minds on this deal."

Reardon's email reveals the difficulties experienced by both Netscape and Microsoft in partnering with Mastercard and Visa. Elgamal seemingly recognized, in May 1995, that working with Microsoft would be necessary to obtaining the endorsements of the two biggest credit card companies for the endorsement of a single online transaction security protocol. Both Mastercard and Visa were credit card network companies backed by member banks that operated as credit card issuers. Member banks comprised the boards of credit card companies, making it necessary for top-level partnerships and decisions to go through representatives of these banks. By mid-1995,

[291] *US v. Microsoft Corp*, 253. (Exhibit 952).

[292] *US v. Microsoft Corp*, 253. (Exhibit 952, p. 2).

both Netscape and Microsoft experienced the repercussions of Gates' dinosaur remark. Gates had inadvertently stoked the Transactions Wars and retail banks responded by withholding their public endorsement of a single security standard.

### *Microsoft's Tidal Wave (1995)*

On the following day, May 26, 1995, a mere week after his company announced the forfeited Intuit acquisition, Gates distributed the now iconic internal memo to Microsoft executives and their direct reports titled, "The Internet Tidal Wave." Penned by Gates himself, the memo is considered the official moment when Microsoft shifted to a company-wide internet-first strategy (this in contrast to the activities of the MSN team). Of the government exhibits entered into public record for the browser and middleware antitrust suit brough forth in 1998, Gate's memo—Exhibit 20—would become the oft-cited moment when Gates switched gears to play catch-up with other internet-minded competitors. Because of the iconic nature of the memo, its date has guided the narrative of Microsoft's slowness to recognize the importance of the internet.

In the Tidal Wave memo, Gates explained the then contemporary mid-1990s internet landscape, what the internet enabled, and what the future would look like with internet-enabled communications. His intent in writing the memo was as follows: "In this memo I want to make clear that our focus on the Internet is critical to every part of our business. The Internet is the most important single development to come along since the IBM PC was introduced in 1981. It is even more important than the arrival of graphical user interface (GUI)."[293] He posited that the internet "will set the course of our industry for a long time to come," and "that virtually every PC will be

[293] Gates (1995), p. 1.

used to connect to the Internet and that the Internet will help keep PC purchasing very healthy for many years to come." The Tidal Wave memo is the most comprehensive look into Gates' expansive considerations of how the internet would impact the PC and software industries. The document is a forthright recognition of an unmissable development in the PC and software industries. Gates' tone is unemotional; the threats and benefits the internet posed to his business were soberly accounted for. The objective analyses of each corner of the software industry and its key players—most notably Sun Microsystems, Adobe, Apple, and Netscape—succinctly identified the product strategy and value proposition of the competition. The memo is galvanizing in the sense that Gates declared a sweeping, full reorientation of his company's various product strategies, resulting in a new Platform group headed by Paul Maritz.[294] If anything, the memo is a business leader's decisive pronouncement to his deputies that the unavoidable tidal wave would force Microsoft's business units and product teams to share a single mission—and it fell on the memo's audience to coordinate and strategize. The memo is aggressive in the writer's intent to remain atop the computing industry, but what is absent in Gates' memo is the prevailing mix of paranoia and aggression in the tone of internal email threads amongst Microsoft executives in the coming few years as the company sought to overtake the likes of Netscape and Sun Microsystems.

While the memo covers the various opportunities for both enterprise and consumer markets from real-time content streaming to 3D-enabled virtual reality shopping and communications, Gates specifically highlighted the importance of setting standards for files and secure financial transactions, as well as how advertising would inevitably affect the free content publishing economy. On Netscape's overall strategy, Gates declared, "They are pursuing a multi-platform strategy where they move the key API into the client to commoditize the underlying operating

[294] Gates (1995), p. 4-5.

system."[295] Gates emphasized the need to compete with Netscape on transactions servers and payment security: "Our server offerings need to beat what Netscape is doing including billing and security support. There will be substantial demand for high performance transactions servers."[296] While there are references to strengthening Microsoft Money, the focus regarding transactions remains competing in the electronic bill paying and transactions space. "Key elements of electronic commerce including security and billing need to be integrated into our platform strategy. On-line allows us to take a new approach that should allow us to compete with Intuit and others. We need to think creatively about how to use the internet/on-line world to enhance Money… Perhaps we can establish the lowest cost way for people to do electronic bill paying… All the financial institutions will find it very easy to buy the best Internet technology tools from us and others and get into this world without much technical expertise."[297] Only a week had passed since Microsoft aborted a merger with Intuit at the cost of $46 million and Gates already was suggesting ways to compete with Intuit on electronic bill payment. What is also notable here is Gates' persistent view of banks as lacking in technical expertise.

The memo led to another offsite internet strategy session. A group of 40 Microsoft executives arrived at the Red Lion Inn in Bellevue, Washington, on June 1, 1995, to brainstorm a new internet strategy for the company. Gates gave a 20-minute talk on his memo and Ben Slivka's scheduled 15-minute talk on the internet as a new platform ran over an hour, during which Slivka suggested that Microsoft give away some software online. Slivka claimed that Gates responded by calling him a communist.[298] Slivka circulated his memo "The Web is the Next Platform" on the

[295] Gates (1995), p. 4.

[296] Gates (1995), p. 5.

[297] Gates (1995), p. 7.

[298] "Inside Microsoft," by Kathy Rebello, *Bloomberg.*

Saturday before the offsite.[299] He described his vision of the Microsoft SuperWeb architecture and monetization opportunities, as well as recommendations for various Microsoft teams to integrate this vision of the web into the core objectives and activities of the respective teams. Emphasizing the importance of setting standards for the web, Slivka wrote that Microsoft needed to avoid repeating the errors of MSN, "There was a time when we thought that we could just "build it and they will come" with MSN, hence all the non-Internet technologies we developed (Marvel RPC, incompatible Mail & News protocols, MOSView, etc.) for MSN. These technology choices are unfortunate, for (in hindsight) I think it is clear that MSN would have been much further along now if we had started from the existing Web and enhanced it."[300]

On Microsoft's existing commitment since 1994 to "extend the Web," Slivka argued, "We should support all of the key internet standards and become key suppliers of Internet technology to all comers." Of these standards, Slivka placed emphasis on the need to enable electronic billing for Microsoft's STT standard such that they became "pervasive."[301] This is the first concrete indication that for Microsoft the protocols for securing transactions in home banking instances and web e-commerce instances had finally converged into a single standard. Adding to his argument from his prior internal presentation on the web from April, Slivka explained part of the attractiveness of the web for users is its usability, "UI [user interface] consistency is easier to achieve because there is less code to write for UI. UI also looks better, because the layout of text, graphics, and controls is automatic…and richer (background bitmaps, sounds, etc.)"[302] It would seem that throughout most of 1994 and the first half of 1995, younger developers like Slivka and

[299] *US v. Microsoft Corp*, 253. (Exhibit 1116, p. 1).

[300] *US v. Microsoft Corp*, 253. (Exhibit 21, p. 3).

[301] *US v. Microsoft Corp*, 253. (Exhibit 21, p. 4).

[302] *US v. Microsoft Corp*, 253. (Exhibit 21, p. 7).

Allard had continued to provide other Microsoft executives with a crash course in why the web (and more broadly, the internet) would only continue to grow in popularity. Slivka's detailed analysis of the major opportunities related to the web boom, as well as the major pitfalls for Microsoft's existing product strategy, once again show how the younger developers at Microsoft who were active internet users before the advent of the web and were the only ones who understood fully how the web was changing access to the internet. Slivka's argument against a closed, proprietary MSN service was not merely the product of his being in charge of developing Internet Explorer. Like Allard in his memo from January 1994, Slivka pointed out the lack of resources (talent) for an organization to be focused on building internet-oriented products. The MSN problem, therefore, was not that Microsoft was attempting to unseat AOL in the ISP market, but rather that it was a distraction from building more future-oriented or future-proof technologies that leveraged the web.

It is difficult to separate Gates' memo, which set the internet strategy for the whole of Microsoft and made Maritz its executor, from the breakdown of the Intuit deal. The memo arrived a year after *Newsweek* shadowed Gates at his Microsoft Money meeting, where he seemingly first conceived of the idea to tackle the entire financial services industry. This also meant that the retail banking industry had a year to react to Gates' dismissal of their purpose and utility. It also marked the year of the internet being top of mind for Microsoft's top executives, despite friction internally that prevented the creation of a strategy that could serve the interests of Microsoft's various product groups. Microsoft, by this point, had waded into contentious territory with banks, and was about to embark on a multiyear war with Netscape over browser adoption.

*"But acquisitiveness, although it is the mainspring of the capitalist system, is by no means the most powerful of the motives that survive the conquest of hunger. Rivalry is a much stronger motive." – Bertrand Russell.*

The following week on May 31, 1995, Gates emailed several executives his thoughts on a partnership with Netscape. His take on the commercial browser market was that clients, meaning browsers, were not profitable. Rather money was to be made on the server-side of the equation, and because Microsoft did not forecast any significant gains in commercial servers, Gates was willing to "help" Netscape with its server business for the next 24 months. The goal was to have Microsoft's STT and OLE protocols become standard in browsers, as well as getting Netscape to focus on servers that could run Windows NT.[303] Gates added that Microsoft could even pay Netscape or become a shareholder in order to make such a deal happen. Rosen responded that Gates' thinking was aligned with the conversations Rosen had conducted with Barksdale. He wrote, "Bottom line: if we [Microsoft and Netscape] go to war with each other, then other industry players will set the terms of engagement (e.g. Visa and MasterCard on processing fees; AT&T and MCI on network issues) and we both loose[sic] more than we gain." He added that Netscape was "very interested in STT." Rosen's email also informed Gates that Barksdale was meeting with the Microsoft team the following week.

According to an email sent by Thomas Reardon the following morning on June 1, Rosen, Fox, and Reardon met late the prior day, likely the result of Gates' email, to review discussion items and strategy for the upcoming meeting with Barksdale. He listed three goals for the meeting:

[303] *US v. Microsoft Corp*, 253. (Exhibit 22, p. 1).

"1. Launch STT, our electronic payment protocol. Get STT presence on the Internet. 2. Move Netscape out of the Win32 Internet client arena. 3. Avoid cold or hot war with Netscape. Keep them from sabotaging our platform evolution."[304] Reardon emphasized that the team's "first and currently most important goal" was launching STT and ensuring it became the adopted standard. Of the hopeful deal scenario items Reardon listed were Netscape sharing "prospective revenue" on the back-office side through Visa and MasterCard transactions. He added that the deal could be non-exclusive where Microsoft and Netscape could both implement additional payment protocols. He continued:

> By partnering with Netscape on payment, even exclusively, we will force Visa and Mastercard and any other backend player to fall quickly into line, and establish the 'per-click' business. This seems to be the grail that we all lust for. My take from the recent W3C meeting is that nothing will solidify the rest of the payment community more than Msft's entry; this community is also looking for leadership from Netscape; if Msft enters with Netscape much of the likely opposition would be steamrolled. Barb points out that Mastercard and Visa expect to play Msft and Netscape off against each other.

Reardon added at the conclusion of the email that the executives on this thread needed to determine whether these negotiations with Netscape would be within or independent of STT negotiations. "We felt that since payment protocols was such a hot issue, that STT needed to be closed on its own, and that all of you obviously need to consider the bigger issues without holding up any STT deal. Is this sensible?"[305] Though Microsoft struggled to form a coherent internet strategy across product groups in the previous year, the core team of executives or product owners at Microsoft working towards launching STT (primarily Fox and Reardon) in 1995 coordinated their efforts in

[304] *US v. Microsoft Corp*, 253. (Exhibit 23, p. 1).

[305] *US v. Microsoft Corp*, 253. (Exhibit 23, p. 2).

engaging Visa, Netscape, and the broader W3C advisory committee. Whether the W3C community was sincere in placing emphasis on Microsoft's entry into the payments standards setting process is unclear, but it may have been the case that advocates for open standards saw Microsoft as a necessary counterbalance to Netscape's meteoric rise and early dominance.

Rosen's push for a close partnership with Netscape was reiterated in Reardon's email. "Dan feels there is reasonable hope for engaging Netscape in long term strategic cooperation, where Netscape might run with the Mac and Win16 clients. As a first pass, we can probably at least get them to move STT client to the Mac and not worry about that problem til we're ready with our own cross-platform tools next year???"[306] On the profitability of the nascent commercial browser market, Reardon wrote, "In every meeting we have with Netscape, they emphasize that they realize there is no money in the client business, though mindshare there leads to many other opportunities. The businesses they see opening up are the server integration business, and the value-add app business (such as RealAudio, Java applets, secure newsgroups, etc)." Maritz proceeded to forward the email to other senior executives, including Gates. Even in the leadup to Microsoft's first formal meeting with Netscape leadership, the company had not reached consensus on what Microsoft's actual strategy was. These emails reveal Microsoft's top-level strategy formulation process as one of engagement without decision. Senior executives eagerly weighed in with lists of possible actions and "what about" questions, but rarely do these executives make a convincing case for a fully articulated, evidence-based strategy.

Included in the government exhibits are both Rosen and Barksdale's notes from the June 2 meeting at Microsoft between Barksdale and Rosen, Maritz, and Myhrvold. At Netscape, Barksdale reported back on June 4 to Netscape personnel, including Clark, Andreessen, and Mike

[306] *US v. Microsoft Corp*, 253. (Exhibit 23, p. 1).

Homer (head of marketing) of his visit to Redmond. Barksdale's emails reveal that the Microsoft executives made it clear that the meeting was taking place with "Bill's blessings," though it was unclear based on Barksdale's account as to Rosen's actual role at Microsoft ("head of industry relations?") and correctly interpreted Myhrvold as the most senior of the three ("the best title in the bunch").[307] Of the meeting, Barksdale wrote, "Generally they want to find ways to work together. Under this pleasant enough goal they were open to many suggestions most of which they made." Of these suggestions Barksdale listed seven, including Microsoft's willingness to consider bundling Netscape server software with NT and allowing customers to pay Netscape directly. The last example on Barksdale's list reads, "The issue of STT was not discussed since their[sic] is a meeting already scheduled for next week but they understand our position that it must be open." Barksdale added that Microsoft's position in this area was that "the credit card companies want to continue to collect a transaction fee by controlling the standards process." Microsoft, at the time, understood that the credit card companies were elbowing their way through the web standards setting process to protect what would become the digital domain of their existing domain of retail transactions fees.

On the topic of MSN, Barksdale quoted the Microsoft attendees as describing MSN as an open network Microsoft felt compelled to build to handle the online traffic that was likely to be generated by Windows 95. Of the misconception that MSN content would not be housed in a closed network, Barksdale comments, "THAT'S[sic] AN UNDERSTATEMENT." He summarized his sentiments of the meeting, "I may be wrong but I think this was the most significant statement of the meeting and offers our greatest opportunity. They now have determined that they can't be THE network for the world because this damn Internet THING has

[307] *US v. Microsoft Corp*, 253. (Exhibit 26, p. 1).

snuck in out of nowhere and ruined the strategy. Therefore they are looking for another way to take advantage of this new opportunity." Barksdale's next steps for the team were to proceed with understanding what would be necessary to enter into a "preferred solutions provider" relationship with Microsoft, if Netscape was in fact interested in the arrangement.[308] Barksdale conveyed a high degree of confidence to his colleagues that stemmed largely from the tremendous head start their company enjoyed in the web/internet race.

On the Microsoft side, Rosen distributed his notes from the meeting on June 5 on the meeting. Among the personnel included on the email thread were Gates, Siegelman, and Allard—but not Fox or Reardon.[309] Rosen understood Netscape's business strategy to be enterprise-oriented (within and amongst companies, followed by the consumer market), and that Netscape enjoyed remaining a private software company with no plans to enter into services. Barksdale appeared to have made it known to the Microsoft executives that Netscape considered Lotus Notes as its most direct competitor, and that he considered it "foolish to start a fight with Microsoft."[310] Rosen noted that openness, the freedom to support any protocol that becomes popular, was a strong sentiment with Netscape. In fact, Rosen and his colleagues corrected the misconception Barksdale held that MSN would be a closed network, thus otherwise prohibiting Netscape from working with Microsoft. On the issue of STT, Barksdale indicated that the process for adoption was in place but Netscape wanted to understand whether it would force Netscape to use "a specific standard that could only come from Microsoft." Netscape also hoped that Netscape's server software could be bundled with Windows NT; after a free trial period, Netscape preferred customers to contact Netscape directly for software plans. Rosen's conclusion of the meeting reads, "NetScape is open

[308] *US v. Microsoft Corp*, 253. (Exhibit 26, p. 2).

[309] *US v. Microsoft Corp*, 253. (Exhibit 28, p. 1).

[310] *US v. Microsoft Corp*, 253. (Exhibit 25, p. 4).

to a broad strategic relationship with Microsoft. They are concerned that we want them to become "less open", restricting their market opportunities. I believe that if we can show them that there are broad enough opportunities working with us, we can both achieve our strategic objectives."[311] Rosen's brief is optimistic and extends the view that so long as Microsoft go through the motions of appearing to be a friendly partner, Netscape will fall in line with Microsoft's requests.

In response to Rosen's notes, Maritz contradicted Rosen's interpretation of the discussion with Barksdale. In fact, Maritz pointed out that Barksdale indicated that "he/they view the client as a key place to make money."[312] He also did not walk away from the meeting with the sense that Netscape was ready for the "broad strategic relationship" as Rosen suggested. Maritz highlighted the disparity between Barksdale's comments about market strategy and Netscape's perceived product strategy: "Also given Barksdale's rather strange view of the market (first opportunity is intra-company, then inter-company, then consumer), I wonder if he speaks for all of Netscape." Though Maritz agreed that Microsoft should move forward with exchanging priority lists for further discussion, he suspected "that it will be [sic] challenge to get them to concretely commit to do something concrete in a given timeframe." Maritz's correspondence reveals that Barksdale's statements at the initial meeting were perceived as evasive or not entirely truthful. Unlike Rosen, Maritz did not take Barksdale's statements at face value.

An email from Rosen on June 9 indicated that Netscape agreed to exchanging priority lists for terms of engagement for further discussion. During this time, IBM and Lotus Notes were engaged in a public struggle after a hostile takeover attempt of Lotus by IBM. Rosen pointed out in his email how this was relevant to the discussion with Barksdale, "The IBM offer for Lotus

[311] *US v. Microsoft Corp*, 253. (Exhibit 25, p. 5).

[312] *US v. Microsoft Corp*, 253. (Exhibit 27, p. 1).

should play into our hands, since he sees Lotus as his #1 competitor." This shows that Rosen continued to take Barksdale's statements at their initial meeting at face value. For Rosen, there did not appear to be the possibility that the head of a competitor upstart would engage with an aggressive giant like Microsoft with misdirection. Lotus' acceptance of IBM's $3.5 billion cash offer would be announced on June 12.[313] On June 14, Rosen circulated the proposed discussion list with his colleagues. He asked for the individuals on the To: line of the email to attend the June 21 meeting. Gates, Myhrvold, Maritz, and Siegelman were among the executives on the CC line. He wrote that the general strategy in negotiating with Netscape was to first "love them to death," specifically: "We will give them sufficient reason to align with us (primarily they should make enough money) that they will have sufficient incentive NOT to do things with our competitors. Most people saw this as preference than getting them to agree not to work with our competitors."[314] The second point he emphasized was that the discussions needed to reach a "sufficient level of detail as soon as possible." Beyond the previous post-meeting email, Maritz does not appear to have suggested a different strategy in approaching Netscape. In further preventing the team from acting on Rosen's initial impressions of Barksdale, Maritz seemingly allowed Rosen to fail. Barksdale's own internal correspondence to Netscape leadership revealed a calculated effort to not give anything away to Microsoft, as well as a certain glee in dancing with the Goliath of the tech industry.

The June 13 draft of Microsoft's discussion list for Netscape to determine the scope of the June 21 meeting appeared to be structured around a heightened sense of partnership between the two companies. What is notable from the email was a clear deemphasizing of Microsoft's primary

[313] "I.B.M. Wins Lotus as Offer is Raised Above $3.5 Billion," by Laurence Zuckerman, *The New York Times*, June 12, 1995.

[314] *US v. Microsoft Corp*, 253. (Exhibit 556, p. 1).

business incentives as it pertained to the browser market that Netscape dominated—STT adoption. Under the topic of Technology, a single bullet point reads, "STT. Microsoft agrees to license Netscape its Secure Transaction Technology to incorporate into Netscape browsers and servers. Microsoft agrees to work with Netscape to adapt STT for non-Windows 95 platforms, including Apple Macintosh and UNIX."[315] Under SSL, Microsoft's discussion point reads, "Netscape has licensed Microsoft SSL technology and Microsoft agrees to incorporate it into their Internet browser product." For OLE discussion, "Netscape agrees to continue its support of OLE." Microsoft's orientation for the discussion, as expressed to Netscape in the document, was a focus on Netscape committing to Windows NT and 95 as platforms for its software offerings. Not only did Microsoft want Netscape to willingly operate as a commercial vehicle for these major Microsoft platforms, it also asked for equity and a seat on Netscape's board of directors. On June 15, Fox forwarded Rosen's email and attached discussion list to Reardon, whose name was not seen on the Netscape meeting agenda included in the trial exhibits but did up attending the meeting.

At some point between April and June 1995, Microsoft's priorities around how to engage Netscape completely shifted. It was as if the news of IBM taking over Lotus gave Microsoft the bravura to abandon its previous top priority, which was to secure an STT agreement from Netscape no matter what. Reardon, Fox, and Gates had all previously emphasized the business implications of focusing on STT. It was a logical extension from Microsoft's attempt to monetize internet-based financial transactions occurring through software (Quicken), as well as Allard's astute observations from January 1994 based on commercial activities gaining traction on the internet (content publishing and e-commerce). Rosen appeared to have been primarily motivated by a desire to co-opt Netscape, a personality-focused strategy rather than a business one.

[315] *US v. Microsoft Corp*, 253. (Exhibit 556, p. 3).

On June 21, 1995, Netscape hosted the formal four-hour discussion meeting at its offices in Mountain View, California. Barksdale, Andreessen, and Homer were the representatives of Netscape. Seven individuals from Microsoft attended the meeting, including Allard, Fox, Reardon, and Rosen. In his summary notes distributed internally, Rosen characterized the meeting as, "In general, it was a sounding out of each others' positions. They are unwilling to share their three year business direction in any specificity (we weren't sure that they had one). They asked a lot of the right questions of us. I believe that we understand each other better."[316] From Rosen's notes alone, it is clear that Rosen (and perhaps his fellow Microsoft attendees) did not have a good grasp of Barksdale, Andreessen, and Homer's reactions during the meeting. On the issue of absorbing most of Navigator's functionality into the Windows platform, with the exception of "the toolbar, cool places or advertising," Rosen observed that "they seemed OK with this concept." It is hard to imagine that a company leading the commercial browser market by virtue of user-friendly interface and features would be simply go along with Microsoft's requests for Netscape to essentially alter its business strategy.

On the issue of STT adoption, Rosen's notes stated that Fox led that portion of the discussion and that Netscape indicated that their progress had been slow and that they were "concerned about licensing terms and pricing." Here, Rosen once again expressed a sense of urgency in working with Netscape on STT, "They have a near term decision, so we must act quickly." The urgency that belied Rosen's drive toward a preferred partnership with Netscape repeatedly failed to account for Netscape's strategy. It was Chris Jones, Program Manager from Systems Division Management, who was one of the Microsoft attendees, who articulated in his

[316] *US v. Microsoft Corp*, 253. (Exhibit 549, p. 2).

response to Rosen's summary a list of Microsoft's priorities in working with Netscape and important questions about the nature of Netscape's business. Jones wrote,

> Assumptions – Microsoft's goals, in priority order, are to:
>
> 1. Own client platform
> 2. Own server platform
> 3. Deliver authoring tools/solutions
> 4. Sell services on top of both
>
> Independent of any relationship, NetScape is an ISV, and they will react to whatever changes Microsoft makes in the platform.[317]

This was a different characterization of Microsoft's top-line strategy for the web. Jones, who led product development at Microsoft, further boiled down the issue with Netscape to one of strategic alignment. "Are they willing to bet that we'll be successful, and will they make the commitment and changes necessary in their strategy to do this?... If, however, they do not agree to do this, we should simply treat them as an ISV and move on." Jones observed about the trio from Netscape, "They were extremely cagey on this subject, and while they didn't oppose our strategy, they also tried as much as possible to preserve their right to be open – in relationships with SUN, ATT, others. Unclear in my mind if they will be more than an ISV, but they didn't say enough to make a definitive decision, and we need more investigation." Jones then pivoted the conversation and offered a solution to what Microsoft should be doing, which was focusing on its own product teams to deliver on the company's internet strategy. "Either way, it is essential that we commit resources to developing and delivering our Internet strategy."

[317] *US v. Microsoft Corp*, 253. (Exhibit 549, p. 1).

Once again, Microsoft personnel continued to advocate for a coherent strategy, but no one appeared to agree on the terms and deliver on this talking point. It is worth noting that Jones' approach was a zero-sum mentality for competing in the software industry, one that appeared to have been pervasive across Microsoft. The prevailing attitude suggested here is that if a software company was not willing to play by Microsoft's rules, then engagement was not worthwhile at all. Furthermore, Jones' perspective originated from Microsoft's product side, which meant platform. The product-first orientation reflected the sentiment shared by Slivka, betraying an overwhelming sense of urgency and paranoia in being toppled from the top position in a given segment of the software industry. What it lacked was the expansive view of the internet and what it meant for product development made clear in Allard's earlier thinking. Moreover, an internal exchange between Slivka and John Messerly from Microsoft Research on the question of whether or not to develop Internet Explorer for Macintosh revealed the Windows-first and Windows-only attitude from members of the Systems division.[318]

Barksdale noted in the antitrust trial that Andreessen was a fast typist and therefore took on the responsibility of notetaking for the Netscape team during the June 21 meeting. The notes are comprehensive in that Andreessen appears to transcribe the dialogue verbatim, as well as include his private reactions to key points during the discussion. The first significant notes from the meeting were in fact Jones' critical question posed internally to his Microsoft colleagues after the meeting: "All of the relationship points revolve around the critical fact of -- is Netscape the kind of company that's going to partner with MS on this or not?"[319] Barksdale responds with a concern about the terms of engagement: "what the line is, where will it move, who is to say where

[318] *US v. Microsoft Corp*, 253. (Exhibit 332, p. 1).

[319] *US v. Microsoft Corp*, 253. (Exhibit 33, p. 1).

it will move, etc.," which Jones agrees with and further presses, "As MS there is benefit to drawing a line to create a value-add, for *a* partner. Is NS that company?" This appeared to be the prevailing tactic, the execution of Rosen's recommended "love them to death" strategy to convince Netscape that together the two companies would spur the growth of the internet market faster than either would accomplish individually. As much as Netscape's top executives came off as "extremely cagey" about their company's three-year strategy, the Microsoft attendees refused to reveal any platform strategy for the next six months: "They know what's coming out in August and slightly after August. They have lots of ideas for 12 months out, but no solid plans."[320]

Andreessen wrote in the notes, "Really perturbed because we put so much client stuff on the list, and they consider the client functionality to be something they build into the platform."[321] Judging from the notes, Reardon appeared to have attempted to assuage Andreessen's concerns by acknowledging Andreessen's advocacy for openness, ensuring that Microsoft planned to build upon HTML rather than "displace" it. If anything, Andreessen certainly was not "OK" with any of the terms Microsoft suggested in the meeting. He revealed to an executive at AOL, who was pursuing an investment deal in Netscape as early as 1995, Microsoft's view of how a partnership with Netscape would play out. The internal emails circulated at AOL detailing this interaction with Andreessen observed, "It was funny to listen to Marc take umbrage at "arrogant 25 year olds from the University of Washington… He also said something like, "Well, if we were going to take money we'd rather have it be from you than Microsoft"."[322] Netscape's frustration resided primarily with Barksdale's observation that it would be foolish to pick a fight with Microsoft. Barksdale's guarding of Netscape's strategy and plans to go public revealed an awareness that

[320] *US v. Microsoft Corp*, 253. (Exhibit 33, p. 6).

[321] *US v. Microsoft Corp*, 253. (Exhibit 33, p. 4).

[322] *US v. Microsoft Corp*, 253. (Exhibit 34, p. 2).

being a software company in the Windows ecosystem was a precarious business. This was a situation that even a leading ISP like AOL understood well. The interaction between AOL and Andreesseen also foretold AOL's eventual acquisition of Netscape years later.

Prior to its public offering in August 1995, Netscape made announcements that demonstrated continued efforts to set transactions standards. In July, Netscape revealed the company's three-phase open payment system: Phase 1, implemented in the first quarter of 1995, was to enable e-commerce transactions via SSL; Phase 2, scheduled for the third quarter of 1995, was to build the infrastructure for PC-to-bank payments with increased security "through a digital certificate and end-to-end encryption of financial transactions; Phase 3, scheduled for the fourth quarter of 1995, would involve deploying software for consumers, merchants, and financial services providers. The new standard-setting solution was Secure Courier, Netscape's new cross-platform (UNIX, Windows, and Macintosh) open security protocol that "builds on existing industry-standard protocols including the Secure Sockets Layers (SSL).[323] Intuit and Mastercard were named as two companies that would "support the new protocol for securing online credit card, debit card, charge card, and micro-financial transactions." The same press release stated that more than six million people had already used SSL-enabled products since December 1994. Secure Courier, which Netscape referred to as a secure digital envelope, would be one of the enhanced features of Navigator 2.0.[324] Netscape had publicly won over, by the summer of 1995, two important entities in adopting a browser-embedded standard for securing transactions. With the rapid adoption of its browser as a gateway to the web, Netscape had a plan in place to support

[323] "Netscape Announces Secure Courier, - A Digital Envelope for Securing Financial Transactions on the Internet," *PR Newswire*, July 18, 1995.
https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease33.html.

[324] "Netscape Introduces Netscape Navigator 2.0," *PR Newswire*, September 18, 1995.
https://web.archive.org/web/20030210235207/http://wp.netscape.com/newsref/pr/newsrelease43.html.

built-in payments—an answer to the placeholder for Error 402. What seemed like the browser market leader's clear path to setting a single standard would quickly turn out to be a messy yearslong effort involving Microsoft and the ire of the entire banking industry.

### *Windows 95 and Resolving the MSN Problem (1994-1996)*

On August 21, 1995, the Federal District Court in Washington concluded the Justice Department's antitrust case against Microsoft. This formalized the settlement as outlined in the 1994 consent decree.[325] Microsoft shipped the beta release of Windows 95 to reviewers and test sites in June 1995 after several delays.[326] Days later, on August 24, Windows 95 launched with a high-profile $200 million marketing campaign.[327] The launch event was hosted by Jay Leno, "Friends" actors Jennifer Aniston and Matthew Perry starred in an hour-long tutorial video produced by the company responsible for Cindy Crawford's exercise videos, and television ads promoting Windows 95 featured the 1981 Rolling Stones song "Start Me Up," highlighting the Start menu icon.[328] Gates himself worked the talk-show circuit, appearing on "Larry King Live" and "Good Morning America" to promote the release.[329] The trade publication *Windows* magazine scheduled a 75-city, 110-stop Windows Magazine Business Productivity Tour featuring an 18-wheeler truck equipped with staff and Windows 95 compatible products aimed at educating

[325] "Judge Clears Antitrust Pact For Microsoft," by Steve Lohr, *The New York Times,* August 22, 1995.

[326] "Another Delay at Microsoft," by Lawrence M. Fisher, *The New York Times,* December 21, 1994. l

[327] "Microsoft Throws Stones Into Its Windows 95 Ads," *The New York Times,* August 18, 1995

[328] "Haven't heard of Windows 95? Where have you been hiding?" by Elliot Stuart, *The New York Times,* July 31, 1995.

[329] "Pirates Are Circling the Good Ship Windows 95," by Steve Lohr, *The New York Times,* August 24, 1995.

consumers and small business owners on the new operating system.[330] Response in the advertising trade press to the marketing campaign was lukewarm. Midnight launch events (involving free pizza in New York City and free newspapers in London) around the world were reported to be overhyped. The *New York Times* wrote, "The enthusiasts turned out -- not in numbers enough to form any crowds stretching down any blocks, but by the dozen, even at some suburban computer stores."[331] Microsoft shipped eight to ten million copies of Windows 95, resulting in overstock with distributors,[332] as Windows 95 sold a million copies in the first four days on the market.[333]

Despite the marketing hype and overestimated initial demand, Windows 95 marked a turning point in the history of the PC. Microsoft made significant changes in its UI features and capabilities, and it was the first Windows OS for consumers that was not a DOS-based shell.[334] Priced at $100, Windows 95 brought a Macintosh-level of usability to the PC market at a more affordable scale. More crucially, it coincided with the web boom spurred by Navigator. By the fall, the press would reflect on the summer of Windows 95 as an inflection point in the tech industry and overall markets: "This summer, during the orchestrated build-up for Windows 95, Wall Street found that Microsoft is the company that drives the American financial markets as only I.B.M. and General Motors could in previous eras. The closing months of 1995 see competitors and potential competitors -- I.B.M., Apple, Lotus Development, Wordperfect, Novell -- fading back from

[330] "A Windows 95 tour is about to hit the road, but Bill Gates isn't at the wheel. Is the CB radio working?" by Anthony Ramirez, *The New York Times,* August 21, 1995.

[331] "Midnight Sales Frenzy Ushers in Windows 95," by Carey Goldberg, *The New York Times,* August 24, 1995. https://www.nytimes.com/1995/08/24/business/midnight-sales-frenzy-ushers-in-windows-95.html

[332] "The Spotlight Again Turns To Microsoft," by Lawrence M. Fisher, *The New York Times,* October 16, 1995.

[333] "Microsoft Reports a Million Sales of Windows 95," by The Associated Press, *The New York Times,* August 30, 1995.

[334] "Personal Computers: What Is Windows 95 Really Like?" by Stephen Manes, *The New York Times,* August 1, 1995.

Microsoft's businesses or bracing fatalistically for the next onslaught."[335] While the investment frenzy surrounding software firms developing applications anticipated for the Windows 95 launch, the *New York Times* observed that the Windows 95 effect was not actually a result of a massive marketing effort. "The fascination, hype and controversy surrounding Windows 95 stems largely from the fact that PC's[sic] are now ubiquitous in the workplace and are fast becoming a mainstream consumer product. The $85- billion-a-year personal computer industry is recognized as a pillar of the American economy. And as a gateway to the Internet, cyberspace and multimedia, the personal computer affects everything from how people communicate with each other to how children are educated."[336] PCs were now essential to consumers accessing something much more exciting than what computers previously offered users—the web.

Shortly before Windows 95 shipped, the Justice Department opened an inquiry on July 14, 1995, into the "forced inclusion" of MSN with the new operating system, stating, "The combination of Microsoft's monopoly power in PC-operating systems with its proposed inclusion of MSN access software in Win95 certainly qualifies as unusual."[337] It was understood at the time that Microsoft's abandoning the Intuit acquisition and the finalization in the comings weeks of the Windows 95 programming code spurred the Justice Department into action around the MSN icon.[338] Siegelman argued that Windows 95 and MSN were two distinct purchase decisions, "No one is being forced to buy Microsoft Network. We're just using the operating system as a distribution vehicle."[339] The Justice Department did not prevent Microsoft from shipping MSN

[335] "Making Microsoft Safe for Capitalism," by James Gleick, *The New York Times Magazine,* November 5, 1995.

[336] "Windows of Opportunity for Microsoft," by Steve Lohr, *The New York Times,* July 31, 1995.

[337] "U.S. Spells Out Antitrust Inquiry Into Microsoft," by Edmund L. Andrews, *The New York Times,* July 14, 1995.

[338] "Microsoft Defends Its On-Line Plans," by Steve Lohr, *The New York Times*, June 10, 1995.

[339] "Microsoft Defends Its On-Line Plans," by Steve Lohr, *The New York Times.*

with Windows 95, which by late July the press had understood may no longer be the primary driver of future revenues for Microsoft.[340] Peter Lewis of the *New York Times* summarized the potent effect of UI, "The real significance of Windows 95 is as a distribution vehicle for a simple icon, or symbol, on the computer screen. By using a computer mouse to click on the icon, the user is given the option of automatically connecting to the Microsoft Network, and from there to the global web of computers known as the Internet."[341]

Back in February 1995, Siegelman told the *New York Times* that Microsoft hoped to get at least 10 percent of the users from the MSN M8 beta program to click on the MSN icons.[342] In the summer of 1995, analysts believed that MSN would enable Microsoft to profit from every online transaction that took place within the MSN network. For industry observers, Microsoft's desire to bypass banks played a pivotal role in its internet services strategy. The *New York Times* characterized MSN's pricing model, which in late July had yet to be finalized, as the primary differentiating feature that set MSN apart from competitors like Prodigy or AOL. The article noted that MSN's pricing model was subsidized by "a small cut of each transaction on line between the customer and the service provider," allowing Microsoft to forgo charging consumers a setup fee. "Buy a shirt from Eddie Bauer or a watch from Swatch through the electronic stores on MSN, and Microsoft will get a percentage of the purchase price. Buy an article from a commercial information data base on MSN, and Microsoft gets a percentage. Bank on line, and Microsoft gets a small fee. Update an electronic encyclopedia with the latest news on Bosnia or on genetic

[340] "U.S. Won't Challenge Microsoft Network Before Its Debut," by John Markoff, *The New York Times,* August 9, 1995.

[341] "The real significance of Windows 95 is reaching the Web with a single click of the mouse," by Peter Lewis, *The New York Times,* July 31, 1995.

[342] "A Physicist Is Propelling Microsoft Into Cyberspace," by Peter H. Lewis, *The New York Times,* February 26, 1995.

research, and Microsoft adds a few virtual coins to the monthly bill."[343] Without owning Quicken, Microsoft still appeared poised to follow through on Gates' transactions fee scheme. Through an internet service that largely competed on price, the firm would instead reap fees potentially from e-commerce and a content paywall. Before Windows 95 had even shipped, the issue of the MSN icon being ever-present on the desktops of PC users became the focal point of both the Justice Department's inquiry as well as vocal criticism from rivals. In early August, Microsoft surprised the tech industry when the company did not price MSN services aggressively and would initially cap the number of subscribers at 500,000 during its first year.[344] It would soon double back on this decision[345] and by December, Microsoft added 525,000 MSN subscribers.[346]

In contrast to the heady Netscape IPO in August 1995, the lack of a coherent and articulated internet strategy finally landed at Microsoft in the form of a Goldman Sachs downgrade of Microsoft stock by removing the company from its recommended buy list on November 16, 1995.[347] Steve Ballmer, then President of Microsoft, responded swiftly by pushing Gates to schedule an event to make a comprehensive Microsoft internet strategy official.[348] For Ballmer and Gates, investing in web and internet-enabled products was not just about driving or maintain adoption of Windows 95—investor and market sentiment was also a factor. On December 7, 1995 (coincidentally the anniversary of the Pearl Harbor attack), Gates would take the stage for his

[343] "A Physicist Is Propelling Microsoft Into Cyberspace," by Peter H. Lewis, *The New York Times.*

[344] "U.S. Won't Challenge Microsoft Network Before Its Debut," by John Markoff, *The New York Times.*

[345] "Microsoft Says It Won't Cap Membership in Its On-Line Service at 500,000," by Leslie Helm, *The Los Angeles*, November 21, 1995.

[346] "Microsoft Network, Competitors Face Formidable Foe in Internet," by T.R. Reld, *The Washington Post*, December 11, 1995.

[347] Motley Fool Staff, "Fool Portfolio Report - 11/16/1995," by the Motley Fool Staff, *The Motley Fool*, November 16, 1995. https://www.fool.com/archive/foolport/1995/11/16/fool-portfolio-report-11161995.aspx.

[348] "Inside Microsoft," by Kathy Rebello, *Bloomberg.*

keynote presentation at Microsoft's internet strategy summit in Seattle and announced officially the company's pivot. Gates referred to the current internet boom as a "gold rush atmosphere" and demoed Internet Explorer 2.0.[349] As part of the "internet business model" he described, Gates singled out content as the biggest area of opportunity.[350] The announcement certainly affected Netscape's stock price, which closed $28.75 down the following day.[351] Within days of the internet summit, Microsoft moved to acquire a startup with search engine technology. Microsoft reportedly offered Excite $75 million, but the startup went public in April 1996 after Excite was counseled that they would raise more money with a public offering.[352] In January 1996, Microsoft acquired Vermeer Technologies Inc., the maker of FrontPage, a software application for creating web pages via a GUI that required no knowledge of HTML, the underlying coding language of web pages.[353] Of this seemingly sudden firm-wide change of strategy, Jeffrey Katzenberger of DreamWorks told *BusinessWeek*, "What they're doing is decisive, quick, breathtaking."[354]

In what was a strange mismanagement of public relations, Viking in the previous month had published and heavily promoted a book by Gates, for which he was paid a $2.5 million advance, that put forth a very different attitude towards the internet. *The Road Ahead* was ghostwritten; Gates shared writing credit with Nathan Myhrvold, largely acknowledged as Gates'

[349] *US v. Microsoft Corp*, 253. (Exhibit 502, p. 4).

[350] *US v. Microsoft Corp*, 253. (Exhibit 502, p. 9).

[351] "Microsoft Seeks Internet Market; Netscape Slides," by Peter H. Lewis, *The New York Times*: Microsoft Seeks the Internet; Netscape Slides," *New York Times (1923-)* (1995). https://www.nytimes.com/1995/12/08/business/microsoft-seeks-internet-market-netscape-slides.html

[352] "Inside Microsoft," by Kathy Rebello, *Bloomberg.*

[353] "Microsoft Acquires Vermeer Technologies, Inc.," *PR Newswire*, January 16, 1996. https://news.microsoft.com/1996/01/16/microsoft-acquires-vermeer-technologies-inc/

[354] "Inside Microsoft," by Kathy Rebello, Bloomberg.

most trusted futurist at Microsoft, and journalist Peter Rinearson.[355] The initial hardcover printing, as many critics and journalists later pointed out, dismissed the immediate possibilities of the internet. The subsequent paperback edition released in 1996 was rewritten to include a chapter dedicated to the internet.[356] The about face of *The Road Ahead* contributed to the narrative that with Windows 95 Microsoft was late to the internet game.

By late January 1996, the *New York Times* acknowledged that full-scale browser war between Microsoft and Netscape was well underway.[357] MSN would exceed 1 million subscribers by spring 1996.[358] Shortly after reaching this milestone, Siegelman was replaced as the head of MSN,[359] and subsequently helped Microsoft launch an online magazine venture, Slate.com.[360] By then, the industry understood that Microsoft was indeed shifting MSN from a proprietary online service to the open web. This change in strategy required hundreds of content providers—which included big names like NBC—to abandon MSN development efforts and shift to developing to web-based content.[361] But MSN's fate was marred from the start when it was formed initially as an interactive television joint venture with TCI. *Wired* magazine characterized the fixation of Gates and his company's efforts in interactive tv in the spring of 1994 as "a consensual hallucination of magnificent proportions."[362] Interactive television efforts at Microsoft would be

[355] "Viking rolls out the big guns to promote Gates's book," Mary B.W. Tabor *The New York Times*, November 20, 1995.

[356] "Skeptics Cite Overload of Useless Information: Internet Arrives At a Crossroads," by Sharon Reier, *The New York Times,* March 14, 1997.

[357] "A Clash of Titanic Web Browsers," by Peter H. Lewis, *The New York Times,* January 30, 1996.

[358] MSN Hits 1 Million Member Mark," *Microsoft Interactive Daily,* March 25, 1996. /

[359] "Microsoft Announces Laura Jennings Named Vice President of MSN; Russell Siegelman to Assume New Responsibilities," *PR Newswire,* April 4, 1996.

[360] "Microsoft's E-Mail Chief To Head MSN," by Michele Matassa Flores, *The Seattle Times,* April 13, 1996.

[361] "New Leader at Helm of the Microsoft Network," by Peter H. Lewis, *The New York Times,* April 15, 1996.

[362] "Microsoft Morphs into a Media Company," by Denise Caruso, *Wired,* June 1, 1996.

closed down in March 1996, and TCI withdrew its $125 million investment in the original venture known as MSN in November 1996.[363] Myhrvold, then head of Applications and Content, told *Wired*, "Yes, we are becoming a media company."[364] As *Wired* described, "This model is a counterculture move for Microsoft, which is being forced to do something it has never had to do before: act like a broadcaster and fill its channel with interactive media that it believes will drive consumers to the MSN channel. (This "channel" strategy, by the way, becomes a movable feast in the context of both Internet via cable modem and interactive television, should either ever materialize.)"[365] Throughout Siegelman's time leading the Marvel project, MSN continued to be plagued by the lack of internal consensus over the service's positioning in the market. Even as the popularity of Navigator and the web continued to change the internet landscape, internal problems at Microsoft contributed more significantly to sealing MSN's fate than competition with Netscape did.

Microsoft announced in April 1996 that beginning the following month, MSN News, its news content aggregator service, would shift to the open web, making its content free without charging for a subscription.[366] Though MSN signed up over a million subscribers in the first seven months of service, the figure paled in comparison to the 15 million web users in North America. When Siegelman's departure from Microsoft was announced in July, the *Seattle Times* observed that Siegelman had been given an impossible task as the nature of internet access was changing rapidly, "What is known is that Siegelman sat in a hot seat during at least the past two years, trying to head MSN as a private online service during a time when the company - and the world - was

[363] "TCI Takes Back $125 Million Stake In Microsoft Network as Strategies Shift," by Mark Robichaux, *The Wall Street Journal*, November 15, 1996.

[364] "Microsoft Morphs into a Media Company," by Denise Caruso, *Wired.*

[365] "Microsoft Morphs into a Media Company," by Denise Caruso, *Wired*

[366] "Microsoft Offering News Without Charge on Internet," by Peter H. Lewis, *The New York Times*, April 30, 1996.

directing itself more toward the global, largely free Internet computer network. Microsoft recently began switching much of MSN's content toward the Internet and giving it away for free, abandoning many of the partners who had signed on to provide information for the private service for a fee."[367] The way that PC users relied on browsers to access the web became an undeniable and lasting trend that Microsoft could not afford to ignore. In responding to the web boom, Microsoft focused much of its efforts on achieving greater market share for Internet Explorer. This conflict is noted in the *Court's Findings of Fact* regarding the ambivalence over its MSN strategy that figured into how Microsoft approached ISPs to privilege Internet Explorer in product bundling practices.

> One of the proposals the executives put forward was that Microsoft "Open Up the Windows Box." In other words, the executives believed that, in exchange for favorable treatment of Internet Explorer, Microsoft should include the client software of IAPs in Windows and give those services prominent placement on the desktop, even if such placement drew attention away from MSN. Over the months that followed, senior Microsoft executives came to the conclusion that opening up the Windows box to MSN's competitors was a necessary price to pay for increasing Internet Explorer's share of browser usage.[368]

This resulted in the first significant move to de-privilege MSN: in March, Microsoft partnered with AOL to place the ISP's icon in Windows 95. Of the decisive shift in strategy, Intel CEO Andrew Grove told *BusinessWeek*, "That was a masterpiece of pragmatic business attitude."[369] By

[367] "Microsoft Vice President Packs His Bags-- Siegelman To Join Pre- Eminent High-Tech Venture-Capital Firm," by Michele Matassa Flores, *The Seattle Times,* July 9, 1996.

[368] *Findings of fact: US v. Microsoft Corp* (C.A. 98-1232). *State of New York, ex rel. Eliot Spitzer, el al., v. Microsoft Corp* (C.A. 98-1233). See findings 135-136.

[369] "Inside Microsoft," by Kathy Rebello, *Bloomberg.*

December 1996, MSN moved onto the web, but behind a paywall. *American Banker* noted that MSN had not yet established "a separate banking center" as previously anticipated.[370]

### *The Rapid Browser Innovation Years (1996-1998)*

In 1996, Netscape capitalized on its early mover dominance in the browser market, promoting its products for e-commerce and furthering its partnerships with Microsoft's rivals. On April 30, 1996 Netscape adopted the QuickTime plug-in for Navigator 3.0 as browsers became more multimedia content-driven, thereby allowing audio and video integration.[371] In response to the security-related headlines it made in 1995 (see Chapter 6), Netscape made a significant push on that front in 1996, offering a $1000 "bugs bounty" to programmers who were able to locate security flaws.[372] Calling out the enhanced security technology of Netscape's e-commerce server technology, a May 29 press release regarding the Home Shopping Network's choice of using Netscape for its internet shopping subsidiary touted the "inherent encryption capabilities" of Netscape software.[373] Netscape would also highlight later in the year the e-commerce outlet of REI, which used Netscape's server software.[374] On June 17, Netscape announced SSL 3.0, providing a list of clients adopting the technology: "Among the companies supporting the SSL 3.0

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[370] "Don't bet against Microsoft, despite clumsy start," *American Banker,* December 9, 1996.

[371] "Apple and Netscape Collaborate to Increase and Enhance Multimedia Content on the Internet, " *PR Newswire,* April 30, 1996.
https://web.archive.org/web/20030416231531/http://wp.netscape.com/newsref/pr/newsrelease134.html.

[372] "New Netscape Software Flaw Is Discovered, by John Markoff, *The New York Times,* May 18, 1996.

[373] "Internet Shopping Network, Leading Online Retailer, Uses Netscape Servers to Offer Easy Access to Products," *PR Newswire,* May 29. 1996.
https://web.archive.org/web/20030214005622/http://wp.netscape.com/newsref/pr/newsrelease153.html.

[374] "REI Launches New Online Store Based on Netscape Software," *PR Newswire,* September 10, 1996.
https://web.archive.org/web/20030623202452/http://wp.netscape.com/newsref/pr/newsrelease234.html.

open protocol for Internet security are @Home Network, Citibank, First Data Corporation, Hypercom, Inc., IBM, Intuit, Inc., KeyWitness Canada, Inc., Lockheed Martin Federal Systems, Motorola Government and Space Technology Group, Northern Telecom (Nortel) Secure Networks, Novell, Inc., Premenos Corp., Security First Network Bank, Siemens Nixdorf, Silicon Graphics, Inc., Sun Microsystems, Inc., and Verisign, Inc."[375] Further enhancing its reputation in encryption technologies, Netscape announces on July 8 that the company was now working with the public sector through the technology arm of the DoD, the Defense Information Systems Agency (DISA), which was using Netscape for its military intranets.[376] Netscape appeared to be in the right time and place with the necessary partnerships to capitalize on an e-commerce boom.

On June 19, 1996, Navigator reached a crucial milestone: an installed base of more than 38 million users. Netscape announced, as a result, that its browser had become "the world's most popular personal computer application."[377] Netscape took the fight to Microsoft with a press release reading, "Netscape Navigator - which has been shipping commercially for just 18 months - has already exceeded the installed base of the most popular PC applications, many of which have been in the market for more than ten years. Recently published figures from Microsoft put the installed base of Microsoft Office users at 22 million, Microsoft Excel at 30 million and Microsoft Word at 21 million." Gates, in an interview with the *Financial Times*, hit back, saying, "just because the Internet is out there, it does not mean that people will throw away their

[375] "Netscape Announces Availability of Secure Sockets Layer 3.0 Software Development Toolkit," *PR Newswire*, June 17, 1996.
https://web.archive.org/web/20030213161822/http://wp.netscape.com/newsref/pr/newsrelease167.html.

[376] "Defense Information Systems Agency to Use Netscape Software with Information Infrastructure Programs," *PR Newswire*, July 8, 1996.
https://web.archive.org/web/20030416194157/http://wp.netscape.com/newsref/pr/newsrelease183.html.

[377] "Netscape Navigator Surpasses 38 Million Users to Become the World's Most Popular PC Application," *PR Newswire*, June 19, 1996.
https://web.archive.org/web/20030204151714/http://wp.netscape.com/newsref/pr/newsrelease170.html.

applications."[378] The browser war quickly intensified thereafter. During August 1996, Netscape announced a slew of deals expanding its browser reach in terms of both content and future functionalities. The race for partnerships with Internet Content Providers (ICPs) heated up as Netscape signed deals with 26 content providers, including the New York Times and Sony Music. Microsoft signed with the likes of the Wall Street Journal, MTV Online, and ESPNet Sports Zone.[379] Netscape acquired Navio Communications, a software company focused on bringing internet technologies to non-PC products.[380] Apple and Netscape announced on August 27 that Netscape would develop a new version of Navigator for Cyberdog, Apple's internet suite.[381] The following day, IBM and Netscape announced the development of a native OS/2 speech-enabled version of Navigator.[382]

In August 1996, Netscape also formally sought Justice Department inquiry into Microsoft's behavior in the market.[383] In doing so, Netscape joined the ranks of Sun and Novell in lobbying the federal government to take formal action against Microsoft. In mid-October 1996, Netscape adopted Microsoft's own internet strategy language in describing Netscape's strategy going

[378] "A Rush for market dominance," in the *Financial Times,* July 3, 1996. Designated as exhibit 83 in *US v. Microsoft Corp.*

[379] "Netscape Moves To Raise Stakes In Browser War," by Peter H. Lewis, *The New York Times,* August 18, 1996. l

[380] "Netscape Announces Navio Communications, Inc. to Extend Power of the Internet to Consumer and Non-PC Devices," *PR Newswire,* August 26, 1996.
https://web.archive.org/web/20021207003723/http://wp.netscape.com/newsref/pr/newsrelease221.html.

[381] "Netscape and Apple Announce Plans to Develop Netscape Navigator for Apple's Cyberdog," *PR Newswire,* August 27, 1996.
https://web.archive.org/web/20030416230710/http://wp.netscape.com/newsref/pr/newsrelease222.html.

[382] "Netscape and IBM announce development of native OS/2 version of Netscape Navigator," *Business Wire,* August 28, 1996.
https://web.archive.org/web/20030416150544/http://wp.netscape.com/newsref/pr/newsrelease224.html.

[383] "Netscape Seeks Microsoft Inquiry," by The Associated Press, *The New York Times,* August 21, 1996.

forward to “embrace and integrate” Microsoft platforms and technologies.[384] Netscape would further escalate the rivalry by making public that Microsoft had sought a stake in Netscape and a seat on Netscape’s board in return for API code for Windows 95.[385]

By 1998, Netscape and Microsoft both boasted feature-laden browsers. In this short span of time, the two companies advanced the build and functionality of webpages, changing how end users could consume and publish content on the web. These innovations in web features contributed directly to how the web looks today. Netscape also quietly gave the world built-in tracking cookies with its first browser in 1994. Both Navigator and Internet Explorer established the ever-present features of today’s web experience, including plug-ins, built-in messaging, video and audio streaming, and POP3 mail server protocols. The rapid innovation years that saw constant one-upmanship between Netscape and Microsoft with each release of their respective browsers gave users an increasingly appealing, entertaining, and dynamic web experience. While the innovations in browser technology remain the remarkable, lasting legacy of this rivalry, it is what both firms failed to accomplish that defines the outcome of the Browser Wars. As Microsoft headed to trial in 1998 and Netscape continued to suffer a slow demise, neither firm ever came close to delivering an in-browser answer to Error 402.

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[384] “Netscape Announces Comprehensive Strategy to 'Embrace and Integrate' Microsoft Platforms and Technology,” *PR Newswire*, October 15, 1996. https://web.archive.org/web/20030204071800/http://wp.netscape.com/newsref/pr/newsrelease267.html.

[385] “Netscape Says Microsoft Sought 20% Stake,” by Reuters, *The New York Times*, September 28, 1995. https://www.nytimes.com/1995/09/28/business/netscape-says-microsoft-sought-20-stake.html.

## Chapter 6 – The Transaction Wars and Digital Currency

*The Transaction Wars: Overview—Signal Innovation Theory Application—E-Money: Smart Cards—E-Money: Digital Currency, Wallets, and Micropayments—SET and Securing Transactions—The Promise of Home Banking Software—Online Banking and Bill Payments Converge—E-Money: Cashless and Bankrupt*

*The Transactions Wars: Overview (1994-1998)*

On August 12, 1994, the *New York Times* declared the internet open for shopping when the first known e-commerce order was placed on Net Market Company, an online marketplace headquartered in New Hampshire that was accessible through Mosaic for Unix users. Net Market Company utilized a data encryption program known as PGP (for "Pretty Good Privacy") based on RSA's security algorithms. The article noted that the greatest challenge to growing e-commerce in 1994 was the attitude of consumers and merchants towards security and privacy: "Alarmed by increasing reports of security breaches on the Internet, many people and businesses are reluctant to transmit sensitive information, including credit cards numbers, sales information or private electronic mail messages, on the network."[386] Before Netscape released its first browser, consumer trust was already an obstacle in the growth of emerging e-commerce.

Nonetheless, it was the promise of a new, booming market in commerce on the web that drove the Transactions War from 1994 into the new millennium. This belief was not just held by the tech futurist entrepreneurs coding browsers and other applications. Executives at companies like Mastercard believed in the hype, too, despite struggling to focus on a payments solution geared for shopping on the web. For some, it was a simple conversion: with merchant server software like those offered by Netscape and Microsoft, retailers would transform the $65 billion catalog-shopping industry into the online shopping industry. Micropayments for infinitely available digital goods and a physical goods market supported by catalog-business scale "superdistribution" would surely enable digital payments to take off.[387] In 1996, a Wells Fargo executive proclaimed to the *Wall Street Journal*, "A whole new series of markets will be opening up." Edward Hogan of

[386] "Attention Shoppers: Internet Is Open," by Peter H. Lewis, *The New York Times*, August 12, 1994.

[387] "E-Money's Pioneers Have Found Cyberspace an Unforgiving Land," by Don Sussis, *The Wall Street Journal*, August 9, 1997.

Mastercard claimed that by the year 2000 electronic cash "will be a multibillion-dollar market."[388] By late 1997, the financial press acknowledged the struggling digital payments startups DigiCash and CyberCash as "a reflection of the immaturity of the market for information and goods that lend themselves to micropayments-transactions of a few dollars to a few cents, which would be uneconomical for credit cards."[389]

Between 1994 and 1998, the war over the future of online financial transactions would go hand in hand with Netscape and Microsoft's race to set standards for the web. Several factors complicated and delayed the setting of a single global online security standard for retail transactions, which in turn delayed the growth of e-commerce. Nearly every tech firm involved in this space—from Netscape and Microsoft to payments startups like Cybercash and hardware companies like Verifone—underestimated the difficulty in getting not only both Visa and Mastercard on board, but also banks, which as an industry preferred to keep Microsoft at arm's length. Eventually Visa and Mastercard would adopt the same standard, ultimately set by Microsoft, which Netscape and other key players would also endorse. But in 1996 Congress held hearings to address the Future of Money, and banks would band together to lobby against Microsoft in both the issue of security standards and changes in US regulations concerning encryption programs, which remained under the umbrella of weapons technology and thereby was a national security concern. The tone and momentum of this rush to capture the future market of digital payments would shift dramatically in 1995 with the rapid adoption of the web through Navigator.

[388] "Will Digital Money Replace The Nation's Credit Cards?" by Neal Templin, *The Wall Street Journal,* June 17, 1996.

[389] "Digicash Eager to Reap Latent Ecash Harvest," *American Banker,* December 11, 1997.

When evaluating the business considerations that drove the rapid innovation of browser technology during these years, the disparity of Netscape and Microsoft's understanding of healthy revenue models is striking. Microsoft would spend years chasing the holy grail of transactions fees, only to lose steam as the antitrust trial took its toll on the company's reputation and focus. While Microsoft made a decisive pivot in 1995 to an internet-first business and product strategy, Netscape failed to pivot each time a major loss was conceded to Microsoft. Netscape recognized when it had fallen behind the likes of Cybercash and Checkfree in the field of transactions security, and would exit the playing field early, but the company never moved beyond the same lineup of products it started out with in 1995.

The narrative set in motion by Bill Gates' 1994 dinosaur quote about usurping banks plagued his firm's efforts in setting the standard for web-based e-commerce transactions, home banking software-based transactions, and online bill payments. Antagonizing the banking industry resulted in challenges working with Visa and Mastercard, both controlled at the board level by their member banks. Digital payments startups suffered the collateral damage from this industry-wide distrust of Microsoft's intentions, which banks extended to nearly all tech firms. Concurrently, banks and credit card companies faced increasingly pressure to invest in cashless electronic solutions like open system stored value cards, or smart cards, as their use became widespread in Europe and Asia. The smart card narrative coincided with an encryption security narrative, and payments companies and tech firms alike suffered a yearslong feedback loop where all parties involved were convinced of the eventual widespread adoption of smart cards to replace cash currency. This was a largely irrational view that did not take into consideration the possibility that credit card companies would eventually lower transaction fees, making it easier for merchants

to accept credit card payment for purchases under ten dollars. In fact, credit card companies had decided a decade prior to not invest in smart card technology as it was a cost prohibitive enterprise.

As the cashless society narrative took hold of the public imagination (as it had done decades prior), the concept of "e-money" gave rise to CyberCash, which specialized in an online electronic wallet product, and DigiCash, the digital currency innovation created by an encryption expert. While CyberCash tried to advance the concept of pure electronic payments and DigiCash promised privacy and anonymity, both startups ultimately tried to deliver products that consumers simply did not need at the time. Though the web was indeed growing in popularity and webpages were becoming more dynamic, the end user did not need more than a credit card to buy a book from Amazon.com.

In the tussle over setting a single security protocol for online transactions, Microsoft would succeed in convincing banks and credit card companies to adopt its SET protocol. Netscape would quickly abandon its own SSL-based protocol and endorse SET. However, in the process of gaining territory to realize Microsoft's transactions fees ambitions, the company would fail to reconcile what it was quickly succeeding with on the browser innovation front: user interface. It would take years before a tech company would provide the best of both worlds: a secured solution that allowed banks and credit card companies to collect their own transactions fees while offering consumers the safety of mind as well as options for payment (credit and debit). It would also require a platform (eBay) with a built-in audience that needed such a payments aggregator (PayPal) to use it widely.

The fight over owning the standard for e-commerce transactions would take place alongside the primary rivalry between banks and Microsoft over the future of electronic retail banking transactions. What started with the 1994 dinosaur quote and Microsoft's aborted acquisition of Intuit would morph into a war over whether and how banks would agree to allow

consumers to perform transactions within home banking software. The web boom would push this fight into the online banking space, where Microsoft would continue to simultaneously fight and cajole financial institutions into adopting a single standard for securing online bill payments. Home banking would become more or less obsolete while online banking and online bill payments would converge into a single issue. As it headed to its antitrust trial, Microsoft would concede ground to Checkfree, finally bowing out of the Transactions Wars.

### *Signal Innovation Theory Application – Transaction Wars Assessment*

The web-based technology products and the motivations driving the actors in the battle over online transactions reveal several identifying conditions classifying the web as a signal innovation. New web-based payment products and systems unlocked the usability and value of the internet, which unlocked consumer-relevance and competitiveness of web-based products and services. These new products and systems, with their focus on retail banking and retail shopping transactions, unlocked the broader business economic potential of the internet. Narratives surrounding the impact of these products and services proliferated, further driving investment interest in web or internet-centric products. Incumbent institutions like banks invested in the productization of web services in retail banking. Technology firms both large and small placed their bets on the ecommerce boom they believed would soon materialize.

*Table 6.1 – Signal Innovation – Foundational Principles – Transaction Wars*

| Condition | Evidence |
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| 1. **Evolve emerging technology.** Build upon and advance the evolution of a more fundamental technology later characterized as general-purpose. | • DigiCash was founded in 1989 by American cryptographer David Chaum, a co-founder of the International Association for Cyptologic Research (IACR). Headquartered in Amsterdam, the company's goal was to introduce "anonymous digital money technology" to the world. In 1982, Chaum published a paper titled "Blind Signatures for Untraceable Payments." As the PC revolution took off, Chaum began to formalize a framework for and the technology supporting electronic cash, or digital currency, that most resembled the convenience and anonymity of cash. A decade later, in an article in *Scientific American*, Chaum detailed the protocol and scenarios of a new anonymous digital payment system based on the concept of blind signatures. He subsequently demonstrated DigiCash technology integrated with Mosaic during his keynote address at the inaugural W3 conference in Geneva in May 1994. This was the first demo of payments over the internet. The DigiCash user interface featured drag-and-drop icons representing coins and receipts and was available for Windows, Macintosh, and UNIX. In October |

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| | 1994, DigiCash debuted its international electronic cash system through a trial with one million "cyber bucks" for several hundred volunteers. The company would also work with Mastercard in developing new technology allowing for low-cost chips to meet the security requirements for smart cards. Yet, DigiCash's flagship digital currency boasted low-cost technical requirements for implementing on a wider scale, especially when compared to smart cards. In 1995, DigiCash supported an Ecash trial size of 10,000 individuals running on a mere "486 machine"—a computer powered by the predecessor to the original Intel Pentium microprocessor. |
| 2. **Accelerate user adoption.** Accelerate the adoption and diffusion of said underlying general-purpose technology. | • By spring of 1995, the world had caught on to the web via Netscape Navigator. In March 1995, Netscape appeared to have settled on a tried-and-true business model of giving away the razor to sell the blades. Navigator ultimately became a free browser product while Netscape's commercial servers went for $1500 to $5000, with companies operating websites purchasing around 20 or more copies of the software. Navigator was not only fast becoming the world's browser of choice, but its makers were successfully converting rapid user adoption into enterprise |

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| | technology sales clout. By April 1995, *American Banker* reported that the issue of the web had become a source of a booming consulting business targeted at financial services firms and that at least 100 commercial banks and financial service providers had established their web domains – and that those websites would be used to offer consumers banking services. Overarching sentiment, however, was still one of skepticism towards security claims made by digital payment startups and Netscape.<br>• The rush towards home banking made many headlines in highlighting the uneasy relationship banks had with technology companies. On the consumer payments front, by the end of 1994 there were several players and alliances formed to tackle the business of internet-based financial transactions that were seen as bank or credit card company-friendly. In other words, these companies and partnerships were strategically positioned as counterweights to the encroachment of Microsoft, whose proposed merger with Intuit was ill-received by the financial services community. |
| **3. Catalyze innovation ecosystems.** Catalyze the growth of an economic ecosystem around the general-purpose technology. | • Steven Levy's *Wired* article also covered the biggest players in the burgeoning e-money (which included currency in electronic form stored on smart cards as well as novel digital |

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| | currencies) and payments space at the time. This included DigiCash, CyberCash, Mondex, Microsoft, and Visa. Though each had its own cryptographic security solution (or criticism or questions of the security guarantees of its competitors), there was a philosophical divide between these companies.<br>• For some, the digitization of money went hand in hand with privacy (meaning transactions must be anonymous) while for others traceability meant a revenue stream from internet-based financial transactions. Levy wrote, "As a result of this mad rush, the road to digital cash was not so much a smooth transitional path but a multi-lane cloverleaf with infuriating turnoffs, circles, and dead ends." The article also discussed key questions from a privately circulated paper by Kawaika Daguio of the American Bankers Association, most importantly, what constituted monetary value (Eric Hughes, co-founder of the Cypherpunks mailing list, was of the opinion that a universally trusted digital currency system can float on its own momentum) and who would regulate electronic money (at that time, the answer was no one). By 1996, the technology necessary was in place for an e-commerce boom—consumers were indeed beneficiaries |

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| | of the rapid innovation in browser technology as well as considered and sophisticated encryption solutions for payments and digital currency. But trust was an issue with both consumers and merchants and, most importantly, banks refused to fully endorse the security claims of tech firms. Two payments startups attempted to address the issues of privacy and security with cutting edge technology, but never managed to overcome the Sisyphean challenge of winning trust: DigiCash and CyberCash. |
| 4. **Intermediate with technology forerunners.** Function as an abstract or concrete technological intermediary between it and the general-purpose technology. | • The advent of digital currency offerings from Digicash and Cybercash further complicated transactions standards for the web. To solve the thorny issue of interoperability of payment systems and providing a single interface for payment on the web, another consortium was formed in December 1995. This time, an international group of academics and industry engineers came together as the Joint Electronic Payments Initiative (JEPI), the result of collaboration between the W3C and CommerceNet. JEPI's goal was to reach a common payment mechanism, where the consumer would choose a default payment system, and test it. In other words, JEPI attempted to create a single payments interface to bypass the issue |

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| | of interoperability in browsers. On October 15, 1996, the W3C and CommerceNet jointly announce the JEPI specifications. Berners-Lee was quoted in the press release, "One of the major ingredients needed for Web commerce is the ability for different payment instruments and protocols to exchange information. We are enthusiastic about JEPI because it effectively addresses this need." JEPI's approach to unifying various payment methods was to ask browser, server, and payment vendors to incorporate the JEPI protocol into their products. |
| **5. Enhance user experience.** Unlock the usability or value of a general-purpose technology through an enhanced user experience (i.e., usability). | • In 1999, Microsoft, IBM, Sun, Compaq, AOL, Mastercard, Visa, and American Express attempted to revive the digital wallets business model, creating a unified wallet interface (essentially a form) called the Electronic Commerce Modeling Language (ECML). Amazon.com, whose 1-Click system contributed to the company's success, did not back ECML. An executive from the company explained to the *New York Times*, "'Wallets are good for the merchants, banks and wallet companies pushing them. But it's not clear what's in it for the consumer." Interestingly, of the dotcom era successes, Amazon.com's leadership appeared to have paid close attention |

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| | to the needs and behaviors of its customers. The online bookseller relied on in-browser SSL security, sidestepping the Transactions Wars, even as it played in the data-light but hype-rich e-commerce space. The death knell for both stored value wallets and digital currency came as early as 1998.<br>• The *New York Times* reported in late November 1998 that digital cash systems have largely failed, and a spokesman for Amazon.com said that "the overwhelming majority" of transactions on Amazon were credit card transactions secured through SSL. A former Visa executive-turned-Silicon Valley venture capitalist explained to the *Times*, "There's no market where pay per use is significant." The following month, the *Times* reported that the market has realized that the holy grail "tollbooth" for online transactions was, in fact, the credit card. "In recent weeks, credit-card companies have appeared to awaken to the reality that second only to plastic, the Internet is the best thing that ever happened to the industry." The introduction of the American Express chip-embedded credit card in 1999 furthered this narrative. |
| **6. Drive market growth.** Unlock the financial, commercial, or broader business economic potential of the general-purpose technology. | • The rise of the web after the early success of the Mosaic browser renewed a former debate over the |

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| | future of money, specifically that of cash. As the variety of activities and goods to purchase online increased, the world began to consider what money was electronically. Wholesale transactions had long moved to electronic transactions, but the concept of money existing and being transacted digitally at the retail level for consumers spurred speculation that technology may eventually win out. An article titled "E-Money" by Steven Levy in the December 1994 issue of *Wired* magazine detailed the contemporary debate on the future of money, specifically digital currency, from the perspectives of both financial services firms and technology companies like Microsoft. On the eve of the internet boom, electronic money meant a likely future of smart cards in a world where point-of-sales systems were largely seen as inadequately guarded against fraud and the advent of color copiers would lead to an increase in counterfeit cash. In 1994, the various answers to how the internet and related technology would replace cash had yet to take into account what was possible through the web.<br>• Netscape, on the other hand, continued to push its server software to financial services clients, making several announcements that it had won over prominent financial services |

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| | institutions. On July 23, Netscape announced that the Bank of America was using Netscape server software for its Internet HomeBanking website (the bank offered its online banking services via the website, AOL, or the bank's customized version of the Managing Your Money software). In mid-August, Netscape announced that Countrywide Home Loans, the largest US independent mortgage lender at the time, was developing "the mortgage industry's most sophisticated Internet systems" on Netscape server and client software. While retail banks in the United States began to invest in online banking services, the *Wall Street Journal* would note 1996 as the year Europe made significant achievements in internet banking as American banks continued to lag in progress. The problem of retail adoption in the US was characterized as a technical literacy issue; retail banking customers in the US were still accustomed to writing checks and conducting business in a branch office. Germany's Deutsche Telekom provided more than 1.8 million home banking users a service called T-Online, while 30% of households in France use France Telecom's Minitel. Conversely, Intuit and Microsoft had capitalized on the intuition that European companies would seek to |

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| | move to all-electronic accounting and secured enterprise agreements with "every major bank in Europe." |
| **7. Unlock new value.** Unlock the consumer-relevance and value competitiveness of the general-purpose technology. | • On December 12, 1994, CyberCash partnered with Wells Fargo to develop secure payment services for the internet, with plans to pilot the service in the first quarter of 1995. At the time, CyberCash was reportedly in talks to license transaction encryption technology from another firm—DigiCash. In May 1995, CyberCash became the first electronic payment developer to gain export approval from the US government of its encryption technology. It also joined forces with Sun Microsystems to promote e-commerce and electronic payments. Consumers could pay via CyberCash's service through a CyberCash pay button on participating merchant websites.<br>• Around the same time, CyberCash began announcing a succession of partnerships with financial institutions, starting with First of Omaha. American Heritage BankCard, U.S. Bancorp, and Mellon Bank Corp. became early CyberCash partners. In July 1995, Checkfree Corp. would license CyberCash's encryption technology for Checkfree Wallet micropayments online in a partnership that would allow both companies' technologies to be bundled with |

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| | browsers. Verifone would make an equity investment in CyberCash in August 1995. By late January 1996, CyberCash secured relationships with more than a dozen financial institutions. It also announced a partnership with Verisign to offer a digital identification coding system as part of its CyberCash wallet product. The following month, Softbank bought a 9.9 percent stake of the company for $15.2 million. CyberCash went public, selling two million shares priced at $17 per share with the price hitting above $30. *Wired* dubbed early 1996 as "Phase Two" of the Internet IPO frenzy, this time with payments processing firms on the top of investors' minds. Through early December 1996, 56 internet-related businesses had gone public, triple the number in 1995. |
| **8. Inspire new narratives.** Build upon existing or inspire new economic or innovation narratives surrounding the general-purpose technology. | • On February 16, 2000, CheckFree announced its acquisition of TransPoint in $1 billion in stock. The deal marked Microsoft's exit from the online bill payments business after a dogged five years chasing the holy grail of owning the standards and profiting from transaction fees. The merger also signaled a market that was not yet ready to sustain multiple competitors. The *Wall Street Journal* reported that online bill payments was seen as "a potential blockbuster |

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| | product of the online financial services industry," but neither billers nor customers seemed to actually see the need for such a service. Furthermore, billers and customers continued to question the security of such online services. In 2000, the online billing business failed to gain traction because, once again, consumers had yet to feel the need for paying bills online.<br>• As with home banking, retail customers continued their analog practices of writing checks and going to bank branches. TransPoint would widely market its billing services in March 2000 through in-flight video presentations on United Airlines, TWA, and US Airways. A Goldman Sachs report in June 2000 described electronic bill payment and presentment (EBPP) as "still in its infancy." The failure of Transpoint was seen as a contributing factor in the reluctance of banks to invest heavily and urgently in EBPP technologies. In May 2001, Intuit exited the bill payment space entirely, selling its front-end bill payment software Quicken Bill Manager to Princeton eCom, a CheckFree competitor. Though home banking, online banking, and online bill payment services had finally converged, the tech industry's prediction of the market potential of these services |

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| | failed to come to fruition. The end of the Millennium Boom in spring of 2001 would also mark the end of the run of blind confidence in the narrative of internet services. |

*Table 6.2 – Signal Innovation – Pre-Incident Indicators – Transaction Wars*

| **Condition** | **Evidence** |
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| 1. **Underutilized disruptive technology.** A significant, disruptive, but niche technological artifact or development limited by technical complexity, usability and interfacing capabilities, and product and service use case application. *This the fundamental technology that has the potential to emerge as general-purpose, which often has existed for some time but never achieved general-purpose "escape velocity."* | • While credit cards became increasingly popular, small businesses generally did not accept credit cards for smaller value purchases due to high merchant fees. Governments and financial services firms globally were looking to pilot open system stored value or prepaid cards enhanced with a microchip (smart cards), giving consumers "electronic purses" to pay for smaller transactions (micropayments) like highway tolls and fast food. Open system smart cards meant that a network of merchants and vending machines would accept smart card payment, while a closed system limits payment to a closed network, like a university where smart cards are used for on-campus dining and other services.<br>• The technology for such cards had by then been around for a decade, held back by the relative high cost to produce prepaid cards and the need for merchants to purchase card readers in |

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| | order to encourage user adoption. In late 1994, prepaid cards were no longer cost prohibitive to buy and reload (consumer side), or to accept as payment (merchant side). That the future of consumer payment methods would be one of both prepaid cards and credit cards seemed a foregone conclusion in the media narrative. The question was not whether consumers would come to use smart cards, but rather who had the best software (in the form of encryption technology) and hardware (for re-loading money) to dominate the market. |
| **2. Competitive innovation ecosystem.** An emerging and highly rivalrous series of complementary technical innovations, built upon said artifact and demarcating a new market ecosystem of no clear winners and aggressive competition. *These are the innovations advancing the fundamental technology and competing for signal innovation status, drawing focus to the underutilized disruptive technology*. | • Steven Levy's *Wired* article also covered the biggest players in the burgeoning e-money (which included currency in electronic form stored on smart cards as well as novel digital currencies) and payments space at the time. This included DigiCash, CyberCash, Mondex, Microsoft, and Visa. Though each had its own cryptographic security solution (or criticism or questions of the security guarantees of its competitors), there was a philosophical divide between these companies. For some, the digitization of money went hand in hand with privacy (meaning transactions must be anonymous) while for others traceability meant a revenue stream from internet-based financial transactions. Levy wrote, |

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| | "As a result of this mad rush, the road to digital cash was not so much a smooth transitional path but a multi-lane cloverleaf with infuriating turnoffs, circles, and dead ends."<br>• The article also discussed key questions from a privately circulated paper by Kawaika Daguio of the American Bankers Association, most importantly, what constituted monetary value (Eric Hughes, co-founder of the Cypherpunks mailing list, was of the opinion that a universally trusted digital currency system can float on its own momentum) and who would regulate electronic money (at that time, the answer was no one). By 1996, the technology necessary was in place for an e-commerce boom—consumers were indeed beneficiaries of the rapid innovation in browser technology as well as considered and sophisticated encryption solutions for payments and digital currency. But trust was an issue with both consumers and merchants and, most importantly, banks refused to fully endorse the security claims of tech firms. Two payments startups attempted to address the issues of privacy and security with cutting edge technology, but never managed to overcome the Sisyphean challenge of winning trust: DigiCash and CyberCash |

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| **3. Compelling narratives.** An explosion of economic narratives surrounding said technical market ecosystem, covered more favorably in new media outlets, less favorably in established media outlets, and inspiring new terms and new uses of existing terms. *This circulation of narratives around a singular disruptive technology, amplified by the influx of technical innovations, suggests a higher probability of a signal innovation-general-purpose technology pairing.* | • At the same time Microsoft executives tried to formulate a strategy for partnering with Netscape in spring and early summer of 1995, Microsoft reentered the fray with the financial services community since its aborted merger with Intuit. On June 12, 1995, Microsoft announced that it planned to launch in the next year smart cards, plastic cards with embedded microchips that would operate as a store of cash. Warren Dent, the director of business development for Microsoft's consumer systems division indicated that Microsoft may first test the chip technology with its employees before offering it publicly. In early June at a meeting with top executives of the world's largest banks, Gates reportedly clarified his "banks are dinosaurs" misquote and indicated that to develop these smart cards Microsoft would work with banks. Gates is quoted as saying, "In no way will we be competition to banks in what we're doing… We're coming up with ways for banks to use our technology. We will never be in the business of doing what banks do." In June 1995, the prevailing attitude of banks and credit card companies towards Microsoft was that the financial services industry did not feel the pressure of working with Microsoft the way others in the technology industry did. Though |

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| | Microsoft announced its plans to develop smart card technology, the company would not formally launch a smart card product until 1999.<br>• An industry executive told *American Banker*, "Banks seem to be very interested in delivering services to cell phones and personal digital assistants… Stock trading is one of the applications driving this." This reflects the thinking brought on by one of the driving forces of the millennium bubble—the stock market as casino. Microsoft would announce its Smart Card Toolkit at COMDEX/Fall '99. In April 1999, David Anastasi, a US West executive in Seattle who recently took on the full-time role as CEO of the Global Chipcard Alliance, told *American Banker* that one of the ways he gauged smart card progress in the market was by the number of press releases. "Three and a half years ago when I started getting involved in smart cards, you'd see one press announcement about them a week… Now there are three to five a day from companies getting together and partnering. That in itself demonstrates that people believe in the technology and capabilities of it." That the entire tech industry remained convinced that their prediction of the future was more accurate than the failed real world pilot programs sponsored by banks demonstrates the industry's capacity |

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| | for the kind of magical thinking feedback loop. Banks had no consumer behavior data to base their decisions on prior to the pilot programs, and when adoption rates indicated that smart cards were not the future, banks abandoned the costly project. |
| **4. Incumbent investment.** Major investment by incumbent institutions into the productization of a technical innovation, unlocking the business economics and user experience factors of a more fundamental technology, often in competition with smaller, disruptive entrants. *Investment activity by large and established market incumbents drives additional focus and increases market speculation.* | • By 1997, the challenges of various digital payments systems in the market were apparent and customers shopping online overwhelmingly preferred a website-embedded (in-browser) secure payments method. The most significant challenge DigiCash faced was its business premise; consumers frankly did not see the need for anonymity in digital payments. Other micropayments startups saw their differentiating features also contribute to their downfall. The Wall Street Journal described in August 1997 that despite David Chaum's advocacy for privacy and anonymity, consumers appear content with the tradeoff of some privacy in return for easy recordkeeping. As for First Virtual, the article noted that the payments company never figured out how to verify the identity of merchants and customers via its communications system, something that digital certificates address. "Other lessons |

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| | learned from the pioneers include the superiority of software over hardware solutions because of the ease with which software can be distributed and updated (learned from Wave Systems); the need for fungibility and central clearinghouse functions rather than unique tokens/monies for each merchant (courtesy of NetBill); and the difficulties of aggregating micropayments (thanks to the travails of Millicent)." |
| **5. Business model transformation.** Accelerated repurposing of how large institutions carry out business and profit-making activities, coincident with the adoption of said complementary technical innovation. *The emergence of new business models is the last step in the temporal transition from underutilized to general-purpose technology via the instantiation of a signal innovation and general-purpose technology pairing.* | • While credit cards became increasingly popular, small businesses generally did not accept credit cards for smaller value purchases due to high merchant fees. Governments and financial services firms globally were looking to pilot open system stored value or prepaid cards enhanced with a microchip (smart cards), giving consumers "electronic purses" to pay for smaller transactions (micropayments) like highway tolls and fast food. Open system smart cards meant that a network of merchants and vending machines would accept smart card payment, while a closed system limits payment to a closed network, like a university where smart cards are used for on-campus dining and other services. The technology for such cards had by then been around for a decade, held back |

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| | by the relative high cost to produce prepaid cards and the need for merchants to purchase card readers in order to encourage user adoption. In late 1994, prepaid cards were no longer cost prohibitive to buy and reload (consumer side), or to accept as payment (merchant side). That the future of consumer payment methods would be one of both prepaid cards and credit cards seemed a foregone conclusion in the media narrative. The question was not whether consumers would come to use smart cards, but rather who had the best software (in the form of encryption technology) and hardware (for re-loading money) to dominate the market.<br>• In 1994, as Mosaic made the web accessible, several digital payment startups began to tackle the thorny task of securing credit card transactions independent of Netscape's SSL efforts—before the popularity of Navigator would supercharge these startups' endeavors and market value. At the time, the perceived opportunities of e-commerce still could not outrun the horror of security breaches and hackers that reigned in the public imagination. But digital payments were a hot topic toward the end of 1994 as the financial press considered future solutions to the "nightmare of cash." A December 1994 *Los Angeles* |

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| | *Times* article addressed the security-related inconvenience of e-commerce at the time: "An Internet-wide system for secure transactions has been the Holy Grail of cyberspace for some time, but only this year has a solution been in sight. During 1994, a whole series of plans for secure credit card transactions and digital cash have been announced, some of them with backing from players big enough that they have to be taken seriously." |

*E-Money: Smart Cards (1994-1996)*

The rise of the web after the early success of the Mosaic browser renewed a former debate over the future of money, specifically that of cash. As the variety of activities and goods to purchase online increased, the world began to consider what money was electronically. Wholesale transactions had long moved to electronic transactions, but the concept of money existing and being transacted digitally at the retail level for consumers spurred speculation that technology may eventually win out. An article titled "E-Money" by Steven Levy in the December 1994 issue of *Wired* magazine detailed the contemporary debate on the future of money, specifically digital currency, from the perspectives of both financial services firms and technology companies like Microsoft. On the eve of the internet boom, electronic money meant a likely future of smart cards in a world where point-of-sales systems were largely seen as inadequately guarded against fraud and the advent of color copiers would lead to an increase in counterfeit cash.[390] In 1994, the various

[390] "E-Money (That's What I Want)," by Steven Levy, *Wired*, December 1, 1994.

answers to how the internet and related technology would replace cash had yet to take into account what was possible through the web.

While credit cards became increasingly popular, small businesses generally did not accept credit cards for smaller value purchases due to high merchant fees. Governments and financial services firms globally were looking to pilot open system stored value or prepaid cards enhanced with a microchip (smart cards), giving consumers "electronic purses" to pay for smaller transactions (micropayments) like highway tolls and fast food. Open system smart cards meant that a network of merchants and vending machines would accept smart card payment, while a closed system limits payment to a closed network, like a university where smart cards are used for on-campus dining and other services. The technology for such cards had by then been around for a decade, held back by the relative high cost to produce prepaid cards and the need for merchants to purchase card readers in order to encourage user adoption.[391] In late 1994, prepaid cards were no longer cost prohibitive to buy and reload (consumer side), or to accept as payment (merchant side). That the future of consumer payment methods would be one of both prepaid cards and credit cards seemed a foregone conclusion in the media narrative. The question was not whether consumers would come to use smart cards, but rather who had the best software (in the form of encryption technology) and hardware (for re-loading money) to dominate the market.

In 1994, Denmark, Portugal, and Singapore were among the most prominent examples of countries deploying open system stored-value cards for micropayments, as they were seemingly moving toward a cashless society. In the United Kingdom, two major banks backed an ambitious system of cards that could be loaded with five currencies simultaneously, known as Mondex.[392] In

[391] Cards previously cost between $5 to $10 but in 1994 cost $1; smartcard readers for merchants cost less than $200

[392] "E-Money (That's What I Want)," by Steven Levy, *Wired.*

Denmark, DANMØNT, a consortium of banks and telecom companies earned interest on the float of the prepaid cards and charging around three cents per transaction. In anticipation of a future of home banking services and prepaid cards, Citibank partnered with Philips Electronics to develop the Philips P100 phone, which featured a screen and pull-out keyboard and a card slot allowing consumers to reload smart card balances.[393]

By the end of 1994, Visa had organized a group of financial services firms to design "Electronic Purse," prepaid smart cards later to be known as Visa Cash.[394] Nationsbank, First Union Bank, and Wachovia Bank signed on to issue Visa Cash cards.[395] In late May of 1995, Visa would announce its investment in the same Philips P100 phone to deliver a range of home banking services, especially for use with smart cards. Philips at the time was already developing an international standard for remote financial services with its banking and technology partners.[396] Mastercard in September 1994 announced it would launch a kind of smart-card application in the form of a prepaid card.[397] In August 1995, Mastercard and eleven big banks formed Smartcash, a smart card joint venture.[398] Citibank invested in testing smart card technology in a Long Island facility. Research institution-based debit card projects like NetCheque and NetCash[399] from the Information Sciences Institute at the University of Southern California and NetBill[400] from the

[393] "Citibank to Use Philips Eletronics for Home Banking," by Bloomberg News, *The New York Times,* April 27, 1994.

[394] "E-Money (That's What I Want)," by Steven Levy, *Wired.*

[395] "Visa Will Put A Microchip In New Card," by Saul Hansell, *The New York Times,* March 21, 1995.

[396] "Visa teams with Philips in Remote Banking Push," by Tracey Tucker, *American Banker,* May 31, 1995.

[397], "MasterCard, Visa Clash On Smart-Card Development," by Jeffrey Kutler, *American Banker,* September 15, 1994.

[398] "Mastercard Joins Banks to Plan Card That Works Like Cash," by Saul Hansell, *The New York Times,* August 17, 1995.

[399] Neuman and Medvinsky (1995).

[400] Sirbu and Tygar (1995).

Information Networking Institute at Carnegie Mellon University brought digital payment solutions from academia to the table. American Express, on the other hand, would rename its traveler's check division in 1995 to focus on stored-value products.[401]

In November 1995, First Union signed merchant agreements for Visa Cash with several prominent fast-food chains, including Baskin-Robbins, Blimpie, Chick-fil-A, Domino's Pizza, and Taco Bell.[402] This further enhanced the narrative that smart cards would soon replace cash transactions under ten dollars. Visa announced in 1995 that Visa Cash would be tested at a wider scale at the 1996 summer Olympic Games.[403] For this large-scale test, Visa would issue about 2 million Visa Cash smart cards where five thousand vending machines, payphones, souvenir shops, and food vendors would be equipped to accept Visa Cash.[404] Smart card chip technology would soon be embedded in debit cards and existing credit cards.[405] In 1996, in hopes of driving user adoption, Citibank, Chase Manhattan, MasterCard, and Visa joined forces, announcing a venture to offer "electronic cash" on smart cards designated with a Visa Cash or Mastercard Cash logo.[406] These cards could hold up to a balance of $100 and could be reloaded via ATM machines or smart card telephones.

At the same time Microsoft executives tried to formulate a strategy for partnering with Netscape in spring and early summer of 1995, Microsoft reentered the fray with the financial

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[401] Saul Hansell By, "Deals Looming To Establish U.S. Ventures In Cash Cards," by Saul Hansell, *The New York Times*, November 9, 1996.

[402] "6 Fast-Food Merchants on 1st Union List of 12 for Visa Smart Card Pilot in Atlanta," by Beth Piskora, *American Banker*, November 15, 1995.

[403] "Association to Use 'Visa Cash' As Name For Stored Value Card," by Valerie Block, *American Banker*, November 13, 1995.

[404] Oldham Jennifer, "Smart Cards Run Their 1st Olympic Trials: Home Edition," by Jennifer Oldham, *The Los Angeles Times*, July 15, 1996.

[405] "Visa Will Put A Microchip In New Card," by Saul Hansell, *The New York Times*, March 21, 1995.

[406] "It's Coming: Your Pocket Cash on a Plastic Card," by Saul Hansell, *The New York Times*, April 10, 1996.

services community since its aborted merger with Intuit. On June 12, 1995, Microsoft announced that it planned to launch in the next year smart cards, plastic cards with embedded microchips that would operate as a store of cash. Warren Dent, the director of business development for Microsoft's consumer systems division indicated that Microsoft may first test the chip technology with its employees before offering it publicly.[407] In early June at a meeting with top executives of the world's largest banks, Gates reportedly clarified his "banks are dinosaurs" misquote and indicated that to develop these smart cards Microsoft would work with banks. Gates is quoted as saying, "In no way will we be competition to banks in what we're doing… We're coming up with ways for banks to use our technology. We will never be in the business of doing what banks do." In June 1995, the prevailing attitude of banks and credit card companies towards Microsoft was that the financial services industry did not feel the pressure of working with Microsoft the way others in the technology industry did.[408] Though Microsoft announced its plans to develop smart card technology, the company would not formally launch a smart card product until 1999.

Amidst the rush towards scalable smart card technology, the Mondex system, announced in 1994, was perceived as the first bridge between e-money and smart cards.[409] Mondex technology differentiated itself in the market as a smart card system that protected consumer privacy. Owned by National Westminster Bank and Midland Bank (which combined held 40% of the United Kingdom's retail banking market in 1995),[410] Mondex International saw early support for its technology, which it sold to banks regionally in franchise rights. HSBC bought rights to offer Mondex cards in most of Asia outside of Japan during the system's trial stage in 1995, while Wells

[407] "Microsoft Developing Electronic Cash Card," by Saul Hansell, *The New York Times*, June 12, 1995.

[408] "Microsoft Developing Electronic Cash Card," by Saul Hansell, *The New York Times.*

[409] "The Color of Mondex," *The New York Times Magazine*, March 6, 1994.

[410] "Mastercard Will Buy Stake in Mondex International," by Reuters, *The New York Times*, November 8, 1996.

Fargo tested the system locally in San Francisco.[411] Banks were expected to charge Mondex customers a monthly service fee of around $2 while Mondex made money from selling hardware, such as a $100 portable card balance checker, called an electronic wallet. Neither Visa nor MasterCard's smart card solutions would allow peer-to-peer transactions, which Mondex provided.[412] But the first Mondex experiment in Swindon, England, was not a success. Only 10,000 of the 190,000 residents signed up for Mondex.[413] In July, *American Banker* reported that amid rumors that Mondex's British backers were losing faith in the enterprise, Mondex "is still perceived as out on a limb, its technology elegant but too elaborate for mass acceptance."[414] While MasterCard and Visa dubbed Mondex transactions "unauditable," DigiCash criticized the Mondex system as not providing consumers with enough anonymity. The same month, Wells Fargo and AT&T would together form the US affiliate of Mondex.[415]

In September 1996, a Bell Communications Research (Bellcore) paper made headlines, claiming that smart card security technology was weak. Criminals could short-circuit the encryption software for the smart card chips and create counterfeit copies of cards with legitimate monetary value.[416] This did little to deter banks from maximizing their involvement with smart card ventures. Mastercard bought a 51% stake in Mondex in November.[417] American Express

[411] "Cashless Society Gets Closer With Plans for Electronic Currency," by Leslie Helm, *The Los Angeles Times*, September 6, 1995.

[412] "Cashless Society Gets Closer With Plans for Electronic Currency," by Leslie Helm, *The Los Angeles Times*.

[413] "It's Coming: Your Pocket Cash on a Plastic Card," by Saul Hansell, *The New York Times,* April 10, 1996.

[414] "Fed Up With Mondex? Not So, Natwest Says," by Jeffrey Kutler, *The American Banker,* July 11, 1996.

[415] "AT&T and Wells Fargo Investing in an Electronic Cash Card," by Saul Hansell, *The New York Times,* July 19, 1996.

[416] "Potential Flaw In Cash Card Security Seen," by John Markoff, *The New York Times,* September 26, 1996.

[417] "MasterCard Acquires 51% Stake In Mondex, 'Smart Card' Maker," by Stephen E. Frank, *The Wall Street Journal,* November 19, 1996.

partnered with Banksys, a consortium of Belgian banks, to market test smart card technology.[418] In December, seven financial institutions—including Wells Fargo and Chase—formed a company to market Mondex in the US.[419] In late 1996, new terminals for merchants that supported Mondex were priced at $500. Microsoft, Schlumberger Electronic Transactions, HP, Bull CP8, and Siemens Nixdorf Informationssysteme AG would jointly announce a smart card security standard that the companies would offer the industry for free, seeing public key technology as key to enabling digital signatures that companies could use to provide employees secure access to computers and intranets, as well as providing security for making online payments.[420]

Though the cost of microchip technology had gone down significantly that by 1995 smart cards cost about $1 each, the transaction costs of reloading balances inhibited the widescale adoption of smart cards for micropayments. In the United States, authorities were wary of the money laundering potential of smart card transactions.[421] Credit card companies and banks did not want the consumer protection liability of insuring the theft or loss of money stored on smart cards. Both Visa and MasterCard, having invested in developing smart card technologies and sponsoring pilot programs only after receiving board-level support of their member banks, struggled to manage the software companies they acquired to develop smart cards. Both Visa and Mastercard appeared to break with Mondex by July 1996, whose system was judged to be "elegant but too elaborate for mass acceptance."[422] By November 1998, the death of smart card adoption in the

[418] "American Express Plans Smart-Card Project," *The New York times* (1996).

[419] "Mastercard's 'Smart Card' Builds Support," by Saul Hansell, *The New York Times,* December 5, 1996.

[420] "Card Frontiers: Industry Standard Eyed for Smart Card Keys to PC Networks," by Valerie Block, *American Banker,* September 11, 1996.

[421] "The World; Money Laundering, New and Improved," by David E Sanger, *The New York Times,* December 24, 1995.

[422] "Fed up with Mondex? Not so, Natwest says," *American Banker,* July 11, 1996.

United States was pronounced in the failure of the few high profile pilot programs. Citibank and Chase Manhattan both shut down their electronic cash smart card program, piloted exclusively in the Upper West Side of Manhattan.[423]

Yet the tech industry refused to concede defeat. Microsoft announced in October 1998 Smart Card for Windows.[424] Microsoft's smart card product focused on three categories: corporate IT secure logon, medical services use, and travel and entertainment loyalty applications.[425] Though by then smart cards were an endeavor largely written off by both Visa and Mastercard, the mood at the RSA '99 conference around smart cards "stemmed from a shared belief that so many bets by so many strategically savvy technologists cannot be too far off the mark."[426] An industry executive told *American Banker*, "Banks seem to be very interested in delivering services to cell phones and personal digital assistants… Stock trading is one of the applications driving this." This reflects the thinking brought on by one of the driving forces of the millennium bubble—the stock market as casino. Microsoft would announce its Smart Card Toolkit at COMDEX/Fall '99.[427] In April 1999, David Anastasi, a US West executive in Seattle who recently took on the full-time role as CEO of the Global Chipcard Alliance, told *American Banker* that one of the ways he gauged smart card progress in the market was by the number of press releases. "Three and a half years ago when I started getting involved in smart cards, you'd see one press announcement about them a week… Now there are three to five a day from companies getting together and partnering. That in

[423] "Got a Dime? Citibank and Chase End Test of Electronic Cash," by Saul Hansell, *The New York Times*, November 4, 1998.

[424] "Smart Card: Card Makers and Allies Stay Bullish on Chip Cards," *American Banker*, January 27, 1999.

[425] "Early Pilot Projects Demonstrate Performance of Smart Card for Windows," *PR newswire*, May 12, 1999.

[426] "Early Pilot Projects Demonstrate Performance of Smart Card for Windows," *PR newswire*, May 12, 1999.

[427] "Microsoft delivers Windows for smart cards," *M2 Presswire*, November 15, 1999.

itself demonstrates that people believe in the technology and capabilities of it."[428] That the entire tech industry remained convinced that their prediction of the future was more accurate than the failed real world pilot programs sponsored by banks demonstrates the industry's capacity for the kind of magical thinking feedback loop. Banks had no consumer behavior data to base their decisions on prior to the pilot programs, and when adoption rates indicated that smart cards were not the future, banks abandoned the costly project.

### *E-Money: Digital Currency, Wallets, and Micropayments (1994-1996)*

Steven Levy's *Wired* article also covered the biggest players in the burgeoning e-money (which included currency in electronic form stored on smart cards as well as novel digital currencies) and payments space at the time. This included DigiCash, CyberCash, Mondex, Microsoft, and Visa. Though each had its own cryptographic security solution (or criticism or questions of the security guarantees of its competitors), there was a philosophical divide between these companies. For some, the digitization of money went hand in hand with privacy (meaning transactions must be anonymous) while for others traceability meant a revenue stream from internet-based financial transactions. Levy wrote, "As a result of this mad rush, the road to digital cash was not so much a smooth transitional path but a multi-lane cloverleaf with infuriating turnoffs, circles, and dead ends." The article also discussed key questions from a privately circulated paper by Kawaika Daguio of the American Bankers Association, most importantly, what constituted monetary value (Eric Hughes, co-founder of the Cypherpunks mailing list, was of the opinion that a universally trusted digital currency system can float on its own momentum) and who

[428] "Smart Cards: Telecom Executive Makes Personal Bet on Chip Cards," *American Banker,* April 14, 1999.

would regulate electronic money (at that time, the answer was no one). By 1996, the technology necessary was in place for an e-commerce boom—consumers were indeed beneficiaries of the rapid innovation in browser technology as well as considered and sophisticated encryption solutions for payments and digital currency. But trust was an issue with both consumers and merchants and, most importantly, banks refused to fully endorse the security claims of tech firms. Two payments startups attempted to address the issues of privacy and security with cutting edge technology, but never managed to overcome the Sisyphean challenge of winning trust: DigiCash and CyberCash.

DigiCash was founded in 1989 by American cryptographer David Chaum, a co-founder of the International Association for Cyptologic Research (IACR). Headquartered in Amsterdam, the company's goal was to introduce "anonymous digital money technology" to the world. In 1982, Chaum published a paper titled "Blind Signatures for Untraceable Payments."[429] As the PC revolution took off, Chaum began to formalize a framework for and the technology supporting electronic cash, or digital currency, that most resembled the convenience and anonymity of cash. A decade later, in an article in *Scientific American*, Chaum detailed the protocol and scenarios of a new anonymous digital payment system based on the concept of blind signatures.[430] He subsequently demonstrated DigiCash technology integrated with Mosaic during his keynote address at the inaugural W3 conference in Geneva in May 1994.[431] This was the first demo of payments over the internet. The DigiCash user interface featured drag-and-drop icons representing coins and receipts and was available for Windows, Macintosh, and UNIX. In October 1994,

[429] "Project Page: DigiCash," on David Chaum personal website, accessible at https://www.chaum.com/ecash.

[430] "Achieving Electronic Privacy," by David Chaum, *Scientific American*, August 1992. https://web.archive.org/web/19970111165732/http://www.digicash.com/publish/sciam.html.

[431] "World's First Electronic Cash Payment Over Computer Networks," by DigiCash, May 27, 1994. https://web.archive.org/web/19970111170653/http://www.digicash.com/publish/ec_pres1.html

DigiCash debuted its international electronic cash system through a trial with one million "cyber bucks" for several hundred volunteers.[432] The company would also work with Mastercard in developing new technology allowing for low-cost chips to meet the security requirements for smart cards.[433] Yet, DigiCash's flagship digital currency boasted low-cost technical requirements for implementing on a wider scale, especially when compared to smart cards. In 1995, DigiCash supported an Ecash trial size of 10,000 individuals running on a mere "486 machine"—a computer powered by the predecessor to the original Intel Pentium microprocessor.[434]

DigiCash licensed RSA Data Security technology for its Ecash system.[435] Though Ecash was a true digital currency, users paid with Ecash through a hybrid model. Online, Ecash was represented visually as coins, issued by a bank, on a computer screen. In the physical world, Ecash could be stored on smart cards. The traceless quality of the Ecash smart cards made Ecash the closest digital duplicate of cash.[436] Chaum's intuition was that the internet would serve as a platform for a new commerce model where consumers had more choice of merchants and would have a desire to maximize their PCs through activities like shopping. However, Chaum wanted to be on the right side of history, believing that a payment system that guaranteed the consumer privacy "would make others look daft, perhaps even immoral, not exercising public responsibility." Some saw Chaum's worldview as too idealistic. Eric Clemons, an information

[432] "Attention Internet Shoppers: E-Cash Is Here ," by Peter H. Lewis, *The New York Times,* October 19, 1994.

[433] "Sun Introduces Industry's Most Comprehensive Package of Intranet Products & Services for Business," *Business Wire,* February 14, 1995.
https://web.archive.org/web/19970111170615/http://www.digicash.com/publish/blue_press.html

[434] "Money Creators: A Player Goes After Big Bucks in Cyberspace," by Karen Epper, *American Banker,* May 12, 1995.

[435] "Ecash Trial is Now Worldwide," *Digicash,* January 6, 1995.
https://web.archive.org/web/19970111170639/http://www.digicash.com/publish/ec_pres2.html

[436] "Money Creators: A Different Drummer on the Data Highway," by Karen Epper, *American Banker,* May 12, 1995.

technology professor at Wharton, described Chaum's views as "Walden Pond meets the Internet."[437]

Chaum pitched DigiCash's technology to banks from the angle of protecting consumer interests by putting privacy first. He said in a 1995 interview, "I tell bankers that if they offered customers something that looked after their interests, they might be able to create the kind of relationship that Apple got with its Macintosh. Some people just love that company, and that's not something you see in banking or credit cards."[438] In October 1995, Mark Twain Bancshares of St. Louis became the first US licensee of the Ecash system, bringing Ecash out from "Monopoly money" mode and into the real world with a trial of up to 10,000 users.[439] In addition to Mark Twain, Sweden Post also signed on as a licensee. In the DigiCash press release, Chaum proclaimed, "It will catalyze enormous growth in electronic commerce on the Internet, and prove of enduring value through its improved protection of consumers and society at large."[440] After consumers and merchants chafed at the transaction and account setup fees, Mark Twain lowered user fees in January 1996.[441] In March 1996, DigiCash partnered with EUnet, the leading European ISP, to roll out Ecash in Finland.[442] Ecash debuted in Finland through Merita, whose account holders could use Ecash coins to buy goods from six participating merchants. Among the

[437] "Money Creators: A Different Drummer on the Data Highway," by Karen Epper, *American Banker*, May 12, 1995.

[438] "Money Creators: A Different Drummer on the Data Highway," by Karen Epper, *American Banker*, May 12, 1995.

[439] "Digicash to Test Live Internet Cash System with Mark Twain," by Jeffrey Kutler, *American Banker*, October 25, 1995.

[440] "First Bank to Launch Electronic Cash," by Digicash, October 25, 1995. https://web.archive.org/web/19970111165245/http://www.digicash.com/publish/ec_pres3.html

[441] "Mark Twain lowers Ecash user charges," *CNet*, January 12, 1996.

[442] "Digicash Deal with Europe's Top Web Server Brings Ecash to Finnish Bank," by Jennifer Kingson Bloom, *American Banker*, March 15, 1996.

merchants were SOM, the Finnish Securities and Derivatives Exchange and Clearing House, and media companies that owned some of Finland's bestselling publications.[443] In May, DigiCash announced that Deutsche Bank would begin its Ecash trial in the fall.[444] Though DigiCash gained publicity and some momentum in Europe through its participation in the European Union's Conditional Access For Europe (CAFE) project,[445] in 1996 Ecash struggled to gain acceptance among merchants. A Mark Twain executive told the *Wall Street Journal* that Ecash faced the same adoption problem as credit cards upon their introduction in the US in the 1960s. On the difficulty of driving user adoption, a DigiCash executive admitted, "There are a lot of chicken-and-egg problems."[446]

While DigiCash specialized in privacy-oriented digital currency, CyberCash developed its sophisticated payments system around the concept of e-wallets. Headquartered in Reston, Virginia, CyberCash Inc. was led by Bill Melton, the creator of the Verifone point-of-sale systems, and Jim Bidzos, the head of RSA, and Steve Crocker from Trusted Information Systems Inc., another prominent encryption technology company. The reputation of its founders in the business of data security and encryption lent the startup cachet that few other competitors enjoyed. CyberCash was described by Bidzos as "extending the credit card network into the Internet."[447] The company was most notable at the time for introducing a new form of payment, peer-to-peer, that allowed

[443] "A Survey of Electronic Cash, Electronic Banking, and Internet Gaming," by DigiCash, March 13, 1996. http://web.archive.org/web/19970111165318/http://www.digicash.com/publish/ec_pres4.html

[444] "Deutsche Bank, DigiCash to Test Electronic Cash," by Kimberley A. Strassel, *The Wall Street Journal,* May 7, 1996.

[445] CAFE was a trial to develop a secure and private electronic payment system as a part of the EU's European Strategic Programme on Research in Information Technology (ESPRIT) program.

[446] "Will Digital Money ReplaceThe Nation's Credit Cards?," by Neal Templin, *The Wall Street Journal,* June 17, 1996.

[447] "Will Digital Money ReplaceThe Nation's Credit Cards?," by Neal Templin, *The Wall Street Journal,* June 17, 1996.

individuals to pay one another without a merchant as an intermediary to process the payment. In addition to peer-to-peer payments, CyberCash also provided customer to merchant payments via credit card and debit card.[448] The basic CyberCash payment protocol was as follows: CyberCash's consumer product, like that of other competitors, required the customer to use CyberCash software to generate an encryption key, and send the payment request to the CyberCash server, which proceeded to forward the payment request to whatever bank or clearing house for authorization before returning the result to the CyberCash merchant software. CyberCash used RSA for its public key algorithm. CyberCash began as a competitor in the secure credit card transactions market, but it would later enter the micropayments segment of the market.

On December 12, 1994, CyberCash partnered with Wells Fargo to develop secure payment services for the internet, with plans to pilot the service in the first quarter of 1995.[449] At the time, CyberCash was reportedly in talks to license transaction encryption technology from another firm—DigiCash.[450] In May 1995, CyberCash became the first electronic payment developer to gain export approval from the US government of its encryption technology. It also joined forces with Sun Microsystems to promote e-commerce and electronic payments.[451] Consumers could pay via CyberCash's service through a CyberCash pay button on participating merchant websites. Around the same time, CyberCash began announcing a succession of partnerships with financial

[448] "CyberCash Payment Systems," Gartner_Inc, 2022, https://www.gartner.com/en/documents/307518/cybercash-payment-systems.
https://web.archive.org/web/20160103054814/http:/www.isoc.org/inet95/proceedings/PAPER/181/abst.html

[449] "Wells Fargo and CyberCash team up to provide secure online payment systems," by Susan Ice, *Business Wire*, December 12, 1994.
https://web.archive.org/web/20000712161833/http://cybercash.com/cybercash/company/news/releases/1994/94dec12.html

[450] "Encryption Protects Virtual Cash for On-Line Shopping on Net," by Daniel Akst, *The Los Angeles Times*, December 7, 1994.

[451] "CyberCash opens Net to small change," by CNet News Staff, *CNet*, September 30, 1996.

institutions, starting with First of Omaha. American Heritage BankCard, U.S. Bancorp, and Mellon Bank Corp. became early CyberCash partners.[452] In July 1995, Checkfree Corp. would license CyberCash's encryption technology for Checkfree Wallet micropayments online in a partnership that would allow both companies' technologies to be bundled with browsers.[453] Verifone would make an equity investment in CyberCash in August 1995. By late January 1996, CyberCash secured relationships with more than a dozen financial institutions. It also announced a partnership with Verisign to offer a digital identification coding system as part of its CyberCash wallet product.[454] The following month, Softbank bought a 9.9 percent stake of the company for $15.2 million.[455] CyberCash went public, selling two million shares priced at $17 per share with the price hitting above $30.[456] *Wired* dubbed early 1996 as "Phase Two" of the Internet IPO frenzy, this time with payments processing firms on the top of investors' minds.[457] Through early December 1996, 56 internet-related businesses had gone public, triple the number in 1995.[458]

In September 1996, CyberCash and Mondex partnered to incorporate smart card technology into CyberCash Wallet. CyberCash then entered the micropayments space; in partnership with six large financial institutions (including NationsBank, First Union, First USA, and PNC Bank), CyberCash launched CyberCoin, a new feature of the CyberCash Wallet that

[452] "Cybercash signs merchant processor to its Internet transaction software," by Robert Jennings, *American Banker*, November 3, 1995.

[453] "Checkfree to use Cybercash encryption system," by Karen Epper, *American Banker, July 18, 1995.*

[454] "Cybercash, Verisign Devising ID for On-Line Purchases," *American Banker*, January 31, 1996.

[455] "COMPANY NEWS;SOFTBANK BUYS A STAKE IN CYBERCASH," by Bloomberg Business News, *The New York Times*, February 16, 1996.

[456] "MARKET WATCH; Internet Dreams: From 10~ To $30," by Floyd Norris, *The New York Times*, February 18, 1996.

[457] "Son of IPO Fever," by Ned Brainard, *Wired*, May 1, 1996.

[458] "The Wildest Surfing of 1996? Try the Market, Not the Web," by Lawrence Carrel, *The Wall Street Journal*, December 9, 1996.

enabled transactions between $0.25 to ten dollars online.[459] As with credit card companies, merchants would pay banks per-transaction fees for consumers that use CyberCoin at a rate of $0.08 for a $0.25 transaction up to $0.31 for a ten-dollar purchase. Users bought CyberCoin for their CyberCash wallets in $20 increments. In October, Netscape incorporated CyberCoin into its LivePayment server software, a move towards realizing the protocol that would address Berners-Lee's Error 402 placeholder.[460] This partnership shifted public perception of CyberCash's performance, as Navigator at the time remained the world's leading web browser in market share.[461]

The product strategy behind CyberCoin was a response to new developments on the web. Melton told CNet, "CyberCoin fulfills a growing need for consumers to purchase lower-priced and 'impulse' items on the Internet, especially digital goods and services that can be instantaneously downloaded to your computer, such as software, articles, research, games, and music."[462] The *Wall Street Journal* reported,

> The potential for such "micropayments" is enormous, analysts say. The ability to transact in small amounts is a critical component in allowing publishers to start charging for on-line information. It gives Internet merchants -- who often had to give information away for lack of a feasible payment system -- a way to get compensated for their efforts.[463]

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[459] "CyberCash lowers barriers to small transactions at Internet storefronts," by Jared Sandberg, *The Wall Street Journal,* September 30, 1996.

[460] "Netscape and CyberCash Announce Relationship to Broaden Payment Options Over the Internet," *Business Wire,* October 7, 1996.
https://web.archive.org/web/20030213163510/http://wp.netscape.com/newsref/pr/newsrelease255.html

[461] "Change Is Good, They Bet," by David S. Hilzenrath, *The Washington Post,* October 21, 1996.

[462] "CyberCash opens Net to small change," CNet News Staff, *CNet,* September 30, 1996.

[463] "CyberCash lowers barriers to small transactions at Internet storefronts," by Jared Sandberg, *The Wall Street Journal,* September 30, 1996.

CyberCoin, in 1996, was one of the first payments solutions to address the kinds of media that web users may want to purchase (the other being DigiCash). In 1996, CyberCash also attempted a bridge between transfers and digital currency. CyberCash planned to release a solution for a cash and check payment replacement solution. In other words, it envisioned a technology that would allow for instant bank account transfers from a customer's account to a merchant's account for the purchase of goods online.[464]

By 1996 DigiCash and CyberCash had introduced to the world an array of innovative retail financial products: an electronic currency wallet that allowed for instantaneous payment for goods online where the value of the digital coin corresponded to the value of the dollar, an anonymous and secure digital currency for a futurist techno utopia, peer-to-peer payments, and software-embedded micropayments. At the same time, both companies spent years trying to convince banks to adopt, endorse, and offer their e-money products. In both cases, DigiCash and CyberCash offered innovative technologies that banks and consumers did not need (yet) as the existing solutions were "good enough." Both startups also grossly underestimated the necessity of trust in the realm of money and payments.

[464] "Will Digital Money ReplaceThe Nation's Credit Cards?," by Neal Templin, *The Wall Street Journal*, June 17, 1996.

*SET and Securing Transactions (1994-1996)*

In 1994, as Mosaic made the web accessible, several digital payment startups began to tackle the thorny task of securing credit card transactions independent of Netscape's SSL efforts—before the popularity of Navigator would supercharge these startups' endeavors and market value. At the time, the perceived opportunities of e-commerce still could not outrun the horror of security breaches and hackers that reigned in the public imagination. But digital payments were a hot topic toward the end of 1994 as the financial press considered future solutions to the "nightmare of cash."[465] A December 1994 *Los Angeles Times* article addressed the security-related inconvenience of e-commerce at the time: "An Internet-wide system for secure transactions has been the Holy Grail of cyberspace for some time, but only this year has a solution been in sight. During 1994, a whole series of plans for secure credit card transactions and digital cash have been announced, some of them with backing from players big enough that they have to be taken seriously."[466]

In October 1994, First Virtual Holdings Inc., through a partnership with Electronic Data Systems Inc. and First USA, began offering consumers a secure online payments system for purchases of digital assets (electronic documents). First Virtual was based in San Diego and founded by Lee H. Stein, a celebrity attorney and financial adviser, along with three principal scientists, Nathaniel S. Borenstein, Einar A. Stefferud, and Marshall T. Rose. The First Virtual system was regarded as "potentially the first true consumer link between the world of credit cards, banks and the Internet, the international web of computer networks."[467] Electronic Data Systems

[465] "An End to the 'Nightmare' of Cash," by Saul Hansell, *The New York Times,* September 6, 1994.

[466] "Encryption Protects Virtual Cash for On-Line Shopping on Net," by Daniel Akst, *The Los Angeles Times,* December 7, 1994.

[467] "COMPANY NEWS; A Credit Card for On-Line Sprees," by John Markoff, *The New York Times,* October 15, 1994.

handled the data processing while First USA provided credit card authorization and payment clearing. The service was based on e-mail technology via private channels, rather than encryption programs that generated keys.[468] *American Banker* described the payment process for a customer using First Virtual: "First Virtual customers who want to buy something on the World Wide Web never type a credit card number into their computer. Instead they read it over the telephone and receive a PIN, or personal identification number, which they use when paying for something on-line. The transaction is settled off-line."[469] The product was called VirtualPIN.

VirtualPIN essentially addressed three things: web-enabled e-commerce, internet-enabled communications via e-mail, and existing payment habits of consumers (namely, shopping via catalog and paying by phone with a credit card). To others at the time, this made the First Virtual system obsolete given the necessity of encryption on the internet.[470] Borenstein, chief scientist at First Virtual, was quoted saying, "People tend to overestimate the effectiveness of encryption."[471] The company claimed its system encountered an average of two unsuccessful hacks a day. First Virtual's business model relied on a 29 cents transaction fee for merchants plus 2% of sales. It also offered, like Netscape, a software for setting up storefronts, called Infohaus. First Virtual would join the dot-com IPO boom in December 1996, offering 2 million shares and debuting on the market above its $9 per share price. First USA, GE Capital Services, and First Data invested a

[468] "Money Creators: A Player Goes After Big Bucks in Cyberspace," by Karen Epper, *American Banker*, May 5, 1995.

[469] "First Virtual goes off-line to secure on-line payments," by Jennifer Kingson Bloom, *American Banker*, February 18, 1997.

[470] "First Virtual goes off-line to secure on-line payments," by Jennifer Kingson Bloom, *American Banker*, February 18, 1997.

[471] "REPORTER'S NOTEBOOK: Internet Boosters Keep Beating the Drum Series," by Jeffrey Kutler, *American Banker*, April 13, 1995.

combined $12.5 million into the startup.[472] These investors essentially were placing bets on consumers never needing a more seamless online transaction experience beyond calling in their credit card numbers.

But it was not until the summer of 1995 that the world saw a mad rush toward setting transactions security standards and, more broadly, making online payments possible. On June 24, 1995, Mastercard and Visa announced that the two companies would work together toward a single solution for standardizing security protocols for transactions.[473] In what looked like a serious coup for Microsoft, partnering with the two largest credit card companies in setting an online payments security standard, the *New York Times* revealed the business model of this agreement: "Visa pays a fee to Microsoft for every transaction using certain Microsoft software. Mastercard will either license this software or write its own." Moreover, Mastercard intended to ban its cards from being used in internet transactions that did not use the Microsoft-Visa-Mastercard software. However, on July 18, Netscape announced Secure Courier, its financial data security protocol developed in partnership with Mastercard and Intuit.[474] On August 14, Checkfree Corp. and Compuserve Inc. announce Wallet, an online payment service provider (a unit of H&R Block).[475] Wallet was slated to go on sale the same day as Windows 95 and was priced at $9.95 with a $9.95 monthly service fee. Both companies would receive "an undisclosed piece of the transactions fees."

Netscape, from the moment of its 1.0 beta release to the run-up of its IPO, made a slew of announcements regarding e-commerce and payments. The company led the market in selling e-

[472] "First Virtual launches IPO," by CNet News Staff, *CNet,* December 13, 1996.

[473] "Credit Cards On Internet Given a Lift," by Saul Hansell, *The New York Times,* June 24, 1995.

[474] "Netscape Announces Secure Courier, -- A Digital Envelope for Securing Financial Transactions on the Internet," by Netscape, July 18, 1995.
https://web.archive.org/web/20030203065255/http://wp.netscape.com/newsref/pr/newsrelease33.html

[475] "Checkfree partner in Compuserve mall," by Karen Epper, *American Banker,* August 14, 1995.

commerce site building software and server software to merchants. Along with other tech firms, both large and small, Netscape was active in putting forth formal security standards recommendations at the W3C conferences. Its most significant announcements in secured transactions-related partnerships would be its agreements with First Data and Mastercard. A 1995 *American Banker* profile of a Netscape executive shed light on the company's sales efforts with the financial services community. Charles Jadallah, director of financial services and an early Netscape sales team member who joined the startup from Visa, led Netscape's efforts in winning over financial institutions to adopt Netscape secure transaction standards for the web.[476] Jadallah pitched Netscape to banks, credit card companies, mutual funds, brokerages, and insurance companies in all major industrialized countries. By the time of the article's publication, a year after the first beta release of Navigator, Netscape had relationships with Mastercard, American Express, Bank of America, Barclays, First Data, and Cardservice.[477] The article described Netscape's server software for transactions:

> That gateway is designed to be neutral to meet the needs and preferences of the buyers and sellers. It could accommodate digital cash or micropayments as easily as credit cards. It gives bankers some comfort that, according to market research and anecdotal reports, credit cards are the No. 1 choice of the pioneering payers on the Internet. But the net is inherently insecure, which is where Netscape and competitors want to fill the breach.

Members from Netscape's secure transactions protocol product team indicated that the effort to get the two biggest credit card companies onboard with a single security standard rested with the credit card companies themselves. They outspokenly disapproved of the Visa and Microsoft's rival

[476] "Netscape's Bank Liaison: Point Man in the Middle," by Jeffrey Kutler, *American Banker,* November 3, 1995.

[477] "Netscape's Bank Liaison: Point Man in the Middle," by Jeffrey Kutler, *American Banker,* November 3, 1995.

proprietary approach with SET (previously STT), going against the W3C's strive for openness. Despite the drama with Mastercard, Visa, and Microsoft, Netscape's product managers remained optimistic about the prospects of a standard endorsed by a major credit company. The example cited was that of Visa and Verifone's point-of-sales equipment.

In fact, in August 1995 Verifone announced first a new division to develop secure payment methods for e-commerce, followed by the announcement of its acquisition of Enterprise Integration Technologies (EIT), an e-commerce software and services firm, for $28 million in stock. Verifone's strategy as a hardware company was to develop both software and hardware that could "combine with Internet browsers and processors to create a payment infrastructure."[478] Verifone partnered with Broadvision Inc. in May 1995 in hopes of creating a "virtual terminal" that would incorporate new digital payment methods with existing payment networks. Verifone was also member of the Oracle-led coalition called Object Definition Alliance, which sought to develop e-commerce standards for channels like interactive television.

On August 23, 1995, the *New York Times* reported that a group of banks, technology companies, and research institutions spearheaded by the Financial Services Technology Consortium announced a joint project to pilot a standard for electronic checks, theoretically made possible through email.[479] Notable members of the group supporting the project included Citibank, the Bank of America, and IBM. The proposed consumer experience was described in the *New York Times* as:

> To use the system, consumers would need an "electronic checkbook," a card that would be inserted into a slot on their computers. The card, which is expected to cost $30 to $40

[478] "In Internet push, Verifone to pay $28 million for software firm," by Tracey Tucker, *American Banker,* August 22, 1995.

[479] "Checks Delivered Via E-Mail Are Planned," by Saul Hansell, *The New York Times,* August 23, 1995.

> wholesale, would be required to verify the identity of the check writer and to prevent forgeries. The group members hope that the electronic checkbook will use the standard format, known as PC Card, that is used for modems and other accessories on most laptop computers. Later, the checkbook might fit onto smaller cards that would contain computer chips. These cards, the size of credit cards, are known as smart cards.

But hackers would capture the consumer's imagination when a string of security-related news regarding banks and Netscape's encryption technology made headlines between August and October 1995. Early August saw the case brought against a 34-year-old Russian hacker accused of a $10 million hack of Citibank's computer systems in 1994. The event prompted Citibank to require customers to use an electronic device that generated a new password for every electronic transfer.[480] Also in August, a student at the École Polytechnique hacked Netscape's 40-bit European version of its software encryption by running a network of 120 computers for eight days.[481] On September 17, Ian Goldberg and David Wagner, computer science graduate students at the University of California at Berkeley, feeling in a "techno mood" after a matinee showing of the movie "Hackers," returned to the Berkeley campus where, after four hours, they successfully hacked Netscape's credit card transaction encryption system and published their encryption key generating program online.[482] The program generated keys for Netscape's protocol in less than one minute and was posted to the Cypherpunks mailing list.[483] James Bidzos, the president of RSA Data Security, capitalized on the media opportunity, telling the *Chicago Tribune* that Netscape,

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[480] "Citibank Fraud Case Raises Computer Security Questions," by Saul Hansell, *The New York Times*, August 19, 1995.

[481] "U.S. to Urge A New Policy On Software: Attempt at Compromise On Scrambling of Data U.S. to Propose a Policy Change on Software," by John Markoff, *The New York Times*, August 18, 1995.

[482] "Finding chinks in Netscape's armor," by Tom Abate, *The San Francisco Examiner*, September 20, 1995.

[483] "Software Security Flaw Puts Shoppers on Internet at Risk," by John Markoff, *The New York Times*, September 19, 1995.

sacrificing due diligence for faster go-to-market, had declined an offer from RSA to test Netscape's SSL security protocol, which used RSA encryption technology, for vulnerabilities.[484] Markets reacted positively to the news the following week, as the incident did little to diminish Andreessen's wunderkind reputation. Netscape's stock closed up on September 20 after the company guaranteed a speedy fix by the beginning of the following week. However, in October 1995, Wells Fargo, which used Netscape technology for its online banking services, took down its online banking program for security evaluation to assuage customers' fears regarding Netscape's security flaws.[485]

During the same period, Sun Microsystems announced Sunsoft's NEO products, the outcome of a long running project previously known as Distributed Objects Everywhere (DOE).[486] *American Banker* described as a use case, "A bank customer could use interactive services on a bank's home page, for example, by testing "what-if" scenarios on mortgage rates - using a version of the bank's own, powerful internal systems."[487] Though NEO would soon become redundant as Sun further developed Java,[488] NEO in fall of 1995 indicated that the possibility of online banking services on the web could outpace the setbacks Intuit and Microsoft encountered with building home banking services into their software.

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[484] "Software Flaw a Setback To Netscape, Industry," by James Coates, *The Chicago Tribune,* September 19, 1995.

[485] "Home Banking: Netscape Security Breach Causes Jitters," by Karen Epper, *American Banker,* October 3, 1995.

[486] "Sunsoft Introduces Neo, The Industry's First Complete Networked Object Computing Environment," SunSoft, September 20, 1995. https://web.archive.org/web/20070311022126/http://www.sun.com/smi/Press/sunflash/1995-09/sunflash.950920.1420.xml

[487] "Technology by Sun Said to Facilitate Internet Offerings," by Jeffrey Kutler, *American Banker,* September 21, 1995.

[488] "Goodbye NEO, hello Enterprise Java Beans - SunWorld - November 1997," by Robert McMillan and Niall McKay, *SunWorld,* November 14, 1997.

On September 28, Microsoft and Visa jointly announced the Secure Transaction Technology (STT), noticeably without Mastercard despite the announcement in June that the two credit card companies would converge their efforts.[489] STT was introduced as a closed proprietary encryption where the source code was only available through licenses from Visa or Microsoft with two versions: one for customers on the purchasing side and one for merchants to collect payment. The consumer experience was largely tied to Windows: the consumer would need to download the STT software online, register a Visa card, receive digital signature keys that would reside on the consumer's PC hard drive, and the data would be activated when purchases are made. Microsoft planned to incorporate STT into MSN, Windows 95, and Microsoft Money. Financial services firms would have to install STT software on their end in order to accept the encrypted transactions.[490] The licensing deal for STT included Spyglass, which would write the code for machines using Windows 3.1, Windows for Workgroups, Macintosh, and Unix.[491] The STT deal was also the first time a major credit card company agreed to cover losses should the underlying software for the transaction failed.[492]

The *New York Times* headline for the article on the STT announce summed up the industry reaction, "Microsoft-Visa On-Line Plan Draws the Ire of Competitors."[493] IBM's head of banking, finance, and securities told the newspaper that the payments standard needed to be an open standard "in the hands of a neutral third party." Netscape and Mastercard now counted Intuit as a

[489] "On-line standard unveiled - without MasterCard," by Valerie Block, *American Banker,* September 28, 1995.

[490] "On-line standard unveiled - without MasterCard," by Valerie Block, *American Banker,* September 28, 1995.

[491] "Visa Backs Shopping On Internet Assurance Of Credit Plan Safety," by James Coates, *The Chicago Tribune,* September 28, 1995.

[492] "Visa Backs Shopping On Internet Assurance Of Credit Plan Safety," by James Coates, *The Chicago Tribune,* September 28, 1995.

[493] "Microsoft-Visa On-Line Plan Draws the Ire of Competitors," by John Markoff, *The New York Times,* September 28, 1995.

third partner in the development of Secure Courier, it's competitor to STT, and said that they intended to make Secure Courier free. The absence of MasterCard from the STT announcement in a mere three months was an early indication that the growth of e-commerce would be slowed by the race to set standards. The same week, Checkfree Corp. enjoyed a successful IPO,[494] characterized by *American Banker* as riding a wave of "Wall Street's growing obsession with firms involved in electronic commerce."[495] But in November, after the recent launch of MSN, the *New York Times* reported that the standards-setting alliance with Mastercard, IBM, and Netscape had fallen apart.[496] Soon thereafter, it appeared that the core alliance between Microsoft and Visa was also failing.[497] At Microsoft's internet strategy event on December 7, 1995, Gates said in his keynote of transactions protocols, "Even within the next few months here, there'll be a lot of progress on this. Basically it'll be very, very straight-forward to spend money on the Internet. Even transactions as little as a cent, the overhead of processing that transaction will be small enough that it can be done economically. And that is essential because if you want a publisher to go out and put content up, they've got to be able to charge a non-zero price, but a very low price so that people browsing around find it attractive."[498] Even in the aftermath of his 1994 dinosaur remark, Gates remained overly optimistic about the prospects of embedded in-browser micropayments technology.

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[494] "Cyber IPO; Checkfree, Provider of On-Line Commerce Services, Hits Street," by Reuters, *The Los Angeles Times*, September 28, 1995.

[495] "Bank systems stocks up for week, riding surge in technology issues," by Brian Tracey, *American Banker*, October 2, 1995.

[496] "Making Microsoft safe for capitalism," by James Gleick, *The New York Times*, November 5, 1995.

[497] "Visa, Microsoft Security Deal Ailing," by CNet News Staff, *CNet*, November 22, 1995.

[498] *US v. Microsoft Corp*, 253. (Exhibit 502, p. 8).

In 1996, as the race between Navigator and Internet Explorer intensified, so did the speed and complexity with which all parties involved with the business of securing online payments formed, abandoned, and reformed partnerships. On January 23, Verifone and Netscape announced that they were jointly developing software expected to be available in October that would "allow consumers to use any major credit card to purchase goods on the World Wide Web portion of the Internet."[499] *American Banker* reported, "The deal was heralded as a potent partnership that draws software and hardware strength from two market leaders. Observers said the arrangement also offers encouragement to banks concerned about the future of Internet- based payments."[500] Here, the difficulty tech firms faced in wooing banks was again highlighted. More than just the marriage of browser and server software technology with secure point-of-sales equipment, the Verifone-Netscape deal appeared to be a workaround for Mastercard's expressed intent to prevent Mastercard holders from using any transactions standard the credit card company did not endorse.

In February 1996, Netscape abandoned its own protocol, joining forces with Mastercard and IBM to endorse the Microsoft and Visa-led protocol, now called SET. Taher Elgamal, Netscape's chief scientist, explained to the *New York Times* that by removing the issue of competing standards, this would make online shopping easier for consumers.[501] Along with Netscape, GTE Corporation, Science Applications International Corporation, Terisa Systems, and Verisign all endorsed SET. Edward Hogan, a MasterCard executive, stated, "There was a blip in the road, but both associations realized that their memberships wanted a single standard."[502] For all parties involved, adoption was key in driving this eventual collaboration between the parties

[499] "Tech Bytes: Verifone, Netscape Plan An Internet Card System," *American Banker*, January 23, 1996.

[500] "NEWS ANALYSIS: Verifone-Netscape Plan for Internet Payments Seems Banker-Friendly," by Karen Epper, *American Banker*, January 24, 1996.

[501] "Plan to Guard Credit Safety On Internet," by John Markoff, *The New York Times*, February 1, 1996.

[502] "Plan to Guard Credit Safety On Internet," by John Markoff, *The New York Times*, February 1, 1996.

involved. Merchants, tech firms, and card companies continued to face consumer reluctance to purchase goods online due to security concerns.[503] Following this announcement, it was reported that Microsoft entered into a non-exclusive partnership with Wal-Mart to develop software for the retail giant to engage in e-commerce. The news was an early endorsement of Microsoft's Merchant Server software.[504] The following month saw the announcement that the Canadian firm Commerce Direct International Inc. would offer secure credit card payment online, leveraging Microsoft's ActiveX to allow for online payments through websites.[505] RSA Data Security would endorse SET in mid-March.[506]

On May 13, 1996, Netscape announced Netscape LivePayment, an "open, cross-platform server software for collecting payments on the Internet" that was analogous to an online cash register.[507] LivePayment, according to Netscape, offered "high-grade encryption." The company press release read:

> To help users transform their Web sites into Internet store fronts, Netscape LivePayment includes templates to facilitate development of payment-ready applications. Using Netscape Navigator Gold premium client software, users can modify the templates to create their own online image quickly and easily. Netscape LivePayment can receive payment information from Secure Sockets Layer (SSL) enabled Internet clients and process the transactions over the Internet. Netscape also plans to support the emerging Secure

[503] "Attention, Cyber-Shoppers," by John Markoff, *The New York Times,* Feburary 4, 1996.

[504] "A Wal-Mart Experiment On Internet," by Peter H. Lewis, *The New York Times,* Feburary 13, 1996.

[505] "Tech Bytes: System Said to Secure On-Line Card Payments," *American Banker,* March 25, 1996.

[506] "Encryption Software Firm Adopts On-Line Protocol," *American Banker,* March 14, 1996.

[507] "Netscape Announces Netscape Livepayment to Facilitate Internet Commerce," *PR newswire,* May 13, 1996. https://web.archive.org/web/20030416151919/http://wp.netscape.com/newsref/pr/newsrelease144.html

> Electronic Transactions (SET) protocol and other payment mechanisms, such as microtransactions, in Netscape LivePayment.[508]

The announcement of LivePayment would drive Netscape's stock price up nearly twenty percent, reaching a year-high of $75 on May 23. Netscape also announced that future Navigator release would include digital wallet technology, "providing a uniform interface for Internet purchases and transactions." This yet-to-released solution would maintain electronic receipts and a ledger of transactions that can be downloaded into personal financial software. LivePayment was supported by CyberCash, First Data, GE Capital Retailer Financial Services, MasterCard, VeriFone, and Wells Fargo. First Data led the beta program for LivePayment, which was priced at $2,995 to be available starting in the third quarter of 1996. In late September, Netscape announced Netscape Payment Kit, which included LivePayment, a software package that allowed businesses to build intranet applications and sites that accepted credit card payments.[509] Netscape also previewed a Netscape software-powered Reuters Web, a private web-based network for Reuters financial services clients providing access to news, historical data, and equities and fixed income research.[510] Netscape appeared to have ceded the standard setting field to Microsoft while continuing to thrive in browser-based payments technology innovation.

But a few months later, in December, Netscape quietly shut down the LivePayment program. Netscape executives conceded that "their company's strength did not lie in facilitating transactions and that getting up to speed would be too costly," considering the short-lived program

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[508] "Netscape Announces Netscape Livepayment to Facilitate Internet Commerce," *PR newswire,* May 13, 1996. https://web.archive.org/web/20030416151919/http://wp.netscape.com/newsref/pr/newsrelease144.html

[509] "Netscape takes payments live on the Net," by CNET News Staff, *CNet,* September 30, 1996.

[510] "Reuters and Netscape Preview Reuters Web, a Private Network for Financial Markets," *PR newswire,* September 25, 1996.
https://web.archive.org/web/20030416190833/http://wp.netscape.com/newsref/pr/newsrelease248.html

as a "lesson in the turbulence of electronic commerce." A year later, in April 1997, LivePayment was officially dead, "quietly dismantled and parceled out to several of the company's technology partners that have greater expertise in Internet payments."[511] This marked Netscape's final attempt at building embedded payments capabilities into the browser. Far from its stock price high of $75 a year prior, Netscape's stock price now "hovers in the high $20s." CyberCash "stepped in most eagerly" to take over LivePayment; the company's existing products most closely mirrored that of LivePayment and Netscape Wallet.

Verifone announced in June 1996 its web payment software and an internet payment system for banks. Verifone signed early adopter clients like Wells Fargo and the Royal Bank of Canada, jumping SET, which would not be available until early 1997.[512] With Verifone's reputation in securing credit card transactions through its point-of-sales system, the company's participation in setting security standards was considered a positive move toward opening up the e-commerce market. In March 1997, Netscape and Verifone would announce plans to bundle Verifone's payment services products into Netscape products.[513]

For all the market hype surrounding e-commerce, in 1996, consumer and merchant trust was still an issue hindering the growth of web-based commerce. Microsoft's Barbara Fox, during her talk at the Cyberpayments '96 conference in Dallas, cited figures from International Data Corp. research indicating that 70% of large and medium-sized businesses see security online as insufficient for commerce while 32% see security as the main obstacle to e-commerce.[514] A week

[511] "On-Line Banking: Netscape Pulls the Plug on Its Net Payment System," by Jennifer Kingson Bloom, *American Banker,* April 16, 1997.

[512] "VeriFone to Introduce SoftwareShielding Internet Retail Activity," by Don Clark, *The Wall Street Journal,* June 18, 1996.

[513] "VeriFone, CyberCash StockSurges After Netscape Pacts," *The Wall Street Journal,* March 3, 1997.

[514] 'Chorus of cheers (mostly) for Internet commerce," by Jeffrey Kutler, *American Banker,* June 26, 1996.

later, the companies behind SET published a revised version of the SET specification, indicating that a consumer-ready SET solution would be ready by the end of the year.[515] In the fall, Visa and MasterCard begin testing SET, engaging in e-commerce trials globally.[516] In October 1996, the credit card companies select Terisa Systems to provide the reference implementation of the SET protocol.[517] By the end of the month, Microsoft announced a line-up of major clients for its Merchant Server 1.0, developed with Verifone, which used the SET protocol.[518] Among the clients were Bank of America, Citicorp, Wells Fargo, and the Royal Bank of Canada.[519] Microsoft also sought to provide a standard for mobility, as the SET standard required that the secured data reside in a PC, through a October 1996 proposal, Personal Information Exchange, to the World Wide Web Consortium.[520] The prevailing assumption at the time was that eventually such a security certificate would be compressed to reside in a smart card chip, furthering the belief that smart cards would be crucial to securing transactions with PC-based access points.

By the end of 1996, it was clear that though Microsoft seemingly edged out Netscape by winning bigger names over to the SET consortium, SET was not a universal standard and "corporate motives have slowed collective progress."[521] On the last day of the year, Mastercard,

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[515] "Visa, Mastercard and Technology Partners Publish Revised Secure Electronic Transactions Method," *PR newswire*, June 25, 1996.
https://web.archive.org/web/20030416194012/http://wp.netscape.com/newsref/pr/newsrelease177.html

[516] "Smart Bits: Visa to Test Electronic Commerce in Taiwan," *American Banker*, September 18, 1996.

[517] "Terisa to provide working model of SET protocol," by Jeffrey Kutler, *American Banker*, October 2, 1996.

[518] "Microsoft Makes It Simple to Sell on the Web; Release of Merchant Server Expected to Ignite Internet Commerce," *PR newswire*, October 31, 1996.

[519] "On-Line Banking: Microsoft's Web Software for Merchants Wins Support," by Jennifer Kingson Bloom, *American Banker*, October 31, 1996.

[520] "Comment: Bankers Are Missing the Boat for Smart Card Journey," by Jerome Svigals, *American Banker*, Ocotber 28, 1996.

[521] "On-Line Banking: Rivals Unite on Rules for Internet Commerce," by Jennifer Kingson Bloom, *American Banker*, November 14, 1996.

IBM, and a Danish bank jointly announced that it would begin testing SET in mid-January while Visa said its version would be ready in 1998, suggesting interoperability issues between the two credit card networks using the same protocol.[522] The advent of digital currency offerings from Digicash and Cybercash further complicated transactions standards for the web. To solve the thorny issue of interoperability of payment systems and providing a single interface for payment on the web, another consortium was formed in December 1995. This time, an international group of academics and industry engineers came together as the Joint Electronic Payments Initiative (JEPI), the result of collaboration between the W3C and CommerceNet.[523] JEPI's goal was to reach a common payment mechanism, where the consumer would choose a default payment system, and test it. In other words, JEPI attempted to create a single payments interface to bypass the issue of interoperability in browsers. On October 15, 1996, the W3C and CommerceNet jointly announce the JEPI specifications.[524] Berners-Lee was quoted in the press release, "One of the major ingredients needed for Web commerce is the ability for different payment instruments and protocols to exchange information. We are enthusiastic about JEPI because it effectively addresses this need." JEPI's approach to unifying various payment methods was to ask browser, server, and payment vendors to incorporate the JEPI protocol into their products.[525]

After testing SET in Denmark in early 1997, the new standard was adopted quickly across Europe by summer 1997.[526] Yet, it continued to suffer from lack of endorsement from financial

[522] "Internet Security System to Be Tested," by Bloomberg Business, *The New York Times*, January 1, 1997.

[523] "W3C Electronic Payments Area. "https://www.w3.org/ECommerce/Overview-JEPI.html.

[524] "World Wide Web Consortium and CommerceNet Announce Major Step Toward Resolving Industry-wide Internet Payment Challenge," by The World Wide Web Consortium, October 15, 1996. https://www.w3.org/ECommerce/pr.html. https://www.w3.org/ECommerce/pr.html

[525] "W3C proposes Web payment standard," by CNet News Staff, *CNet*, April 17, 1996.

[526] "Cyberscape: IBM Says it Can Make Internet Payments Safe," by Paul Floren, *The New York Times*, July 21, 1997.

firms. Bankers and merchants criticized SET for being "too slow, too expensive and far too cumbersome for shoppers to use."[527] While Chase worked with Wal-Mart to test SET technology in stores, other banks were slow to promote SET given the estimated $3 to $5 cost per customer to sign users up for SET. Interoperability was also an issue, as Mastercard and Visa's respective versions of SET were not compatible with one another. Visa and Mastercard pitched SET to merchants under the auspices that merchants would suffer less credit card fraud, thereby covering for the high user and transaction costs. In December 1997, an analyst described to CNet the difficulties amongst the corporate parties involved in getting SET off the ground, saying that "SET is the same soap opera."[528] By November 1998, it was clear that SET was not a success.[529] A Mastercard executive explained the situation to *American Banker*, "SET was viewed in the past as a product for e-commerce, and that was the wrong positioning." By 2002, SETCo, which managed and promoted the use of the SET specification, stopped updating its website.[530] Though Microsoft succeeded in edging Netscape out of the standards setting battle, its SET protocol was largely considered dead on arrival.

[527] "New Security System for Internet Purchases Has Its Doubters," by Saul Hansell, *The New York Times*, November 24, 1997.

[528] "Net earnings: E-commerce in 1997," *CNet*, December 24, 1997.

[529] "SET: A Made-for-Bankers Message That Some how Never Clicked," *American Banker*, November 17, 1998.

[530] The archived SET website is accessible at https://web.archive.org/web/20020930024644/http://www.setco.org:80.

*The Promise of Home Banking Software (1993-1996)*

*"Basically what Microsoft is trying to do is tax every bit transition in the whole world." Unnamed software company executive, 1995.*[531]

In late 1995, as Bill Gates embarked an apology tour of sorts for his 1994 dinosaur remark, banks remained skeptical of both Microsoft (despite the aborted merger with Intuit) and the promise of the internet. Home banking first arrived on the PC in 1983 when banks believed a broad-based system of electronic delivery services would cut branch-based costs and generate revenues.[532] After significant monetary investment from banks the technology failed to catch on with customers, but it was the popularity of Quicken, with its personal and household financial planning capabilities and checkbook metaphor user interface, that appeared to fulfill the promise of home banking. By the end of 1994, banks faced two dilemmas fueled by the rise of the internet: the seemingly imminent capture of the emerging home banking market by software companies and the advent of electronic money necessary for consumers to make purchases online with security and privacy. For banks, the future of retail transactions was, one way or another, within Microsoft's reach. *American Banker* described aptly portrayed the tensions between the banks and tech firms:

> Unlike in the past, when banks could simply purchase, lease, or license the technology they needed from companies eager to profit from such a relationship, the new technological giants may be positioning themselves for a much different role. Instead of being content to profit by helping banks serve their customers better, the nonbanks realize that technology may allow them to take banks' customers away, product by product.[533]

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[531] "Making Microsoft safe for capitalism," by James Gleick, *The New York Times,* November 5, 1995.

[532] "BANKING GOES INTO THE HOME," by Robert A. Bennett, *The New York Times,* December 7, 1983.

[533] "Key question for emerging systems: where is the money?," by Thomas P. Vartanian, *American Banker,* June 17, 1996.

MasterBanking, launched in April 1993, was an online bill payment venture between Mastercard and Checkfree. Mastercard hoped that by year end 30 to 40 banks would sign up for the service.[534] In the same year, Visa attempted to partner with Intuit; the partnership reportedly failed over differences in business strategy. After unsuccessful attempts at providing banks with an electronic banking product, Visa acquired the electronic banking and bill payments division of U.S. Order Corporation in August 1994.[535] Intuit, on the other hand, had announced in July the acquisition of a rival payments processing company, National Payment Clearinghouse, which would later be renamed Intuit Services. For a software firm, this was the first concrete step Intuit took in becoming a transactions services provider. The new business unit under Visa rebranded as Visa Interactive.[536] In September 1994, Visa Interactive made its first major announcement: it would work with H&R Block's software unit to provide home banking services through H&R Block's Meca software application, Managing Your Money.[537] Visa Interactive's vision for home banking entailed customers signing up for "bankbranded, user-friendly" home banking services through their financial institutions.[538] For banks and credit card companies, home banking services and online e-commerce transactions already comprised a hotly contested emerging market.[539] In October 1994, Eugene Lockhart, chairman of Mastercard, told the *New York Times*, "As the customer gets more and more remote from the physical branch, how does the bank maintain that

[534] "Mastercard In Electronic Bank Venture," by Saul Hansell, *The New York Times,* April 29, 1993.

[535] "COMPANY NEWS; Visa Buying Electronic-Payment Operation," by Saul Hansell, *The New York Times,* August 4, 1994.

[536] "Visa buys U.S. Order's payment unit," *American Banker*, August 4, 1994.

[537] "H&R Block unit to make home-banking software for Visa," *American Banker,* September 21, 1994.

[538] "H&R Block unit to make home-banking software for Visa," *American Banker,* September 21, 1994.

[539] "BUSINESS TECHNOLOGY; Banks Going Interactive to Fend Off New Rivals," by Saul Hansell, *The New York Times,* October 19, 1994.

relationship? It's a very very big question that no one has the answer to."[540] In early October 1994, Chase partnered with Microsoft to offer home banking services through Microsoft Money.[541] By the end of the year, Chase announced the Chase CallBook 220, a hardware product with a screen that users not yet comfortable with PC products could plug into a phone and access bank account information and services.[542] Shortly after the Chase-Microsoft Money partnership announcement, Microsoft and Intuit announced a merger. In doing so, Microsoft would acquire the leading personal finance software application, as well as a payments processing unit in National Payment Clearinghouse. Had the merger gone through, Microsoft would have acquired a transactions services business.

By spring of 1995, the world had caught on to the web via Netscape Navigator. In March 1995, Netscape appeared to have settled on a tried-and-true business model of giving away the razor to sell the blades. Navigator ultimately became a free browser product while Netscape's commercial servers went for $1500 to $5000, with companies operating websites purchasing around 20 or more copies of the software.[543] Navigator was not only fast becoming the world's browser of choice, but its makers were successfully converting rapid user adoption into enterprise technology sales clout. By April 1995, *American Banker* reported that the issue of the web had become a source of a booming consulting business targeted at financial services firms and that at least 100 commercial banks and financial service providers had established their web domains –

[540] "BUSINESS TECHNOLOGY; Banks Going Interactive to Fend Off New Rivals," by Saul Hansell, *The New York Times*, October 19, 1994.

[541] "Gates and Chase team up to take on Intuit," *Businessweek*, October 23, 1994.

[542] "Chase makes leadership bid in home banking race," by Jeffrey Kutler, *American Banker*, December 5, 1994.

[543] "BUSINESS TECHNOLOGY; Netscape Knows Fame And Aspires to Fortune," by Peter H. Lewis, *The New York Times*, March 1, 1995.

and that those websites would be used to offer consumers banking services.[544] Overarching sentiment, however, was still one of skepticism towards security claims made by digital payment startups and Netscape.[545]

The rush towards home banking made many headlines in highlighting the uneasy relationship banks had with technology companies. On the consumer payments front, by the end of 1994 there were several players and alliances formed to tackle the business of internet-based financial transactions that were seen as bank or credit card company-friendly. In other words, these companies and partnerships were strategically positioned as counterweights to the encroachment of Microsoft, whose proposed merger with Intuit was ill-received by the financial services community.[546] Fears of Microsoft moving into the consumer banking space as an intermediary were not unfounded. In early May, Bank of American and Nationsbank joined forces to buy Meca's Managing Your Money, a competitor software to Quicken and Microsoft Money, from H&R Block.[547] While the Intuit acquisition was under investigation by the Justice Department, Quicken was the leading home banking software, boasting seven million users. Yet, Microsoft Money had a licensing deal with Chase Manhattan, business that Intuit had failed to acquire.[548] The scrutiny of Microsoft's activities in the home banking space were founded in different anxieties for different parties. For the Justice Department, Quicken and Microsoft Money together

[544] "REPORTER'S NOTEBOOK: Internet Boosters Keep Beating the Drum," by Jeffrey Kutler, *American Banker*, April 13, 1995.

[545] "REPORTER'S NOTEBOOK: Internet Boosters Keep Beating the Drum," by Jeffrey Kutler, *American Banker*, April 13, 1995.

[546] "Computer Associates cozying up to banks in financial software challenge to Microsoft," *American Banker*, November 24, 1994.

[547] "2 Banks to Buy Meca Software For Personal Financial Program," by Lawrence M. Fisher, *The New York Times*, May 11, 1995.

[548] "U.S. SUES TO BLOCK $2 BILLION MERGER MICROSOFT SEEKS," by Lawrence M. Fisher, *The New York Times*, April 28, 1995.

held 90 percent of that segment of the software market. For banks, Microsoft would suddenly have the ability to levy "a fee of only fractions of a cent for each transaction, the software giant could have reaped billions of dollars in revenue." Nathan Myhrvold told *Wired* in late 1994, "Explicitly or implicitly there's a fee involved. Even in a pure-cash transaction, you pay for those costs. Cash is an expensive thing to move around. You have to hire guards from Brinks with guns and all that bullshit. That's all included in the price of things you buy."[549] Microsoft had predicted that in the near future 40 percent of all banking will be processed on PCs. In the organization's attempt to get ahead of this trend, Microsoft had sought to make Quicken the user interface of MSN's finance section.[550]

In what was regarded as a quick turnaround after Microsoft walked away from the merger in May 1995, Intuit announced in July 1995 that 19 financial institutions would offer home banking services through Quicken.[551] Quicken users who were customers of institutions like American Express and Chase would be able to transfer money between accounts, pay bills, and download account data onto their PCs. Intuit Services Corporation, the transactions processing unit of the software company, would act as the data clearinghouse between the Quicken user and the financial institution. Intuit CEO Scott Cook indicated that Quicken users would likely pay a monthly fee to the bank or credit card company for these home banking services, and that Intuit would also collect transaction fees from the institutions.[552]

On June 7, AT&T entered the home banking stage by announcing that the company would offer a $350 device for lease at a monthly rate of $13.95 that would allow customers to pay bills

[549] "E-Money (That's What I Want)," by Stephen Levy, *Wired*, December 1994.

[550] "Why Did Microsoft Abandon Intuit?," by Lee Gomes, *The Seattle Times*, May 22, 1995.

[551] "Intuit Signs 19 Deals for Home-Banking Software," by Laurie Flynn, *The New York Times*, July 15, 1995.

[552] "Intuit Signs 19 Deals for Home-Banking Software," by Laurie Flynn, *The New York Times*, July 15, 1995.

via commands on their TV screens. The same AT&T and Checkfree software would also be available for PCs.[553] This move by a telecommunications giant seemed to validate Gates' interactive TV ambitions dating from 1993. After having offered home banking services to its customers for a year through Microsoft Money, Chase announced on June 13 Chase Direct, an electronic banking account package that customers could sign up for over telephone without filling out paperwork.[554]

Checkfree would eventually partner with Cybercash, using Cybercash's encryption technology to process certain payments online.[555] Visa announced in August that it would partner with Worlds Inc., a San Francisco software firm, to put "virtual branches" on the internet, using security protocols developed by Visa and Microsoft.[556] Visa's virtual branches would offer more than just home banking services online; it would feature entertainment and retail storefronts through an online marketplace. The announcement appeared to be part of a banking industry race to offer internet products: Cardinal Bancshares was testing its Security First Network Bank. In October 1995, the bank was operational having received approval from the Office of Thrift Supervision to become the first bank operating purely online.[557]

For Intuit and Quicken, the narrative shifted by October 1995 when contractual disputes and technical challenges of working with multiple banks within a single system made home banking via Quicken increasingly unlikely in 1995. *American Banker* reported that ultimately the inability of a consortium of banks to get on the same page prevented the successful rollout of the

[553] "AT&T to Provide Banking on a Home TV," by The Associated Press, *The New York Times,* June 7, 1995.

[554] "Chase Introducing New Electronic-Banking Account," by Saul Hansell, *The New York Times,* June 13, 1995.

[555] "Checkfree to use Cybercash encryption system," by Karen Epper, *American Banker,* July 18, 1995.

[556] "Home banking: Visa Developing 'Virtual Branches' That Banks Can Open on the Internet," by Karen Epper, *American Banker,* August 11, 1995.

[557] "On-Line Bank Set to Start: 1," by Reuters, *The New York times* October 17, 1995.

home banking service.[558] On October 19, an announcement between Intuit and Netscape appeared to bind the two software firms together through Intuit's new internet strategy by integrating Quicken with Navigator, providing users with free access to Intuit's new website, the Quicken Financial Network, and a low-cost internet access deal via Concentric, an ISP.[559] The following week, it was rumored that Mastercard was in talks with Meca and Servantis Systems to revive Mastercard's home banking program.[560] In November 1995, Intuit announced an agreement with DST Systems to allow Quicken users access to mutual fund information via the internet, with the goal of allowing mutual fund shareholders to one day make transactions online, responding to the proliferation of mutual funds during the Millennium Boom years.[561] Intuit made another push in December to expand Quicken's home banking services by partnering with AOL. Both Gates and Cook made their cases at the Bank Administration Institute conference in Atlanta.

For Gates, his showing was part of what appeared to be an apology tour with the banking industry whereas Cook sought to pitch Intuit as a software partner for banks to expand their reach.[562] Gates was described by *American Banker* as having "repented for calling banks 'dinosaurs,'" and pitched the concept of embracing open systems via Microsoft-supported standards, giving banks the flexibility to choose personal finance software and processing services.[563] At the time, Microsoft seemingly had pivoted its strategy, seeking to offer software products to banks given the web boom instead of profiting from transactions fees. The *New York*

[558] "Hookup to Quicken, Money no slam dunk," by Karen Epper, *American Banker,* October 10, 1995.

[559] "Internet access: Intuit to provide Internet access directly from Quicken," by Netscape, October 19, 1995. https://web.archive.org/web/20030211173442/http://wp.netscape.com/newsref/pr/newsrelease55.html

[560] "Executive Briefing - Fed May Have to Close Daiwa's N.Y. Branch," *American Banker,* October 30, 1995.

[561] "Intuit Signs Fund Firm for Internet Services," by Brian Tracey, *American Banker*, November 30, 1995.

[562] "2 On-Line Banking Champions at Crossroad," by Paul Lewis, *The New York Times,* December 5, 1995.

[563] "NEWS ANALYSIS: Gates Helped Microsoft's Cause By Disarming Bankers at Meeting," by Karen Epper, *American Banker*, December 13, 1995.

*Times* reported, "Microsoft appears to be pulling back from some of its ambitious plans for home banking, reflecting the company's new emphasis on electronic mail and the Internet's World Wide Web rather than through proprietary networks that the company can control." Typical for Microsoft, the firm sought to reassure potential partners of its motives and the openness of its technologies. Amid Gates' apology tour to woo banks into working with Microsoft on standards-setting, the rumors surfaced of the breakup of the alliance of technology firms and credit card companies (namely, Mastercard and Visa) behind SET; Microsoft and Visa appeared to be on shaky ground in late November. By mid-February 1996, the two companies announced a home banking and bill payment services partnership for Microsoft Money. This announcement effectively gave banks the option to choose Visa for transactions processing, instead of Intuit Services, which handled banking and billing processing for Microsoft Money. Visa, unlike Intuit, enjoyed the support of banks given that the credit card company worked with 19,000 client banks.[564]

In early 1996, Intuit experienced teething issues in processing transactions for its customers, where some bill payments were routed to the wrong merchants and other payments were posted late. Processing between Quicken and American Express failed frequently.[565] In February 1996, *American Banker* reported that an Akron, Ohio-based bank, FirstMerit Corp., was "taking it slow" when it came to investing in online banking services. The bank's chief executive explained, "We are not seeing the sense of strong demand that would warrant a great sense of

[564] "Visa and Microsoft to Plan Home Banking System," by Peter H. Lewis, *The New York Times*, February 15, 1996.

[565] "SPENDING IT; Finding Your Glitch in Banking on Your PC," by Saul Hansell, *The New York Times*, February 25, 1996.

urgency."[566] This is one of the early but rare indications that the industry was responding to a sense of urgency generated by the narrative of technology innovation, rather than consumer demand.

On March 25, 1996, Checkfree Corp. moved into investment transactions services when it announced its acquisition of Security APL Inc., a Columbus, Ohio-based online portfolio management software company.[567] Checkfree's founder and CEO Pete Kight noted that advances in technology were "rapidly blurring distinctions between banks, investment banks, and brokerage firms" and that his company sought to integrate newly acquired technologies into a "single screen" UI for its customers.[568] Investments in television-based home banking software continued in 1996, but by May, an article in *American Banker* on tv banking indicated that, despite the hype from tech firms, the demand for such a service may not actually exist.[569] Bill Melton of CyberCash, however, told *American Banker* in October 1996 that he envisioned smart card chip readers through WebTV as a banking access point for the mass market.[570]

In June, Intuit and AOL together announced BankNOW, a home banking service for bill payment and money transfers, the first to be offered jointly between a major software firm and one of the largest ISPs. Cook emphasized that BankNOW would "branded by the bank, priced by the bank, and sold by the bank," addressing the challenges that Intuit faced in partnering with banks on Quicken home banking services.[571] Unlike Quicken, BankNOW did not need to be installed on

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[566] "Easing onto the Information Superhighway," *American Banker,* February 12, 1996.

[567] "Checkfree Buying Security APL, a Pioneer Of Investment Services Over," *American Banker,* March 25, 1996.

[568] "Checkfree Touts Single Screen Home Banking," *American Banker,* June 10, 1996.

[569] "Tech Firm Hoping Consumers Tune In to TV Banking," by Jennifer Kingson Bloom, *American Banker,* May 10, 1996.

[570] "Cybercash's CEO Let His Curiosity Lead His Career Path," by Jennifer Kingson Bloom, *American Banker,* October 21, 1996.

[571] "America Online, Intuit team up to offer a home banking service," by Jennifer Kingson Bloom, *American Banker,* June 13, 1996.

a computer. Though Intuit and AOL offered BankNOW to banks for free, banks would still pay monthly processing fees. The Federal Reserve Board approved the joint acquisition by a coalition of banks of an internet banking software firm, Five Paces Software Inc., whose product allowed customers to open accounts, transfer funds, and pay bills from PCs.[572] In mid-June 1996, Visa Interactive signed an agreement with Security First Network Bank to use Five Pace's Virtual Bank Manager software for online transactions. The software was originally designed for Security First Network Bank, the first pure Internet bank, based on technology developed by Hewlett Packard for the Department of Defense.[573] Visa Interactive sought to make web transactions possible by the end of 1996 through this licensing agreement. Despite the deal, Security First Network Bank continued to struggle in August 1996.[574] In September, New England Life Insurance Co. joined the five banks in ownership of Meca, further enhancing the narrative that home banking would expand from retail banking transactions to insurance and mutual fund transactions.[575]

Upon the launch of Bank of America's revamped website in 1996, *American Banker* ran a timeline of Bank of America's activities in response to technological innovations in retail banking. In the summer of 1995, the bank simultaneously invested in home banking (through its joint acquisition of Meca with NationsBank), an access point through AOL, and online banking via the bank's own standalone website.[576] After testing and prototype iteration, Bank of America launched its online banking site with transactional capabilities in June 1996, giving customers the option to bank through the AOL network or on the web. As part of the bank's testing scheme, *American*

[572] The buyers were Cardinal Bancshares, Huntington Bancshares, Wachovia Corp., and Area Bancshares. "Fed Allows Bank Group to Buy Internet Banking Services Firm," *American Banker,* May 23, 1996.

[573] "Visa to Use Security 1st System for Web Banking," *American Banker,* June 14, 1996.

[574] "A Virtual Bank Grapples with Reality," *American Banker,* August 19, 1996.

[575] "Bank Consortium Allows Nonbank into Meca Fold," *American Banker,* September 23, 1996.

[576] "An On-Line Time Line: B of A and Home Banking," *American Banker,* June 18, 1996.

*Banker* reported that a Bank of America executive observed more than 60 people for an hour each over the course of two weeks, seated behind a one-way window, attempting "to read their body language… trying to detect any minor twitch that could signify discomfort with his company's evolving home banking product."[577] One of the discoveries of these tests was the subjects' concerns about privacy, which the bank addressed through UI indicators like padlock icons to indicate secured pages.

The rush to sell home banking services in the midst of the web's growing popularity did enjoy some success in the market. Citibank slashed its home banking fees in the summer of 1995 and saw home banking customers increase threefold. Quicken saw home banking sign-up increase by nearly 100,000 new customers in fall 1995 after it announced it partnered with a large number of banks.[578] 1996 also saw startups like BankSite Online[579] and Digital Insight[580] provide website and online banking services to bring small community banks and credit unions online. Still, the *New York Times* reported in August 1996 that only one to two percent of all US households with PCs used a home banking program, signaling a gap between the media narrative driving home banking software development and actual consumer demand, especially as more PC users made their way online to the web.[581]

In early September 1996, IBM and a consortium of 15 banks formed a company called Integrion Financial Network to set transactions standards for online banking. IBM's goal was to

[577] "BankAmerica PC Banking Had to Pass Road Test," *American Banker, June 18, 1996.*

[578] "SPENDING IT; Banking at Home: Once More, With Feeling," by Saul Hansell, *The New York Times,* February 25, 1996.

[579] "On-Line Entrepreneur Has Set His Site for Banks," *American Banker,* July 25, 1996.

[580] "Giving Credit Unions a Boost into Cyberspace," *American Banker,* August 29, 1996.

[581] "Test-Driving the New Home Banking Software," by Barbara Wall, *The New York Times,* August 24, 1996.

attract banks of all sizes to the promise land of online banking.[582] Integrion's banking partners included big names like Bank of America, the Royal Bank of Canada, Banc One, and NationsBank, as well as regional players like KeyCorp, Michigan National Bank, and Washington Mutual Services Bank. Integrion's play was to develop the security standards that would support online banking on the web, rather than through a software. The business model for Integrion was distinctly different from Microsoft: transaction fees would be made by participating banks while IBM profited from selling software and services for Integrion.

Netscape, on the other hand, continued to push its server software to financial services clients, making several announcements that it had won over prominent financial services institutions. On July 23, Netscape announced that the Bank of America was using Netscape server software for its Internet HomeBanking website (the bank offered its online banking services via the website, AOL, or the bank's customized version of the Managing Your Money software).[583] In mid-August, Netscape announced that Countrywide Home Loans, the largest US independent mortgage lender at the time, was developing "the mortgage industry's most sophisticated Internet systems" on Netscape server and client software.[584] While retail banks in the United States began to invest in online banking services, the *Wall Street Journal* would note 1996 as the year Europe made significant achievements in internet banking as American banks continued to lag in progress. The problem of retail adoption in the US was characterized as a technical literacy issue; retail

[582] "Major Banks, IBM Launch Online Service; Finance: Customers will be able to check their balances, write checks, transfer funds and e-mail their institutions," by The Associated Press, *The Los Angeles Times*, September 10, 1996.

[583] "Internet Homebanking Service From Bank Of America Uses Netscape Client and Server Software," *PR newswire*, July 23, 1996.
https://web.archive.org/web/20030416200850/http://wp.netscape.com/newsref/pr/newsrelease193.html

[584] "Countrywide Home Loans Uses Netscape Platform to Develop Extensive Internet and Intranet Solutions," *PR newswire*, August 15, 1996.
https://web.archive.org/web/20030416230645/http://wp.netscape.com/newsref/pr/newsrelease220.html

banking customers in the US were still accustomed to writing checks and conducting business in a branch office. Germany's Deutsche Telekom provided more than 1.8 million home banking users a service called T-Online, while 30% of households in France use France Telecom's Minitel.[585] Conversely, Intuit and Microsoft had capitalized on the intuition that European companies would seek to move to all-electronic accounting and secured enterprise agreements with "every major bank in Europe."

Before the end of 1996, Mastercard's ill-fated foray into home banking would come to an end. Throughout the years, Mastercard, like Visa through its Visa Interactive unit, struggled on the home banking side despite having entered the market as early as 1993. Mastercard positioned MasterBanking as a reseller of Checkfree's payments processing services. While Mastercard made significant investments in smart cards, it failed to keep MasterBanking up with technology advancements, operating on a decade-old remote banking platform that ran on Prodigy, now a struggling ISP.[586] Since its inception, there were points at which it was unclear whether Mastercard's home banking service was operational.

In the second half of 1996, banks demonstrated increasing cooperation amongst themselves in an effort to counter "the growing influence of high-tech forces."[587] The Bankers Roundtable, a trade group representing 125 of the biggest banks, formally endorsed a sweeping set of recommendations of a technology task force that led over the past year a series of behind-the-scenes discussions between the industry's top executives. Banks came to the agreement that

[585] "Europe's Banks Aim to MoveTheir Services to the Internet," by Kimberley A. Strassel, *The Wall Street Journal*, December 9, 1996.

[586] "MasterCard quietly pulls the plug on ill-starred home banking effort," by Jennifer Kingson Bloom, *American Banker*, November 26, 1996.

[587] "Banks unite in fight to keep a grip in an on-line world," by Jeffrey Kutler, *American Banker*, September 27, 1996.

security, privacy, and risk management were all issues of mutual interest. The Bankers Roundtable called for "collaborative action" amongst banks to "ensure that banks have a hand in technical standards, promote development of secure payment mechanisms, and consider options for payment settlement." The formation of the task force and the collaboration between competitors marked a shift in the financial services industry in its dealings with tech firms. In recognizing that their "share of payments markets might erode," banks sought a collective solution in the name of consumer good.[588] Banks, it seemed, were capable of working together while rival tech firms were not.

Concurrently, the web boom was finally shifting the home banking services towards online banking and bill payments as banks and other financial institutions launched services on their websites. In July 1996, Microsoft renewed its contract with Intuit Services for processing transactions through Microsoft Money. A week later in early August, the CEO of Intuit Services resigned, followed by the announcement of other departures from its leadership team. In September, Intuit announced its exit from the home banking business when it agreed to a $228 million acquisition of Intuit Services by rival firm Checkfree.[589] After investing $30 million in Intuit Services to achieve the company's goal of enabling financial transactions, Intuit chose to focus on the front-end development of its core business, decoupling Quicken from the back-end transactions processing network. By selling Intuit Services, banks would be free to use whatever processing technology or vendor of their choice for transactions initiated through Quicken, ending the software maker's embattled attempt to win banks over.

[588] "Banks unite in fight to keep a grip in an on-line world," by Jeffrey Kutler, *American Banker*, September 27, 1996.

[589] "Why Intuit pulled plug on home banking processing," by Drew Clark, *American Banker*, September 27, 1996.

Intuit also committed to publishing software specifications through an open protocol called OpenExchange.[590] This marked a turning point for Intuit, as it pivoted from seeking revenues from processing payments and transfers to focusing on setting an open, universal financial data exchange protocol to be adopted by financial institutions. In mid-November, Chase signed a three-year contract with Checkfree for bill payment processing for customers banking on PCs, including through Microsoft Money, and via telephone. Chase, soon to offer online banking, would also use Checkfree for payment processing services on its website.[591] Checkfree, having made its first move in positioning itself as a bank-friendly payments processing entity, seemed poised to reap the benefits from Microsoft's strained relationship with banks.

### *Online Banking and Bill Payments Converge (1997-2001)*

*"Bills are your best content." Attributed to Bill Gates, whilst addressing banks, 1995.*

With adoption figures suggesting that Netscape Navigator now overtook Microsoft Word as the world's most popular software application, the web boom was undeniably in full swing at the end of 1996. Technology firms, banks, and payment processors now recognized the shift to web-based retail transactions was likely to happen soon. As a result, the battleground of home banking, online banking, and online bill payment would soon converge into a single struggle. On January 16, 1997, Microsoft, Intuit, and CheckFree announced the joint development of a single,

[590] "Why Intuit pulled plug on home banking processing," by Drew Clark, *American Banker,* September 27, 1996.

[591] "Chase signs with Checkfree for bill-payment processing," by Drew Clark, *American Banker,* November 15, 1996.

unified standard called Open Financial Exchange (OFX) for financial institutions to exchange financial data over website and software like Quicken and Microsoft Money. OFX converged Open Financial Connectivity from Microsoft, OpenExchange from Intuit, and CheckFree's proprietary bill payment protocols.[592] The three companies would also work with Visa Interactive to link OFX to the Visa ADMS bill payments system.

To get ahead of the problems Microsoft encountered in previous years with the creation and endorsement of SET, Microsoft indicated that OFX would link with a competing payments standard, the Gold Message Standard from Integrion Financial Services, and eventually converge in 1998. This development meant that Microsoft and Intuit moved further away from their mid-1990s hopes of collecting fees on internet transactions. CheckFree would still collect a per transaction fee.[593] A Forrester Research analyst explained to *Wired*, "It was really the financial service providers - the banks, brokerages, and investment houses - that forced the issue."[594] Integrion launched the GOLD protocol in March. Though the official story was that GOLD and OFX would eventually merge, banks were still fighting to control the standard. A spinoff of the Washington-based Bankers Roundtable, the Banking Industry Technology Secretariat (BITS), focused primarily on the issue of banks maintaining control over electronic payment and banking standards.[595] GOLD and OFX relied on "remarkably similar methods for establishing communications between personal computers and bank computers."[596] GOLD, however, included

[592] "Intuit, Microsoft and CheckFree Create Open Financial Exchange," *PR newswire*, January 16, 1997.

[593] "Microsoft and Intuit in E-Bank Detente," by Wired Staff, *Wired*, January 16, 1997.

[594] "Microsoft and Intuit in E-Bank Detente," by Wired Staff, *Wired*, January 16, 1997.

[595] "IBM group launches rival home banking standard," by Drew Clark, *American Banker*, March 21, 1997.

[596] "IBM group launches rival home banking standard," by Drew Clark, *American Banker*, March 21, 1997.

interbank transfers. The backers of OFX and GOLD maintained that the two standards would be interoperable by the fall and converge in 1998.

Developments among the same parties over the summer of 1997 suggested that home and online banking protocols, bill payment protocols, and secure credit card transaction protocols would eventually align on a common standard and protocol. By 1997, banks and bill payment companies struggled with the problem of "bill presentment," a term that encompassed all features of online billing, including user interface, notifications, and payments processing. In late June, Microsoft and First Data announced a Denver-based joint-venture called MSFDC. The company would begin trials of its bill payment service that summer.[597] One of Microsoft's responsibilities in the MSFDC venture was to "design a slick consumer interface superior to existing electronic bill-payment services" and allow push notifications for billing.[598] MSFDC's goal was to create a closed-loop electronic billing and bill payments system. *Fortune* magazine painted the future bill payments scenario enabled by MSFDC rosily:

> The genius of this business model is that all players actually do seem to come out ahead: Consumers get a convenient, free service; billers save money; banks bolster their online offerings--and Microsoft and First Data become the conduit of choice for billing and payment processing on the Net. Longer term, the success of MSFDC could pay even bigger dividends for its founders. Tracking the flow of consumer financial transactions over the Web is as close as you get to taking the pulse of the electronic marketplace. With Microsoft and First Data ruling the Web billing universe, you can bet they won't miss a beat.[599]

[597] "Microsoft and First Data to Create A Billing Service on the Internet," by Patricia Lamiell, *The New York Times,* June 27, 1997.

[598] "Bill Gates, bill collector," by Mary J. Cronin, *Fortune,* October 13, 1997.

[599] "Bill Gates, bill collector," by Mary J. Cronin, *Fortune,* October 13, 1997.

*American Banker*, on the hand, characterized the founding of MSFDC as Microsoft's breaking through the "bank blockade" that thwarted its Intuit acquisition two years ago, "Banks, accustomed to their governorship of the payments system, are now prey in a technology-driven business that they no longer control. The launch of MSFDC sent a message to the industry: Electronic bill payment and presentment (EBP&P) is coming, and banks are not in the driver's seat."[600] Once again, Microsoft's moves in the online transactions space endangered the control banks would have over fees, market share, and standards. Though the head of MSFDC claimed that it had no interest in making its software a "central repository" for consumers and merchants, it echoed Bill Gates' prior claims at a banking industry conference that Microsoft had no interest in the payments business.[601] Wells Fargo and KeyBank became the first banks to pilot MSFDC's online payment service in December.[602] In January 1998, MSFDC announced a program for third-party companies—consulting firms—to sell and implement MSFDC's software, replicating Microsoft's own enterprise technology systems integrator ecosystem.[603] By late 1998, the venture would announce pilots with both banks and billers. Participating banks included Banc One, Norwest Corp., Merrill Lynch, Citibank, and Mellon Bank.[604]

Integrion responded to Microsoft's activities swiftly, acquiring Visa Interactive in late August, merging Visa's online transactions and bill payments service with Integrion's online banking standards technology (Visa would still operate its ePay service that transferred funds

[600] "1 Microsoft, First Data to devour EBP&P market," by Joanna Smith Bers, *American Banker*, December 1, 1997.

[601] Andergassen, Nardini, and Ricottilli, (2017).

[602] "Wells Fargo, Key Bank, Major Billers to Pilot MSFDC's Internet-Based Electronic Bill Presentment and Payment Service," *PR newswire*, December 3, 1997.

[603] "MSFDC Announces New Third-Party Program for Implementing Its Electronic Bill Payment and Presentment System," *PR newswire*, January 28, 1998.

[604] "First Union, TransPoint Announce Internet-Based Bill Delivery And Payment Pilot," *PR newswire*, November 2, 1998.

between billers and banks).[605] The merger was seen as a response on the part of banks to the partnership between Microsoft and Intuit on OFX. In October, CheckFree took over Visa Interactive through a ten-year partnership deal with Integrion. The deal allowed Integrion to buy 3 million shares of Checkfree for $63 million and the opportunity to acquire up to a 15 percent stake in CheckFree if the partnership could add 8.5 million new users to CheckFree's billing service.[606] With the bank members of Integrion representing half of the retail banking population in North America, Integrion's ambitions with CheckFree did not appear unrealistic. In March 1998, the group published the specification of its GOLD standard.[607] The *Wall Street Journal* described Integrion in April 1998 as "a giant electronic pipeline."[608] In May, Visa and CheckFree announced a new joint venture that would integrate Visa's ePay service with CheckFree's offerings—CheckFree was now equipped to challenge MSFDC with a large built-in base of billing clients.[609]

In spring of 1998, Intuit granted Meca Software an exclusive deal to sell customized versions of Quicken to banks alongside Meca's own customized Managing Your Money software. This was another development that signaled software firms had to tailor their products to banks' interests. Banks sought to protect their brands by controlling aspects of customers' online banking experience, maintaining features of the personalized customer experience that clients received in person at branches, banks "feared being reduced to commodity providers, indistinguishable among

[605] "Integrion buys Visa Interactive," *CNet,* August 25, 1997.

[606] "Banking deal may threaten MS," *CNet,* October 29, 1997.

[607] "IBM and Consortium to Issue Standards for Online Banking," by Patricia Lamiell, *The New York Times,* March 21, 1997.

[608] "Technology Spurs Bank Mergers As Companies Search for Savings," by Matt Murray and Raju Narisetti, *The Wall Street Journal,* April 23, 1998.

[609] "Visa, Checkfree Team Up to Challenge MSFDC Electronic Payment Venture," by Drew Clark, *American Banker,* May 21, 1998.

the many companies listed on computer screens that are controlled by rivals from the world of technology."[610] Integrion and Microsoft announced plans to develop a joint connection between Integrion's platform and Microsoft Money, which would use OFX.[611] Though personal finance software remained popular in 1998, the shift toward pure web-based online banking and bill payment appeared to be in motion.

But in August 1998, the *New York Times* reported the disparity between the expected boom in internet banking services and actual adoption numbers, as well as the downfall of home banking software as banks poured investment into online banking. Citing a Tower Group analyst's estimates, only six percent of customers have electronic banking services in the United States.[612] The article suggests that internet banking services adoption was slowed by the "the greatest rush of bank mergers in history." However, an executive from Citibank explained that an uptick in internet banking amongst its customers occurred in 1995 when Citibank eliminated associated fees, while a manager of electronic banking for PNC Bank of Pittsburgh told the *New York Times*, "We're still struggling with 'What does the customer want to do?' and 'As a bank, have we created a redundant way of doing business?'" The article described the move to online as one driven by the convenience for consumers of a single UI: "In contrast, browser programs for navigating the World Wide Web offer customers and banks a universal interface on almost any computer system and eliminate problems that customers often encounter installing proprietary software." A year later, *American Banker* reported that the market may soon see the plateau of PC banking, according

[610] "Intuit-Meca Deal Eases Fears of Software Giants," by Drew Clark, *American Banker,* April 2, 1998.

[611] "MICROSOFT: Integrion and Microsoft to connect interactive financial services platform and Money 99," *M2 Presswire,* April 16, 1998.

[612] "Mergers and Year 2000 Slow On-Line Banking," by J. Wallace David, *The New York Times,* August 24, 1998.

to adoption figures of both online banking transactions and growth in household purchases of PCs.[613]

Citibank joined the MSFDC venture in September and the company was renamed TransPoint.[614] The company's bill delivery and payment service was renamed TransPoint E-Bills and Citibank adopted E-Bills technology for the bank's online services launching in October.[615] Three years after Wells Fargo first put customer banking services on the web, major banks were now rushing to adopt web technologies.[616] Throughout 1999, TransPoint appeared to gain traction with banks.[617] In July 1999, TransPoint technology was integrated into MSN MoneyCentral, where users were able to pay bills directly on the web.[618] In late January 2000, online bill payment and home banking converged when TransPoint and Intuit signed a letter of intent to partner in growing the online bill delivery market.[619] On February 1, 2000, TransPoint announced its peer-to-peer payment service Pay Anyone,[620] adopting a digital payment feature that was primarily championed by the likes of CyberCash and DigiCash. Integrion, on the other, had reduced the number of its member institutions to 12 banks by April 1999, down from its highest at 20.[621] In the fall, Integrion changed leadership and governance structure. Its adoption figures, however, were healthy. In

[613] "Computer Banking Gains, But at Something Less Than 'Internet Speed'," *American Banker,* August 9, 1999.

[614] "MICROSOFT: Citibank to join Microsoft and First Data joint venture (MSFDC)," *M2 Presswire,* September 14, 1998.

[615] "Citibank Sets New On-Line Bank System," by Saul Hansell, *The New York Times,* October 5, 1998.

[616] "Banks change with the new electronic lanscape," *CNN Money,* September 15, 1998.

[617] "MSFDC Announces New Third-Party Program for Implementing Its Electronic Bill Payment and Presentment System," by Microsoft, May 5, 1999.

[618] "First Union, TransPoint Announce Internet-Based Bill Delivery And Payment Pilot," by Microsoft, July 21, 1999.

[619] "TransPoint Will Team With Intuit to Bring Comprehensive E-Bills Offering to More Than 50 Million Online Consumers," *Business Wire,* January 31, 2000.

[620] "TransPoint Launches Powerful New Version of Its Online Bill Payment Service, Allowing Consumers to Pay All of Their Bills on the Internet," *PR newswire,* February 1, 2000.

[621] "High times for Integrion," by Brian O'Connell, *American Banker,* February 7, 2000.

February 2000, Integrion exceeded 1.5 million users and added 100,000 new users per month.[622] In 2000, Integrion shifted gears and began to target regional banks.

On February 16, 2000, CheckFree announced its acquisition of TransPoint in $1 billion in stock.[623] The deal marked Microsoft's exit from the online bill payments business after a dogged five years chasing the holy grail of owning the standards and profiting from transaction fees. The merger also signaled a market that was not yet ready to sustain multiple competitors. The *Wall Street Journal* reported that online bill payments was seen as "a potential blockbuster product of the online financial services industry," but neither billers nor customers seemed to actually see the need for such a service. Furthermore, billers and customers continued to question the security of such online services.[624] In 2000, the online billing business failed to gain traction because, once again, consumers had yet to feel the need for paying bills online. As with home banking, retail customers continued their analog practices of writing checks and going to bank branches. TransPoint would widely market its billing services in March 2000 through in-flight video presentations on United Airlines, TWA, and US Airways.[625] A Goldman Sachs report in June 2000 described electronic bill payment and presentment (EBPP) as "still in its infancy."[626] The failure of Transpoint was seen as a contributing factor in the reluctance of banks to invest heavily and urgently in EBPP technologies. In May 2001, Intuit exited the bill payment space entirely, selling its front-end bill payment software Quicken Bill Manager to Princeton eCom, a CheckFree

[622] "High times for Integrion," by Brian O'Connell, *American Banker*, February 7, 2000.

[623] "CheckFree Holdings buying a rival, Transpoint," by Bloomberg News, *The New York Times*, February 16, 2000.

[624] "CheckFree to Buy TransPoint LLC In $1 Billion Deal," by Carrick Mollenkamp, *The Wall Street Journal*, February 16, 2000.

[625] "Millions to Learn About TransPoint Through Nationally Syndicated TV Program And In-Flight Video Presentation," *PR newswire*, March 29, 2000.

[626] "It's Too Soon To Call Banks E-Bill Laggards," *American Banker*, June 7, 2000.

competitor.[627] Though home banking, online banking, and online bill payment services had finally converged, the tech industry's prediction of the market potential of these services failed to come to fruition. The end of the Millennium Boom in spring of 2001 would also mark the end of the run of blind confidence in the narrative of internet services.

### *E-Money: Cashless and Bankrupt (1997-2001)*

In the same years where online banking and online bill payments captured the attention of Microsoft, Intuit, Checkfree, and retail banks, e-money startups experienced a slow death despite attempts to pivot their businesses. The novelty of digital currency and e-wallets required consumer trust, something that CyberCash and DigiCash eventually realized only banks could provide. While the company was among a number of competitors both large and small racing to capitalize on a future explosion of e-commerce, CyberCash's bank-supported micropayments offering addressed the integration of multimedia into webpages as Netscape and Microsoft amped up browser technology innovation in their continued browser war. Ultimately, it was still a blind bet on potential user behavior: consumers were not clamoring for a micropayments solution. Consumers wanted efficiency and a guarantee that their credit card numbers would not be stolen online. Melton addressed this trust advantage held by banks, calling it out as the complication at the heart of CyberCash's inability to grow. Melton said in June 1996, "We must have the banks stand up and say it's secure. That's all it takes."[628] He said that the "presence, credibility,

[627] "Intuit, Once an EBPP Threat, Deals Self Out," by Andrew Roth, *American Banker,* May 21, 2001.

[628] "Chorus of cheers (mostly) for Internet commerce," by Jeffrey Kutler, *American Banker,* June 26, 1996.

relationships, and liquidity" that formed the foundation of banking could be transferred to cyberspace. Banks, Melton protested, "have the franchise on credibility."

In September 1996, at both a Treasury Department-sponsored conference and the Institute of International Finance Annual Membership Meeting, Comptroller of the Currency Eugene Ludwig discussed the importance of consumer trust for electronic payments and money to flourish. Ludwig stated, "First, although there were some strong differences of opinion about several issues at this conference, everyone agreed on one thing: the key to developing a robust electronic money system is trust. The new electronic marketplace offers businesses new opportunities for increased efficiencies, larger markets and greater profits, and offers consumers greater convenience and access to new products and services. Nonetheless, how useful this marketplace becomes will depend on how much confidence all participants — businesses and consumers alike — have in its dependability and integrity."[629] The Comptroller emphasized that transactions online should be "enforceable and reliable," and that cooperation between the private and public sectors was essential, given that the technology was "evolving so rapidly that government cannot possibly develop and retain all the expertise necessary to accomplish any of its objectives without the support and cooperation of industry."[630]

Ultimately, consumer trust was hard to replicate online when the banks and credit card companies failed to align their interests and endorse a universal mechanism for securing credit card transactions. In 1996, Verisign, a RSA Data Security spinoff, was touted for potentially

[629] "Remarks by Eugene A. Ludwig Comptroller of the Currency Before The Institute of International Finance Annual Membership Meeting Washington D.C.," by the Office of the Comptroller of the Currency, September 30, 1996.

[630] "Remarks by Eugene A. Ludwig Comptroller of the Currency Before the Department of the Treasury Conference Toward Electronic Money and Banking The Role of Government," by the Office of the Comptroller of the Currency, September 20, 1996.

providing the "missing link" to securing online transactions.[631] Security Dynamics Technologies acquired RSA Data Security in April 1996.[632] "An arms race is already raging between those working to armor-plate digital cash with doubly and triply secure cryptography and those working to pierce the armor. Security experts assume that nefarious characters, in search of an unending stream of money, are already investing millions in the next stages of research and development."[633] Microsoft and VeriSign would make Digital IDs available for Internet Explorer 3.0 in August 1996.[634] CNet listed in a November 1996 article the obstacles preventing e-commerce from taking off in 1996, "To break the cycle, there are three challenges that must be overcome: the lack of a compelling online shopping experience, consumers' skittishness about Net security, and the complexity of merchant back-end systems."[635] A December 1996 article in the *New York Times*, addressing the issue of consumer "lingering reluctance" to give credit card numbers over the internet, explained to readers, "To insure your card information is coded, however, you must make sure the Web browser you are using is a "secure" one, meaning it supports the coding standard for making transactions. The current versions of Netscape Navigator and Microsoft Explorer, the most popular browsers, use what is called Secure Socket Layer technology, affording transactions the highest level of security possible on the Internet."[636] John Reed, then chairman of Citicorp, said at a Treasury Department conference in late 1996 that consumers are most concerned by privacy and

[631] "RSA's precocious spinoff making a name in internet security," by Jeffrey Kutler, *American Banker,* April 15, 1996.

[632] "Computer Security Concern Agrees to Be Sold for Stock," by Peter H. Lewis, *The New York Times,* April 16, 1996.

[633] "DEAD AS A DOLLAR," by James Gleick, *The New York Times Magazine,* June 16, 1996.

[634] "Microsoft and VeriSign Announce Availability of Digital IDs for Microsoft Internet Explorer 3.0 Users," *PR newswire,* August 13, 1996.

[635] "E-commerce: a hard sell," by CNet News Staff, *CNet,* November 21, 1996.

[636] "Malls and Stores Find New Outlets In Cyberspace," by Laurie J. Flynn , *The New York Times,* December 5, 1996.

security, "This is not a question of economics or efficiency. It is a question of trust. The consumer will have to trust you. The Internet is fundamentally flawed in that regard."[637]

By early 1997, the market began to react to the multimillion-dollar losses and five to six-figure revenues posted by CyberCash and First Virtual. CyberCash share price tumbled 21 percent after Hambrecht and Quist, the original underwriter of its IPO, downgraded its recommendation. The reason for the downgrade was that e-commerce had grown more slowly than previously expected. CyberCash revenues for calendar year 1996 amounted to $127,000, operating at a $26.5 million loss. Hambrecht and Quist's projection for 1997 had been $25 million in revenue.[638] Most of CyberCash's revenue actually came from consulting services, rather than its core payments processing business. First Virtual performed better, with $696,000 in revenue for 1996 at a loss of $10.7 million. But by February 1997, Stein was marketing his company as a developer of communications technology, rather than as solely a payment system. In March, First Virtual began beta testing its payment system for Microsoft Merchant Server.[639] It would shutter its VirtualPIN secured payments offering in early 1998.[640] In May 1998, Softbank became the majority shareholder of First Virtual for $6 million, at $0.60 a share.[641]

By 1997, the challenges of various digital payments systems in the market were apparent and customers shopping online overwhelmingly preferred a website-embedded (in-browser) secure payments method. The most significant challenge DigiCash faced was its business premise; consumers frankly did not see the need for anonymity in digital payments. Other micropayments

[637] "As the technology advances, security debate still rages," by Jeffrey Kutler, *American Banker,* December 23, 1996.

[638] "CyberCash, First Virtual lose big," by CNet News Staff, *CNet,* January 31, 1997.

[639] "Short Take: Online payment beta tested," by CNet News Staff, *CNet,* March 28, 1997.

[640] "The Bankrupt Promise of Micropayments," by Reuters, *Wired,* April 15, 1998.

[641] "First Virtual gets reprieve," *CNN Money,* May 1, 1998.

startups saw their differentiating features also contribute to their downfall. The *Wall Street Journal* described in August 1997 that despite David Chaum's advocacy for privacy and anonymity, consumers appear content with the tradeoff of some privacy in return for easy recordkeeping. As for First Virtual, the article noted that the payments company never figured out how to verify the identity of merchants and customers via its communications system, something that digital certificates address. "Other lessons learned from the pioneers include the superiority of software over hardware solutions because of the ease with which software can be distributed and updated (learned from Wave Systems); the need for fungibility and central clearinghouse functions rather than unique tokens/monies for each merchant (courtesy of NetBill); and the difficulties of aggregating micropayments (thanks to the travails of Millicent)."[642]

In fall of 1997, both CyberCash and DigiCash made an international push for micropayments technology. DigiCash secured partnerships with Deutsche Bank and Nomura Research Institute. In November 1997, CyberCash established a joint venture in Japan with a group of Japanese banks and companies, including Softbank. This was a similar approach to its German venture with Dresdner Bank and Sachsen LB.[643] By the end of 1997, DigiCash underwent a leadership change, acknowledging that though the company had the technical capabilities, it had missed the opportunity to become a major player in supplying the backend solution for smart cards, further engaging in the tech industry's ongoing narrative of the promise of smart card adoption.[644] Relocating its headquarters to Palo Alto with new leadership, DigiCash was now pivoting, offering

[642] "E-Money's Pioneers Have Found Cyberspace an Unforgiving Land," by Don Sussis, *The Wall Street Journal*, August 9, 1997.

[643] "CyberCash hits Japanese beach in a bid to shore up the micropayments market," by Andrew Reinbach, *American Banker*, November 10, 19997.

[644] "Digicash Eager to Reap Latent Ecash Harvest," *American Banker*, December 11, 1997.

the market its technical prowess in writing the necessary software for companies like Visa and Mondex, using its advanced compression algorithms it had developed in 1996.

In October 1998, Citigroup, Chase Manhattan, Bank of America, Barclays, Deutsche Bank, ABN Amro, Bankers Trust, and Hypo Vereinsbank formed a joint venture, described as a "global trust enterprise," "to manage and promote a digital certificate system for validating business customers over the Internet."[645] The certificate system was slated to have a smart card component and designed to quickly allow for e-commerce to grow on a global scale. *American Banker* reported, "In the process, they brought instant legitimacy and credibility to a concept that has challenged the sales forces of information-security and payment-system vendors and that even some bankers have had trouble bringing to the attention of their top executives and boards."

Even Intel would join the secured payments race late in May 1998, investing in CyberCash.[646] By this time, CyberCash closed down its Wallet business, which CyberCash had previously planned to adapt into a Java application. Seeing, finally, the boom in both e-commerce and content providers on the web, along with how Americans have been reluctant to adopt payment methods other than credit cards for online shopping, CyberCash shifted to sourcing ad revenues. Melton acknowledged in 1998 that the US market was unlike the European market, "where there's a shortage of credit cards and society is more cash and prepaid-card-oriented."[647] Yet, CyberCash was not entirely abandoning CyberCoin even as it shut down its CyberCash Wallet program. The company was adapting it in 1998 to the new trends in e-commerce, such as the one-click payment method on Amazon.com. The second generation CyberCoin was set to be built into a merchant website as a Java application. In 1998, CyberCash ran trials of the new CyberCoin in the UK,

[645] "8 Top Banks Team Up on Digital Certification," *American Banker*, October 22, 1998.

[646] "Putting out feelers," by Julie Pitta, *Forbes*, May 18, 1998.

[647] "The Bankrupt Promise of Micropayments," by Reuters, *Wired*, April 15, 1998.

Germany, and Japan. In May, CyberCash hoped its $57 million acquisition in cash and stock of ICVerify, a firm specializing in credit card transactions software for online merchants as well as physical retail point-of-sales systems, could drive CyberCash adoption with more online merchants.[648] In July, CyberCash let go of 20 percent of its staff. CyberCash stock, which traded in the $60 range in June 1996, and fell steadily to $11.12.[649] The *Washington Post* reported, "People who follow CyberCash generally agree on two things: that if the company can hang on long enough for electronic payments to become a widespread phenomenon, it will be well positioned to cash in."[650]

The death knell for both stored value wallets and digital currency came as early as 1998. The *New York Times* reported in late November 1998 that digital cash systems have largely failed, and a spokesman for Amazon.com said that "the overwhelming majority" of transactions on Amazon were credit card transactions secured through SSL.[651] A former Visa executive-turned-Silicon Valley venture capitalist explained to the *Times*, "There's no market where pay per use is significant." The following month, the *Times* reported that the market has realized that the holy grail "tollbooth" for online transactions was, in fact, the credit card. "In recent weeks, credit-card companies have appeared to awaken to the reality that second only to plastic, the Internet is the best thing that ever happened to the industry."[652] The introduction of the American Express chip-embedded credit card in 1999 furthered this narrative.[653]

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[648] "CyberCash to buy ICVerify," *CNet,* March 18, 1998.

[649] "CyberCash Can't Oust Credit Cards," by Mark Leibovich, *The Washington Post,* July 3, 1998.

[650] "CyberCash Can't Oust Credit Cards," by Mark Leibovich, *The Washington Post,* July 3, 1998.

[651] "Electronic Cash for the Net Fails to Catch On," by Peter Wayner, *The New York Times,* November 28, 1998.

[652] "Advertising: The real winners in electronic commerce are turning out to be the credit-card companies," by Bob Tedeschi, *The New York Times,* December 15, 1998.

[653] "A new piece of hardware could help Internet merchants cut fraud-associated costs, if it catches on among consumers," by Bob Tedeschi, *The New York Times,* September 20, 1999.

Mark Twain Bank, now owned by Mercantile Bank, closed its ECash test on September 14, 1998. By this time, a Digital Equipment-backed project for micropayments known as MilliCent was being tested, as was Minipay by IBM.[654] A November 1998 *Wired* news headline read, "DigiCash Outta Cash"—Chaum's startup had filed for Chapter 11 bankruptcy.[655] Like with CyberCash, the company's leadership understood the value of its proprietary technology and sought new funding to salvage its business.[656] DigiCash would become eCash Technologies Inc., based in Bothell, Washington, and in 2002 would sell to InfoSpace of Bellevue, Washington, an online white-pages telephone directory information reseller with a payment gateway product called Authorize.Net, then used by 120,000 merchants.[657] Chaum, on the other hand, would continue his crusade for anonymity in digital payments, devising plans for a new secure credit card transactions software business in 1999 in response to the e-commerce boom. The *New York Times* reported, "Mr. Chaum's new system is designed to work seamlessly with credit cards, which most people use to pay for Internet purchases. His plan is to issue special credit card numbers that will be good for only one use. People will be able to purchase the numbers over the Net like traveler's checks, then use them for a purchase at a Web site."[658] The business never came to fruition.

In an attempt to pivot its failing business, Cybercash licensed its payment software to Nortel Networks, SAP, and Sprint in mid-April 2000. As *American Banker* noted in its coverage of this development, "Cybercash is projected to lose $31.2 million in 2000 and more than $16 million in 2001, according to SunTrust. The company has never shown a profit and SunTrust has

[654] "DigiCash loses U.S. toehold," *CNet,* September 2, 1998.

[655] "DigiCash Outta Cash," by Wired News Report, *Wired,* November 6, 1998.

[656] "Electronic Commerce: Bankrupt Digicash to Seek Financing, New Allies," *American Banker,* November 10, 1998.

[657] "InfoSpace Buys eCash Technologies," by Steve Bills, *American Banker,* March 1, 2002.

[658] "A Cloak for Shoppers' Web Dollars," by Peter Wayner, *The New York Times,* November 11, 1999.

not projected when it expects to break even." In December 2000, CyberCash announced it would acquire Network 1 Financial Corp., an internet payment services business based in McLean, Virginia, in a merger valued at around $45 million.[659] The following month, Melton resigned.[660] In March 2001, CyberCash laid off 28% of its employees and filed for Chapter 11 bankruptcy.[661] When CyberCash shares last traded on Nasdaq on March 2, 2001, the stock was priced at $0.78.[662] The *Wall Street Journal* reported that CyberCash failed to raise the funds for the acquisition; instead, Network 1 Financial, according to a verbal offer, would acquire all of CyberCash's operating assets. The following month, VeriSign and First Data submitted the winning bid for CyberCash's assets for $20 million.[663]

Despite its ultimate demise, the story behind CyberCash's relative longevity in the brief internet boom was its superior technology. CyberCash Wallet failed to find a market as Netscape and Microsoft made quick leaps in browser technology, increasingly inculcating users to a more integrated and seamless web experience. This meant that web users were less likely to install separate payment software and retrieve security keys for each individual purchase on a website. In reorienting its business strategy, CyberCash ultimately adapted to a less secure security technology because not only did consumers still prefer to pay with their credit cards directly, but they also only required transaction security that was "good enough."[664] CyberCash and DigiCash lost the transactions wars because neither firm's products gained enough market adoption to set the web

[659] "CyberCash Agrees to AcquirePayment-Service Network 1," by Dow Jones Newswires, *The Wall Street Journal,* December 14, 2000.

[660] "Founder Gone, CyberCash Has Network 1," by Andrew Roth, *American Banker,* February 5, 2001.

[661] "CyberCash Shelves Acquisition, Files for Bankruptcy Protection," by WSJ News Roundup, *The Wall Street Journal,* March 2, 2001.

[662] "CyberCash of Reston Files for Chapter 11," by Neil Irwin, *The Washington Post,* March 3, 2001.

[663] "VeriSign To Acquire CyberCash," by Neil Irwin, *The Washington Post,* April 16, 2001.

[664] "Cybercash's Lesson in Web Survival," by Peter Wayner, *The New York Times,* August 10, 1998.

standard for secure payments or micropayments. However, Netscape and Microsoft, by driving browser and thereby web adoption and providing "good enough" SSL encryption, outmaneuvered CyberCash and DigiCash despite, ultimately, still failing to win the war. These woes continued to plague the other big names as well.

In 1999, Microsoft, IBM, Sun, Compaq, AOL, Mastercard, Visa, and American Express attempted to revive the digital wallets business model, creating a unified wallet interface (essentially a form) called the Electronic Commerce Modeling Language (ECML).[665] Amazon.com, whose 1-Click system contributed to the company's success, did not back ECML. An executive from the company explained to the *New York Times*, "'Wallets are good for the merchants, banks and wallet companies pushing them. But it's not clear what's in it for the consumer."[666] Interestingly, of the dotcom era successes, Amazon.com's leadership appeared to have paid close attention to the needs and behaviors of its customers. The online bookseller relied on in-browser SSL security, sidestepping the Transactions Wars, even as it played in the data-light but hype-rich e-commerce space.

[665] "A Chilly Welcome For Digital Wallets," by Ian Austen, *The New York Times,* November 4, 1999.

[666] "A Chilly Welcome For Digital Wallets," by Ian Austen, *The New York Times,* November 4, 1999.

## Chapter 7 – The Encryption Wars, Fintech, and New Frontiers

*The Encryption Wars: Overview—Signal Innovation Theory Application—The E-Commerce Narrative—Regulators and the E-Commerce and Payments Narrative—The Encryption Wars—The End of the Browser Wars: Antitrust, Mozilla, and AOL—Epilogue*

*The Encryption Wars: Overview*

In their efforts to set security standards for online transactions, competing firms like Netscape and Microsoft faced a common foe in retail banks. Yet, between 1996 and 1998, when it became clear to the public that the web boom was well underway, the software industry had a unified and conflicting relationship with regulators and policymakers. This was reflected in the two overarching narratives that captured the attention of the US government with regards to the promise and perils of the internet. The first was the forecasted sea change that e-commerce would bestow upon the markets and society in general. This e-commerce narrative was tied to the online payments narrative that took both tech and financial services firms on several detours in the 1990s, resulting in industry and market hype over smart cards, micropayments, and online wallets. The second was an America-first narrative that the tech industry lobbied to counter the Clinton administration's unsuccessful attempt to pass legislation that would enforce a backdoor recovery key for encrypted products. This fight—what is known as the Encryption Wars—would begin with the failed Clipper chip initiative and end with the relaxing of encryption export regulations in 2000.

In the same manner that retail and institutional investors alike were swept up in the dotcom boom, various federal agencies commissioned reports or made policy recommendations that appeared to feed the internet frenzy as these very agencies sought to better understand the web's effects on society and markets at large. Between 1996 and 1998, governments, journalists, and tech industry professionals all cited forecasted figures for e-commerce market potential from reports published by various consulting firms. These figures varied drastically and were known to be primarily conjecture. After each holiday shopping season, the media coverage would cite a different reason for why e-commerce had yet to take off (website outages, security breaches, inventory issues, etc.). The e-commerce narrative was one that promised market-level changes and

would spur the Clinton administration in 1997 to advocate for a "global free-trade zone" on the internet and both houses of Congress to pass legislation enacting a multi-year moratorium on taxes for online sales. In addition to Congress and the White House—where the Vice President headed the Clinton administration's internet-related efforts and communications—the Department of Commerce, the Treasury, and the Federal Reserve all produced reports and initial recommendations concerning the new digital economy, and more specifically, e-commerce. Even the US Patent Office could not escape the e-commerce rush; software patents would become a new battleground when Amazon.com is awarded a 17-year patent on its 1-Click Payment feature.

In the same way that Microsoft seemed captivated by the holy grail of setting security standards for retail banking and credit card transactions, regulators fed the legitimacy of the e-commerce narrative by continuously addressing the issue despite adopting a uniform "wait-and-see" approach to regulating e-commerce. The most concrete and significant step the government took was the Federal Reserve's modification of Regulation E in 1996 that would limit consumer liability for credit card fraud to $50. For regulators, online payments systems and the growth of e-commerce were intwined. Beyond Vice President Al Gore, the most prominent voices from the federal government that offered any meaningful commentary were those of the Comptroller of the Currency Eugene Ludwig and the Chairman of the Federal Reserve Board Alan Greenspan. Between 1996 and 2000, Ludwig's public remarks would straddle the fine line between addressing the banking industry's fervent opposition to the tech industry as a whole and encouraging banks to take the rapid pace of technological innovation in finance seriously as the industry sought a full repeal of the 1933 Glass-Steagall Act. Greenspan, on the other hand, would repeatedly invoke Schumpeter's creative destruction theory to explain away investor frenzy, encouraging a positive attitude towards technology and innovation. Yet, during the same time, other members of the

Federal Reserve Board gave public remarks that reflected a much more sober and cautious attitude towards the overall market effects of digital currency, digital payments systems, and e-commerce.

Invariably tied to the e-commerce narrative was the Encryption Wars, which began in 1993 when the Clinton administration advocated for the global adoption of the Clipper chipset developed by the National Security Agency (NSA). The chip initiative was to give government agencies the ability to intercept communications through a backdoor key recovery scheme—a key escrow. A year later, the discovery of a fatal security flaw in the technology would render the initiative a failure and nonissue. However, the Clipper chip would make hackers, technologists, and civil libertarians alike wary of the NSA's wiretapping ambitions—the true lasting legacy of the Clipper chip. The White House's ambitions for passing encryption legislation would continue and in October 1996, Gore introduced a revised encryption initiative. Both the House and the Senate would introduce controversial encryption legislation, a fraught process covered extensively by the press.

As the web took off globally, software makers faced individual case-by-case treatment for exporting encryption software via the State Department as encryption products fell under the US Munitions List (USML). From browsers to digital payments software, tech firms had to apply to the government to export less secure versions of their US native products. This resulted in American software firms' inability to sell cutting edge secured products to customers overseas. The tech industry seized on this lost opportunity, putting forth an America-first argument, to lobby the government to relax export controls. As both political parties neared an upcoming presidential election, the crucial sponsor of the Senate encryption bill, Senator John McCain, withdrew his support in April 1999 amidst rumors of a presidential bid. Gore, on the other hand, faced the pressure of maintaining his reputation as champion of the tech industry while serving as the face

of the White House's various encryption initiatives. By early 2000, the White House not only abandoned its key escrow proposals, but also fully liberalized encryption export.

Though the fight to export more secure browsers and payment software products to the rest of the world was won, by 2000 the Browser Wars were over. The Justice Department brought its antitrust suit against Microsoft in 1998, which made for sensationalized coverage of both the company and Bill Gates. Microsoft would lose the case in 2000 but with a new administration. the government would not seek the breakup of Microsoft. Concurrently, the Justice Department tried Visa and Mastercard for anticompetitive duality. The court's decision in 2001 would reveal the member banks' behind-the-scenes decisions regarding investment in smart cards and a single online security protocol. By February 1998, Netscape appeared to acknowledge its defeat in the Browser Wars. The company launched the Mozilla.org project, which developed and released the source code of its browser, now Mozilla. In November 1998, AOL announced its acquisition of Netscape. AOL would announce its own online bill payments ambitions via the acquisition and partnership with Intuit, but the AOL and TimeWarner merger in 2000 would delay the service. By the time AOL Bill Pay launched in 2004, the company was already in its decline.

### *Signal Innovation Theory Application – Encryption Wars Assessment*

The uncertain relationship between the US government and technology companies during the web boom also reveal conditions that help classify the web as a signal innovation. The improvement of encryption technology for web browsers is an enhancement of user experience. Relaxing of encryption export control meant that US firms selling internet-based technologies were able to better compete in new markets, which itself was an important narrative driving the debate over the

Encryption Wars. In addition, leaders from both the Treasury Department and the Federal Reserve in the public eye encouraged the financial services industry to widely adopt the internet and its related technological innovations.

*Table 7.1 – Signal Innovation – Foundational Principles – Encryption Wars*

| Condition | Evidence |
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| 1. **Evolve emerging technology.** Build upon and advance the evolution of a more fundamental technology later characterized as general-purpose. | • Attempts at securing channels for e-commerce had occurred prior to the advent of the web. Whether through gated online networks, localized bulletin board systems, or otherwise. However, as web adoption and diffusion began to supplant other network channels, e-commerce so too transitioned to the web, and then exploded in popularity.<br>• By December 1997, a Forrester Research analyst told the *New York Times* that 1997 a "watershed year" for many online retailers, and that 25 percent of an estimated 40 million Internet users had made a purchase on the web. While American Express estimated that credit card transactions of e-commerce purchases would total somewhere between $4 and $6 billion for the year, Forrester Research estimated a more conservative $2.4 billion. The *New York Times* noted that the 1997 holiday season is the first significant one for e-commerce, |

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| | as "more consumers learn how to find what they want and become comfortable that they will not be defrauded when they do." By 1998, the e-commerce market appeared to be finally showing signs of its long-predicted boom. The increase in user adoption meant, once again, the heightened scrutiny of transactions security, which the *Wall Street Journal* reported was the outcome of the seemingly rapid growth of e-commerce. "Sales through Web sites are taking a growing share of the market for books, airline tickets, securities and several other product categories. Consumers this year are expected to spend $3.3 billion over the Web, Forrester Research Inc. estimates, and business purchases are running at several times that rate."[667] By January 1998, the *Wall Street Journal* reported that issues that hindered the growth of e-commerce in the early years of the web had largely been resolved by the end of 1997, citing the increase in customer comfort with the idea of online shopping. This change was due to the increasingly enhanced user experience of the web (through built-in multimedia features and messenger/chat applications) and that |

[667] "Firms Scramble to Fix FlawIn Web Encryption Software," by Don Clark, *The Wall Street Journal,* June 26, 1998.

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| | "well-known financial institutions came on board." In just a couple of years since the debut of Mosaic that allowed for easy point-and-click web browsing, the web seemed poised to deliver the promise of e-commerce. |
| **2. Accelerate user adoption.** Accelerate the adoption and diffusion of said underlying general-purpose technology. | • The concomitant advent of billing, payments, transaction, and encryption technologies in concert with the liberalization of internet access and activities drove an evermore rapid transition to the internet, and supported a positive feedback loop across the software-hardware-network triad.<br>• In late November 1996. The White House first distributed a work-in-progress paper documenting the Clinton administration's e-commerce agenda. The draft, written with "the cooperation of major high-tech businesses" by a task force headed by Ira Magaziner, covered "online transactions, including tariffs, e-cash, domain name trademarks and key recovery." The final framework, titled "A Framework for Global Electronic Commerce," debuted on July 1, 1997. As a part of this unified e-commerce policy agenda, President Clinton announced that he would direct the Treasury Secretary, the Commerce Secretary, and Trade Representative Charlene Barshefsky to "oppose new taxes on the Net and eliminate barriers |

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| | to free e-trade" and establish "basic consumer protections and a legal framework." The Administration's stance on regulating e-commerce highlights the immense market potential of e-commerce as the primary reason for a "non-regulatory" policy, stating, "Commerce on the Internet could total tens of billions of dollars by the turn of the century. For this potential to be realized fully, governments must adopt a non-regulatory, market-oriented approach to electronic commerce, one that facilitates the emergence of a transparent and predictable legal environment to support global business and commerce."<br>• This near-term hands-off approach applied to the nascent innovation of electronic payment technologies as well, citing the rapidly changing commercial web environment. The framework argues, "For these reasons, inflexible and highly prescriptive regulations and rules are inappropriate and potentially harmful. Rather, in the near term, case-by-case monitoring of electronic payment experiments is preferred." In other words, the White House in 1997 put forth a framework for non-regulation that did less to address regulations and the future of digital payments than it did to further the narrative of a potential boom in e-commerce. |

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| **3. Catalyze innovation ecosystems.** Catalyze the growth of an economic ecosystem around the general-purpose technology. | • The rise of the web was especially felt in the US Patent Office, which fielded an unprecedented number of software related patents in the late 1990s. By 1999, patent law emerged as a potential obstacle to e-commerce growth. The most public display of this trend came out of the rivalry between Amazon.com and Barnes & Noble. Amazon.com first introduced its 1-Click payment service in September 1997 and subsequently applied for a patent. 1-Click was a feature that enabled customers to save their shipping and billing details in their Amazon.com user account and check out on the site with a single click. This effectively removed the sludge of having to enter in personal information every time a customer makes a purchase. In October 1999, the Patent Office awarded Amazon.com a patent for 1-Click for a duration of 17 year Later that month, Amazon.com promptly sued Barnesandnoble.com for patent infringement. Barnes & Noble's e-commerce business had introduced an Express Lane single-click ordering feature on its website in May 1998. But these online booksellers were not the only ones involved in copycat accusations in court. Amazon.com's |

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| | lawsuit came a week after Priceline.com filed suit against Microsoft for Expedia.com's alleged copying of Priceline.com's bidding model E-commerce, with all its proclaimed market potential, became a battleground for protecting UX inventions and novel business models as matters of intellectual property. |
| **4. Intermediate with technology forerunners.** Function as an abstract or concrete technological intermediary between it and the general-purpose technology. | • Official intermediary status of the web was accorded with the U.S. government's permitting of Netscape Navigator distribution featuring RC4 128-bit security.<br>• On July 16, 1996, coinciding with the publication of a web security whitepaper penned by Netscape's encryption and security leadership, the US government granted Netscape permission to distribute Navigator and Netscape servers with RC4 128-bit encryption on the web for download by US citizens. The company's press announcement indicated that Netscape may be "the first company to receive official government approval to electronically download export-controlled software, and Netscape Navigator and Netscape FastTrack Server are the only software products available for approved Internet distribution with RC4 128-bit security." Jim Bidzos of RSA Data Security is quoted in the press release emphasizing the multifaceted nature |

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| | of securing e-commerce. "Online services involving consumer privacy, such as banking, demand the strongest possible encryption, and without it the full potential of the Internet cannot be realized. Today's breakthrough announcement from Netscape and its partners ensures that encryption capable of inspiring both business and consumer confidence is widely available, and available today." Marc Andreessen is quoted saying that stronger encryption will help drive adoption web-based communications and e-commerce. |
| **5. Enhance user experience.** Unlock the usability or value of a general-purpose technology through an enhanced user experience (i.e., usability). | • By late August 1999, "Web site usability" (what is now referred to as User Experience design) had emerged as an area of concern for e-commerce web design, spawning a new field of consulting services. Further demonstrating the market's enthusiasm for e-commerce opportunities, the *Wall Street Journal* reported in October that some businesses were bullish on Russia as an emerging market for e-commerce, despite the country's weak economy and low usage rate of credit cards. The following month the *New York Times* reported that many large retailers had recently launched their e-commerce sites in time for the holiday season, but that many companies struggled "to find enough programmers, designers, |

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| | marketers and fulfillment specialists to get the job done quickly." Later the same month, the *New York Times* reported that "the e-tailing rush is under way." The article cited forecasts of more than 20 million shoppers to spend more than $6 billion in online purchases, triple the holiday season sales of 1998. |
| **6. Drive market growth.** Unlock the financial, commercial, or broader business economic potential of the general-purpose technology. | • While payments businesses continued to extend the e-commerce boom narrative, the Treasury Department engaged with the advent of these technologies primarily through the Office of the Comptroller of the Currency (OCC). In January 1996, Eugene Ludwig emphasized in a speech on the topic of financial modernization (a topic of debate largely centered on a repeal of the Glass-Stegall Act) at the Exchequer Club the need for the financial services industry to consider issues beyond repealing Glass-Steagall. Ludwig suggested that financial modernization was quickly becoming an issue of technological innovation and e-commerce even as the banking industry focused its attention on repealing Glass-Steagall. He emphasized, "Our ability to bring banking and financial services into the 21st century will determine how fast and effectively we realize technology's vast, still untapped, potential to fuel |

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| | economic growth and opportunity for American businesses and consumers." Ludwig goes on to ask who will benefit from Bill Gates' envisioned "friction free capitalism," where every Fortune 500 company is connected to the internet: "Totally electronic market trading, e-money, a paperless payments system, vastly more sophisticated risk pricing and risk control models are all on the horizon. Just think about what the tremendous increases in computer power has meant to an information-intensive business like banking." |
| **7. Unlock new value.** Unlock the consumer-relevance and value competitiveness of the general-purpose technology. | • By the summer of 1997, in the midst of the struggle of relaxing export restrictions on encryption products, the narrative of the encryption wars was firmly rooted in the promise of a stratospheric growth in e-commerce, and the imminent threat of American businesses losing out if the Clinton administration failed to adopt an America-first approach to regulating encryption software. On June 25, 1997, the *New York Times* reported, "In a move intended to speed up the growth of international electronic commerce, the Commerce Department granted permission today to the Netscape Communications Corporation and the Microsoft Corporation to export more secure |

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| | versions of their software to banking customers." In its coverage of an East Room reception of technology industry executives hosted by the President and the Vice President, the *New York Times* reported that President Clinton had been under pressure to "quickly build a secure online marketplace for American business." |
| **8. Inspire new narratives.** Build upon existing or inspire new economic or innovation narratives surrounding the general-purpose technology. | • This narrative feedback loop on the growth potential of e-commerce would continue towards the end of the decade with federal agencies. The Department of Commerce addressed the impact of information technology on the US economy in its April 1998 report "The Emerging Digital Economy." The introduction quotes Federal research Board Chairman Alan Greenspan's congressional testimony positing that innovations in communications and information technology were driving high growth rates of productivity. It also highlighted the theory that America was in the midst of a "long boom" that would last until 2020, citing a 1997 *Wired* magazine article. |

*Table 7.2 – Signal Innovation – Pre-Incident Indicators – Encryption Wars*

| Condition | Evidence |
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| **1. Underutilized disruptive technology.** A significant, disruptive, but niche technological artifact or development limited by technical complexity, usability and interfacing capabilities, and product and service use case application. *This the fundamental technology that has the potential to emerge as general-purpose, which often has existed for some time but never achieved general-purpose "escape velocity."* | • Focusing on securing transactions, Microsoft announced in September 1997 Server Gated Crypto, an SSL extension that allowed for 128-bit encryption in online communications between banks and customers. On October 1, 1996, Gore revealed another revised encryption initiative from the Clinton administration. The proposal was intended to "support the growth of electronic commerce, increase the security of the global information, and sustain the economic competitiveness of U.S. encryption product manufacturers during the transition to a key management infrastructure." Executive Order 13026 of November 15, 1996, formally transferred the control of commercial encryption products on the State Department's US Munitions List (USML) to the Commerce Control List (CCL) of the Department of Commerce. |
| **2. Competitive innovation ecosystem.** An emerging and highly rivalrous series of complementary technical innovations, built upon said artifact and demarcating a new market ecosystem of no clear winners and aggressive competition. *These are the innovations advancing the fundamental technology and competing for signal* | • Media attention around a German start-up began to play into the narrative that US export laws were hampering American competition in the software industry globally. The *New York Times* reported that "U.S. export restrictions have been a boon for Brokat Informationssysteme GmbH, a two-year-old start-up |

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| *innovation status, drawing focus to the underutilized disruptive technology.* | company in Boeblingen, Germany." Brokat provided secure transaction software for banks, including Deutsche Bank, and services like America Online in Europe. Its Xpresso Security Package provided users an added layer of security for Navigator and Internet Explorer. In April, the *New York Times* ran a lengthy profile of Brokat, detailing success in selling its security software to over 30 large banking and financial institutions.<br>"But what is most remarkable is that Brokat's rapid growth stems in large part from the Alice in Wonderland working of American computer policy. Over the last two years, Brokat and a handful of other European companies have carved out a booming business, selling powerful encryption technology around the world that the U.S. government prohibits American companies from exporting. Encryption technology has become a big battleground in the evolution of electronic commerce and the Internet. As in the United States, European banks and corporations are racing to offer online financial services, and many of these services are built around Internet programs sold by American companies like Netscape and Microsoft." |

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| **3. Compelling narratives.** An explosion of economic narratives surrounding said technical market ecosystem, covered more favorably in new media outlets, less favorably in established media outlets, and inspiring new terms and new uses of existing terms. *This circulation of narratives around a singular disruptive technology, amplified by the influx of technical innovations, suggests a higher probability of a signal innovation-general-purpose technology pairing.* | • In 1998 Greenspan began to repeat and refine in his public remarks a narrative of American capitalism and the technological progress by invoking Schumpeter and creative destruction. The following month, Greenspan said before an audience in Boca Raton, Florida, that creative destruction was "…reflected in the shifting of capital from failing technologies into those technologies at the cutting edge." Innovation in financial technologies was the driving force behind this trend, Greenspan argued. "Every innovation has suggested further possibilities to profitably meet increasingly sophisticated consumer demands. A significant percentage of new ventures fail. But among those that genuinely reduce costs or enhance consumer choice, many will prosper."<br>• In January 2000, Greenspan spoke of technology and the US economy. He posited that perhaps in the year 2010 we will look back and declare that "the American economy was experiencing a once-in-a-century acceleration of innovation," or alternately, the 1990s were "just one of the many euphoric speculative bubbles that have dotted human history." In explaining the fluctuations in outsized valuations of tech startups, Greenspan cited the "never-ending" process of innovation as the primary |

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| | challenge to predicting which new technologies would succeed. “One result of the more-rapid pace of IT innovation has been a visible acceleration of the process of “creative destruction,” a shifting of capital from failing technologies into those technologies at the cutting edge.”<br>• On the economic impact of technology innovation, Greenspan said in remarks made via videoconference on April 7, 2000, days after Microsoft’s stock price plunged upon news of the antitrust trial ruling,<br>“When historians look back at the latter half of the 1990s a decade or two hence, I suspect that they will conclude we are now living through a pivotal period in American economic history. New technologies that evolved from the cumulative innovations of the past half-century have now begun to bring about dramatic changes in the way goods and services are produced and in the way they are distributed to final users. Those innovations, exemplified most recently by the multiplying uses of the Internet, have brought on a flood of startup firms, many of which claim to offer the chance to revolutionize and dominate large shares of the nation's production and distribution system. While the process of innovation, of course, is never-ending, the development of the transistor after |

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| | World War II appears in retrospect to have initiated a special wave of innovative synergies. It brought us the microprocessor, the computer, satellites, and the joining of laser and fiber-optic technologies. By the 1990s, these and a number of lesser but critical innovations had, in turn, fostered an enormous new capacity to capture, analyze, and disseminate information. It is the growing use of information technology throughout the economy that makes the current period unique." |
| 1. **Incumbent investment.** Major investment by incumbent institutions into the productization of a technical innovation, unlocking the business economics and user experience factors of a more fundamental technology, often in competition with smaller, disruptive entrants. *Investment activity by large and established market incumbents drives additional focus and increases market speculation.* | • Three days later, in another videoconference speech before the National Automated Clearinghouse Association, Greenspan discussed innovation and retail payments systems:<br>"The phrase "Internet time" has now been added to our vocabulary. Behind this phrase is a serious observation that advances in information technology allow new ideas to be transformed into products and services much more rapidly than a few years ago, thus greatly speeding up product cycles. At the same time, new information technologies have broken down barriers between firms and stimulated very creative and competitive processes across the economy. Some traditional financial |

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| | institutions have tended to view this process with concern. As many firms have driven to find new ways to supply financial and other kinds of information, along with transactions and accounting services, some have expressed concern that their traditional payment franchise is being eroded. This concern is another manifestation of the insecurity brought on by innovation and change."<br>• That Friday, April 14, 2000, Greenspan, in a speech honoring economist Anna Schwartz, emphasized the boon technological innovation has been for the financial services industry, resulting in what he called a "knowledge float." "One of the profound effects of technology on financial services is that the increasing availability of accurate and relevant real-time information, by reducing uncertainty, reduces the cost of capital." In other words, in the leadup to the bubble that was the dotcom investment frenzy, Greenspan publicly put forth the argument that the contemporary market growth was largely due to technological advances in financial services and that creative destruction conveniently explained away this trend.<br>• In July 2000, Greenspan continued to tie the market realities with the |

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| | innovation cycle narrative—in a positive light:<br>"More important, the recent period has been marked by a transformation to an economy that is more productive as competitive forces become increasingly intense and new technologies raise the efficiency of our businesses. With the rapid adoption of information technology, the share of output that is conceptual rather than physical continues to grow. While these tendencies were no doubt in train in the "old," pre-1990s economy, they accelerated over the past decade as a number of technologies with their roots in the cumulative innovations of the past half-century began to yield dramatic economic returns." |
| **2. Business model transformation.** Accelerated repurposing of how large institutions carry out business and profit-making activities, coincident with the adoption of said complementary technical innovation. *The emergence of new business models is the last step in the temporal transition from underutilized to general-purpose technology via the instantiation of a signal innovation and general-purpose technology pairing.* | • In 2012, Marc Andreessen spoke at a *Wired* conference of the difficulty both Netscape and Microsoft encountered in building payments into the browser: "… it was essentially impossible to do… we tried, we tried… it was impossible at that point… we both tried… it actually took PayPal in a lot of ways to open everything up… the web would have turned out very differently, in some ways I think much better because we would have had, for example… business models evolve maybe in a much healthier way in a lot of |

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| | cases…on the other hand, you would have lost a lot… a lot of free content, free services." More accurately, it took the combination of a popular e-commerce destination along with PayPal, a payments aggregator, to boost both e-commerce growth and broad consumer trust in the security of online transactions. eBay would attempt to secure a payments solution for its growing business by first acquiring BillPoint in 1999, then signing an agreement with Wells Fargo for peer-to-peer credit card payments in March 2000 where Wells Fargo acquired a 35% stake in BillPoint. The CEO of BillPoint, Janet Crane, was formerly an executive at Mastercard and the head of Mondex USA.<br>• But the market leader in the peer-to-peer payments space was X.com, a banking and financial services startup founded by Elon Musk, which in August 2000 boasted three million PayPal accounts. In September 2000, X.com claimed that PayPal processed more than 100,000 online transactions a day. Originally a peer-to-peer payments software for PalmPilots made by Confinity, which merged with X.com in March 2000, PayPal would become X.com's flagship product and primary focus by October 2000. By then, PayPal was listed on eBay as the preferred payment |

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| | provider for half of the platform's auctions. X.com also signed a five-year agreement with Intuit to become the exclusive payment provider for Intuit's small-business products. As an online banking startup, X.com was the recipient of $170 million in investment from "Sequoia Capital, Nokia Ventures LP, Goldman Sachs, Deutsche Bank Alex. Brown, Qualcomm Inc., Lab Morgan, Technology Associates Management Corp., Idealab Capital Partners, and Credit Agricole." X.com, therefore, took after Checkfree's approach and began as a bank-friendly tech startup. The firm would rename itself PayPal in 2001. In March 2001, PayPal claimed to add 20,000 new customers daily, processing more than 150,000 payments. The company would boast 10 million user accounts in September 2001. Challenging market conditions in 2001 would delay PayPal's IPO until February 2002. A week after PayPal's public offering, eBay would double down on its BillPoint investment, buying back Wells Fargo's 35% stake. Months later, in July 2002, eBay announced its acquisition of PayPal, valuing the payments firm at $1.5 billion. eBay closed down BillPoint by the end of the year. In October 2005, PayPal acquired VeriSign's payment gateway business, inheriting the CyberCash |

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| | payment service. In a decade's time, some of CyberCash's original technology wound up as part of the leading online payments provider's services. |

*The E-Commerce Narrative (1996-1998)*

*"In America, information technologies have accounted for a quarter of our economic growth in an economy that is the best in a generation in America despite the current difficult financial global situation… [President Clinton] does not want government doing anything that would mess up the progress and the incredible promise of e-commerce." Secretary of Commerce William Daley, 1999.*[668]

Amidst the investment euphoria of the dot-com boom and its accompanying narrative of imminent e-commerce gains, federal agencies and legislators sought to understand the economic impact of the rise of the web. Between 1996 and 1998, Congress sought to learn from developments in electronic payments in Europe while the Federal Reserve offered its opinion on the issuance of a digital currency. The Clinton administration and Congress spent most of 1997 embroiled in a tussle over encryption export regulations, which would eventually be relaxed in 2000.

By the summer of 1997, in the midst of the struggle of relaxing export restrictions on encryption products, the narrative of the encryption wars was firmly rooted in the promise of a stratospheric growth in e-commerce, and the imminent threat of American businesses losing out if

[668] "OECD Realizing The Potential of Global Electronic Commerce," by the OECD, August 24, 1999, p. 44.

the Clinton administration failed to adopt an America-first approach to regulating encryption software. On June 25, 1997, the *New York Times* reported, "In a move intended to speed up the growth of international electronic commerce, the Commerce Department granted permission today to the Netscape Communications Corporation and the Microsoft Corporation to export more secure versions of their software to banking customers."[669] In its coverage of an East Room reception of technology industry executives hosted by the President and the Vice President, the *New York Times* reported that President Clinton had been under pressure to "quickly build a secure online marketplace for American business."[670]

The East Room reception was followed by the publication of a framework circulated in late November 1996. The White House first distributed a work-in-progress paper documenting the Clinton administration's e-commerce agenda. The draft, written with "the cooperation of major high-tech businesses" by a task force headed by Ira Magaziner, covered "online transactions, including tariffs, e-cash, domain name trademarks and key recovery."[671] The final framework, titled "A Framework for Global Electronic Commerce," debuted on July 1, 1997. As a part of this unified e-commerce policy agenda, President Clinton announced that he would direct the Treasury Secretary, the Commerce Secretary, and Trade Representative Charlene Barshefsky to "oppose new taxes on the Net and eliminate barriers to free e-trade" and establish "basic consumer protections and a legal framework."[672] The Administration's stance on regulating e-commerce highlights the immense market potential of e-commerce as the primary reason for a "non-regulatory" policy, stating, "Commerce on the Internet could total tens of billions of dollars by

[669] "Netscape and Microsoft Are Cleared on Exports," by John Markoff, *The New York Times,* June 25, 1997.

[670] "Clinton Issues 'Hands Off' Policy on Internet Commerce," by Sandra Sobieraj, *The New York Times,* July 2, 1997.

[671] "White House Sets E-Commerce Agenda," by Rebecca Vesely, *Wired,* November 26, 1996.

[672] "White House Unveils E-Commerce Policy," by Rebecca Vesely, *Wired,* July 1, 1997.

the turn of the century. For this potential to be realized fully, governments must adopt a non-regulatory, market-oriented approach to electronic commerce, one that facilitates the emergence of a transparent and predictable legal environment to support global business and commerce."[673] This near-term hands-off approach applied to the nascent innovation of electronic payment technologies as well, citing the rapidly changing commercial web environment. The framework argues, "For these reasons, inflexible and highly prescriptive regulations and rules are inappropriate and potentially harmful. Rather, in the near term, case-by-case monitoring of electronic payment experiments is preferred."[674] In other words, the White House in 1997 put forth a framework for non-regulation that did less to address regulations and the future of digital payments than it did to further the narrative of a potential boom in e-commerce.

The White House's e-commerce framework's "tens of billions" e-commerce market potential by the year 2000 became even more hyperbolic in a January 1996 speech given by the Comptroller of the Currency Eugene Ludwig. "Experts believe electronic commerce — $245 billion today — will account for nearly $3 trillion by 2005."[675] In a slightly more cautious tone, the Treasury Department's introductory whitepaper on policy issues regarding electronic money and banking in September 1996 reads, "Although the subject of much discussion, the actual level of Internet commerce remains modest by any standards. Scattered, unofficial estimates, the only ones available, suggest a level in the range of $100 million to $200 million in annual transactions."[676] Figures quoted by the press were just optimistic; in May 1996, the *Wall Street Journal* quoted $324 million in worldwide e-commerce retail sales for the previous year, spread

[673] Archived site acessible at https://clintonwhitehouse4.archives.gov/WH/New/Commerce/read.html.

[674] Archived site acessible at https://clintonwhitehouse4.archives.gov/WH/New/Commerce/read.html.

[675] Archived site acessible at https://clintonwhitehouse4.archives.gov/WH/New/Commerce/read.html.

[676] "An Introduction to Electronic Money Issues," by the Office of the Comptroller of the Currency, September 20, 1996.

across some 100,000 retailers.[677] In November 1996, when reporting on the Treasury Department's recommendation to not impose a federal tax on online sales, the *New York Times* cited industry analysts' expectations that e-commerce sales would exceed $70 billion a year by the end of the decade, up from a projected $500 million for 1996.[678] The federal government and the press alike shared an incredible faith in the near-future market potential of e-commerce. Online shopping emerged as the clear torch bearer for the internet frenzy amongst investors and regulators in the dot-com era.

Even as the press and federal government agencies quoted the various forecasts for e-commerce, occasional mentions of the difficulties of measuring and predicting such growth figures appeared in relevant reports. A 1998 World Trade Organization (WTO) whitepaper e-commerce discussed the difficulty in empirically assessing the growth of e-commerce, citing both the complication of defining what constitutes electronic commerce and the lack of data given e-commerce's short history. This resulted in "huge differences" in quoted figures.[679] The WTO report cited e-commerce growth projections from the *Financial Times*, *The Economist*, Forrester Research, ActivMedia, and IDC. Forrester Research projected e-commerce sales to reach $327 billion by 2002, while ActivMedia and IDC forecasted global e-commerce sales to reach $200 to 300 billion by 2001.

The paper highlighted the proliferation of online financial services as one of the key impacts of the web boom. The same report also cited Booz, Allen and Hamilton data, suggesting that by 2000 nearly all financial institutions will have a website offering basic services to

[677] "Reading the market: How Wall Street whiz found a niche selling books on the Internet," by G. Bruce Knecht, *The Wall Street Journal*, May 16, 1996.

[678] "Treasury Report Will Oppose Federal Taxes on Internet Sales," by Peter H. Lewis, *The New York Times*, November 21, 1996.

[679] "Special Studies 2: Electronic Commerce and the Role of the WTO," by the WTO, 1998, p. 23.

customers while 42 percent plan to offer bill payment and balance inquires. While only one percent of US households used online banking in 1997, this figure was expected to grow to 16 percent by 2000.[680] On the topic of how e-money "largely failed to materialize," the WTO report explained, "People were found to dislike paying for very small, metered transactions for which electronic money was originally conceived. Furthermore, the minimum amounts for payment by credit cards the most prominent alternative to electronic money) are continuing to decline."[681] By 1998, credit card companies already began to respond to the threat of alternative digital payment methods and systems by lowering merchant fees. The slow growth of e-commerce in reality gave banks time to consider security issues related to online transactions without the urgency that the press suggested was felt by the White House. In early 1997, banks did not feel the rush to adopt an electronic money or currency system or enhance existing smart card security technology simply because the technologies were not widely adopted.[682]

The press followed the progress of e-commerce closely. By December 1997, a Forrester Research analyst told the *New York Times* that 1997 a "watershed year" for many online retailers, and that 25 percent of an estimated 40 million Internet users had made a purchase on the web. While American Express estimated that credit card transactions of e-commerce purchases would total somewhere between $4 and $6 billion for the year, Forrester Research estimated a more conservative $2.4 billion. [683] The *New York Times* noted that the 1997 holiday season is the first significant one for e-commerce, as "more consumers learn how to find what they want and become

[680] "Special Studies 2: Electronic Commerce and the Role of the WTO," p. 30.

[681] "Special Studies 2: Electronic Commerce and the Role of the WTO," p. 41-42.

[682] "Less urgency in gearing for new payment forms," by Jennifer Kingson Bloom, *American Banker*, February 26, 1997.

[683] "Money Starts to Show in Internet Shopping," by Saul Hansell, *The New York Times*, December 1, 1997.

comfortable that they will not be defrauded when they do."[684] By 1998, the e-commerce market appeared to be finally showing signs of its long-predicted boom. The increase in user adoption meant, once again, the heightened scrutiny of transactions security, which the *Wall Street Journal* reported was the outcome of the seemingly rapid growth of e-commerce. "Sales through Web sites are taking a growing share of the market for books, airline tickets, securities and several other product categories. Consumers this year are expected to spend $3.3 billion over the Web, Forrester Research Inc. estimates, and business purchases are running at several times that rate."[685] By January 1998, the *Wall Street Journal* reported that issues that hindered the growth of e-commerce in the early years of the web had largely been resolved by the end of 1997, citing the increase in customer comfort with the idea of online shopping. This change was due to the increasingly enhanced user experience of the web (through built-in multimedia features and messenger/chat applications) and that "well-known financial institutions came on board."[686] In just a couple of years since the debut of Mosaic that allowed for easy point-and-click web browsing, the web seemed poised to deliver the promise of e-commerce.

While shoppers were now confident in the security inherent in web browsers to conduct credit card transactions, electronic money was now seen as having stalled the growth of e-commerce: "Customers wondered why they should trust these relative unknowns with money or all of the private and personal information that attenuates financial relationships."[687] More crucially, the federal government moved to amend Federal Reserve Regulation E to protect

[684] "Money Starts to Show in Internet Shopping," by Saul Hansell, *The New York Times*, December 1, 1997.

[685] "Firms Scramble to Fix FlawIn Web Encryption Software," by Don Clark, *The Wall Street Journal*, June 26, 1998.

[686] "E-Commerce Looks to Bloom After Strong Showing in 1997," by Don Sussis, *The Wall Street Journal*, January 31, 1998.

[687] "Firms Scramble to Fix FlawIn Web Encryption Software," by Don Clark, *The Wall Street Journal*, June 26, 1998.

consumers, limiting consumer liability for credit card fraud to $50. In doing so, the Federal Reserve extended consumer protections from the physical world to the digital. The *Wall Street Journal* explained that when Regulation E was amended, banks saw e-commerce as "an opportunity to extend their franchise, rather than as a threat to it," and quickly began to place ads online to encourage web users to make purchases online.[688] Additionally, on June 24, 1998, the House passed a bill preventing state and local governments from imposing internet taxes for three years. The legislation was described as a "pre-emptive strike" to "throw cold water on the frenzy to tax the Internet."[689] The Senate, which originally pushed for a six-year moratorium on internet taxation, followed suit in early October.[690]

However, in early March 1999, the *New York Times* dedicated "E-commerce" column reported that online retailers struggled with the abandoned cart problem, where shoppers fill their carts with product but do not convert to buyers. "Tired of such almost-sales, e-commerce sites have begun looking at the problem and are feverishly devising methods to convert these browsers into buyers."[691] By late August, "Web site usability" (what is now referred to as User Experience design) had emerged as an area of concern for e-commerce web design, spawning a new field of consulting services.[692] Further demonstrating the market's enthusiasm for e-commerce opportunities, the *Wall Street Journal* reported in October that some businesses were bullish on Russia as an emerging market for e-commerce, despite the country's weak economy and low usage

[688] "Firms Scramble to Fix FlawIn Web Encryption Software," by Don Clark, *The Wall Street Journal*, June 26, 1998.

[689] "House Bill Protects Internet From New Taxes," *The New York Times*, June 24, 1998.

[690] "Attention Internet Shoppers: No New Taxes," by Matthew L. Wald, *The New York Times*, October 9, 1998.

[691] "Internet retailers are attracting lots of window shoppers," by Bob Tedeschi, *The New York Times*, March 8, 1999.

[692] "On-line merchants find that a well-designed Web site can have a big impact on the bottom line," by Bob Tedeschi, *The New York Times*, August 30, 1999.

rate of credit cards.[693] The following month the *New York Times* reported that many large retailers had recently launched their e-commerce sites in time for the holiday season, but that many companies struggled "to find enough programmers, designers, marketers and fulfillment specialists to get the job done quickly."[694] Concerns with sourcing, fulfillment, and brand management also prevented traditional retailers from leaping into the e-commerce space. The Limited, the women's clothing retailer group, began planning its e-commerce rollout in mid-1997, but did not launch its sites until 1999.[695] Later the same month, the *New York Times* reported that "the e-tailing rush is under way." The article cited forecasts of more than 20 million shoppers to spend more than $6 billion in online purchases, triple the holiday season sales of 1998.[696] eToys and Amazon.com both ran out of stock of Pokémon toys before December, and a consultant suggested to the newspaper that the reason for the drastic uptick in online sales for 1999 was that the 1998 shopping season had been plagued by website failures.[697] These reports of the various challenges that prevented retailers from capturing the immense potential of online shopping reflect a continuation of the narrative established several years earlier, when Navigator first experienced a surge of popularity. Each passing holiday shopping season saw news coverage of why it—the elusive hundred-billion online sales record—*should* have happened this year but did not.

This narrative feedback loop on the growth potential of e-commerce would continue towards the end of the decade with federal agencies. The Department of Commerce addressed the

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[693] "E-Commerce Bulls See Russia As Big Market for Web Retailing," by Jeanette Borzo, *The Wall Street Journal,* October 17, 1999.

[694] "All that some retailers want before Christmas is a functional Web site," by Bob Tedeschi, *The New York Times,* Noveember 1, 1999.

[695] "All that some retailers want before Christmas is a functional Web site," by Bob Tedeschi, *The New York Times,* Noveember 1, 1999.

[696] "The Nightmares Before Christmas," by Bob Tedeschi, *The New York Times,* November 29, 1999.

[697] "The Nightmares Before Christmas," by Bob Tedeschi, *The New York Times,* November 29, 1999.

impact of information technology on the US economy in its April 1998 report "The Emerging Digital Economy." The introduction quotes Federal research Board Chairman Alan Greenspan's congressional testimony positing that innovations in communications and information technology were driving high growth rates of productivity.[698] It also highlighted the theory that America was in the midst of a "long boom" that would last until 2020, citing a 1997 *Wired* magazine article.[699] To illustrate the report's argument of the outsized future impact of e-commerce on the US economy, the report relies on data and forecasts from consulting and research firms. Brief case studies focused on businesses like Amazon.com and Dell demonstrate the rapid growth of e-commerce already underway, while the report leaned heavily on contemporary business news coverage to discuss industry trends. Key trends in the emerging digital economy included online banking, B2B e-commerce, personalized marketing, secure transactions, and privacy laws. On retail credit card transactions for e-commerce, the report discusses network effects in consumer trust. "Web retailers believe that concerns about credit card security will lessen, particularly as more people shop online, have trouble-free experiences, and tell their friends and relatives about them. In fact, some already detect greater comfort among their consumers this year as compared to one year ago… Word of mouth, combined with technology and standards for safeguarding sensitive information, should help to alleviate this concerns."[700]

Yet, by March 1999, the lackluster performance of e-commerce, in comparison with the forecasts, did not go unnoticed. The *Wall Street Journal* wrote, "Pick a number, any number. That

[698] "The Emerging Digital Economy," by the U.S. Department of Commerce, July 1998, p. 1.

[699] "The Long Boom: A History of the Future, 1980–2020," by Peter Schwartz and Peter Leyden, *Wired*, July 1, 1997.

[700] "The Emerging Digital Economy," by the U.S. Department of Commerce, July 1998, p. 39.

is what some analysts appear to be doing when they forecast electronic-commerce growth."[701] True to the ongoing media narrative surrounding the internet and the promise of e-commerce, the article suggested that e-commerce was in fact growing so fast that analysts struggled to keep up. "What exactly is going on here? Basically, the e-commerce juggernaut is moving forward at such a rapid clip -- from almost nothing in 1995 to an estimated $26 billion in sales for 1997, according to the OECD -- that traditional tools for measuring economic and technological activity are having a hard time keeping up." And yet the article also conceded that the hype of the previous several years were concocted from thin air. The chief executive of an internet consulting firm told the *Journal* that these forecasts were based on "hunch," that the research was "unscientific," and that "nobody should make business decisions based on any set of figures coming from the Internet industry."

Even so, the government did not heed this warning. In June 1999, the Department of Commerce published a follow-up report. Secretary of Commerce William Daley wrote in the accompanying statement of the "promise" of e-commerce he wrote of a year prior:

> That promise is being fulfilled. This past year, electronic commerce has grown beyond almost everyone's expectations. Every day, more people are finding new ways to provide innovative products and services electronically… While the numbers are still small, when compared to our overall economy, they are growing more rapidly and provide more evidence that electronic commerce will be the engine for economic growth in the next century.[702]

[701] "E-Commerce Growth Projections Seem to Be Just Analysts' Hunches," by Kevin J. Delaney, *The Wall Street Journal*, March 18, 1999.

[702] "The Emerging Digital Economy II," by the U.S. Department of Commerce, June 1999.

Again, the report quotes a speech given by Greenspan the month prior to emphasize the rapid growth of the digital economy.[703] In line with the prior report, the Commerce Department used specific case studies of companies (Travelocity and Quicken Mortgage) to demonstrate overall trends in the digital economy, while continuing to rely on forecast figures from consultancies. In fact, the report explained that forecasts made a year ago were now considered too low and have since been revised.[704] The report also highlighted the challenges federal statistical agencies faced in collecting data to measure e-commerce.[705] Just before the March 2000 market peak of the dot-com bubble, the Commerce Department released a new index dedicated to tracking e-commerce sales figures (excluding services). This was the first step the government took in empirically understanding the economic impact of the tech boom, especially as various research firms regularly released conflicting estimates.[706] It is important to note that consultancies are opaque when it comes to their proprietary research methodologies and sources. Though the narrative of the promise of e-commerce took off concurrently with the rapid adoption of the web, government agencies like the Commerce Department relied for nearly five years on private sector research firms for e-commerce forecasts.

The rise of the web was especially felt in the US Patent Office, which fielded an unprecedented number of software related patents in the late 1990s. By 1999, patent law emerged as a potential obstacle to e-commerce growth. The most public display of this trend came out of the rivalry between Amazon.com and Barnes & Noble. Amazon.com first introduced its 1-Click

[703] "The Emerging Digital Economy II," by the U.S. Department of Commerce, June 1999, p. 1.

[704] "The Emerging Digital Economy II," by the U.S. Department of Commerce, June 1999, p. 5.

[705] "The Emerging Digital Economy II," by the U.S. Department of Commerce, June 1999, p. 12-13.

[706] "U.S. Unveils New Quarterly Index to Track E-Commerce," by Yochi J. Dreazen, *The Wall Street Journal*, March 3, 2000.

payment service in September 1997 and subsequently applied for a patent.[707] 1-Click was a feature that enabled customers to save their shipping and billing details in their Amazon.com user account and check out on the site with a single click. This effectively removed the sludge[708] of having to enter in personal information every time a customer makes a purchase. In October 1999, the Patent Office awarded Amazon.com a patent for 1-Click for a duration of 17 years.[709] Later that month, Amazon.com promptly sued Barnesandnoble.com for patent infringement. Barnes & Noble's e-commerce business had introduced an Express Lane single-click ordering feature on its website in May 1998.[710] But these online booksellers were not the only ones involved in copycat accusations in court. Amazon.com's lawsuit came a week after Priceline.com filed suit against Microsoft for Expedia.com's alleged copying of Priceline.com's bidding model.[711] E-commerce, with all its proclaimed market potential, became a battleground for protecting UX inventions and novel business models as matters of intellectual property.

Software patents had become the fastest growing sector of the United States Patent office by 1999 and their enforcement began to play a role in the governing of e-commerce as early movers in the market sought advantages of exclusive features. A *New York Times Magazine* article titled "Patently Absurd" described the legal landscape of e-commerce as, "The one-click injunction capped a burst of skirmishing in 1999 -- the start of what promises to become furious, wide-ranging

[707] Jeffrey P. Bezos et al., "METHOD AND SYSTEM FOR PLACING A PURCHASE ORDER VIA A COMMUNICATIONS NETWORK," (2014). https://patents.google.com/patent/US5960411A/en

[708] Thaler and Sunstein (2021), p. 153. "any aspect of choice architecture consisting of friction that makes it harder for people to obtain an outcome that will make them better off (by their own lights)."

[709] "Amazon.com Receives Patent for 1-Click," *PR newswire,* October 12, 1999.

[710] "Amazon Wins Court Ruling to Protect Patent on Order System," by Saul Hansell, *The New York Times,* December 3, 1999.

[711] "Amazon Sues Big Bookseller Over System For Shopping," by Leslie Kaufman, *The New York Times,* October 23, 1999.

courtroom warfare -- over who will control electronic commerce. As the year 2000 begins, few of America's e-commerce leaders are not targets of patent litigation."[712] The article noted that Amazon.com was awarded a patent in early 1998 for a so-called secure method of communicating credit card information involving showing the customer only the last few digits of each credit card number, a practice used by many companies.[713] More publicly, the 1-Click patent's 17-year lifespan became a controversial topic with technologists. In response to the negative commentary online, Amazon.com founder and CEO Jeff Bezos published an open letter in March 2000 calling for shortened software patent lifespans, a gesture largely seen as a public relations maneuver.[714] Bezos proposed a span of three or five years, explaining that "in the age of the Internet, a good software innovation can catch a lot of wind in 3 or 5 years."[715] Ironically, e-commerce would not mature until the end of the 17-year patent lifespan, coinciding with widespread global adoption of mobile web technologies. Nevertheless, Amazon.com remained the dominant force in e-commerce at the time of the patent's expiration.

[712] "Patently Absurd," by James Gleick, *The New York Times Magazine,* March 12, 2000.

[713] "Secure method for communicating credit card data when placing an order on a non-secure network," US patent by Jeffrey P. Bezos, March 10, 1998.

[714] "Chairman of Amazon urges reduction of patent terms," by Matt Richtel, *The New York Times,* March 11, 2000.

[715] Memo accessible at https://web.archive.org/web/20011115131605/http://www.amazon.com/exec/obidos/subst/misc/patents.html/

*Regulators and the E-Commerce and Payments Narrative*

*"'You don't want to go in with your regulatory guns blazing and end up shooting the innocent." Eugene Ludwig, 1996.*[716]

"First came cyberspace. Now comes cybermoney," read the opening line of a June 1996 *Wall Street Journal* article describing the advent of DigiCash's electronic currency available via Mark Twain Bank.[717] By 1996 the popularity of the web gave credence to the claims of a cashless, credit card-less world predicted by futurists. Federal agencies would begin examining the existential crisis of what defined money in a digital world, as well as the implications of commercial activity on the web in terms of consumer protection and money laundering. Officials from across the federal government uniformly responded to this trend by acknowledging the potentially significant impact these innovative financial technologies would have on the US economy and adopting a cautious "wait-and-see" approach towards regulating retail electronic payments.

The Federal Reserve's modification of Regulation E, proposed in April 1996, would be the singular exception. The amendment would limit consumer liability for credit card fraud to $50. However, changes to Regulation E would be delayed in 1996 due to related stipulations in the Economic Growth and Regulatory Paperwork Reduction Act of 1996 (EGRPRA).[718] Limiting consumer liability for credit card fraud at $50 removed a major obstacle for the growth of e-

[716] "Will Digital Money ReplaceThe Nation's Credit Cards?," by Neal Templin, *The Wall Street Journal,* June 26, 1996.

[717] "Will Digital Money ReplaceThe Nation's Credit Cards?," by Neal Templin, *The Wall Street Journal,* June 26, 1996.

[718] Macintosh (1998).

commerce, which once again put banks at odds with tech firms. The *Wall Street Journal* reported in 1997, "Because of this, issuing banks saw the possibility of a disastrous invasion of their electronic-money systems that would leave them forced to reimburse merchants for extensive losses that couldn't be recovered."[719] The contentious relationship between banks and tech firms apparently did not conclude with what appeared to be an increase in consumer trust in spending money online.

By the mid-1990s, Congress was working towards a full repeal of the Glass-Steagall Act of 1933, resulting in the Financial Services Modernization Act of 1999 (also known as the Gramm–Leach–Bliley Act). Repealing Glass-Steagall remained the primary regulatory focus the banking industry throughout those years. But between 1996 and 1999, Eugene Ludwig, the Comptroller of the Currency, advocated publicly for banks to both embrace and take seriously the future impact of technology on both retail and commercial banking. Alan Greenspan, Chairman of the Federal Reserve Board, would further the narrative behind the media frenzy of the dot-com boom through a series of speeches that seemingly conflated technological innovation with productivity driving market growth. These statements from the nation's most prominent financial regulators demonstrated the potency of that many storylines around the web-driven potential of e-commerce and retail transactions.

1996 marks the beginning of the US government's sincere exploration of the breadth and impact of innovative financial technologies. In March 1996, the Federal Reserve System formed the Financial Services Research Group headed by economist James Thomson to research the policy

[719] "E-Money's Pioneers Have Found Cyberspace an Unforgiving Land," by Don Sussis, *The Wall Street Journal,* August 9, 1997.

implications of digital payment systems.[720] On June 11, 1996, executives of American and European electronic payments businesses testified at a congressional hearing before the Subcommittee on Domestic and International Monetary Policy of the Committee on Banking and Financial Services. The hearing was the fourth in a series under The Future of Money hearings to direct attention to new technologies, rather than pursuing new legislation. These testimonies furthered the narrative around e-commerce and the road to future of widespread open system smart card adoption. Representatives of GEMPLUS, Mondex, and Danmønt focused their testimonies on explaining their business models and products. Tim Jones of Mondex demonstrated a potential future use of the cellphone, where the device doubles as a "personal cash dispenser" for reloading smart cards.[721] Henning Jensen of Danmønt reiterated to Congress that Danmønt operates as an infrastructure company providing Denmark with a payment system separate from that of credit and debit cards, rather than a payments company.[722]

Smart cards and chip devices figured prominently in these testimonies, reflecting the sentiment that consumers would adopt both software and hardware in order to use secure payment technologies to shop online. Denis Calvert, Vice President and General Manager of Verifone's US Financial Retail Division, highlighted two trends, public key cryptology (specifically SET) and "the exponential growth of the Internet to continue internationally and the value transfers to reach into the hundreds of billions of dollars in the near future."[723] On public key certificates, Calvert

[720] Jeffrey Kutler, "Banks finally awakening to threat nonbanks pose to payment systems," *The American banker* 161, no. 44 (1996). https://www.americanbanker.com/news/banks-finally-awakening-to-threat-nonbanks-pose-payment-systems

[721] "The future of money. Part 4, June 11, 1996 : hearing before the Subcommittee on Domestic and International Monetary Policy of the Committee on Banking and Financial Services, House of Representatives, One Hundred Fourth Congress, second session," by the United States Congress. House Committee on Banking and Financial Services Subcommittee on Domestic and International Monetary Policy, p. 9.

[722] "The future of money," p. 13.

[723] "The future of money," p. 15.

stated, “We expect that public key cryptology will rapidly become a foundation for secure electronic commerce transactions in the broadest sense, not just for payments.” Calvert continues in his testimony to describe the importance of Verifone’s Payport, an at-home chip card reader attached to a PC, declaring, “If a sufficiently large number of these chip devices or appliances are distributed to consumers as a security component for the Internet-based home banking applications, it seems possible that they could have a significant catalytic effect on the future of private sector commerce, both on and off the Internet, and on the public sector transfer payments dispersed over the Internet.”[724] On the future of the smart card market, Marc Lassus, Chairman and President Directeur General of GEMPLUS Card, cited the widespread use of chip cards in France, Germany, and Portugal as model examples of adoption. There seemed to be no question of the United States not following these trends emerging from across the Atlantic.

On the topic of digital currency, Jeffrey Ritter, Program Director of Electronic Commerce Law, and Information Policy Strategies (ECLIPS) at the Ohio Supercomputer Center and Chair of the American Bar Association Committee on the Law of Commerce in Cyberspace, offered a much more thoughtful testimony. Ritter noted that of the electronic payments businesses represented at the hearing, Danmønt’s “is the closest example to what we would call electronic money, meaning something that is approved by the central bank as an electronic equivalent, something that must be accepted as legal tender.” In terms of e-commerce application, Ritter pointed out that currency on the Internet need not be sanctioned by a government so long as it is accepted in payment.[725] “But currency, as a product, requires more than just technology. It requires a commercial framework.

[724] “The future of money,” p. 16.

[725] “Report to the Council of the European Monetary Institute on Prepaid Cards,” by the Working Group on EU Payment systems, May 1994. The Working Group on EU Payments Systems concluded in its report that only credit institutions should be allowed to issue electronic purses

For the small transactions, for the large transactions, the need is uniform. There must be predictability in the value and there must be security in the confidence that the bill is really being paid."[726] When asked about the banking industry's role in a cashless future, Ritter stressed the necessity of banks in earning consumer trust for electronic payments. "My own opinion is that the banking industry plays a bridge between national monies and these different payment mechanisms that is an essential role for the future of commerce on the Net. To completely bypass the banking network would, though the technology exists perhaps to do so with some of the products that we have seen today, is going to place a tremendous pressure on those companies to find mechanisms that will earn consumer confidence."[727] This sentiment reflected the deep chasm between banks and tech firms created by the Gates dinosaur quote.

The same month the Congressional Budget Office (CBO) published a report examining electronic payments innovations and how these new technologies would impact retail payments and federal policymaking. The study is the earliest and most prominent government whitepaper demonstrating a clear split between public narrative of the promise of e-commerce and the reality of a consumer-focused market for electronic payments. On the overall outlook of novel electronic payment systems, the study summarized, "The technical and market uncertainties facing these products are quite large. No one knows what will be the demand for the new payment mechanisms among consumers or the value of new payment methods to merchants."[728] This is an unusual departure at the time from the industry and investor frenzy around e-commerce and payments covered by the media. The study also emphasized household spending and saving behavior, noting that though electronic payments systems can serve a variety of customers, stored value smart card

[726] "Report to the Council of the European Monetary Institute on Prepaid Cards," p. 35.

[727] "Report to the Council of the European Monetary Institute on Prepaid Cards," p. 46.

[728] "Emerging Electronic Methods for Making Retail Payments," by the Congressional Budget Office, June 1996.

companies largely target private consumers and households, for whom their novel payment solution did not necessarily offer greater convenience nor lower costs. In other words, the study found that novel payment systems or methods were "unlikely to affect the decisions of households about spending and saving."[729]

Another departure from the popular smart card narrative is the study's assessment of the industrial policies in Europe and communications infrastructure in the United States that had long ago determined the fate of smart card adoption in both regions. Non-US governments leveraged smart cards as a component of vehicle for promoting industrial policies around semiconductors and other electronic equipment. Banks in those countries were either part of the government or heavily regulated, and therefore allowed banks and telephone monopolies to work in conjunction to promote smart card adoption.[730] The advantage of smart cards that made their use for telephone calls to authorize transactions popular abroad was based on the convenience of storing telephone or transaction data on a card, and thereby at the point of purchase on a network, rather than in a central computer. But this is only a convenience in an environment that lacked the communications infrastructure, and the previous decade saw improvements such as automated modems to authorize use of a credit card. Increasingly sophisticated systems depended on "high-quality infrastructure for data communications, which is something the United States has in abundance."[731] The report concluded, "Thus, the lack of acceptance of stored-value cards in the United States probably does not stem from technological backwardness but from the presence of an economical alternative. Who needs a stored value card when a nearby ATM or the merchant can quickly authorize a debit or credit purchase?" The market opportunity for smart cards in the US would, at best, be an

[729] "Emerging Electronic Methods," p. 5.

[730] "Emerging Electronic Methods," p. 12.

[731] "Emerging Electronic Methods," p. 12.

addition to existing payment methods. Based on both infrastructure and consumer behavior in the United States, smart cards never stood a chance in the digital payments market. Despite this reality and the publication of the CBO report in 1996, tech firms and banks continued to invest and experiment with smart card products and technology.

In September 1996, digital payments and e-commerce would come to the attention of the G7. Treasury Secretary Robert E. Rubin announced two initiatives aimed at considering the implications of electronic money. US regulators would look at consumer protection issues while an international group of regulators under the G7 would example international cooperation for international digital transactions.[732] The same month, the Federal Deposit Insurance Corporation (FDIC) decided crucially that money stored on smart cards were not federally insured deposits. The Federal Reserve recommended that card systems not hold more than $100 in value and that systems with no central records of card balances be exempt from consumer protection rules.[733]

The Committee on the Federal Reserve in the Payments Mechanism Federal Reserve System published its findings in January 1998 a paper focused on retail electronic systems.[734] The report stated, on the issue of regulating the emerging retail payment systems sector, "The Federal Reserve's role in these efforts should be to foster cooperation and information-sharing among retail payments system participants, including commercial providers of retail payment services, the Reserve Banks and other parties. The goal of these efforts should be to analyze and encourage adoption of the legal, regulatory and market underpinnings that are necessary to foster the

[732] "Group of Ten - Electronic Money - Consumer protection, law enforcement, supervisory and cross border issues," by the Bank of International Settlements, April 1997.

[733] "Regulators Turn Spotlight on Cybermoney," by Saul Hansell, *The New York Times*, September 19, 1996.

[734] "The Federal Reserve in the Payments Mechanism," by the Committee on the Federal Reserve in the Payments Mechanism, Federal Reserve System, January 1998.

development of new and emerging retail payment methods, rather than to promote any particular payment method or approach."

While payments businesses continued to extend the e-commerce boom narrative, the Treasury Department engaged with the advent of these technologies primarily through the Office of the Comptroller of the Currency (OCC). In January 1996, Eugene Ludwig emphasized in a speech on the topic of financial modernization (a topic of debate largely centered on a repeal of the Glass-Stegall Act) at the Exchequer Club the need for the financial services industry to consider issues beyond repealing Glass-Steagall. Ludwig suggested that financial modernization was quickly becoming an issue of technological innovation and e-commerce even as the banking industry focused its attention on repealing Glass-Steagall.[735] He emphasized, "Our ability to bring banking and financial services into the 21st century will determine how fast and effectively we realize technology's vast, still untapped, potential to fuel economic growth and opportunity for American businesses and consumers."[736] Ludwig goes on to ask who will benefit from Bill Gates' envisioned "friction free capitalism," where every Fortune 500 company is connected to the internet:

> Totally electronic market trading, e-money, a paperless payments system, vastly more sophisticated risk pricing and risk control models are all on the horizon. Just think about what the tremendous increases in computer power has meant to an information-intensive business like banking.[737]

[735] "Ludwig: Glass-Steagall focus diverts banks' attention from urgent technological issues," by Olaf de Senerpont Domis, *American Banker*, January 25, 1996.

[736] "Remarks by Eugene A. Ludwig Comptroller of the Currency Before the Exchequer Club," by the Office of the Comptroller of the Currency, January 24, 1996.

[737] "Remarks by Eugene A. Ludwig Comptroller of the Currency Before the Exchequer Club."

Included in the examples he cites as conflicts between technology companies and financial institutions is the problem of regulating stored value smart cards. On this topic, Ludwig emphasized that "…non-bank issuance of electronic value could present the banking industry with a competitive inequality far more significant to a far larger class of banks than anything now troubling the proponents of Glass-Steagall reform." Ludwig asked his audience, "How could we ever hope to work through the maze of issues that pits the banking industry against non-banks?" On to modernize the financial services industry, Ludwig advocated abandoning "the narrow, protectionist, special interest-driven way we've viewed the future of financial services in America," adhering to free market principles, and "striking the proper balance between necessary regulation and unnecessary burden" in regulations. In persuading the banking industry to thoughtfully and timely consider the implications of financial technologies, Ludwig seemed to suggest that banks must work with technological innovation rather than against it.

1996 also saw the Comptroller speak extensively on the Treasury Department's stance on regulating e-commerce-related areas. Ludwig revealed that Secretary of the Treasury Robert Rubin tasked the Office of the Comptroller of the Currency (OCC) in 1995 with coordinating the Treasury's policymaking activities related to e-commerce and electronic money. In the fall of 1996, Secretary Rubin established the Consumer Electronic Payments Task Force, chaired by Ludwig. While encouraging leaders in the banking industry to address the implications of technology, Ludwig was more circumspect on the topic of digital currency, which by 1996 was the subject of speculation of a potential future meltdown several years before Y2K concerns. At a conference on May 6, 1996, Ludwig's cautioned against the wild forecast figures regarding the internet and e-commerce, suggesting that banks take these figures "with a large grain of salt." He

cited a specific figure—that a projected 20 percent of US household spending would take place online by 2005—and declared it unlikely.[738]

In his concluding remarks, Ludwig further emphasized that the bank regulatory community recognized the advent of new technologies but did not necessarily buy into the hype. He conceded that technology innovation in financial services was in fact "not pure speculation — they are becoming more real every day, although not with quite the speed some in technology would like to believe." In fact, two days later at an American Bankers Association conference Ludwig described the recent hype surrounding virtual currency as "gee whiz" media coverage and "hoopla and concern about new electronic banking products." Once again, on the topic of stored value smart cards and online banking, Ludwig declared that the US was unlikely to see "robust use of this technology" in the near future.[739] Still, the Bank Technology Committee of the Office of the Comptroller of the Currency issued a risk guidance bulletin to banks on stored value smart cards in September 1996.[740]

However, consistent with his speeches on financial modernization, Ludwig described the forthcoming economic impact of electronic money and banking as "a freight train coming down the tracks, and we can see its headlight and hear its chugging in the distance. Just because it hasn't arrived yet doesn't mean we shouldn't start getting ready." Ludwig's various public remarks emphasized to banks the necessity of keeping up with technological innovation while maintaining a tempered view of the potential gains brought on by technology in the immediate future. Beyond

[738] "Remarks by Eugene A. Ludwig Comptroller of the Currency Before the Conference on Digital Commerce 96 Law, Policy, Profit & Pitfalls on the Global Information Network Washington D.C.," by the Office of the Comptroller of the Currency, May 6, 1996.

[739] "Remarks by Eugene A. Ludwig Comptroller of the Currency Before the ABA Conference on Financing Commerce in Cyberspace Washington D.C.," by the Office of the Comptroller of the Currency, May 8, 1996.

[740] "OCC Issues Guidance on Smart Card/Stored Value Card Risks," by the Office of the Comptroller of the Currency, September 10, 1996.

implications for branch banking (as electronic banking removes geographic barriers) and fundamental changes for the financial services industry overall, Ludwig compared the impact of innovative technologies like electronic money and banking to a General-Purpose Technology—the automobile. "Consider the advent of the automobile — hailed by virtually everyone as a marked advance over the horse drawn carriage. But the changes wrought by the automobile in terms of where and how we live and work have been more profound than a mere change in modes of transportation. I suspect the same may well be true of electronic banking and commerce." Therefore, the internet, in Ludwig's view, was unlikely to yield extraordinary returns in the near-term, but was likely to become a paradigm-shifting development in financial services over time.

As the banking industry's regulator, Ludwig did not shy away from calling out Bill Gates' dinosaur quote from 1994. At the American Bankers Association 1996 Annual Convention, Ludwig urged bankers to take a proactive role in responding to innovative technologies shaping the future of their industry. "Gates had it wrong. Banks are not dinosaurs. If one is going to use any metaphor, perhaps a better one is that at least some banks had been sleeping giants. A combination of factors has awakened them to their potential."[741] Ludwig's reference to the infamous quote demonstrated how potent the narrative of technology firms encroaching on the territory of banks was since Gates' 1994 dinosaur remark.

In September 1996, the Treasury Department sponsored a conference titled "Toward Electronic Money and Banking: The Role of Government" and published a whitepaper covering the developments in electronic cash and home banking technologies. In addressing the challenges in projecting the growth potential of e-money, the paper states, "Estimates of future growth are

[741] "Remarks by Eugene A. Ludwig Comptroller of the Currency Before the American Bankers Association Annual Convention," by the Office of the Comptroller of the Currency, October 5, 1996.

clouded by competing forces."[742] The paper acknowledges the continued excitement around financial technologies stemming from the promise of the retail market potential. The paper emphasizes the need to understand the pace of technological development in e-money in formulating policy recommendations. As e-money technologies mature and gain widespread adoption, the private sector is poised to resolve many of the most prominent challenges stemming from these innovations (such as security, fraud, and money laundering prevention), making improvements along the way. Government intervention, the Treasury Department maintained, "could delay, deny, or limit the quality of such improvements." Much in line with the industry activity around smart card offerings, the Treasury Department predicted that widespread use of open system smart cards "seems to be at least two years away," with "considerable commercial interest in developing these new means of payment in the United States for both closed and open systems." However, the paper noted, "The growth of Internet commerce may increase the volume of Internet financial transactions, but will not necessarily guarantee the growth of electronic money." The whitepaper explained that "some observers" believe that the lowering of credit card merchant fees will become the dominant payment method online due to the "existence of a huge, familiar, and successful infrastructure currently supporting credit card purchases and clearings."

In a March 22, 1997, speech, the Ludwig would continue his appeal, encouraging leaders of community banks to view technological innovations in banking as an opportunity, citing the Apollo Trust Company's investment in online banking services for their customers in Apollo, Pennsylvania.[743] However, in 1997 the OCC would attend to a new narrative now gripping the

[742] "An Introduction to Electronic Money Issues," by the Office of the Comptroller of the Currency, September 20, 1996, p. 3.

[743] "Remarks by Eugene A. Ludwig Comptroller of the Currency before the Independent Bankers Association of America, Phoenix, Arizona," by the Office of the Comptroller of the Currency, March 22, 1997.

banking industry and the federal government—risk managing Y2K. Ludwig would testify before Congress on the subject of Y2K in July and November 1997. In addition to Y2K concerns, the aftermath of the Asian Financial Crisis also overtook the continued efforts of regulators, legislators, and banks to publicize the need for financial modernization. Some developments of note include the approval in January 1998 of Zions First National Bank of Salt Lake City, Utah, as the first financial institution to certify digital signatures.[744] In late April 1998, the Consumer Electronic Payments Task Force recommended in its report self-regulatory initiatives for issuers of electronic money products.[745] The report acknowledged the uncertainty of the adoption of e-money innovations. "Credit and debit cards are increasingly being accepted for smaller dollar payments – payments that traditionally were made in cash. Whether open e-money systems will succeed against this array of competing products in the this market is unclear."[746] The report suggested that e-money would remain a "minor segment" of the payments market in the US in coming years.

Another federal agency whose leaders played a significant role in providing commentary or guidance on financial technologies during this period was the Federal Reserve. As discussed previously, the concrete regulatory change in encouraging e-commerce came from the Fed in the from of an amendment to Regulation E. In addition to this change, the Chairman and Vice Chairman of the Federal Reserve repeatedly addressed innovations in retail payments systems in public speeches between 1996 and 2001. Governor Edward Kelley, Jr. spoke at the CyberPayments

[744] "OCC Approves a National Bank to Certify Digital Signatures," by the Office of the Comptroller of the Currency, January 13, 1998.

[745] "Consumer Electronic Payments Task Force Issues Report Encouraging Self-Regulatory Initiatives and Consumer Education," by the Office of the Comptroller of the Currency, April 30, 1998.

[746] "The Report of the Consumer Electronic Payments Task Force," by the Office of the Comptroller of the Currency, April 1998.

’96 Conference on the subject,[747] while Greenspan discussed regulatory issues at the Treasury Department’s September 1996 conference. Greenspan framed the topic of electronic payments in the US market as a paradox, wherein wholesale transaction had long been electronic but retail payments going electronic was a novelty.[748] He would repeat the “paradox” narrative in future speeches on electronic payments and technology, predicting that “electronic money is likely to spread only gradually and play a much smaller role in our economy than private currency did historically.” In March 1997, Greenspan encouraged an optimistic attitude towards information technology, saying,

> …I want to emphasize that the information age is not something to be feared, but may well be a vast opportunity. Personal computers, an array of software, and new communications channels have placed powerful and creative technologies directly into the hands of individuals. The current enthusiasm of society for science and technology, particularly among young people, holds great promise for the future. If history is any guide, it is from this enthusiasm that the future will be born.”

In 1998 Greenspan began to repeat and refine in his public remarks a narrative of American capitalism and the technological progress by invoking Schumpeter and creative destruction.[749] Greenspan used this trope to support the argument that the market expansion was the result of rational investor behavior:

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[747] “Remarks by Governor Edward W. Kelley, Jr., Developments in electronic money and banking, at the CyberPayments '96 Conference, Dallas, Texas,” by the Federal Reserve Board, June 18, 1996.

[748] “Remarks by Chairman Alan Greenspan, Regulation of electronic payment systems at the U.S. Treasury Conference on Electronic Money & Banking: The Role of Government, Washington DC,” by the Federal Reserve Board, September 19, 1996.

[749] “Remarks by Chairman Alan Greenspan at the Haas Annual Business Faculty Research Dialogue, University of California, Berkeley, California,” by the Federal Reserve Board, September 4, 1998.

> The forces that shape the degree of confidence are largely endogenous to an economic process that is generally self-correcting as consumers and investors interact with a continually changing market reality. I do not claim that all market behavior is a rational response to changes in the real world. But most of it must be. For, were it otherwise, the relatively stable economic environments that have been evident among the major industrial countries over the generations would not be possible.

On the effects of technology and trade (and creative destruction), Greenspan said in April 1999, "Standards of living rise because the depreciation and other cash flows of industries employing older, increasingly obsolescent, technologies are marshaled to finance the newly produced capital assets that almost always embody the cutting edge technologies. This is the process by which wealth is created incremental step by incremental step. It presupposes a continuous churning of an economy in which the new displaces the old."[750] The following month, Greenspan said before an audience in Boca Raton, Florida, that creative destruction was "…reflected in the shifting of capital from failing technologies into those technologies at the cutting edge." Innovation in financial technologies was the driving force behind this trend, Greenspan argued. "Every innovation has suggested further possibilities to profitably meet increasingly sophisticated consumer demands. A significant percentage of new ventures fail. But among those that genuinely reduce costs or enhance consumer choice, many will prosper."[751]

In January 2000, Greenspan spoke of technology and the US economy. He posited that perhaps in the year 2010 we will look back and declare that "the American economy was experiencing a once-in-a-century acceleration of innovation," or alternately, the 1990s were "just

[750] "Remarks by Chairman Alan Greenspan before the Dallas Ambassadors Forum, Dallas, Texas," by the Federal Reserve Board, April 16, 1999.

[751] "Remarks by Chairman Alan Greenspan, Information, productivity, and capital investment, before The Business Council, Boca Raton, Florida," by the Federal Reserve Board, October 29, 1999.

one of the many euphoric speculative bubbles that have dotted human history."[752] In explaining the fluctuations in outsized valuations of tech startups, Greenspan cited the "never-ending" process of innovation as the primary challenge to predicting which new technologies would succeed. "One result of the more-rapid pace of IT innovation has been a visible acceleration of the process of "creative destruction," a shifting of capital from failing technologies into those technologies at the cutting edge."

On the economic impact of technology innovation, Greenspan said in remarks made via videoconference on April 7, 2000, days after Microsoft's stock price plunged upon news of the antitrust trial ruling,

> When historians look back at the latter half of the 1990s a decade or two hence, I suspect that they will conclude we are now living through a pivotal period in American economic history. New technologies that evolved from the cumulative innovations of the past half-century have now begun to bring about dramatic changes in the way goods and services are produced and in the way they are distributed to final users. Those innovations, exemplified most recently by the multiplying uses of the Internet, have brought on a flood of startup firms, many of which claim to offer the chance to revolutionize and dominate large shares of the nation's production and distribution system. While the process of innovation, of course, is never-ending, the development of the transistor after World War II appears in retrospect to have initiated a special wave of innovative synergies. It brought us the microprocessor, the computer, satellites, and the joining of laser and fiber-optic technologies. By the 1990s, these and a number of lesser but critical innovations had, in turn, fostered an enormous new capacity to capture, analyze, and disseminate information. It is the growing use of information technology throughout the economy that makes the current period unique.[753]

[752] "Remarks by Chairman Alan Greenspan, Technology and the economy, before the Economic Club of New York, New York, New York," by the Federal Reserve Board, January 13, 2000.

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Three days later, in another videoconference speech before the National Automated Clearinghouse Association, Greenspan discussed innovation and retail payments systems:

> The phrase "Internet time" has now been added to our vocabulary. Behind this phrase is a serious observation that advances in information technology allow new ideas to be transformed into products and services much more rapidly than a few years ago, thus greatly speeding up product cycles. At the same time, new information technologies have broken down barriers between firms and stimulated very creative and competitive processes across the economy. Some traditional financial institutions have tended to view this process with concern. As many firms have driven to find new ways to supply financial and other kinds of information, along with transactions and accounting services, some have expressed concern that their traditional payment franchise is being eroded. This concern is another manifestation of the insecurity brought on by innovation and change.[754]

That Friday, April 14, 2000, Greenspan, in a speech honoring economist Anna Schwartz, emphasized the boon technological innovation has been for the financial services industry, resulting in what he called a "knowledge float." "One of the profound effects of technology on financial services is that the increasing availability of accurate and relevant real-time information, by reducing uncertainty, reduces the cost of capital."[755] In other words, in the leadup to the bubble that was the dotcom investment frenzy, Greenspan publicly put forth the argument that the contemporary market growth was largely due to technological advances in financial services and that creative destruction conveniently explained away this trend.

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[754] "Remarks by Chairman Alan Greenspan, Retail payment systems, before the National Automated Clearinghouse Association Annual Meeting, Los Angeles, California (via videoconference)," by the Federal Reserve Board, April 10, 2000.

[755] "Remarks by Chairman Alan Greenspan, Technology and financial services, before the Journal of Financial Services Research and the American Enterprise Institute Conference, in Honor of Anna Schwartz, Washington, D.C.," by the Federal Reserve Board, April 14, 2000.

In July 2000, Greenspan continued to tie the market realities with the innovation cycle narrative—in a positive light:

> More important, the recent period has been marked by a transformation to an economy that is more productive as competitive forces become increasingly intense and new technologies raise the efficiency of our businesses. With the rapid adoption of information technology, the share of output that is conceptual rather than physical continues to grow. While these tendencies were no doubt in train in the "old," pre-1990s economy, they accelerated over the past decade as a number of technologies with their roots in the cumulative innovations of the past half-century began to yield dramatic economic returns.[756]

Though he continued to invoke Schumpeter, by October 2000 Greenspan's tone shifted, likely in response to market conditions. He spoke via videoconference at the Financial Markets Conference sponsored by the Federal Reserve Bank of Atlanta.[757] Greenspan cautioned against regulating technologies affecting financial services:

> Authorities need to remember that the optimal rate of failure of regulated financial intermediaries is not zero, in part because of the inevitable and necessary process of creative destruction. Policymakers also need to be cautious about efforts to direct the evolution of the financial market infrastructure--that is, trading systems and payment, clearance, and settlement systems. Government authorities are poorly suited to picking winners and losers among competing technologies and market structures. Innovations have to be tested by the marketplace-- ultimately by consumer choice. Those that fall short of

[756] "Remarks by Chairman Alan Greenspan, Structural change in the new economy, before the National Governors' Association, 92nd Annual Meeting, State College, Pennsylvania," by the Federal Reserve Board, July 11, 2000.

[757] "Remarks by Chairman Alan Greenspan, Electronic finance at the Financial Markets Conference sponsored by the Federal Reserve Bank of Atlanta, Sea Island, Georgia (via videoconference)," by the Federal Reserve Board, October 16, 2000.

> creating sufficient value added will fail, and their capital will be redirected to potentially more productive uses.

The following month, Greenspan spoke at the Women in Housing and Finance annual reception for regulators, reiterating that technology innovations were an indication of creative destruction, again emphasizing the way finance has benefited from real-time transactions and information. He cautioned, again, "For policymakers, supervisors, and regulators, I would only suggest some general guidelines for the coming years: Proceed cautiously, facilitate and participate in prudent innovation, allow markets to signal the winners and losers among competing technologies and market structures, and overall--as the medical profession is advised--do no harm."[758]

While Greenspan repeated an enthusiastic narrative on technology innovation, the Vice Chair of the Federal Reserve and Governors of the Federal Reserve Board spoke extensively and more concretely on the trends and realities of new electronic payments systems. Vice Chair Alice Rivlin spoke at the Federal Reserve Bank of Chicago in May 1998 on the challenges of widespread adoption of innovative payments technologies. Rivlin pointed out that US retail payments was "resistant to change." Citing the recent shift to the euro, Rivlin suggested that a psychological factor was at play in the American attitude towards cash.

> There may be something about money that generates a special conservatism and fear of the unknown. The shift to the euro clearly has strong emotional overtones for many Europeans, especially older Europeans, who feel some important part of their heritage is disappearing

[758] "Remarks by Chairman Alan Greenspan, Technology and banking, at the sixth annual reception for regulators, sponsored by Women in Housing and Finance, Washington, D.C.," by the Federal Reserve Board, November 20, 2000.

> with the franc, the mark, and the lire. The tangibility of paper may have some emotional appeal. It's not gold, but at least you can see it, touch it, lock it up and know where it is.[759]

More potently, she discussed the problem of banks responding to change brought on by technological innovation by promoting multiple competing systems, "each claiming to be the great wave of the future." Rivlin cites the yearslong apprehension banks had towards Microsoft, without naming the firm or Bill Gates.

> The result is ferment and frustration in the financial services industry, coupled with fear that some outside force--usually a particularly successful and often demonized software vendor--will suddenly find a way to overcome the reluctance and inertia of banks and their customers and set up a whole new payments mechanism that wholly or mostly bypasses the institutions we now call "banks". Without strong leadership and active consensus building across the diverse institutions and constituencies that make up the users and providers of retail payments, we may be stuck in this dilemma for quite a while.[760]

Roger Ferguson, Jr., throughout his time a member of the Federal Reserve Board of Governors and subsequently as Vice Chairman, spoke extensively on specific innovations in digital payments and online financial services technologies. In June 1998, Ferguson testified before the Subcommittee on Finance and Hazardous Materials of the Committee on Commerce on the implications of e-commerce. Like Rivlin, Ferguson summarized the developments in electronic money and financial technologies in a practical and more restrained manner. Though online transactions are "widely reported to be on the increase," Ferguson reminded the Subcommittee that growth in adoption of digital payment technologies "has been slower than many observers

[759] "Remarks by Vice Chair Alice M. Rivlin, The U.S. retail payments system before the 34th Annual Conference on Bank Structure and Competition of the Federal Reserve Bank of Chicago," by the Federal Reserve Board, May 7, 1998.

[760] "Remarks by Vice Chair Alice M. Rivlin."

anticipated several years ago."[761] For some of these new payment systems, Ferguson explained that new "technical infrastructure" had to be in place to gain consumer adoption. In the same testimony, Ferguson indicated that the Federal Reserve had no intention to compete with private firms in issuing electronic currency. He argued that competing with the private section "could well stifle the current environment of experimentation and innovation" while the environment of rapid innovation in financial technologies made adoption "highly uncertain."

On the topic of forecasting banking trends, Ferguson acknowledged in September 1998 that both current state estimates and future state projections were "all over the map."[762] He cautiously noted that online banking remained an interesting development to watch and that smart card pilots in the country suggested that consumer demand for such a payments system was weak. Ferguson cited "numerous simple tools for "surfing the web""—browsers—as having helped the internet move into "mass adoption" in the 1990s. Browsers, therefore, drove online investing into what Ferguson described then as "early mass adoption"—along with several other factors. "Some apparent reasons for its success include our long economic boom, a graying population looking towards retirement, significantly lower transaction costs, and the provision of associated investor information and services." Even in discussing widespread adoption of the web and internet technologies, Ferguson's public remarks on the subject of innovation in financial technologies remained tethered to reality.

By September 1999, another leader from the Fed would note that credit cards had largely triumphed over other digital payment methods online. Governor Edward Gramlich noted in a

[761] "Testimony of Governor Roger W. Ferguson, Jr., Implications of developments in electronic commerce, before the Subcommittee on Finance and Hazardous Materials of the Committee on Commerce, U.S. House of Representatives," by the Federal Reserve Board, June 4, 1998.

[762] "Remarks by Governor Roger W. Ferguson, Jr. at the Bank Administration Institute's Symposium on Payments System Strategy, Washington, D.C.," by the Federal Reserve Board, September 29, 1998.

speech that most e-commerce transactions still relied on credit cards and that open system stored value cards offered the biggest cost savings relative to cash rather than online transactions.[763] Ferguson in early 2001, now Vice Chairman, noted in a speech that the market was reality-checking the value of tech firms despite ongoing media attention directed at e-commerce start-ups. "The rapid reassessment of the business prospects of some e-commerce firms during the course of last year is a reflection of this reality."[764] On the progress of payments and e-commerce, Ferguson concedes that innovations in online payment technologies are in fact based on preexisting payment systems and that online transactions are still increasing despite market fluctuation. Emphasizing the importance for older, established payment protocols to evolve with the advent of new technologies, Ferguson also highlights the disparity in tracking or forecasting online transactions growth. He cites the Census Bureau's estimates that in 2000 retail transactions online totaled roughly $20 billion, while other "private calculations" suggested closer to $40 billion. E-commerce and online financial services were in fact growing, but the hyperbolic tendencies of consultancies and the media still needed to be taken into account.

By late August 2001, Ferguson openly described some of the payments businesses as failures. Among these failures is the smart card. Ferguson said, "The "cashless society" appears little closer today than when that phrase began to be used forty years ago. One likely explanation is that network effects are important in determining which innovations succeed or fail. In many retail payment experiments, too few consumers or merchants use a payment network or a new

[763] "Remarks by Governor Edward M. Gramlich before the Electronic Payment Symposium, University of Michigan, Ann Arbor, Michigan," by the Federal Reserve Board, September 17, 1999.

[764] "Remarks by Vice Chairman Roger W. Ferguson, Jr. at the Owen Graduate School of Management, Vanderbilt University, Nashville, Tennessee," by the Federal Reserve Board, February 14, 2001.

instrument for these technology-driven services to become economically viable."[765] The following week, Ferguson spoke at the Federal Reserve Bank of Philadelphia, reiterating the adjustment in attitude towards predictions about payments systems of the past several years. The evolution of these payments systems remained slow despite the many innovative alternatives piloted in the 1990s. While both customers and banks benefit from the newfound convenience of line banking services, Ferguson explained, "…simple ideas such as electronic bill payment by consumers and businesses have turned out to be more of a challenge than we imagined a few years ago."[766]

The discrepancy in expressed enthusiasm for innovations in financial technologies between the public remarks of Greenspan and other leaders from the Fed like Rivlin and Ferguson demonstrate the split between the narrative of e-commerce and reality. The level of detail in Rivlin and Ferguson's public remarks and congressional testimonies demonstrates that researchers at the Federal Reserve had access to information that reflected the growth and adoption of the web and new digital payment systems, as well as similar information on existing payment technologies.

### *The Encryption Wars (1994-2001)*

In April 1993, the Clinton administration launched an encryption initiative that instigated what the *New York Times* called "the first holy war of the information highway."[767] The object of controversy was the Clipper chip, a chipset developed by the National Security Agency (NSA) intended for phones that required the user to surrender the assigned cryptographic key in escrow

[765] "Remarks by Vice Chairman Roger W. Ferguson, Jr. at a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming," by the Federal Reserve Board, August 31, 2001.

[766] "Remarks by Vice Chairman Roger W. Ferguson, Jr. at the Federal Reserve Bank of Philadelphia, Philadelphia, Pennsylvania," by the Federal Reserve Board, September 4, 2001.

[767] "Battle of the Clipper Chip," by Steven Levy, *The New York Times Magazine*, June 12, 1994.

to the government.[768] Ultimately a federal standard backdoor decryption scheme that would give government agencies the ability to intercept communications for surveillance or intelligence, the key escrow requirement central to the Clipper chip initiative generated immense controversy during the first of the encryption wars of the 1990s and later the encryption export wars, centered around software, from 1996 to 2000.[769] By June 1994, a researcher at Bell Labs revealed a serious flaw in the Clipper technology and the following month, after then-Representative Maria Cantwell of Washington introduced legislation for relaxing encryption software export regulations, Vice President Al Gore communicated a change in the Clinton administration's stance on key escrow through a letter to Cantwell.[770]

The Clipper chip controversy made hackers, like the famed Cypherpunks, and civil libertarians alike, even more suspicious of the NSA's wiretapping intentions. It also occurred as sophisticated users of the internet were already using separate encryption programs to safeguard email communications. During the early 1990s, such encryption software programs were made available on the internet for free. The most popular example is Phillip Zimmerman's PGP. Though the war over the Clipper chip was seemingly over in 1994, the rise of the web in 1995 and the launch of transactions businesses that relied on encryption technology revived media coverage on encryption regulations. In May 1995, CyberCash announced that the Department of Commerce had approved the export of its encryption technology intended for international banks.[771] The technology had previously been restricted under the International Traffic in Arms Regulations, which controls the distribution of defense and space-related and prohibited the export of encryption

[768] "White House Clipper Statement (4/16/93)," by the White House Press Secretary, April 16, 1993.

[769] Jarvis (2020).

[770] "Gore Shifts Stance on Chip Code," by John Markoff, *The New York Times,* July 21, 1994.

[771] "INFORMATION TECHNOLOGY; Export Approved for Software To Aid Commerce on Internet," *The New York Times,* May \8, 1995.

technology. CyberCash's encryption system did not encrypt messages in bulk, but only small sections of a transaction message. But by August, after a year's silence on the key escrow controversy, the Clinton administration indicated it would propose new changes to encryption export laws.[772] This followed the news that a student in France successfully hacked Netscape's 40-bit European edition of Navigator.[773] Key escrow remained central to the White House's revised proposal, revealed in September,[774] prompting tech companies including Apple, Microsoft, Novell, and Oracle to form a coalition to draft its own proposal.[775] By this time, encryption and key escrow had become a divisive topic among politicians, tech companies, cryptographers, civil libertarians, privacy advocates, legal experts, and federal agencies including the NSA and the FBI.

On July 16, 1996, coinciding with the publication of a web security whitepaper penned by Netscape's encryption and security leadership, the US government granted Netscape permission to distribute Navigator and Netscape servers with RC4 128-bit encryption on the web for download by US citizens.[776] The company's press announcement indicated that Netscape may be "the first company to receive official government approval to electronically download export-controlled software, and Netscape Navigator and Netscape FastTrack Server are the only software products available for approved Internet distribution with RC4 128-bit security." Jim Bidzos of RSA Data Security is quoted in the press release emphasizing the multifaceted nature of securing e-

[772] "U.S. to Urge A New Policy On Software: Attempt at Compromise On Scrambling of Data U.S. to Propose a Policy Change on Software," by John Markoff, *The New York Times,* August 18, 1995.

[773] "U.S. Proposes Policy Change in Computer Access Technology," by Reuters, *The Los Angeles Times,* August 18, 1995.

[774] "TECHNOLOGY: ON THE NET; Privacy for computers? Clinton sets the stage for a debate on data encryption," by Peter H. Lewis, *The New York Times,* September 11, 1995.

[775] "Industry Group Rebuffs U.S. On Encryption," by John Markoff, *The New York Times,* November 8, 1995.

[776] "Netscape Granted Approval by U.S. Government to Distribute Highly Secure Versions of Netscape Software Products on the Internet," *PR newswire,* July 16, 1996.

commerce. “Online services involving consumer privacy, such as banking, demand the strongest possible encryption, and without it the full potential of the Internet cannot be realized. Today's breakthrough announcement from Netscape and its partners ensures that encryption capable of inspiring both business and consumer confidence is widely available, and available today.” Marc Andreessen is quoted saying that stronger encryption will help drive adoption web-based communications and e-commerce.

Focusing on securing transactions, Microsoft announced in September 1997 Server Gated Crypto, an SSL extension that allowed for 128-bit encryption in online communications between banks and customers.[777] On October 1, 1996, Gore revealed another revised encryption initiative from the Clinton administration. The proposal was intended to “support the growth of electronic commerce, increase the security of the global information, and sustain the economic competitiveness of U.S. encryption product manufacturers during the transition to a key management infrastructure.”[778] Executive Order 13026 of November 15, 1996, formally transferred the control of commercial encryption products on the State Department’s US Munitions List (USML) to the Commerce Control List (CCL) of the Department of Commerce. Weeks later, the *New York Times* reported that tech companies now saw the White House as having reneged on previously agreed upon terms for loosening encryption export controls. Companies still had to apply for a license to export encryption products, and licenses for products protected by 56-bit keys or higher would be considered on a case-by-case basis.[779]

[777] “On-Line Banking: Microsoft Paves Way, With 128-Bit Codes, for Secure Internet Banking,” by Jeffrey Kutler, *American Banker*, September 11, 1997.

[778] Kehl, Wilson, and Bankston (2015).

[779] “A Compromise On Encryption Exports Seems To Unravel,” by John Markoff, *The New York Times*, December 6, 1996.

In late March of 1997, the Clinton administration failed to garner support for its proposal for law enforcement agencies to adopt an international key escrow standard.[780] Media attention around a German start-up began to play into the narrative that US export laws were hampering American competition in the software industry globally. The *New York Times* reported that "U.S. export restrictions have been a boon for Brokat Informationssysteme GmbH, a two-year-old start-up company in Boeblingen, Germany." Brokat provided secure transaction software for banks, including Deutsche Bank, and services like America Online in Europe. Its Xpresso Security Package provided users an added layer of security for Navigator and Internet Explorer. In April, the *New York Times* ran a lengthy profile of Brokat, detailing success in selling its security software to over 30 large banking and financial institutions.

> But what is most remarkable is that Brokat's rapid growth stems in large part from the Alice in Wonderland working of American computer policy. Over the last two years, Brokat and a handful of other European companies have carved out a booming business, selling powerful encryption technology around the world that the U.S. government prohibits American companies from exporting. Encryption technology has become a big battleground in the evolution of electronic commerce and the Internet. As in the United States, European banks and corporations are racing to offer online financial services, and many of these services are built around Internet programs sold by American companies like Netscape and Microsoft.[781]

The following month saw the White House yield further ground on encryption export controls when the Commerce Department said it would allow the export of the most powerful security

[780] "U.S. Rebuffed in Global Proposal For Eavesdropping on the Internet," by John Markoff, *The New York Times,* March 27, 1997.

[781] "U.S. Restrictions Give European Encryption a Boost," by Edmund L. Andrews, *The New York Times,* April 7, 1997.

software for securing financial transactions. Covered under this new exception were international funds transfers between banks, home banking software, and the SET standard.[782] Further magnifying the ways export controls were preventing American software companies from competing abroad was the May 20 announcement that Sun Microsystems would sell advanced 128-bit data-encryption software created with Elvis+Company, a Russian entity, to international customers.[783] Other companies would follow suit in relying on foreign subsidiaries to sell encryption software outside the United States. On June 25, the Commerce Department granted both Netscape and Microsoft permission to export 128-bit versions of their browsers to banking customers. This change only applied to the sale of software to banks and software used for financial transactions, not for communications.[784] The following week President Clinton announced the White House's stance on making the internet a "global free-trade zone." Dennis Tsu, Sun Microsystems' director of electronic commerce, expressed to the *New York Times*, that the lack of standard patent, copyright, and privacy protections could "could result in the loss of billions of dollars in sales to aggressive overseas competitors whose governments have already moved to secure electronic commerce."[785]

Throughout the summer and fall of 1997, both the House and the Senate debated proposed legislation for government restrictions on encryption technology. The dramatic twists and turns of these debates were covered extensively by the *New York Times*.[786] As late as early October 1997,

[782] "U.S. to Ease Rules on Export of Finance Encryption Technology," by John Markoff, *The New York Times,* May 9, 1997.l

[783] "Sun Is Seeking Sales Abroad Of Latest Encryption Software," by Bloomberg News, *The New York Times,* May 20, 1997.

[784] "Netscape and Microsoft Are Cleared on Exports," by John Markoff, *The New York Times,* June 25, 1997.

[785] "U.S. to Ease Rules on Export of Finance Encryption Technology," by John Markoff, *The New York Times,* July 2, 1997.

[786] Accessible at https://archive.nytimes.com/www.nytimes.com/library/tech/reference/index-encrypt.html.

the top White House internet policy adviser, Ira Magaziner, admitted that the Clinton administration still did not have a clear position at present on the issue of encryption.[787] In November 1997, rumors circulated that the Clinton administration would double back on its intentions to loosen data encryption export regulations. Security and software firms lobbied that tightening the data export rules "would curtail the growth of electronic commerce, which promises to become a global business."[788] Once again, the crux of the issue resided in the administration's push for backdoor key recovery technology that would provide law enforcement agencies tools for electronic surveillance of transactions.[789] However, this time banks once again revealed their ongoing distrust of software companies. "Several computer industry executives called the debate intriguing because it had redefined the lines in the encryption battle. In this case, banks -- concerned in part about competition -- have sided with law enforcement and national security executives, opposing software companies, securities firms and Internet commerce start-ups."[790]

In February 1998, the *New York Times* reported that in private meetings with Silicon Valley executives, President Clinton expressed "that he is sympathetic with their viewpoint but that he is under great pressure from law enforcement and national security officials to put even greater controls in place on encryption technology."[791] An unnamed tech executive told the paper, "To us this is really important, but it's just an irritant to him." In March, technology companies and civil liberties groups, among others, formed a coalition called Americans for Computer Privacy, and

[787] "Clinton's Top Internet Adviser Says U.S. Encryption Policy Is Unformed," by Martin Nisenholtz, *The New York Times*, October 7, 1997.

[788] "White House May Tighten Data Exports," by John Markoff, *The New York Times*, November 24, 1997.

[789] "White House May Tighten Data Exports."

[790] "White House May Tighten Data Exports."

[791] "Encryption Issue Threatens Silicon Valley Rapport With Clinton White House," by John Markoff, *The New York Times*, February 27, 1998.

announced that the coalition had a $5 to 7 million budget for a national lobbying ad campaign. The same day of the announcement, Gore indicated a change in the White House's stance on key escrow, through a letter to Senate Democratic Leader Tom Daschle.[792] Gore described the optimal path forward as, "to pursue a good faith dialogue over the coming months between industry and law enforcement, which can produce cooperative solutions, rather than seeking to legislate domestic controls." Later the same month, the Justice Department told Congress that the FBI, previously the most vocal supporter of key escrow, was now retreating from its position.[793]

In April, a study by the Economic Strategy Institute claimed that total direct and indirect losses from export controls will cost the US economy an estimated $35 to 96 billion over the next five years.[794] The *New York Times* quoted from the study, "Foreign encryption makers continue to outrank U.S. producers in number, to increase their product lines faster than do U.S. firms, and to market encryption products that are just as strong as those produced in the United States." Later the same month, Secretary of Commerce William Daley, when introducing the department's first digital economy report, publicly stated that export controls forced American software companies to lose out to foreign competitors. Daley described the current trajectory as a "lose-lose path."[795] Daley said, "The ultimate result will be foreign dominance of the market. This means a loss of jobs here, and products that do not meet either our law enforcement or national security needs."

In late June 1998, the *Wall Street Journal* ran a lengthy article detailing the success of Brokat. The narrative is clear: Brokat's wins came at the expense of American firms like RSA Data Security. Bidzos told the *Journal*, "It's so frustrating to stand by and watch the market you

[792] "Gore Letter Seems to Soften Stance on Encryption," by Jeri Clausing, *The New York Times*, March 5, 1998.

[793] "FBI Halts Its Push for Encryption Access Legislation," by Jeri Clausing, *The New York Times*, March 18, 1998.

[794] "Study Puts Price on Encryption Controls," by Jeri Clausing, *The New York Times*, April 1, 1998.

[795] "Commerce Chief Calls U.S. Encryption Policy Flawed," by Jeri Clausing, *The New York Times*, April 16, 1998.

created get handed on a silver platter to the rest of the world."[796] The article illustrates the amount of business American software firms lose due to export restrictions:

> Mr. Bidzos ticks off the overseas giants that called him looking for deals that he had to turn down: Lloyds TSB PLC, SAP AG, Siemens AG and Cie. des Machines Bull, to name a few. Microsoft Corp. says it has lost "hundreds of thousands" of potential users of its software. Consensus Development Corp., which licenses encryption to firms such as International Business Machines Corp., says it loses about 40% of new business leads because they turn out to be overseas clients.

As the *New York Times* did a year prior, the article highlights the success of Brokat as a result of these restrictions. Though Brokat started as an encryption software company, it eventually developed a showcase software platform built on Java for financial institutions, which most clients buy. With over 1,400 clients, Brokat in 1998 made the de facto banking OS for Europe. In retelling the company's origin story, the *Wall Street Journal* reported that the company made its first sale before even having a market-ready product when it first pivoted to encryption. "When five friends founded Brokat in 1994, they never realized that they would be among the biggest beneficiaries of the U.S. regulations. They decided to start a company to help European financial institutions transfer information over electronic networks. Each bank that the Brokat team approached, however, said the same thing as it ushered them out the door: Your products are great, but U.S. export laws mean we can't get the software to keep our information safe." The article goes on to say that Brokat now had a waiting list for "lowest-priority projects" because demand for their software was so high. Brokat's success in a short span of time gave the firm confidence to expand

[796] "Europeans Unlock Encryption Market, Thanks to U.S. Software Export Rules," by Kimberley A. Strassel, *The Wall Street Journal,* June 30, 1998.

to the US market. In 1999, Cybernetica, a firm in Estonia, would advertise, "Strong crypto. Long keys. No export restrictions."[797]

Once again, as if responding in real-time to media coverage of the economic suffering of American software firms, the Commerce Department announced a week later that it would allow export of encryption software products with no key escrow requirements, "but only for banks and financial institutions in 45 nations that have acceptable money-laundering laws."[798] This change allowed financial institutions, after acquiring the license for their headquarters, to export the technology to their branches in any of the approved nations. But the bad press for strict encryption export controls did not end there. The *New York Times* reported that an American encryption expert had renounced his US citizenship in favor of Anguilla in order to start a software company to provide software for securing electronic transactions.[799] Less than two weeks later, the White House announced further relaxation of export controls by adding other "key business sectors" in addition to banking.[800] These included online retailers and businesses in medical, insurance, health, and proprietary information businesses. At the RSA Data Security conference in San Jose in January 1999, Bidzos opened his talk with a simple explanation for why encryption was such a hot topic: public key encryption is "a solution in search of a problem," and that problem is e-commerce.[801] This is an unequivocal summation of the force of the promise of e-commerce in

[797] "Encryption Products Found To Grow in Foreign Markets," by John Markoff, *The New York Times*, June 10, 1999.

[798] "Administration to Allow Limited Data-Scrambling Exports," by Jeri Clausing, *The New York Times*, July 8, 1998.

[799] "Encryption Expert Says U.S. Laws Led to Renouncing of Citizenship," by Peter Wayner, *The New York Times*, September 6, 1998.

[800] "Adminstration Announces New Concessions on Encryption Policy," by Jeri Clausing, *The New York Times*, September 16, 1998.

[801] "Conference Underscores Growing Role of Encryption," by Peter Wayner, *The New York Times*, January 20, 1999.

driving legislation. Ted Goldstein, chief technical officer at Transactor, a San Francisco startup working with Citibank on an e-wallet called Citiwallet, told the *New York Times* that SSL remains the foundation for e-commerce because it is built into standard browsers.[802]

A pivotal moment in the encryption export wars came in April 1999, when key escrow legislation in the Senate fell apart because Senator John McCain, then thought to be considering a Presidential bid, suddenly withdrew his longtime support for the bill. In August 1999, a mathematician at a small Canadian software firm discovered a digital key in Window NT labeled "NSA key."[803] This embroiled Microsoft in an accusation that the tech company had a backdoor encryption alliance with the NSA.[804] Weeks later, the Clinton administration ultimately withdrew its key escrow proposal, simplifying the Commerce Department's stipulations for export licenses.[805] Companies would now go through a one-time review while export restrictions due to security concerns remained in place for nations labeled as terrorist.[806] The *Wall Street Journal* described this development in the yearslong struggle over relaxing export controls as the result of Gore's presidential bid. "What shifted -- dramatically -- was the political calculus, which finally forced the administration to face reality."[807] Bidzos told the *Journal* that compared to George W. Bush, Gore "has been granted a chilly reception" in Silicon Valley after years of serving as the face for encryption initiatives for the White House. Records from the Clinton Digital Library show

[802] "Conference Underscores Growing Role of Encryption," by Peter Wayner, *The New York Times.*

[803] "A Mysterious Component Roils Microsoft," by John Markoff, *The New York Times*, September 4, 1999.

[804] "Microsoft Denies Windows Backdoor," by The Asssociated Press, *The New York Times,* September 3, 1999.

[805] "White House Eases Export Controls on Encryption," by Jeri Clausing, *The New York Times* September 17, 1999.

[806] "White House Eases Export Controls on Encryption." Nations excluded were Iran, Iraq, Libya, Syria, Sudan, North Korea, and Cuba.

[807] "Just Like That, the War's Over On the Encryption Battlefield," by Jason Fry and Megan Doscher, *The Wall Street Journal,* September 17, 1999.

a series of outreach meetings with Silicon Valley executives known as the Gore-Tech network, where Gore emphasized innovation as an engine of economic growth.[808] The article also illustrates Bidzos's explanation for the mounting pressures to liberalize encryption export:

> Jim Bidzos, vice chairman of RSA Security Inc. and a 15-year veteran of the encryption wars, sees a number of factors that gradually came to exert more and more pressure. The first came to the fore about five years ago, as foreign firms started waking up to the opportunity that U.S. export controls posed for their sales teams. The second factor, in his thinking, was the tremendous contribution technology has made to the economy. A third came about 18 months ago, when the administration tried -- and failed -- to get other nations to take a hard line on encryption policy. Then this year, a bill to liberalize export policy attracted more than half of the House's members as co-sponsors -- and survived the usual national-security machinations aimed at derailing it.

The *New York Times* described Gore's predicament, "It has also been a politically sensitive issue for Vice President Al Gore, who found that the computer executives he has assiduously courted in Silicon Valley for seven years remained angry about the government's efforts to control encryption products. They flooded his office with complaints."[809] Commerce Department officials said that Gore's domestic policy adviser Dan Beier participated in discussions on revising export controls, but that "political concerns never came up in the interagency meetings on altering the regulations." In January 2000, the new encryption export regulations were published in the Federal Register.[810] The restrictions were further relaxed in July when the White House announced that American companies no longer needed export licenses to sell encryption products to any end user in the

[808] "OVP - Gore tech/Tech Outreach [2]," *Clinton Presidential Library & Museum,* Clinton Digital Library1993-2001. Available at https://clinton.presidentiallibraries.us/items/show/5067.

[809] "U.S. Removes More Limits On Encryption," by David E. Sangar and Jeri Clausing, *The New York Times,* January 13, 2000.

[810] "White House Eases Rules on Encryption Exports," by Jeri Clausing, *The New York Times,* January 12, 2000.

European Union, Australia, Norway, the Czech Republic, Hungary, Poland, Japan, New Zealand, and Switzerland.[811] In January 2001, the list was expanded, the last of the Clinton administration's activities on this front. The tech industry's story seemed confirmed when VeriSign indicated that there was an e-commerce-driven increase in demand for encryption in March 2000.[812]

Even as the encryption export laws were liberalized, the surveillance ambitions of the NSA from the Clipper chip days continued to haunt public perception of US-made encrypted software. In early 2000, China issued "sweeping new restrictions on encryption technology" that raised concerns for foreign firms doing business in China. "In theory, firms like Microsoft and IBM will have to strip their software of their own encryption codes and replace them with Chinese-made products."[813] China would quickly relax these encryption restrictions.[814] Nonetheless, this became a reality in July 2001, when Microsoft agreed to allow native Chinese-built encryption software to be built into Windows after unfounded rumors regarding backdoor spying circulated on Chinese Internet chat rooms and published in state newspapers.[815]

[811] "Administration Retools Rules on Encryption Device Exports," by David Stout, *The New York Times*, July 18, 2000.

[812] "Demand for VeriSign's Encryption Surges With Increase in Online Transactions," by William M. Bulkeley, *The Wall Street Journal*, March 7, 2000.

[813] "Few Comply as China Enacts Encryption Rules," by Reuters, *The New York Times*, February 1, 2000.

[814] "China Relaxes Strong Rules On Net Encryption Programs," by Matt Forney, *The Wall Street Journal*, March 13, 2000.

[815] "Microsoft to Include Chinese Encryption Software in System," by Matt Pottinger, *The Wall Street Journal*, July 9, 2001.

*The End of the Browser Wars: Antitrust, Mozilla, and AOL (1997-2004)*

Though plagued by multiple Justice Department investigations since 1990, Microsoft avoided a full-scale antitrust trial until late 1997, when the tech giant found itself back in court over allegations that it violated the terms of its 1994 consent decree. On December 11, 1997, Judge Thomas Penfield Jackson of the United States District Court in Washington issued a temporary order barring Microsoft from forcing OEMs to bundle Internet Explorer with their Windows PC shipments.[816] This would mark the beginning of colorful hearings through early 1998 featuring claims and demonstrations of whether a user could successfully uninstall IE and still run Windows 95. At a scheduling conference to set a date for the subsequent hearing, Judge Jackson said that his clerk was able to uninstall Internet Explorer 3.0 in 90 seconds; afterwards, the OS functioned "flawlessly."[817]

The hearings centered around the language in the consent decree that exempted "integrated products" from the terms. The Department of Justice argued that license agreements with OEMs that forced the *bundling* of IE with Windows violated the decree as IE and Windows were two separate products, while Microsoft argued that IE was fully *integrated* within the Windows OS.[818] The Justice Department's case focused on Microsoft's abuse of market power as the maker of the most popular OS to squeeze out a browser software competitor, primarily Netscape.[819] This anticompetitive behavior did not seemingly harm consumers, which remains central to the Chicago

[816] "Unbundling Microsoft: News Analysis" by Steve Lohr, *The New York Times*, December 13, 1997.

[817] "Judge uninstalls IE in 90 seconds," *CNET*, December 19, 1997.

[818] "Even Microsoft's Internet Browser Defends Itself," by Stephen Manes, *The New York Times*, January 6, 1998.

[819] "Why Microsoft Takes a Hard Line With Government," by Steve Lohr and John Markoff, *The New York Times*, January 12, 1998.

School[820] interpretation of the Sherman Act, or hinder innovation. Gates would later remark, "What the government is asking would significantly hamper us from competing through innovation and would put everything we've worked for and built for the last 23 years at risk."[821]

On January 13, 1998, the Justice Department asked that Microsoft be held in contempt of Judge Jackson's December 11 order and be fined $1 million a day for not offering OEMs the simple option for an upgraded version of Windows 95 to allow IE to be deleted without damaging shared files that prevent other programs from running.[822] Both sides proceeded to call an expert witness demonstrating varying results of uninstalling IE.[823] Before the end of the month, Microsoft would settle the contempt of court case.[824] By April, Microsoft conceded some control over desktop customization to OEMs[825] as hearings continued, with both sides attempting to define what constituted an integrated product.[826] Though the Justice Department invited Microsoft to continue negotiations over the issue of desktop customization, settlement talks broke down over this very issue.[827] On May 18, the Justice Department filed suit, ending the department's dogged multiyear pursuit of Microsoft. Gates described the filing as "ironic"—that "in the United States -

[820] Based on the ideas of Aaron Director and popularized by Robert Bork in the 1970s, the Chicago School of Antitrust interpreted antitrust law through the narrow lens of consumer welfare and doing away with the Congressional intent of the Sherman Act. Though a Post-Chicago School of economists emerged in the 1980s and the Clinton administration saw the Microsoft trials, the judiciary reverted to the Bork interpretation in the subsequent years.

[821] "Justice Department Expected to File Suit Against Microsoft," by Steve Lohr and Joel Brinkley, *The New York Times,* May 18, 1998.

[822] "At Hearing, Microsoft and U.S. Spar," by Jeri Clausing, *The New York Times,* January 13, 1998.

[823] "Federal Judge Confronts Microsoft Over Browser," by Jeri Clausing, *The New York Times,* January 14, 1998. l

[824] "Microsoft Settles With U.S. on Contempt Issue," by Jeri Clausing, *The New York Times,* January 22, 1998.

[825] "Microsoft Bows on Opening Screen Options," by Steve Lohr, *The New York Times,* April 21, 1998.

[826] "Justice Department Is Closely Questioned in Microsoft Case," by Jeri Clausing, *The New York Times,* April 21, 1998.

[827] "Justice Department Expected to File Suit Against Microsoft," by Joel Brinkley, *The New York Times,* May 18, 1998.

- where freedom and innovation are core values -- that these regulators are trying to punish an American company that has worked hard and successfully to deliver on these values."[828] Microsoft's defense described the government's demand that Microsoft add Navigator to its Windows 98 shipments as forcing the *New York Times* to wrap the front section of the *Wall Street Journal* around its newspaper, or, alternatively, forcing Coca-Cola to add cans of Pepsi to each six-pack of Coca-Cola.[829] The antitrust trial from fall of 1998 to 1999 was covered extensively by the media.[830] The colorful characters (specifically judges and attorneys), revelations of anticompetitive machinations of Microsoft to gain browser share, the "hardcore" culture of Microsoft as expressed through the language and tone of its internal emails, accusations of doctored video demos, and Gates' evasiveness in the video depositions all made the trial an irresistible feast of business-interest drama for the mainstream media. Seemingly in defiance of the looming antitrust trial, Microsoft made an unsuccessful bid to acquire 3Com's Palm Pilot software business in August.[831] Barksdale's testimony in October produced the "bombshell" that Microsoft had suggested in June 1995 to illegally divide the browser market,[832] while Microsoft counterargued that Netscape eagerly sought the meeting.[833] Interestingly, Marc Andreessen's notes from the June 1995 meeting between Netscape and Microsoft had been in the Justice Department's possession since late June 1995 when the government was investigating Microsoft for antitrust

[828] "U.S. and States File Suits Against Microsoft," by Joel Brinkley, *The New York Times,* May 19, 1998.

[829] "Analogies As Complex And Murky As the Case," by John Markoof, *The New York Times,* May 21, 1998.

[830] "Ongoing Coverage of Microsoft Antitrust Case," *The New York Times,* accessible at https://archive.nytimes.com/www.nytimes.com/library/tech/reference/index-microsoft-98.html. Also see Auletta (2001).

[831] "Push to Buy Palm Shows Aggression Is Consistent," by John Markoff, *The New York Times*, October 19, 1998.

[832] "Antitrust Case Relies Heavily on Events at a 1995 Meeting," by Steve Lohr, *The New York Times,* October 20, 1998.

[833] "Microsoft Disputes Netscape Meeting Account: Microsoft Disputes Account of Key Meeting," by Joel Brinkley, *The New York Times,* October 23, 1998.

violations in its MSN bundling plans.[834] Microsoft accused IBM of collusion with its competitors, producing an email from IBM's head of software asking Sun Microsystems and Netscape for help in persuading Oracle and Novell "to put Microsoft on the defensive."[835]

The Justice Department's case made extensive use of email exhibits as evidence of Microsoft's anticompetitive intentions and behavior, making *U.S. v. Microsoft* "the first major E-mail trial." The *New York Times* reported, "The human testimony often pales next to the E-mail evidence. On the stand or in videotaped testimony, the people being questioned shrug, mumble and forget. The E-mail is alive with ideas and competitive zeal, punctuated with profanity and exclamation points."[836] The famous "hardcore" culture of Microsoft was evident in the language used in emails and attached presentation files. But it extended beyond Microsoft, as emails revealed that industry executives referred to Netscape's plight in the browser wars as a "jihad."[837] Though the colorful language made for sensational moments, the "zeal" and "profanity" may be the result of the medium, rather than the intent or mood of the writer.[838]

The *Court's Findings of Fact* from November 1999, which find Microsoft guilty of abusing its market power, offer a detailed narrative of Microsoft's history of anticompetitive behavior on various fronts. These chronological findings describe a multi-sided platform business[839] that

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[834] Exhibit 1260 of *US v. Microsoft* request for documentation accessible at http://www.justice.gov/sites/default/files/atr/legacy/2006/03/03/1260.pdf. Also see exhibit 1259 (Netscape makes emailed notes available) https://www.justice.gov/sites/default/files/atr/legacy/2006/03/03/1259.pdf.

[835] "Microsoft Accuses I.B.M. of Attempted Collusion," by Joel Brinkley, *The New York Times,* November 19, 1998.

[836] "Antitrust Case Is Highlighting Role of E-Mail," by Steve Lohr, *The New York Times,* November 2, 1998.

[837] Exhibit 1233 of *US v. Microsoft* accessible at https://www.justice.gov/sites/default/files/atr/legacy/2006/03/03/1233.pdf.

[838] Peterson, Hohensee, and Xia (2011). A University of Washington linguistics study of the Enron emails, the largest publicly available corpus of emails available at https://dl.acm.org/doi/pdf/10.5555/2021109.2021120.

[839] Rochet and Tirole (2003).

formed the Microsoft Windows ecosystem, wherein Microsoft had separate relationships with Intel, OEMs, ISPs (software developers), IAPs (access providers), and ICPs (content providers). Microsoft's economic expert witness, economist Richard Schmalensee, address some of these issues of antitrust policy with such a business in a 2000 paper, after the trial concluded.[840]

The *Findings* also revealed why Microsoft adamantly refused to yield desktop customization or default browser software choice to OEMs. Microsoft commissioned a number of external and internal tracking studies to better understand how consumers and developers alike responded to its browser product.[841] Microsoft relied on its discovery of the *default effect*[842] to privilege IE as the default browser in Windows.

> Very soon after it recognized the need to gain browser usage share at Navigator's expense, Microsoft identified pre-installation by OEMs and bundling with the proprietary client software of IAPs as the two distribution channels that lead most efficiently to browser usage. Two main reasons explain why these channels are so efficient. First, users must acquire a computer and connect to the Internet before they can browse the Web. Thus, the OEM and IAP channels lead directly to virtually every user of browsing software. Second, both OEMs and IAPs are able to place browsing software at the immediate disposal of a user without any effort on the part of the user. If an OEM pre-installs a browser onto its PCs and places an icon for that browser on the default screen, or In its internal decision-making, Microsoft has placed considerable reliance on studies showing that consumers tend strongly to use whatever browsing software is placed most readily at their disposal, and that once they have acquired, found, and used one browser product, most are reluctant — and indeed have little reason — to expend the effort to switch to another. Microsoft has

[840] Schmalensee (2000).

[841] External Microsoft survey, exhibit 2084 from *US v. Microsoft*, accessible at https://www.justice.gov/sites/default/files/atr/legacy/2006/03/03/2084.pdf and exhibit 361 https://www.justice.gov/sites/default/files/atr/legacy/2006/03/03/361.pdf.

[842] Sunstein and Thaler (2021), p. 108. Default options are options "that will prevail if the chooser does nothing."

> also relied on studies showing that a very large majority of those who browse the Web obtain their browsing software with either their PCs or their IAP subscriptions.[843]

Of the various methods of gauging consumer demand and navigating the challenges of product prototyping, Microsoft stands out as the one entity to have sought some empirical way of understanding its browser users.

After issuing the *Findings of Fact* in November 1999, Judge Jackson appointed Judge Richard Posner to serve as mediator, in hopes of reaching a settlement with Microsoft.[844] On April 2, 2000, after months of unsuccessful negotiations, Judge Posner concludes the mediation[845] and news of the breakdown of settlement talks were reported over the weekend. On Monday, April 3, the NASDAQ fell 7.6 percent as share prices for Microsoft and other technology firms took a nosedive in response to the news that the Department of Justice had won its case.[846] Microsoft would eventually lose the appeal, but under a new administration, the Justice Department announced on September 6, 2001, that it would not seek the breakup of company, nor continue to pursue issues pertaining to the firm's software bundling practices regarding its next OS release, Windows XP.[847] In the aftermath of the antitrust trials, Microsoft would become a "gentler giant."[848]

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[843] *US v Microsoft: Court's Findings Of Fact*, p. 72-73. Accessible at https://www.justice.gov/atr/us-v-microsoft-courts-findings-fact and https://www.justice.gov/sites/default/files/atr/legacy/2006/04/11/v-f.pdf.

[844] "Microsoft Case Gets U.S. Judge As a Mediator," by Joel Brinkley, *The New York Times*, November 20, 1999.

[845] "Microsoft and U.S. Unable To Reach Antitrust Accord," by Joel Brinkley, *The New York Times*, April 2, 2000.

[846] "Index Tumbles 7.6% as Judge's Ruling in Antitrust Case Is Awaited: Nasdaq Gives Its Microsoft Verdict," by Mitchell Martin, *The New York Times,* April 4, 2000.

[847] "Justice Department Says it Will Not Seek Microsoft Breakup," by The Associated Press, *The New York Times*, September 6, 2001.

[848] Wu (2018), p. 98.

Yet the case brought against Microsoft was not the only antitrust litigation in those years that touched on the rapid innovation years of the browser wars. The history and challenges of developing a single secured transactions standard for the internet came to light not in Microsoft's antitrust trial, but in the antitrust case brought against Visa and Mastercard. On October 7, 1998, the Justice Department sued Visa and Mastercard for hindering competition via a duality, "the joint control of both networks by the same group of banks."[849] The complaint offers a clearer picture of what led to the credit card companies' delayed involvement with setting standards for secure transactions over the internet. The Department of Justice alleged that in response to Visa's October 1995 announcement to work with Microsoft on STT, MasterCard told its member banks that it had "no choice but to respond competitively" by partnering with other software providers.[850] The member banks then pressured Visa to abandon its agreement with Microsoft and cooperate with Mastercard, which Visa complied with. The complaint also raises the issue of smart cards, alleging that the Mastercard and Visa boards jointly decided in the late 1980s that neither company would offer smart card products.[851]

The court's decision of October 2001 revealed that per Microsoft and Visa's original April 1995 STT agreement, Microsoft would indeed, as industry insiders and the media believed, "receive a per transaction fee."[852] Visa and Microsoft's joint announcement and publication of the STT protocol in September 1995 was a response to Mastercard's refusal to endorse STT.

[849] "Justice Department Files Antitrust Suit Against Visa and MasterCard for Limiting Competition in Credit Card Network Market," *DOJ Press Release*, October 7, 1998. Available at https://www.justice.gov/archive/atr/public/press_releases/1998/1974.htm.

[850] *US v. Visa*, 98 (Civ. 7076 (2000)), p. 25. https://www.justice.gov/sites/default/files/atr/legacy/2015/01/27/1973.pdf

[851] *US v. Visa*, 98, p. 22.

[852] *US. v. Visa, et al. Decision*. June 25, 2015. Available at https://www.justice.gov/atr/case-document/decision-0. https://www.justice.gov/atr/case-document/decision-0.

Mastercard shared IBM and Netscape's concerns regarding interoperability, as STT "was not truly open because the specification did not disclose the application program interfaces to the Windows operating system, and favored a Microsoft application."[853] Mastercard quickly followed suit with the publication of the Secure Electronic Payment Protocol (SEPP). Responding to pressure from member banks, who feared the costs associated with having two de facto standards, Visa and MasterCard merged STT and SEPP to form what ultimately became SET. In February 1996, the SET protocol was altered to include an American Express requirement. The court did not find evidence of a causal link between the delay in implementing a single internet transactions security standard and the "dual governance" of Visa and Mastercard's member banks wielding significant influence over the development. "The record reflects only that all banks had an interest in a single standard and in investing in a single infrastructure to support that standard, regardless of how heavily weighted their portfolios were toward one association or the other." The court also noted that there was no way to predict whether STT would have been successful given the "undisputed" fact that "SET has been a commercial failure and has not been implemented on a wide-scale basis." The decision goes on to cite the prevailing reliance on SSL in browsers for securing credit card transactions, which was available in Netscape's browser to consumers and merchants at no cost. On SSL's encryption strength reputation, the decision noted that "most merchants use and are satisfied with SSL." This reaffirms the observations made by Amazon.com executives years prior, that their customers overwhelmingly used credit cards for transactions conducted in-browser. Microsoft, therefore, spent years in conflict with the banks governing Visa and Mastercard's decisions chasing a technology that neither banks or merchants saw necessary.

[853] *US v. Visa, et al. Decision.*

Amid the Microsoft antitrust trial news, Netscape would make an announcement signaling the beginning of the end of the browser wars. Hours after Microsoft's contempt of court settlement on February 22, 1998, Netscape announced that it would distribute Communicator 4.0 for free immediately, as well as making the source code available for licensing—also for free.[854] Jim Barksdale explained the motive in his remarks in the company's press release, "By giving away the source code for future versions, we can ignite the creative energies of the entire Net community and fuel unprecedented levels of innovation in the browser market. Our customers can benefit from world-class technology advancements; the development community gains access to a whole new market opportunity; and Netscape's core businesses benefit from the proliferation of the market-leading client software."[855] This coincided with Netscape's worst performing quarter for browser revenues.[856] Netscape announced that the source code for Communicator 5.0 would be published by the end of the first quarter.[857] On February 23, Netscape announced the Mozilla.org project, a dedicated team developing the free client source code.[858] On March 31, the first developer release

[854] "Browser War: A Concession And a Push," by Steve Lohr, *The New York Times*, January 23, 1998.

[855] "Netscape Announces Plans to Make Next-Generation Communicator Source Code Available Free on the Net," *PR Newswire*, January 22, 1998.
https://web.archive.org/web/20030207125110/http://wp.netscape.com/newsref/pr/newsrelease558.html.

[856] "Netscape Announces Preliminary Fourth Quarter Results," *PR Newswire*, January 5, 1998.
https://web.archive.org/web/20030414020559/http://wp.netscape.com/newsref/pr/newsrelease556.html. Visually indicated in court via Exhibit 1261 https://www.justice.gov/sites/default/files/atr/legacy/2006/03/03/1261.pdf.

[857] The push to get the source code out by the deadline was the subject of a documentary from the year 2000, *Code Rush* by David Winton et al.

[858] "Netscape Announces Mozilla.org, a Dedicated Team and Web Site Supporting Development of Free Client Source Code," *PR Newswire*, February 23, 1998.
https://web.archive.org/web/20030212095945/http://wp.netscape.com/newsref/pr/newsrelease577.html.

of Communicator 5.0 source code was made available for download on the new Mozilla site.[859] In May, Netscape and Mozilla.org made the Netscape Messenger source code openly available.[860]

After making its software source code public, Netscape continued its B2B efforts, focusing on e-commerce. On May 19, Netscape announced an e-commerce software licensing agreement with Citibank, in what was a continued push for Netscape's enterprise business.[861] The following month, the company publishes its outline for how enterprise software solutions can enable e-commerce success in "the Net Economy."[862] Netscape and VeriSign jointly publish a whitepaper on Open Public Key Infrastructure in late July.[863] In August, Citibank is announced as the "anchor tenant" of the forthcoming Personal Finance Channel on Netscape Netcenter.[864] Moving in-sync with the prevailing driving trends in the industry, Netscape announced on November 9 a new bill presentment and payment application, Netscape BillerXpert 1.0, featuring "one-click payment, in-depth statement analysis, customized views of billing information, and personalized content."[865]

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[859] "Netscape Accelerates Communicator Evolution With First Release Of Next-Generation Communicator Source Code to Developer Community Via Mozilla.org," *PR Newswire*, March 31, 1998. https://web.archive.org/web/20030212050737/http://wp.netscape.com/newsref/pr/newsrelease591.html.

[860] "Netscape's Mozilla.org to Begin Release of Messenger Source Code to The Internet Developer Community," *PR Newswire*, May 12, 1998. https://web.archive.org/web/20030213140304/http://wp.netscape.com/newsref/pr/newsrelease615.html.

[861] "Citibank and Netscape Sign Worldwide Electronic Commerce Software Licensing Agreement," *PR Newswire*, May 19, 1998. https://web.archive.org/web/20030201205708/http://wp.netscape.com/newsref/pr/newsrelease616.html.

[862] "Netscape Outlines Strategy for Net Economy," *M2 Presswire*, June 4, 1998. https://web.archive.org/web/20030213101652/http://wp.netscape.com/newsref/pr/newsrelease629.html.

[863] "Netscape and Verisign Extend Relationship to Enhance Extranet Security," *M2 Presswire*, July 28, 1998. https://web.archive.org/web/20030414021928/http://wp.netscape.com/newsref/pr/newsrelease653.html.

[864] "Netscape and Citibank Announce Major Worldwide Agreement to Launch Personal Finance Channel on Netscape Netcenter," *PR Newswire*, August 11, 1998. https://web.archive.org/web/20021202220527/http://wp.netscape.com/newsref/pr/newsrelease659.html.

[865] "Netscape's New Internet Bill Presentment and Payment Solution Helps Companies Improve Customer Satisfaction," *PR Newswire*, November 9, 1998, https://web.archive.org/web/20030213100751/http://wp.netscape.com/newsref/pr/newsrelease697.html.

Netscape executive Ben Horowitz is quoted in the press release as saying, "With more and more companies delivering compelling new content and bill presentment and payment services on vertical portals, we believe 1999 will be the year Internet billing will become a mainstream reality." On November 24, 1998, AOL and Netscape announce AOL's acquisition of Netscape, valuing the company at $4.2 billion. The acquisition is touted in the press release as an e-commerce-oriented effort, one that involved a strategic partnership with Sun Microsystems. The companies now formed a trifecta to "enhance its delivery" of "easy-to-deploy, end-to-end solutions for e-commerce."[866] The acquisition would be completed in March 1999, ultimately valuing Netscape at $10.2 billion.[867] The acquisition brought AOL into the ongoing transactions wars as it sought to execute Microsoft's original strategy for MSN to house a personal finance portal where users can pay bills online. In November, AOL and Intuit would announce a partnership to offer AOL users an online bill payment service slated for the following year.[868]

But in 2000, the AOL and TimeWarner merger would appear to delay AOL's online bill payments service. It would not be until January 2002 that AOL and Intuit announce a five-year agreement for Intuit to serve as the exclusive bill payment service provider. Intuit's software had already served as the interface for AOL's personal finance channel since 2001, but the online bill payment service was anticipated to launch in 2003.[869] Also in January 2002, AOL entered into an agreement with Yodlee to license the firm's technology on AOL's Personal Finance channel.[870] In

[866] "America Online, Inc. to Acquire Netscape Communications Corporation in Stock Transaction Valued At $4.2 Billion," *Business Wire*, November 24, 1998. https://web.archive.org/web/20030205005225/http://wp.netscape.com/newsref/pr/newsrelease707.html.

[867] "AOL Says Deal to Acquire Netscape Has Been Completed," *The Wall Street Journal*, March 18, 1999.

[868] "America Online Deal With Intuit," by Bloomberg News, *The New York Times*, November 25, 1999.

[869] "AOL, Intuit in bill payment deal," *CNET*, January 2, 2002. https://www.cnet.com/tech/services-and-software/aol-intuit-in-bill-payment-deal.

[870] "Yodlee to provide personal touch to AOL," by Jim Hu, *CNET*, January 2, 2002.

March 2004, AOL would finally launch AOL Bill Pay, a customized version of Yodlee's BillDirect billing aggregator software.[871] Nearly a decade after Microsoft's supposed plans to make Quicken the personal finance interface of MSN, AOL—as it enters its own decline—achieves this ambition superficially through licensing the technology of a household finance software provider and a billing accounts aggregator startup.

## *Epilogue (2001-Present)*

*"…one of the big mistakes, one the things that I wish we could go back in time and fix, is we should have built payments into the browser. If we had built payments—the counterfactual alternate history I like playing with is—what if payments had been built in the browser, one-click payments from the very beginning starting in '92." Marc Andreessen, 2012.*[872]

From the initial popularity of Mosaic and the stratospheric success of Navigator to the yearslong hype of global e-commerce, media coverage of internet IPOs and untapped profits drove a narrative that captured the imaginations of the general public, as well as those of the leaders working within the tech and financial services industries. This narrative created a feedback loop where tech executives continued to tout smart cards even after their banking industry counterparts pronounced the technology a failure. The promise of the internet, in the form of online transactions fees, drove Microsoft to pursue the endorsement and adoption of SET for years to no avail. Retail

[871] "AOL, Yodlee Teaming Up On Bill Pay," *American Banker*, March 16, 2000.

[872] "Future of the Internet," a conversation with Marc Andreessen at the *Wired Business Conference*, published December 27, 2012, on YouTube. https://youtu.be/ZanFDSho4-M.

investors gambled on companies with any semblance of connection to the internet. The immediacy of the internet via the web, through the portal of a PC, made this kind of thinking possible for years without any significant reality check. As Robert Shiller wrote in 2000, "What matters for a stock market boom is not, however, the reality of the Internet revolution, which is hard to quantify, but rather the *public impressions* that the revolution has created. Public reaction is influenced by the intuitive plausibility of Internet lore, and this plausibility is ultimately influenced by the ease with which examples or arguments come to mind. If we are regularly spending time on the Internet, then these examples will come to mind very easily."[873]

Under the George W. Bush administration, antitrust scrutiny reverted back to the Reagan-era freeze on big case litigation, paving the way for the rise of new tech giants in 2000s.[874] The web transformed the software economy from a two-sided one to a multi-sided platform economy where companies like Facebook and Google invariably gave away some service or product to the end user for free. This created the new attention economy, where the end user's attention is leveraged as a commodity in an ad revenue-driven business model. In giving away many products for free in addition to providing the world with an increasingly sophisticated web search engine, Google would lead the market in ad revenues and eventually acquire the greatest browser market share with Chrome.

The advent of mobile technology then unlocked the e-commerce potential predicted long ago as the promise of the web. When Amazon's 1-click payment patent expired 17 years later, the technology finally caught up with the ambition that tech firms and banks harbored in the 1990s: mobile web technology and the sophistication of mobile hardware and wearables now allowed for

[873] Shiller (2000), p. 63.

[874] Wu (2018), p. 119-124

contactless payment in both the digital and physical worlds. ApplePay, Google Pay, Alipay, AmazonPay, Stripe, Square, Shopify, PayPal, and others are all participants in a competitive electronic payments systems market. The success of payments startups two decades into the new millennium would signal a potential "internet shift from ads to commerce"[875] In China, however, where broad adoption of a single payment interface (Ant Group's Alipay) has led to a largely cashless society, the government began a tech sector-oriented crackdown on mobile payment apps in April 2021.[876]

In 2012, Marc Andreessen spoke at a *Wired* conference of the difficulty both Netscape and Microsoft encountered in building payments into the browser: "… it was essentially impossible to do… we tried, we tried… it was impossible at that point… we both tried… it actually took PayPal in a lot of ways to open everything up… the web would have turned out very differently, in some ways I think much better because we would have had, for example… business models evolve maybe in a much healthier way in a lot of cases…on the other hand, you would have lost a lot… a lot of free content, free services."[877] More accurately, it took the combination of a popular e-commerce destination along with PayPal, a payments aggregator, to boost both e-commerce growth and broad consumer trust in the security of online transactions. eBay would attempt to secure a payments solution for its growing business by first acquiring BillPoint in 1999, then signing an agreement with Wells Fargo for peer-to-peer credit card payments in March 2000

[875] "Stripe's $95bn price tag heralds internet shift from ads to commerce," by Tim Bradshaw, *The Financial Times,* March 25, 2021.

[876] "China Orders Tech Giants to Unbundle Financial Services," by Keith Zhai, *The Wall Street Journal,* April 30, 2021.

[877] "Future of the Internet," a conversation with Marc Andreessen at the *Wired Business Conference*.

where Wells Fargo acquired a 35% stake in BillPoint.[878] The CEO of BillPoint, Janet Crane, was formerly an executive at Mastercard and the head of Mondex USA.[879]

But the market leader in the peer-to-peer payments space was X.com, a banking and financial services startup founded by Elon Musk, which in August 2000 boasted three million PayPal accounts.[880] In September 2000, X.com claimed that PayPal processed more than 100,000 online transactions a day.[881] Originally a peer-to-peer payments software for PalmPilots made by Confinity, which merged with X.com in March 2000, PayPal would become X.com's flagship product and primary focus by October 2000.[882] By then, PayPal was listed on eBay as the preferred payment provider for half of the platform's auctions. X.com also signed a five-year agreement with Intuit to become the exclusive payment provider for Intuit's small-business products. As an online banking startup, X.com was the recipient of $170 million in investment from "Sequoia Capital, Nokia Ventures LP, Goldman Sachs, Deutsche Bank Alex. Brown, Qualcomm Inc., Lab Morgan, Technology Associates Management Corp., Idealab Capital Partners, and Credit Agricole."[883] X.com, therefore, took after Checkfree's approach and began as a bank-friendly tech startup. The firm would rename itself PayPal in 2001. In March 2001, PayPal claimed to add 20,000 new customers daily, processing more than 150,000 payments.[884] The company would boast 10 million user accounts in September 2001.[885] Challenging market conditions in 2001

[878] "Wells, Ebay Sign Deal For Person-To-Person Credit Card Payments," *American Banker*, March 2, 2000.

[879] "Billpoint CEO a Smart Card Booster No More," by Lavonne Kuykendall, *American Banker*, December 19, 2000.

[880] "Chasing X.com, ProPay Has Deal With Auction Site," by Megan J. Ptacek, *American Banker*, August 11, 2000.

[881] "In Brief: Web Bill Payer Picks Processing Software," *American Banker*, September 1, 2000.

[882]"X.com Scraps Bank Strategy To Focus on PayPal System," *American Banker*, October 11, 2000.

[883] "X.com Scraps Bank Strategy To Focus on PayPal System," *American Banker.*

[884] "Billpoint Sees an Opportunity as Rival PayPal Initiates Fees," *American Banker*, March 15, 2001.

[885] "PayPal Files for an IPO, Testing a Frosty Market," by Don Clark, *The Wall Street Journal*, October 1, 2001.

would delay PayPal's IPO until February 2002.[886] A week after PayPal's public offering, eBay would double down on its BillPoint investment, buying back Wells Fargo's 35% stake.[887] Months later, in July 2002, eBay announced its acquisition of PayPal, valuing the payments firm at $1.5 billion. eBay closed down BillPoint by the end of the year. In October 2005, PayPal acquired VeriSign's payment gateway business, inheriting the CyberCash payment service.[888] In a decade's time, some of CyberCash's original technology wound up as part of the leading online payments provider's services.

The postscript to the three battlegrounds that shaped the rapid advancement and adoption of the web—the Browser Wars, the Transactions Wars, and the Encryption Wars—is largely ongoing. The browser market is complicated by the mobile hardware market where one OS comprises a premium segment (Apple's iOS) and another is given away for free with lower-cost smartphones (Google's Android). iOS provides a default Apple browser product, Safari, with Google's search engine set as the default—a default option costing Google a reported $15 billion. The Transactions Wars, now officially belonging to the world of fintech, morphed into healthy competition among a number of companies but is complicated by the issue of cryptocurrency speculation and regulation. The Encryption Wars, now called the Crypto Wars, has for the past decade centered on national security and surveillance issues, and is now intertwined with the cryptocurrency debate. What remains the commonality among these rivalries, economies, and debates is that they are the product of the web, and that the various narratives about the web that drove markets, firms, and individuals to ultimately realize a world of products, services, and possibilities embodying the original promise technologists envisioned in the 1990s.

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[886] "PayPal: IPO Omen or Anomaly?" by Joanna Glasner, *Wired*, February 15, 2002.

[887] "Electronic Commerce: Buying Out Wells, eBay Intensifies P-to-P Fight," *American Banker*, February 22, 2002.

[888] "In Deal, PayPal Gets Merchant Market Scale," *American Banker*, October 12, 2005.

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# Chapter 8 – Conclusion

*Analyses and Research Conclusions—The Emerging Case of Blockchain and Decentralized Finance—Future Extensions—Closing Thoughts*

*Analyses and Research Conclusions*

In this work I have argued that the information revolution and dissemination of advanced information technologies has enacted change on a global scale not seen since the advent of the first machine age. Our present digital revolution, designated by the aggregated emergence of computing hardware, computing software, and digital communications networks or digital platforms (i.e., the internet and world wide web), is often invoked as a second machine age, a fourth industrial revolution, or a fifth techno-economic paradigm. Substantive forces of socio-economic and geopolitical change resultant from the adoption and diffusion of these technologies have affected all corners of the globe since the 1970s, recasting the ways in which people work and live. While many works have explored the breadth of these technological forces and their effects, few have explored the causes and conditions for their emergence. The work takes this gap in the research as its starting point.

Contemporary economic literature links paradigmatic technological advance with economic growth through the concept of general-purpose technologies as an explanatory device. General-purpose technologies are those technologies that lever economic and social impact at a national or global scale. When convergent, these technologies operate centrally in history's large-scale, path-breaking technological revolutions. Existing treatments of the mechanisms of innovation underpinning the development, adoption, and diffusion of general-purpose technologies remain surprisingly limited. These innovation processes often remain a "black box" in the economic literature. The innovation literature, though extensive, puts forth as many questions as it does answers given the categorical looseness of the term innovation, which can describe everything from the idea for a singular process improvement, to something as complex as nuclear fusion, to a systems-level description of processes directed toward innovation. The work

herein performs a review of the innovation studies literature in the service of explaining the development, adoption, and diffusion of general-purpose technologies, and introduces the concept of signal innovation as a causal explanation. In contrast to studies that seek a systems-level explanation, pointing to factors of industrial policy, social norms, cultural factors, defense concerns and more, this study seeks a narrower approach by posing the question, why do some innovations emerge as truly path-breaking and turn into general-purpose technologies, while others do not.

The work introduces the theory of signal innovations as an explanatory concept and uses the case of the world wide web as part of an analytic historical study. Signal innovations take a more fundamental technology, upon which it is built, to deliver two coincident "unlocks" that cause said fundamental technology to transform into a general-purpose technology. A signal innovation thus can be understood as an innovation systems catalyst and technological intermediary that explains the movement toward escape velocity of a given general-purpose technology.

It achieves this by first radically improving the utility or value of said underlying technology by enhancing the user experience of said technology. In this case, the internet, which prior to the emergence of the web required serious command line prowess and technical competence, became far more navigable and useful to non-technical audiences. Secondly, a signal innovation unlocks the financial and commercial relevance of a technology by tapping into the technology's macroeconomic potential, business investment potential, and consumer spending potential. In essence, business economic positive spillover effects that catalyze a virtuous cycle of evermore innovation in the same area. Drawing from the emerging field articulated by Robert Shiller known as narrative economics, these effects are driven by the constellation and confluence

of narratives in service of the innovation that propel increasing levels of development, advancement, distribution, adoption, and diffusion. Such a contagion takes hold until the signal innovation propels the fundamental technology to a period of disruptive saturation, which results ultimately in global or national socioeconomic transformation. In retrospect, the technology can thus be properly classified as a general-purpose technology, the result of the catalyzing influence of a signal innovation.

The user experience unlock of the web was achieved via the introduction of the personal web browser, which offered users a graphical interface by which to navigate the world wide web. The Browser Wars era of the story, defined by the collision between Netscape and Microsoft and their respective Navigator and Internet Explorer desktop web browsing software, is a narrative of rapid innovation in software design and engineering. The business economic unlock of the web was achieved through its manifestation of the digital economy. The introduction of web-based financial services technologies—fintech—and the implementation of payments and transactions protocols, alongside encryption standards and technology, made digital commerce a reality. These Transaction and Encryption Wars played out in the early attempts at implementing a digital currency. Science fiction authors such as Neal Stephenson explored such ideas as digital currency, alongside many others that came to pass in the digital revolution in the cyberpunk literature.[889] Their ideas were increasingly becoming a reality across the last decade of the twentieth century. By the time of this paper's publication in 2022, the origins of the modern digital economy, unified by the rapid transition to a zero marginal cost society where products, goods, and services are virtualized, can be traced back to this era of contemporary history.

[889] Stephenson (2002).

In 1993, CERN, the European Organization for Nuclear Research, released Tim Berners-Lee's protocol for the web into the public domain and made its use royalty free. The same year marked the beginning of the web boom, when the National Center for Supercomputing Applications (NCSA) released Mosaic, the first popular graphical web browser. When one of Mosaic's original inventors, Marc Andreessen, co-founded a rival browser company in spring of 1994, the move marked the beginning of what is commonly known as the Browser Wars. While the first major rivalry was between Mosaic and Netscape Navigator, the second and more consequential rivalry was the one between Microsoft and Netscape between 1995 and 1999. In a race to procure greater market share, the Browser Wars resulted in not only the meteoric rise in popularity of the web, but also demonstrable evidence of rapid innovation from the entities involved in enhancing the user experience (UX) of the web.

The industry and market dynamics that gave way to the Browser Wars are best understood through evaluation of the landmark antitrust cases that took place prior to and nearing the conclusion of the Browser Wars as examined in this paper. The first case, an antitrust suit against IBM, ended in January 1982 after thirteen years when it was summarily dismissed as "without merit." The case coincided with change internally at IBM as the company developed the unbundled IBM PC in partnership with Microsoft, sharing original equipment manufacturer (OEM) responsibilities by partnering with software providers. In decoupling hardware from software, the IBM PC's success gave way to the PC Revolution, resulting in the proliferation of hardware manufacturers and the dominance of Windows as the standard-setting operating system. This decoupling led to a rapidly maturing software industry dominated by Microsoft by the time the web gained traction in 1993.

The second antitrust case is the infamous suit against Microsoft beginning in 1998 and decided in 2000. *United States v. Microsoft Corporation* was in fact the culmination of the Federal Trade Commission (FTC) and Justice Department's resolute efforts to prosecute Microsoft since 1990. The court's findings revealed not only Microsoft's anticompetitive behavior in the software market, but more importantly the leverage the company had enjoyed as the maker of Windows, the dominant OS of the PC and software industries. While software companies relied entirely on a dual-pricing revenue model—one price for the private user and one price for educators or companies—Microsoft's position in the market led to the development of multisided economics. Microsoft earned revenues from selling shrink-wrapped software to individuals and organizations alike while also receiving fees from hardware manufacturers, content providers, and internet service providers. This unique multisided revenue model mapped directly to Microsoft's anticompetitive practices, which included pressuring partner companies into exclusionary or prohibitive agreements as it sustained its dominance in the personal computing software industry.

The rise of the web produced in turn a nascent commercial browser industry that seemingly sat apart from the broader software industry. The popularity of Navigator quickly resulted in a wildly successful market debut for Netscape in August 1995, which helped encourage an investment frenzy for all things internet related. While the Browser Wars yielded more and better features for webpages and applications with each browser release, the forces driving the rapid innovation that defined the narrative of the web boom are best understood through the business economic factors driving decision-making at each of these companies. Between late 1994 and mid-1995, Netscape made a slew of announcements relating to browser and server software products and partnerships focused on securing transactions online. This future-oriented attitude was based on a belief that the e-commerce boom would soon occur, and Netscape Navigator would be the

gateway to online shopping. Netscape, like Microsoft in the PC and software industry, had a head start in a race to set standards for both browsing and spending on the web. Yet, despite its overnight success and browser market dominance, Netscape, like its original nemesis behind Mosaic (or rather, Spyglass, the private company formed to help the NCSA profit from its research institution-backed invention), relied on a dual-pricing business model. Spyglass would eventually secure a lucrative deal with Microsoft, which licensed the source code of Mosaic to quickly build Internet Explorer to ship with Windows 95.

During the time that Andreessen helped invent Mosaic and later Navigator, Microsoft devoted significant time and resources to internet-enabled TV software, known as WebTV. The company's fixation with WebTV led to a venture called the Microsoft Network, which would remain the thorn in Microsoft's internet dilemma for years to come. Code-named Marvel, and later launched (or relaunched) as MSN, the interactive television plan would be scrapped in favor of a closed-internet content product and service positioned to rival America Online (AOL) on other online services then dominant in the 1990s. By 1995, it became clear to industry professionals and investors alike that the web—now synonymous with the internet—would be an open platform. The gated institutional dynamics of online services could not forestall what would be dubbed the internet tidal wave. This point would be argued internally by younger developers at Microsoft and lead efforts at the highest corporate level to formulate an internet strategy, beginning in 1994. Toward the end of 1994, Microsoft had by then already made an unsuccessful bid for a browser company and was deep in negotiations with Spyglass.

By spring of 1995, the team building Internet Explorer (IE) would argue to the rest of the company that the open web, in the most extreme case, would likely topple Windows as the platform of choice for PC users—and MSN would likely play a role in working against Microsoft's efforts

to commercialize the web. While executives and managers at Microsoft continued to tussle over the problem that was MSN, the company's leadership continued to fumble the task of forming a coherent internet strategy. By mid-1995, it was clear to Microsoft executives that they could no longer ignore the rise of Netscape, and the internet strategy conversation would seemingly be sidelined again as the Redmond company sought to reign in Netscape's ambitions and influence.

In the spring of 1994, a *Newsweek* reporter shadowed Bill Gates throughout a day's meetings at the Microsoft campus in Redmond, Washington. What the subsequent article that appeared later in July gave the world as a clear glimpse into both Gates' abrasive leadership style and the big picture thinking that drove the economics of his business. In trying to figure out how to improve the market share of Microsoft Money, the company's home banking software application, Gates described a vision of a Microsoft-led banking future. Gates is quoted as saying "Banks are dinosaurs," and that Microsoft can "bypass" banks by owning the transaction fee on every retail banking transaction taking place within its software. Gates envisioned a world where every bill payment and transfer of funds would take place within the Windows 95 platform—and thereby Microsoft would stand to profit from transactions fees. Gates' mere words had stoked the Transactions Wars.

Several months later, in October 1994, Microsoft announced its acquisition of software company Intuit, valued at $1.5 billion at the time. Intuit was the maker of Quicken, then the most popular personal finance software program. Microsoft publicly spoke of Quicken not as a software, but rather as an interface. The industry understood that Microsoft intended to make Quicken the online gateway to financial services features on its upcoming internet service and portal MSN. Despite Microsoft's move to offload its own competing software Microsoft Money by selling it to another competitor, the software giant could not avoid antitrust scrutiny from the Department of

Justice. By November 1994, the Justice Department's probe was magnified with the lobbying efforts of Microsoft's competitors. Among these competitors was the brokerage firm Charles Schwab. For the first time, Microsoft's enemies included a financial services firm.

By early 1995, the banking industry's indignant and fearful reaction to the "dinosaur" quote made its way into financial services industry media coverage. Checkfree Corp. would sue an Intuit-owned payments processor, positioning itself as a payments company allied with the financial services community rather than with the software industry. One of the earliest moves from banks responding to Microsoft's seemingly imminent encroachment on their transactions fees territory came when H&R Block put up its software company Meca for sale following the Intuit acquisition announcement. The tax preparation company did not see a future in competing with Microsoft. In May, Bank of America and NationsBank jointly acquired from H&R Block the software company behind the Manage Your Money application. On April 27, 1995, the Justice Department filed suit against Microsoft to stop the Microsoft-Intuit merger. After having publicly announced that the company would seek a speedy trial, Microsoft abandoned the merger on May 19, paying Intuit a breakup fee of $46 million. Following the aborted merger, Intuit moved quickly to secure partnerships with banks to provide Quicken users with home banking features. Even so, Intuit CEO Scott Cook told the press that Gate's dinosaur quote had already hindered Intuit's progress in negotiating in-application services and fees with banks.

Thus, May 1995 marked a turning point in the entanglement of the software and financial services industries, as well as the imminent Browser War between Microsoft and Netscape. Not only did banks join forces to invest in home banking software (Meca) and Microsoft abandon its Intuit acquisition, but Wells Fargo also became the first retail bank to put banking services on the web with the launch of its website on May 18. A week later, Gates distributed his now famous

internal memo, “The Internet Tidal Wave,” in which he details the reasons why the internet was now critical to every part of Microsoft’s business. The memo came with the announcement of a new Platform group headed by Paul Maritz, effectively designating Maritz as the executor of Microsoft’s internet strategy.

The memo was followed by another corporate executive internet strategy retreat. As with the previous retreat in 1994, younger developers argued for a product strategy for the open web. Ben Slivka, the head of the Internet Explorer team, gave a talk based on his internal memo, “The Web is the Next Platform,” which ran over an hour from its schedule 15-minute allotment. It is during this talk that Slivka suggested that Microsoft give away software online for free, to which Gates responded by calling Slivka a communist. Executives left the retreat, yet again, without a coherent internet strategy. A week later, Gates asked several executives about a potential partnership with Netscape, believing that there had to be a mutually beneficial path forward given his belief that the commercial browser business was not profitable. This prompted two concurrent efforts by Microsoft to leapfrog Netscape in terms of strategy. Barbara Fox and Thomas Reardon would lead efforts in securing a security protocol development deal with Visa, while Dan Rosen led internal efforts towards persuading Netscape to a partnership deal.

June 1995 saw Microsoft and Netscape engage on the topic of partnership and quickly leave the formal meeting as rivals. Rosen would push for a partnership strategy in which Microsoft would somehow co-opt Netscape, despite Maritz’s reservations. Netscape, on the other hand, was primarily interested in understanding the exact cost of doing business with Microsoft, which was soon shipping the long-awaited Windows 95. Court documents also show that AOL showed an interest in investing in Netscape as early as summer 1995. After the unsuccessful meeting between Netscape and Microsoft, Netscape would go on to make several announcements indicating

progress in setting security standards for online transactions protocols. The company would also enjoy a widely reported and heady initial public offering in August 1995.

After the splashy worldwide launch of Windows 95 in August, Microsoft would publicly announce in December 1995 a corporate-wide pivot to being an internet-first company. At the same time, the company now faced a new Justice Department inquiry. This time, the DoJ was probing the dangers of Microsoft's bundling of MSN with Windows. Yet, since the project's inception in 1994, Microsoft failed again and again in reaching any internal consensus regarding MSN's strategy and direction. But over the course of 1996 the company would resolve the MSN problem. WebTV efforts, which gave birth to the MSN project, would be shuttered in March 1996. A month later, Microsoft reneged on its deals with content providers—all participating in a subscription-based strategy with MSN—by shifting MSN to the open web. Russell Siegelman, who spearheaded the doomed MSN project, would be replaced and go on to help Microsoft found Slate.com.

By the end of 1996, MSN was on the web but remained behind a paywall. In other words, Microsoft spent 1996 dismantling MSN, which encompassed its pre-web boom internet strategy. What followed Microsoft's course correction and entry into the commercial browser market are the rapid browser innovation years that spanned 1996 to 1998. Netscape and Microsoft tirelessly put forth more innovative features and functionalities for building and consuming web pages at a breathtaking pace until the Justice Department formally sues Microsoft in 1998. By then, Netscape was struggling to survive as Microsoft's anticompetitive tactics—leaning largely on Windows' market dominance—made it increasingly difficult for Netscape to partner with other firms or ink enterprise deals to large businesses. Microsoft's zero-sum strategy in gaining browser market dominance drove both companies to deliver a dynamic and appealing user experience for browsing

the web. The rivalry and the challenges software firms faced in working with the financial services industry ultimately prevented Netscape and Microsoft from delivering an in-browser payment system.

On August 12, 1994, the *New York Times* declared the internet open for shopping when the first known e-commerce order was placed on Net Market Company, an online marketplace headquartered in New Hampshire that was accessible through Mosaic for Unix users. Net Market Company utilized a data encryption program known as PGP (for "Pretty Good Privacy") based on RSA's security algorithms. The article noted that the greatest challenge to growing e-commerce in 1994 was the attitude of consumers and merchants towards security and privacy: "Alarmed by increasing reports of security breaches on the Internet, many people and businesses are reluctant to transmit sensitive information, including credit cards numbers, sales information or private electronic mail messages, on the network."[890] Before Netscape released its first browser, consumer trust was already an obstacle in the growth of emerging e-commerce.

Nonetheless, it was the promise of a new, booming market in commerce on the web that drove the Transactions War from 1994 into the new millennium. This belief was not just held by the tech futurist entrepreneurs coding browsers and other applications. Executives at companies like Mastercard believed in the hype, too, despite struggling to focus on a payments solution geared for shopping on the web. For some, it was a simple conversion: with merchant server software like those offered by Netscape and Microsoft, retailers would transform the $65 billion catalog-shopping industry into the online shopping industry. Micropayments for infinitely available digital goods and a physical goods market supported by catalog-business scale "superdistribution" would

[890] "Attention Shoppers: Internet Is Open," by Peter H. Lewis, *The New York Times*, August 12, 1994.

surely enable digital payments to take off.[891] In 1996, a Wells Fargo executive proclaimed to the *Wall Street Journal,* "A whole new series of markets will be opening up." Edward Hogan of Mastercard claimed that by the year 2000 electronic cash "will be a multibillion-dollar market."[892] By late 1997, the financial press acknowledged the struggling digital payments startups DigiCash and CyberCash as "a reflection of the immaturity of the market for information and goods that lend themselves to micropayments-transactions of a few dollars to a few cents, which would be uneconomical for credit cards."[893]

Between 1994 and 1998, the war over the future of online financial transactions would go hand in hand with Netscape and Microsoft's race to set standards for the web. Several factors complicated and delayed the setting of a single global online security standard for retail transactions, which in turn delayed the growth of e-commerce. Nearly every tech firm involved in this space—from Netscape and Microsoft to payments startups like Cybercash and hardware companies like Verifone—underestimated the difficulty in getting not only both Visa and Mastercard on board, but also banks, which as an industry preferred to keep Microsoft at arm's length. Eventually Visa and Mastercard would adopt the same standard, ultimately set by Microsoft, which Netscape and other key players would also endorse. But in 1996 Congress held hearings to address the Future of Money, and banks would band together to lobby against Microsoft in both the issue of security standards and changes in US regulations concerning encryption programs, which remained under the umbrella of weapons technology and thereby was a national security concern. The tone and momentum of this rush to capture the future market of

[891] "E-Money's Pioneers Have Found Cyberspace an Unforgiving Land," by Don Sussis, *The Wall Street Journal,* August 9, 1997.

[892] "Will Digital Money Replace The Nation's Credit Cards?" by Neal Templin, *The Wall Street Journal,* June 17, 1996.

[893] "Digicash Eager to Reap Latent Ecash Harvest," *American Banker,* December 11, 1997.

digital payments would shift dramatically in 1995 with the rapid adoption of the web through Navigator.

When evaluating the business considerations that drove the rapid innovation of browser technology during these years, the disparity of Netscape and Microsoft's understanding of healthy revenue models is striking. Microsoft would spend years chasing the holy grail of transactions fees, only to lose steam as the antitrust trial took its toll on the company's reputation and focus. While Microsoft made a decisive pivot in 1995 to an internet-first business and product strategy, Netscape failed to pivot each time a major loss was conceded to Microsoft. Netscape recognized when it had fallen behind the likes of Cybercash and Checkfree in the field of transactions security, and would exit the playing field early, but the company never moved beyond the same lineup of products it started out with in 1995.

The narrative set in motion by Bill Gates' 1994 dinosaur quote about usurping banks plagued his firm's efforts in setting the standard for web-based e-commerce transactions, home banking software-based transactions, and online bill payments. Antagonizing the banking industry resulted in challenges working with Visa and Mastercard, both controlled at the board level by their member banks. Digital payments startups suffered the collateral damage from this industry-wide distrust of Microsoft's intentions, which banks extended to nearly all tech firms. Concurrently, banks and credit card companies faced increasingly pressure to invest in cashless electronic solutions like open system stored value cards, or smart cards, as their use became widespread in Europe and Asia. The smart card narrative coincided with an encryption security narrative, and payments companies and tech firms alike suffered a yearslong feedback loop where all parties involved were convinced of the eventual widespread adoption of smart cards to replace cash currency. This was a largely irrational view that did not take into consideration the possibility

that credit card companies would eventually lower transaction fees, making it easier for merchants to accept credit card payment for purchases under ten dollars. In fact, credit card companies had decided a decade prior to not invest in smart card technology as it was a cost prohibitive enterprise.

As the cashless society narrative took hold of the public imagination (as it had done decades prior), the concept of "e-money" gave rise to CyberCash, which specialized in an online electronic wallet product, and DigiCash, the digital currency innovation created by an encryption expert. While CyberCash tried to advance the concept of pure electronic payments and DigiCash promised privacy and anonymity, both startups ultimately tried to deliver products that consumers simply did not need at the time. Though the web was indeed growing in popularity and webpages were becoming more dynamic, the end user did not need more than a credit card to buy a book from Amazon.com.

In the tussle over setting a single security protocol for online transactions, Microsoft would succeed in convincing banks and credit card companies to adopt its SET protocol. Netscape would quickly abandon its own SSL-based protocol and endorse SET. However, in the process of gaining territory to realize Microsoft's transactions fees ambitions, the company would fail to reconcile what it was quickly succeeding with on the browser innovation front: user interface. It would take years before a tech company would provide the best of both worlds: a secured solution that allowed banks and credit card companies to collect their own transactions fees while offering consumers the safety of mind as well as options for payment (credit and debit). It would also require a platform (eBay) with a built-in audience that needed such a payments aggregator (PayPal) to use it widely.

The fight over owning the standard for e-commerce transactions would take place alongside the primary rivalry between banks and Microsoft over the future of electronic retail banking transactions. What started with the 1994 dinosaur quote and Microsoft's aborted

acquisition of Intuit would morph into a war over whether and how banks would agree to allow consumers to perform transactions within home banking software. The web boom would push this fight into the online banking space, where Microsoft would continue to simultaneously fight and cajole financial institutions into adopting a single standard for securing online bill payments. Home banking would become more or less obsolete while online banking and online bill payments would converge into a single issue. As it headed to its antitrust trial, Microsoft would concede ground to Checkfree, finally bowing out of the Transactions Wars.

In their efforts to set security standards for online transactions, competing firms like Netscape and Microsoft faced a common foe in retail banks. Yet, between 1996 and 1998, when it became clear to the public that the web boom was well underway, the software industry had a unified and conflicting relationship with regulators and policymakers. This was reflected in the two overarching narratives that captured the attention of the US government with regards to the promise and perils of the internet. The first was the forecasted sea change that e-commerce would bestow upon the markets and society in general. This e-commerce narrative was tied to the online payments narrative that took both tech and financial services firms on several detours in the 1990s, resulting in industry and market hype over smart cards, micropayments, and online wallets. The second was an America-first narrative that the tech industry lobbied to counter the Clinton administration's unsuccessful attempt to pass legislation that would enforce a backdoor recovery key for encrypted products. This fight—what is known as the Encryption Wars—would begin with the failed Clipper chip initiative and end with the relaxing of encryption export regulations in 2000.

In the same manner that retail and institutional investors alike were swept up in the dotcom boom, various federal agencies commissioned reports or made policy recommendations that appeared to feed the internet frenzy as these very agencies sought to better understand the web's

effects on society and markets at large. Between 1996 and 1998, governments, journalists, and tech industry professionals all cited forecasted figures for e-commerce market potential from reports published by various consulting firms. These figures varied drastically and were known to be primarily conjecture. After each holiday shopping season, the media coverage would cite a different reason for why e-commerce had yet to take off (website outages, security breaches, inventory issues, etc.). The e-commerce narrative was one that promised market-level changes and would spur the Clinton administration in 1997 to advocate for a "global free-trade zone" on the internet and both houses of Congress to pass legislation enacting a multi-year moratorium on taxes for online sales. In addition to Congress and the White House—where the Vice President headed the Clinton administration's internet-related efforts and communications—the Department of Commerce, the Treasury, and the Federal Reserve all produced reports and initial recommendations concerning the new digital economy, and more specifically, e-commerce. Even the US Patent Office could not escape the e-commerce rush; software patents would become a new battleground when Amazon.com is awarded a 17-year patent on its 1-Click Payment feature.

In the same way that Microsoft seemed captivated by the holy grail of setting security standards for retail banking and credit card transactions, regulators fed the legitimacy of the e-commerce narrative by continuously addressing the issue despite adopting a uniform "wait-and-see" approach to regulating e-commerce. The most concrete and significant step the government took was the Federal Reserve's modification of Regulation E in 1996 that would limit consumer liability for credit card fraud to $50. For regulators, online payments systems and the growth of e-commerce were intwined. Beyond Vice President Al Gore, the most prominent voices from the federal government that offered any meaningful commentary were those of the Comptroller of the Currency Eugene Ludwig and the Chairman of the Federal Reserve Board Alan Greenspan.

Between 1996 and 2000, Ludwig's public remarks would straddle the fine line between addressing the banking industry's fervent opposition to the tech industry as a whole and encouraging banks to take the rapid pace of technological innovation in finance seriously as the industry sought a full repeal of the 1933 Glass-Steagall Act. Greenspan, on the other hand, would repeatedly invoke Schumpeter's creative destruction theory to explain away investor frenzy, encouraging a positive attitude towards technology and innovation. Yet, during the same time, other members of the Federal Reserve Board gave public remarks that reflected a much more sober and cautious attitude towards the overall market effects of digital currency, digital payments systems, and e-commerce.

Invariably tied to the e-commerce narrative was the Encryption Wars, which began in 1993 when the Clinton administration advocated for the global adoption of the Clipper chipset developed by the National Security Agency (NSA). The chip initiative was to give government agencies the ability to intercept communications through a backdoor key recovery scheme—a key escrow. A year later, the discovery of a fatal security flaw in the technology would render the initiative a failure and nonissue. However, the Clipper chip would make hackers, technologists, and civil libertarians alike wary of the NSA's wiretapping ambitions—the true lasting legacy of the Clipper chip. The White House's ambitions for passing encryption legislation would continue and in October 1996, Gore introduced a revised encryption initiative. Both the House and the Senate would introduce controversial encryption legislation, a fraught process covered extensively by the press.

As the web took off globally, software makers faced individual case-by-case treatment for exporting encryption software via the State Department as encryption products fell under the US Munitions List (USML). From browsers to digital payments software, tech firms had to apply to the government to export less secure versions of their US native products. This resulted in

American software firms' inability to sell cutting edge secured products to customers overseas. The tech industry seized on this lost opportunity, putting forth an America-first argument, to lobby the government to relax export controls. As both political parties neared an upcoming presidential election, the crucial sponsor of the Senate encryption bill, Senator John McCain, withdrew his support in April 1999 amidst rumors of a presidential bid. Gore, on the other hand, faced the pressure of maintaining his reputation as champion of the tech industry while serving as the face of the White House's various encryption initiatives. By early 2000, the White House not only abandoned its key escrow proposals, but also fully liberalized encryption export.

Though the fight to export more secure browsers and payment software products to the rest of the world was won, by 2000 the Browser Wars were over. The Justice Department brought its antitrust suit against Microsoft in 1998, which made for sensationalized coverage of both the company and Bill Gates. Microsoft would lose the case in 2000 but with a new administration. the government would not seek the breakup of Microsoft. Concurrently, the Justice Department tried Visa and Mastercard for anticompetitive duality. The court's decision in 2001 would reveal the member banks' behind-the-scenes decisions regarding investment in smart cards and a single online security protocol. By February 1998, Netscape appeared to acknowledge its defeat in the Browser Wars. The company launched the Mozilla.org project, which developed and released the source code of its browser, now Mozilla. In November 1998, AOL announced its acquisition of Netscape. AOL would announce its own online bill payments ambitions via the acquisition and partnership with Intuit, but the AOL and TimeWarner merger in 2000 would delay the service. By the time AOL Bill Pay launched in 2004, the company was already in its decline.

*The Emerging Case of Blockchain and Decentralized Finance*

At the time of this writing, one of the most promising technological innovations dominating the press and dimensions of academic inquiry is blockchain, the latest transformational digital network platform to emerge in our modern digital revolution.[894] Blockchain is best described as "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way."[895] It serves as the underlying technology supporting Bitcoin and other cryptocurrencies, which continue to increase in popularity.

Parallels have already been drawn already between blockchain and the advent of the world wide web. Similar to the web, blockchain is an open, distributed, global platform. One of its colloquial namesakes is the World Wide Ledger.[896] On the blockchain, personal information is private and secure—meaning anonymized—while, in contrast, all activity is transparent and incorruptible and stored in code. Via peer-to-peer networks of computers, this in contrast to the centralized services the current web infrastructure relies on, reconciliation and verification of all activities occur simultaneously throughout the network in a form of mass computing collaboration. It thus resolves many of the security and privacy inconsistencies that the web is built upon. It does this by ensuring validated and anonymous transactions between parties activated via peer-to-peer connections between computers. It is no surprise that the potential future applications of these technological capabilities are staggering.

Regardless of the overall geometry of cryptocurrency's end-state, recent research suggests that blockchain—cryptocurrency's underlying technology—may be best considered a general-

[894] Zheng et al (2018).

[895] Iansiti and Lakhani (2017).

[896] Tapscott and Tapscott (2016).

purpose technology.[897] As this work discussed, single technologies that come into wide use, enact social, political, and economic transformation on a global-international scale, and are replete with spillover effects are described as general-purpose.[898] For all its promise, however, blockchain adoption has been slow, and in this area differs from the internet, an established and codified general-purpose technology. Since blockchain's advent 12 years ago, its primary use is still market speculation conducted in cryptocurrency markets, while practical applications are still few and far between.[899] Contrast this with the web, which in 12 years had come into mass adoption. In December 1995, 16 million users were active on the internet. By 2001, that number had risen to over 513 million, representing over 3,100 percent growth in just a few short years.[900] And herein lies a puzzle: Though by contemporary design blockchain demonstrates all the characteristics of general-purpose technology, it has yet to cross the economic and financial threshold, socio-cultural, and geopolitical-regulatory that came to define the web as a transformational innovation.[901]

Critical to the taxonomy of general-purpose technologies is the diffusion, adoption, and synergistic effects of the underlying innovation, which rather than being consider incremental or disruptive (which blockchain certainly is), instead becomes transformational and reconfigures societies, polies, and economies. And though blockchain may have that potential, it is not clear as of yet that it will have that effect. Further research in the area of signal innovations is required, particularly to historical case studies addressing general-purpose technologies. Elucidation of

[897] Kane (2017).

[898] Bresnahan and Trajtenberg (1995), Bresnahan (2010) Lipsey, Bekar, and Carlaw (1998), Carlaw, Lipsey, and Bekar (2005).

[899] Schatsky, Arora, and Dongre (2018).

[900] Data gathered from World Bank at https://datacatalog.worldbank.org/dataset/world-development-indicators/.

[901] Stratopoulos, Wang, and Ye (2021).

historical cases, and the construction of a quantitative framework, ideally, could help bridge causal explanations of transformative histories of innovation. Applying findings from these studies to further examination of blockchain could help identify compelling signal innovation use cases. These could come in the form of non-fungible tokens (NFTs), cryptocurrencies, blockchain-based infrastructure (i.e., applied to stock markets and thereby replacing existing clearinghouse models for transactions), or heretofore unconceived applications.

In many respects, blockchain and its most popular use case instanced in cryptocurrencies (or cryptotokens), first with Bitcoin and now a host of alternatives including Ethereum, Tether, Cardano, and others, resembles a return to the earliest forms of market exchange. Bitcoin in 2009 showed how digital money could work, absent a trusted a third-party, whether a government, a commercial bank or payments processor such as Visa. The emerging field of decentralized finance (DeFi) in fact is a conscious effort to return to pre-statist means and ways of exchange, trade, and investment. Barter operated in a similar peer-to-peer fashion, but was hampered by inefficiency given the need for a perfect match at any given instant between supply and demand amongst peers. Money of course became the solution to the problem of matching as a medium of exchange and store of value. As in the case of Bitcoin and cryptocurrencies or cryptotokens, early forms of money were too decentralized. Later, specie money, defined by a currency's anchoring to artifacts of value, including gold and silver, became dominant. Non-collateralized or fiat currency controlled by central banks is today's dominant form of money, secured by the backing of governments.[902]

DeFi, broadly, is best understood as describing the competitive market of decentralized financial applications encroaching on the traditional financial services sector's monopoly on

[902] Prasad (2021).

financial functions: exchange, saving, lending, and "tokenization." By virtue of its network effects, and the recombination of products and applications it enables, a new financial system many argue is emerging, free from the constraints of the existing financial infrastructure: centralized control, limited access, inefficiency, lack of interoperability, and opacity. The modern financial system consists primarily of commercial bank deposits that rely on the backing of central banks for collateral in the form of reserves, and for the administration of interbank payments. DeFi's open-source, decentralized, and bottom-up fully digitalized and virtualized nature means that it costs no more to provide services to a customer with $100 or $100 million in assets. Serious scholars are arguing that DeFi will replace all centralized financial infrastructure in the future given its extraordinarily low barriers to entry over contemporary mainstream financial services architecture.[903]

Eswar Prasad argues that the revolution has already begun. He asks readers to consider one use case for DeFi: international payments. The current cross-border payment system relies on a multitude of transfers between banks occupying different localities. A series of commercial intermediaries facilitate the direction of money flows from one financial peer to another. New fintech technologies are making earnest attempts to piggyback on the existing financial system's architecture. Early entrants like PayPal, and more recent competitors such as Venmo have greatly reduced friction costs in the domain of peer-to-peer monetary exchange. That said, most international transfers are subject to costly transaction fees, money laundering checks, and delays. In a future scenario, state money will serve as a store of value, Prasad argues, while private currencies will be the predominant form of currency used for payments and transactions.

[903] Ramachandran, Santoro, and Harvey (2021).

Stablecoins—privately issued cryptocurrencies back by a reserve of fiat currency such as the U.S. dollar—coluld serve as the private currency supporting payments and transactions.

Of course, the risk implicit in cryptocurrency has received considerable press due to the volatility in their value inspired by wild speculation. And indeed, discussion and resurrection of state-backed digital currency has already begun. Prasad argues that non-stable assets like Bitcoin will never be able to function as stores of value due to their fundamental lack of backing. As such, central banks will continue as the "lender of last resort" and retain control over macroeconomic policy. This even in a system marked by decentralized payment systems, built upon stablecoins and linked to fiat currencies. It is ironically fiat currency's elasticity that delivers more stability, contrary to the artificial scarcity of Bitcoin, whose production has been permanently capped. In kind, central banks themselves are now creating their own digital currencies: Fiat digital currency backed by a central bank is a much more appealing prospect for businesses, which can be assured that when times are bad the central bank can step in and print more.

This expansive view of the financial system, combining public and private, government and commercial products, services, and assets in the form of domestic central bank digital currencies and international stablecoin, is likely to reconfigure extensions of state power in the international system. State-run digital currencies have enormous potential as a surveillance tool but run the risk of overreach via privacy intrusions. The introduction of a digital U.S. dollar will likely only further its preeminence as the currency of choice by virtue of its holdings and available debt. The introduction of new international securities may assist in circumventing capital controls and sanctions, but despite libertarian protestations that we are entering a new paradigm in the financial sector, such a future is by no means certain. Eras of "free banking" in Scotland and the

U.S. when banks issued their own banknotes, similar to stablecoins, were brought to an end in the middle of the 19th century not because of better technology but because the state reasserted control.

### *Future Extensions*

Where do we go from here? There exists an urgency in domains of both scholarship and practice to build and apply the theory introduced here and expand on its applications. The theory of signal innovation requires further elucidation. Three vectors of research advancing the theoretical componentry, data, and analyses included in this paper appear the most consequential. These are, *first*, the conceptual advance of the theory of signal innovations, namely its elaboration via extraction and investigation of the levers and drivers specifically underpinning the central dimensions of user experience and business economic logic. Detail of these drivers via qualitative methods could then be used via the textual analysis techniques currently employed in narrative economics to quantifiably model signal innovation theory. The output of a framework and rubric for evaluation of technologies could support financial due diligence efforts. *Second*, the identification of additional case studies through an initial audit of the existing general-purpose technology literature. Identification of these case studies and their development will further qualitative exploration and ultimately quantitative review via the rubric suggested in the first research extension. This could include the near-term extension of the qualitative instantiation of the theory to the case of blockchain and present-day decentralized finance (DeFi). So much similarity exists already to the genesis of the digital platform economy and the web in the 1990s, and arguments around blockchain-as-general-purpose technology have already captured academic attention. Data gathering and case study construction of blockchain and initial application of the

signal innovation theory to blockchain technologies can begin immediately. As the research comes in, the theoretical frame can be applied to foster new insight and, potentially, forecast the blockchain technologies most likely to emerge as a signal innovation, and thus catalyze blockchain as a general-purpose technology. They are addressed in turn here. *Third*, and lastly, understanding the emergence of transformational innovation can address the challenges regulators face in ensuring healthy competition in the marketplace. Signal innovation theory can help antitrust regulators better understand what makes a nascent competitor's technology a potentially transformational one, rather than focusing solely on marketplace dynamics. This fills a gap in the current antitrust literature on federal agency action in proposed acquisitions of smaller firms by established big tech firms. In understanding the nuances of user experience design as they pertain to specific business economics considerations, regulators can avoid conflating certain aspects of a technology's design with the underlying business model. This is a pressing issue in 2022 as the SEC considers regulatory action against certain "digital engagement practices" in retail trading applications and the EU charges Apple with leveraging its market position to privilege its Apple Pay system over those of competitors.

*This includes, firstly, a nuanced detailed of the levers or drivers that can activate the catalyzing processes that give rise to general-purpose technologies. A rubric or comprehensive audit-like function could conceivably be applied to technology investment due diligence processes. Investors and venture capital firms rely on consistent rubrics for evaluation of investment opportunities. Building a framework to better understand the nature of innovation in service of both seeking a paradigm-shifting investment and fostering innovation can only enhance existing strategies, which primarily focus on scale and business models.* Similarly, government agencies have increasingly absorbed private-sector best practices. When choosing what projects to fund and

not fund, a fully realized model would help support this decision-making process. Moreover, concrete identification of levers, drivers, or indicators that a given technology may be operational as a signal innovation could support forecasting efforts. Indicators would fall into two families or top-level hierarchical categories of drivers: user experience and business economics. Detailing these drivers is of pressing need for future study given the practical applications. Initially qualitative, quantitative metrics can be tied to these evaluation procedures, which could then fold in to more expansive and numbers-based forecasting efforts. The textual analysis techniques of narrative economics will play a central role in the theory's further articulation, definition, and application of these categories.

Scholars should seek to work in concert with those engaged in the growing narrative economics discipline. The same principles can be applied to move toward quantifying historical and contemporary economic and innovation narratives. Given the implicit interdisciplinary nature of innovation studies and what is being attempted with narrative economics, potential opportunities for new understandings may emerge as scholars partner on research projects. Engaging with textual analysis techniques, the time series data collection efforts occurring in the narrative economics discipline, which include focus group interviews and written archival materials, such as the data gathered as part of this work, can serve as the core for quantification. From there, the combination of researchers engaged in coding the nature of narratives along with the advance in semantic information and semiotics via machine learning and artificial intelligence will likely serve as the next major step forward in the economics discipline. It is worth noting that as Shiller points it, there is value in making explicit the implicit, intuitive judgments leaders of nations and corporations often make through the unearthing of these narratives. As Daniel Kahneman pointed out, despite all the hype around data science and sophisticated analyses, at day's end, leaders often

rely on intuition or gut instinct over principled data-driven decision-making.[904] There is an interesting body of research suggesting that intuition, when combined with the depth of knowledge such professionals have acquired over years of experience with problems in the same domain, yield in fact laudable outcomes.[905] There is much interesting research—predicated on the rapid evolution of young and emerging disciplines, specifically neuroscience—occurring in the field of decision-making.

*Second, the introduction of the theory of signal innovations in this paper offers a basic structure to understanding pathbreaking transformational innovation. The next step in efforts to advance and validate the theory—moving ultimately to confirm, modify or edit, further elaborate, or disprove the existing set of signal innovation propositions—comes in the form of additional case studies of general-purpose technologies, ideally in the form of analytic histories.* A non-exhaustive list of future technologies worth exploration might include the automobile, the airplane, the computer, the steam engine, and the printing press. One could argue that in the case of the automobile, for example, the relevant signal innovation might be the Ford Model T. It notionally fits the criteria of building on the foundation of a more fundamental technology—the architectural concept of the automobile itself—and fused it with a set of business economic factors. Henry Ford consciously built the Model T to sell to the growing American middle class. Narrative economic factors propelled the automobile-as-freedom narrative, and in turn the world transformed on the basis of newfound mobility and the commercial opportunities the automobile unlocked. The parallels to the case of the internet (equivalent to preexisting automobiles) and the world wide web and personal web browser (commensurate to the Model T and moving assembly line processes)

[904] Kahneman et al. (2016).

[905] Hoogendoorn et al., (2009), Damasio (1996), Dunn, Dalgleish, and Lawrence (2006), Bechara and Damasio (2005), Schmitt, Brinkley, and Newman (1999), Hoogendoorn, Merk, and Treur (2010), Hoogendoorn et al. (2017).

are almost too obvious to point out. Regardless, validating the theory via qualitative analysis of this and other comparable case studies should be the next step for scholars.

The elucidation of the web3 or blockchain as general-purpose technology, and triangulation with the signal innovation theory introduced here could be an initial case study, as describe earlier, with in-depth qualitative detail on the various blockchain technologies being introduced. This qualitative detail could then later be used in a more thorough manner based on the nuances of the development of a given signal innovation rubric. As such, these efforts can occur and be pursued in parallel. This elucidation of blockchain-as- will necessarily include review of the existing general-purpose technology literature. Here, gaps in articulation of existing general-purpose technology theory, whether addressed directly in some of the causal literature, or simply on the basis of the logic for use of general-purpose technology as classifier will be part of the effort. As such, signal innovation theory can serve as both a bridging mechanism and developmental platform for expansion of the current literature on general-purpose technologies. Data gathering here will be the critical factor. Many of these technologies are in the earliest stages. Description and identification of specifics of the technology, and the twofold user experience and business economic dimensions of signal innovation theory will help identify the likeliest candidates to serve as signal innovations. Furthermore, the cases to be made across these two dimensions can help further the debate and exploration of blockchain as a current general-purpose technology, or one that is likely to emerge in the future.

Researchers interested in signal innovation may seek to explore the emerging set of what are now called web3 or blockchain technologies. Due to the hype surrounding cryptocurrencies (in the sense of both media focus and the Ponzi scheme-like “hype” efforts on social media), it can be incredibly difficult to discern valid applications of the technology from the questionable or

outright fallacious. For example, the smart contract functionality of Ethereum has countless possible applications. But currently, much of the intellectual energy in the space has been spent on immediate monetary gain in the form of cryptocurrency speculation. Researchers in the social sciences and humanities would do well to gain technological familiarity with the space. Additionally, technical specialists would do well to begin collaborating with individuals outside their field. Applications of technology rely, as the signal innovation theory posits, in unlocking a set of business economic factors that bring about mass change. Decoupling the speculative aspects of blockchain and crypto-assets from the underlying applications of the technology will be aided by further objective analysis of the space. Similar to the web, the instantiation of a revolutionary financial services industry may be the compelling result. Unlike the historical examples put on offer, applications of blockchain have highly relevant parallels to the signal innovation of the web given the aligned capacity to transformational transactions and payments, a cornerstone of the narrative of the web.[906]

*Third, understanding the emergence of transformational innovation can address the challenges regulators face in ensuring healthy competition in the marketplace. Signal innovation theory can provide antitrust regulators a reinforced rubric for determining what makes a nascent competitor's technology a potentially transformational one, rather than focusing solely on marketplace dynamics.* Given the role payments and transactions played in the narrative of this work, this extension may be the most relevant upon which to extend and further test the concept of signal innovations. C. Scott Hemphill and Tim Wu point have argued that the uncertainties

[906] See "Blockchain in the Banking Sector: A Review of the Landscape and Opportunities," *Harvard Law School Forum on Corporate Governance,* posted January 28, 2022. Available at https://corpgov.law.harvard.edu/2022/01/28/blockchain-in-the-banking-sector-a-review-of-the-landscape-and-opportunities.

associated with innovation and technological change have led to underenforcement in protecting nascent competitors within a given industry. A nascent competitor is typically a smaller firm viewed as a potential future threat to an established larger firm. Nascent competitors are often subject to suitor established firms, who target upstarts for acquisition where the nascent competitor is effectively eliminated from the market through the merger.[907] Hemphill and Wu find their definition of nascent competition from the way the court understood Netscape's role in the market in the Microsoft antitrust case. Nascent competition is important, they argue, because it is defined by the firm's potentially industry-changing—and often pathbreaking—innovative technology, which often carries with it general-purpose applications. They argue that the "risk of lost innovation strongly tips the balance in favor of a bias to action" against harmful acquisitions. The authors point us to existing antitrust law under Section 7 of the Clayton Act, which regulates potential competition in a limited way but, as they note, has ignored innovation. Section 2 of the Sherman Act similarly is focused on an established firm's anticompetitive behavior, here in service of maintaining a monopoly. In both cases, the implications of innovation are not addressed. They go on to argue that due to the lack of understanding and unpredictability of innovation, later-acquired evidence may need to play a role in challenging consummated mergers. The signal innovation theory could fill this gap in future-looking considerations, which could provide scholars, legal and otherwise, a paradigm for exploration of pathbreaking innovations in the context of antitrust scholarship.

In understanding the nuances of user experience design as they pertain to specific business economics considerations, regulators can now begin to take steps to avoid conflating certain aspects of a technology's design with the underlying business model, given both increased

[907] Hemphill and Wu (2020).

understanding and scrutiny on design decisions by the public and policymaking agencies. This has come as Big Tech and social media platforms have garnered attention due to their consciously addictive user interface and experience design qualities, a domain of inquiry long ignored. In late August 2021, the SEC requested comments on what the agency termed digital engagement practices of fintech platforms. The agency's definition of these practices or tools included "behavioral prompts, differential marketing, game-like features (commonly referred to as gamification), and other design elements or features designed to engage with retail investors on digital platforms (e.g., websites, portals, and applications), as well as the analytical and technological tools and methods."[908] In his prepared remarks before the Investor Advisory Committee on March 10, 2022, SEC Chair Gary Gensler highlighted that the agency was looking into what firms are optimizing for when designing the user experiences for their digital platforms and when behavioral nudges cross into the territory of recommendations.[909] The news was largely perceived as a move towards the SEC's intention to regulate certain aspects of fintech app design in the aftermath of media scrutiny of Robinhood's gamified app features. As one news article in July 2021 described the user experience:

> The app has a colorful, uncluttered layout and lets users begin trading with as little as $1. For a long time, new investors were congratulated for their first trade with a confetti animation. That was scrapped amid scrutiny from politicians and regulators. Investors who get a friend to sign up are offered a chance of snagging a share of a high-price glamour

[908] "SEC Requests Information and Comment on Broker-Dealer and Investment Adviser Digital Engagement Practices, Related Tools and Methods, and Regulatory Considerations and Potential Approaches; Information and Comments on Investment Adviser Use of Technology," press release available on the SEC website, August 27, 2021. https://www.sec.gov/news/press-release/2021-167.

[909] "SEC Requests Information and Comment on Broker-Dealer," press release issued August 27, 2021, available on the SEC website. https://www.sec.gov/news/press-release/2021-167.

stock such as Apple Inc. For inspiration, they can browse the 100 most-held stocks among fellow users.[910]

Yet, given the broad sweep of tools and features listed under the umbrella of digital engagement practices, it is unlikely that the SEC will succeed in regulating so many features that comprise a fintech platform. For example, digital engagement practices here would include user mapping, notification sound design, business models, machine learning algorithms, brand design, and marketing campaigns. This is in addition to every possible design choice associated with user interface design, which includes fonts (type, color, size, weight, etc.) and all the intuitive and iterative choices designers make in wireframing a digital product. In taking steps to protect investors from harmful nudges, the SEC is conflating product design with business strategy. Product design, by virtue of the design being done in service of building a product, is an output of business strategy. In fact, Robinhood's S-1 filing from July 2021 highlighted the company's simple and attractive app design as one of its value propositions; the company owned 55 design patents as of March 2021.[911]

Similarly, in May 2022, the EU determined on a preliminary basis that Apple used its market dominance to restrict third-party access to necessary near-field communication (NFC) technology for developing mobile payment solutions.[912] The focus of the EU investigation is on Apple's behavior with perceived mobile wallet competitors, not on Apple's business strategy. In July 2020, Apple acquired a Canadian startup specializing in NFC payment systems,[913] and later

[910] Tan (2021). See also "Robinhood's Role in the 'Gamification' of Investing," *Bloomberg*, December 18, 2020.

[911] "Robinhood Markets, Inc.," SEC S-1 registration form available on the SEC website at https://www.sec.gov/Archives/edgar/data/1783879/000162828021013318/robinhoods-1.htm.

[912] "EU Accuses Apple of Abusing Mobile-Payment Market Power," by Kim Mackrael and Laurence Norman, *The Wall Street Journal*, May 2, 2022.

[913] "Apple Buys Startup to Turn iPhones Into Payment Terminals," by Mark Gurman, *Bloomberg*, August 1, 2020.

in March 2022 acquired a London-based credit-scoring firm.[914] The company announced the anticipated Tap to Pay contactless payment feature for the iPhone in February 2022.[915] These moves were part of an internal operation at Apple code-named Breakout, a strategy to replace Apple's existing fintech services partners and handle transactions and credit checks in-house, which was first reported in March 2022.[916] *This effort resembles Microsoft's efforts nearly three decades ago in owning transactions processing as a business strategy. Given the global adoption of mobile technology and Japan's widespread adoption of NFC technology for at least a decade, mobile-enabled NFC technology may be evaluated as a potential signal innovation case study for blockchain technologies. Such a study, centered on user experience design decisions in particular, could help shed useful insight into the divide between technological innovation and business model innovation.*

### *Closing Thoughts*

The next phase-shift in the world will likely mimic the dynamics articulated in the case study of the world wide web. The web took off because of its generative capacity to establish platforms of commerce and trade. So much of the story of its adoption and diffusion, and the driving considerations behind its evolution, were commercial and financial in nature. Corporations and management understood its capacity to upset the balance of power in the monetary system. Those realities did not come to pass, but the same ethos driving the web—John Perry Barlow's

[914] "Apple Acquires U.K. Financial Health Startup Credit Kudos," by Giles Turner, *Bloomberg,* March 23, 2022.

[915] See "Apple unveils contactless payments via Tap to Pay on iPhone," a press release published on Apple.com, February 8, 2022.

[916] "Apple Working to Bring More Financial Services In-House," by Mark Gurman, *Bloomberg,* March 30, 2022.

vision of a free and open internet—was ultimately coopted by the state. Whether it be government-private actor mechanisms of control, or transitions of influence predicated on network effects and paradigmatic periods of centralized versus diffused geometries of power in geopolitics, the cyclical story remains the same. That said, the work being performed by scholars working on behavioral finance or narrative economics questions the ascribed regulatory purported by prior economic historians. In fact, these dynamic shifts appear far more irregular than previously believed.[917] To wit, the future is by no means apprehensible, and far more uncertain and random than most ever consider.

To the extent that this paper can introduce a better understanding of the course of innovations, that it can offer a new lens to understand the role of narrative and the importance of the stories we tell, we may be able to build superior systems of healthy competition that reward ingenuity and invention in the service of economic growth and human flourishing and prosperity—innovation—that can create a world future generations will admire. What is interesting for me as an author is that I entered this project with deep questions on the relationship between innovation, technology, economic growth, human prosperity, and well-being. I left with a far stronger appreciation for the financial services sector, and the role broadly finance plays in the architecture of our social world. It strikes me that we have only begun to scratch the surface of the power of a truly democratic financial system and its capacity to better the world.

Financial markets bring together the collective intelligence of a massive network of financial professionals and the broader network of, at this point, nearly all of humanity into the global economy. While imperfect—as humans so too are—the proper structures in place, and by tapping into global financial markets, we can solve some of the world's most intractable problems

[917] Shiller (2019).

with the next two decades. Problems like cancer, global poverty, and the energy crisis.[918] Pulling on threads from all the cited literature covered in this work, narratives matter. A lot. And as Lo observes, "sometimes things need to be believed in before they are seen."[919] The next phase of human progress will rely on bold vision and grand strategy to navigate a path that rejects endemic zero-sum approaches to the world. Positive feedback loops, expansive value, and a rejection of all that is destructive can be codified into financial systems of the future. The fabric of the web galvanized the adoption and diffusion of the internet by making the protocols and infrastructure accessible, adaptable, and actionable. They suddenly had new value thanks to the twofold bolstering of user experience the web provided with the intimate linkages to financial transactions and payments. Friction costs were reduced, and adoption skyrocketed such that modern finance is now wholly digital. To the degree that reconciliation of finance can co-occur with the building of the good society, innovators and entrepreneurs may find boundless opportunity for investment as financing becomes increasingly decentralized, open-source, and accessible.

Signal innovation as a concept breathes new understanding into the dynamics of innovation. Scholars would do well to explore comparable cases to prove out the theory. To the degree we can understand the driving mechanisms behind transformative innovation, that we can protect the norms, institutions, and narratives that inspire large-scale research and development programs, to the extent we can ask more of the world's citizenry to pursue aims very much in line with the Long Now Project and Global Priorities Institute, to the degree we can bridge the gaps between disciplines and fold-in the very best knowledge science and the humanities have to co-offer, and to the degree we can make finance and investment, technology and innovation, activated

[918] Lo (2019), p. 400.

[919] Lo (2019), p. 397.

through new technologies like blockchain, and artificial intelligence, coupled with expansive-thinking, we just don’t know how good life can get.

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