# PLANNING FOR BROADBAND:

## An Evaluation of California's High Speed Internet Infrastructure Programs

Ryan G. Miller

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Manish Chalana
Jan Whittington

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# ABSTRACT

## Planning for Broadband:

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Ryan G. Miller

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Chair of the Thesis Supervisory Committee:

Manish Chalana

Assistant Professor

Department of Urban Design and Planning

This thesis assesses the implementation of the California Advanced Services Fund (CASF), which expands broadband Internet service to high-need communities in rural California. I examine 25 successful projects funded by the program as well as one large project which failed to obtain funding from the program – dubbed Golden Bear Broadband. By pulling from the fields of economics, philosophy, and political science, I attempt to understand how the planning process for CASF projects affects the program's goal of serving high need communities. I also examine equity issues surrounding the program's funding mechanism and policy objectives. By reconstructing the stakeholder agreements made in planning for Golden Bear Broadband, I show that the planning process lead to a project design that was forced to stray from program objectives. I conclude with recommendations for reforming broadband subsidization policy in California and observations about how alternate plans for service expansion are currently being carried out in rural parts of the state.

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# 1 INTRODUCTION

Infrastructure – or the lack of it - has enormous influence over the trajectory of a community. This thesis presents a topic centered on familiar themes in infrastructure planning as they apply to a relatively new type of infrastructure – high speed or 'broadband' Internet networks. In 2012, more than 2% of California households lacked access to a fixed broadband connection. As the importance of having a reliable home internet connection continues to grow, the State of California is working toward extending high speed internet to all its residents. The California Advanced Services Fund (CASF) is the state organization tasked with funding this effort by subsidizing privately-built infrastructure servicing high-need communities. With the CASF program not yet seven years old, there have already emerged winners and losers to the competitive grants and loans offered by the Fund.

This work pulls from the fields of economics, philosophy, and political science in its pursuit of an answer the following research question: How does the planning process for CASF affect the program's goal of serving high need communities? What follows is a program evaluation informed by empirical data regarding the program's results thus far, with a focus on the planning process for an ambitious $120 million proposal spanning the rural northern reaches of the state. This empirical analysis tests my hypothesis that the unique demands of the CASF program can lead to situations where project design does not reflect program objectives.

### Context

The American Recovery and Reinvestment Act (ARRA) of 2009 provided an unprecedented federal push in the direction of public sector involvement in promoting residential broadband access in the United States. This thesis examines just one manifestation of this push, with elements specific to the unique policy framework of the State of California. The deployment of broadband into remote communities is a timely planning topic – as economies and societies continue to migrate to the online world, there is a growing public interest in closing the 'Digital Divide'. Amidst the current regulatory controversy regarding net neutrality, "Internet fast lanes", and looming federal policy decisions which may determine the fate of the Internet's status as a public good, the plight of rural Americans without Internet access is garnering a higher profile. Universal access to broadband may come to be regarded as the most important utility provision issue faced by the developed world in this era.

### Research Design

I take a three-part approach in analyzing the implementation of various aspects of the CASF program. First, I explore the series of agreements that led to the final proposal for Golden Bear Broadband, which would have been a $120 million project delivering additional middle-mile capacity and last-mile service to large portions of rural northern California. Next, I examine demographics and existing service availability in the communities that would

have been served by the Golden Bear Broadband proposal in an effort to determine if project design met program goals. Finally, I examine the demographics of communities which had already received funding for CASF projects by the end of calendar year 2013.

**Study Purpose**

In 2014, the importance of closing the Digital Divide is not new as an economic or public policy issue, but it remains new as a planning issue.[1] Only in the past few years have public efforts to provide residential broadband Internet required the kind of spatial expertise and concern for equity in decision making offered by urban planners. By examining the planning process behind the Golden Bear Broadband proposal, I hope to contribute toward a better outcome for future planners attempting to use public funds to extend access to high need portions of the state. By expanding my scope beyond that single project and looking more broadly at potential issues present in the CASF program, I hope to offer future policymakers some suggestions for how to reform or replace the program in an effort to simplify program implementation and achieve more equitable outcomes. Finally, it is also my hope that this thesis contributes in some small way to a greater understanding of the seriousness with which planning academics and professionals – including my colleagues in this graduate program – ought to start lending toward Internet infrastructure planning. With or without the attention of the infrastructure planning community, these projects are underway and are set to transform the way many Americans connect with their world.

1. Marc Bernman and Thomas W. Sanchez, *Planning As If People Matter: Governing for Social Equity* (Washington: Island Press), 125

# 2 LITERATURE REVIEW

This literature review consists of three components. Section 2.1 includes the literature of theory surrounding relevant topics such as the economic models and market structures of the telecommunications industry, equity in infrastructure planning, and implementation of public policy. Section 2.2 explores empirical literature on the topic of program implementation. Finally, Section 2.3 thoroughly describes the history of public involvement in residential broadband provision on the part of both the federal and California state governments, meant to give the reader a foundation in policy efforts that lead to the CASF program.

## 2.1 THEORETICAL LITERATURE

The current state of residential broadband deployment in rural California can be better understood by examining the economic theories which have informed utility development, regulation, and expansion up to the present. This discussion of economic theory will address 1.) publicly regulated monopolies, 2.) public subsidies for rural utilities, 3.) neoclassical economic theory, 4.) public goods theory, 5.) transaction cost economics and 6.) program implementation literature.

### Publicly Regulated Monopolies

Under neoclassical economic theory, there are some markets for goods and services with natural tendencies toward the emergence of one firm as the dominant supplier of the good or service. Firms in these markets, often shielded from competition via structural, legal, or strategic barriers which bar other firms from entering the market, are known as *natural monopolies*[2]. Through their power to largely set their own prices and restrict supply, monopolistic firms often adopt strategies that enrich themselves while causing deadweight losses to economies around them.[3]

Utility services are especially predisposed to develop into natural monopolies. Utilities differ from other types of goods in that their provision is generally dependent on a network of distribution infrastructure that reaches the homes and businesses of individual consumers. This distribution infrastructure is an example of what economists term "fixed costs" – that is – costs that must be incurred both in the short term and in the long term in order to do business.[4] If a private "Firm A" selling electricity – a classic utility – develops a distribution network into a particular neighborhood, the chances of a competing "Firm B" developing a parallel network in that neighborhood

2. David Besanko and Ronald Breautigam. Microeconomics: Third Edition (Hoboken, NJ: Wiley Press, 2008), 444

3. Ibid, 441

4. William Baumol and Rober Willig, "Fixed Costs, Sunk Costs, Barriers, and Sustainability of Monopoly", *The Quarterly Journal of Economics* vol. 96 no. 3, pp 408

approaches zero, giving Firm A a natural monopoly in that neighborhood. The fixed infrastructure cost incurred by Firm A has become a structural barrier to entry for Firm B.

Utilities' tendency toward natural monopoly has led to widespread regulatory action by public commission in the United States. The concept of the publicly regulated monopoly is explained here using the example of the regulation of electric service in California. In the period between 1905 and 1920, each state in the United States adopted policies to regulate the sale of electricity.[5] During this time, the role of the newly-formed California Railroad Commission expanded in 1912 to include natural gas, electric, water, and telephone companies under the 1912 Public Utilities Act.[6] The agency was renamed the California Public Utilities Commission (CPUC), and has now been regulating the electric, gas, and telecommunications industries from its San Francisco headquarters for more than 100 years.

The primary regulatory mechanism employed by the CPUC and other state agencies is *franchising,* tied to strict price controls. Defined by Webster's Dictionary as "the right or license granted to an individual or group to market a company's goods or services in a particular territory",[7] the concept of *franchising* allows the regulatory agency to guarantee a monopoly for a firm in exchange for the firm agreeing to limit prices to levels that do not far exceed the cost of production. This arrangement guarantees business for the firm and minimizes the risk for duplicative infrastructure investments, while also avoiding the deadweight loss incurred by unregulated monopolists.

Today, the Commission tightly regulates the market territory and prices charged for electricity and natural gas by utilities such as the Pacific Gas and Electric Company (PG&E), one of the nation's most well-known publicly regulated monopolies.[8] PG&E's franchise agreement involves price-setting by the CPUC, but also includes publicly-funded discount programs for low income customers[9] and requirements to provide service to remote communities. These programs indicate regulatory objectives beyond that of correcting for deadweight losses due to monopoly, and point to issues of income and spatial equity in service provision. The following sections explore these issues in greater detail.

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5. George L. Priest, "The Origins of Utility Regulation and the 'Theories of Regulation' Debate", *Journal of Law and Economics* 36, no. 1, 1993, 297.

6. "CPUC History and Structure," California Public Utilities Commission, accessed 10 May 2014, http://www.cpuc.ca.gov/PUC/aboutus/puhistory.htm

7. "Franchise," definition by Meriam-Webster Online, accessed 30 September 2014, http://www.merriam-webster.com/dictionary/franchise

8. "Company Profile," Pacific Gas and Electric Company, accessed 10 May 2014, http://www.pge.com/en/about/company/profile/index.page

9. "CARE Residential Single-Family Program", Pacific Gas and Electric Company, accessed 30 September 2014,http://www.pge.com/myhome/customerservice/financialassistance/care/singlefamily/faq/

**Equity in Infrastructure Provision**

Infrastructure – or the lack of it - has enormous influence over the economic trajectory of a community. When public decision-making is involved in determining infrastructure investment, planners must balance multiple criteria in selecting projects. This section explores the concept of 'equity' as it relates to the provision of public utilities.

Equity is a notion concerned who pays and who benefits from public investments, and whether the distribution of those benefits and costs would be considered fair. The determinants of a 'fair' distribution of costs and benefits could be determined by examining equality of access, need, demand, preference, or willingness-to-pay.[10] The explicit use of these determinants in selecting between public investments can be termed 'equity planning'. Such approaches take the needs of disadvantaged groups into special consideration, and are often concerned with equality of opportunity and even with equality of outcomes.[11] Equity planning is similarly concerned with defining 'need' for infrastructure and tends to support projects that promise to bring large benefits to an area regardless of the area's *ability to pay* for those benefits.[12]

Equity planning is a strategy that welfare economists and philosophers such as John Rawls would actively pursue in order to promote equalities of opportunity. In *A Theory of Justice*, Rawls argues that a just society must not only ensure liberty, free expression, and equal protection under the law, but must ensure equal opportunity by providing all members of society what he terms primary goods - "things which a rational man wants [no matter] whatever else he wants".[13] This concept is often invoked to support universal access to education, healthcare, and childcare, but it also extends to physical infrastructure as well. Rawls would argue that a just society, providing for equal opportunity, would also work to ensure universal access to transportation and communications – in other words, the mechanisms required to participate in broader society.

However, such equity concerns are not always a consideration in public infrastructure projects. When public decision-making attempts to mirror private decision-making, attempts are made to quantify the net benefits and net costs incurred by a project, regardless of who bears such benefits and costs. This approach to planning is manifested in the widespread use of benefit-cost analysis, a tool that many planners and policymakers use to determine which projects to fund or which policies to pursue given limited budgets. Benefit-cost analysis allows planners to predict the quantity of desired outcomes such as additional tax revenue or employment, but it cannot measure the *qualities* of these outcomes. Such analyses typically take little consideration of *who* receives benefits

10. William Lucy, "Equity Planning for Infrastructure: Applications," *Infrastructure Planning and Management* (1988): 227

11. Beatley, "Equity and Distributional Issues in Infrastructure Planning," 215

12. William Lucy, "Equity Planning for Infrastructure: Applications," *Infrastructure Planning and Management* (1988): 230

13. John Rawls. *A Theory of Justice*. New York: Basic Books (1974): 59

or *where* costs come from.[14] The process has also been criticized for its reliance on apparently arbitrary assumptions about the future values of irreplaceable resources, raising issues of intergenerational equity.[15]

Equity concerns in utility planning are best understood as spatial imbalances between areas that are well-served, and areas which are poorly served, due to lower abilities to pay or higher costs to provide the service. The two go hand-in-hand when sparsely populated areas (where providing service to each additional customer incurs a higher fixed infrastructure cost) are correlated with lower incomes (lower ability to pay for the service). When public agencies use equity concerns as planning criteria, such imbalances have been addressed by subsidizing service in underserved areas. This concept is the topic of the following section.

**Public Subsidies for Rural Utilities**

In rural areas where ability to pay for critical infrastructure does not match the cost of providing the infrastructure, governments may intervene where permitted to promote equal access. In some cases, this is achieved by creating new public enterprises to provide services where none had existed before. An example of such public enterprise is the hydroelectric power projects of the Tennessee Valley Authority, formed as one of many Depression-era 'New Deal' programs aimed at tackling rural poverty.

Where the government does not ensure universal utility access through its own enterprise, it can choose to subsidize existing utility providers in the form of grants or loans to develop infrastructure into underserved areas. It may also, through price controls attached to franchise agreements, ensure the presence of *cross-subsidization*, a situation where one group of users pays a higher share of the cost, on a per-unit basis, than another group of users. A look at public strategies for rural telephone access in both the US and Australia offers an example of each of these forms of subsidy.

The expansion of telephone service in the United States in the years following World War II is an example of the government promoting utility expansion via grants and loans to existing firms. Owing in part to the enormous success of federally-funded rural electrification projects, the Rural Electrification Act was expanded in 1949 to offer low-cost loans and grants to cover the capital costs of infrastructure investments into rural areas. Title II of the Rural Electrification Act sets the groundwork for grant and loan amounts and points to such objectives as universal access to 911 emergency services as key goals of the project.[16]

Expansion of telephone service in rural Australia instead relies on a franchise agreement with one firm, Telstra, described by the World Bank as Australia's "former monopolist communications company", akin to AT&T in the

14. Timothy Beatley, "Equity and Distributional Issues in Infrastructure Planning: A Theoretical Perspective," *Infrastructure Planning and Management* (1988): 209-211

15. Kristen A. Vitro, University of Washington Master's Thesis (Awaiting Publication)

16. United States Congress, *Rural Electrification Act of 1936: Title II – Rural Telephone Service* (As amended through 2008)

United States. Australia's communications regulatory agency, AUSTEL, holds Telstra to a universal service obligation, which requires it to "provide reasonable access" to telephone service "on an equitable basis, for all Australians, wherever they reside or conduct a business."[17] In order to pay for the rural service, AUSTEL estimates the cost of the universal service obligation and then calculates a fee charged to all telecommunications firms in Australia – including Telstra's competitors – to pay for the service. In this way, rural telephone service is cross-subsidized by urban populations regardless of which firm provides their access.[18]

**Neoclassical Economics and Public Goods Theory**

Economics in the neoclassical tradition is the study of on the production and consumption of goods and the markets that facilitate those exchanges. Neoclassical economics is concerned primarily with production and consumption of goods, with an emphasis on identifying price based upon the costs of production (which determines supply) and consumer choice (which determines demand). While most people who have taken an undergraduate course in economics have a basic understanding of the economics of private goods according to neoclassical theory – price, quantity, supply, and demand for such goods as hamburgers and automobiles – not all goods are as simple to examine. The remainder of this section expands on neoclassical theory to examine public goods theory – which attempts to understand goods that have costs or benefits that accrue publicly as opposed to privately. The following section will then introduce an alternate way of understanding the economy based on the costs of doing business at the organizational level.

A more targeted examination of goods which are consumed not privately but *collectively* has been developed over the second half of the 20th century by such economists as Buchanan[19] and Samuelson.[20] These goods are distinguished from private goods in that it may not be possible to exclude any person from the benefit offered by the good once it has been produced, and one person's enjoyment of the good may not reduce the enjoyment of the good by another. These goods are difficult to address within the framework of the traditional market, so they are often provided in whole or in part by public entities via taxation and bureaucratic implementation. Such goods are also often associated with *external benefit,* that is, any benefit to society that is not captured in the price or cost of the good itself.[21]

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17. Timothy Irwin, "Price Structures, Cross-Subsidies, and Competition in Infrastructure", The World Bank Group: Public Policy for the Private Sector, note no. 107, pp. 2 (1997).
18. Ibid, pp. 3
19. James M. Buchanan, "An Economic Theory of Clubs," *Economica* 32 (1965)
20. Paul A. Samuelson, "A Pure Theory of Public Expenditure," *The Review of Economics and Statistics* 36 (1954)
21. Barry C. Field and Martha K. Field, *Environmental Economics: 5th Edition* (New York: McGraw-Hill, 2009), 78

Few of the goods we think of as public goods can be said to be *purely* public, rather, goods are usually examined on a two-dimensional plane with the good's degree of *rivalry* (the degree to which consumption by one person diminishes the benefit derived by another) and its degree of *excludability* (the ability to deprive non-payers of the benefits produced by the good). All goods can broadly be categorized according to these two dimensions as follows:[22]

- Pure private goods – consumption is both rivalrous and excludable; no external benefits
- Price-excludable public goods – consumption is non-rivalrous but excludable; external benefits when produced or consumed
- Congestible public goods – consumption is rivalrous but non-excludable; benefits accrue collectively
- Pure public goods – consumption is both non-rivalrous and non-excludable; benefits accrue collectively

Public goods which have benefits that accrue collectively can be further defined as *merit goods*. To the extent that there is an external benefit associated with its consumption, under a completely free-market system, a less than socially optimal level of consumption would take place. The opposite is true for goods with external costs – in the absence of government intervention, a more than socially optimal amount of the good will be produced.

In many cases, the task of accounting for external costs and benefits (the terms social costs and social benefits may also be used) falls to the public sector. This is often the case for goods with social benefits such as vaccinations and education, as well as for goods with social costs, like fossil fuels and recreational drugs like nicotine and alcohol. Economist Arthur Pigou, one of the first to identify the existence of these social costs and benefits, advocated for a system of redistributive taxes. His idea was to subsidize 'goods' via significant taxation of 'bads' - with the taxation serving both to decrease the consumption of those bads as well as to raise public revenue to finance the 'goods'.[23] While government intervention via Pigouvian taxes would later fall under some criticism by Coase and others, elements of the concept have retained popularity in policy and environmental fields.

**Transaction Cost Economics**

An alternative approach to understanding efficiencies in economies comes in the form of transaction cost economics. Economist Ronald Coase defines the concept of 'transaction costs' in both the *Nature of the Firm* and *The Problem of Social Cost*. Coase first defined transaction costs in *The Nature of the Firm* as the costs of doing business, later refined as "search and information costs, bargaining and decision costs, policing and enforcement costs".[24] Coase argues that the pursuit to minimize these costs is what defines the size and scope of any firm, and

22. David N. Hyman, *Public Finance: A Contemporary Application of Theory to Policy: 10th Edition* (Mason, OH: Cengage, 2010), 152

23. Arthur C. Pigou. "The Economics of Welfare – The Definition of Marginal Social and Private Net Products." London: Macmillan and Co., 1932. http://www.econlib.org/library/NPDBooks/Pigou/pgEW13.html. Accessed 2 October 2014.

24 Dahlman, Carl J,"The Problem of Externality". Journal of Law and Economics no. 22, 141–162

it is in fact the reason why firms exist at all.[25] In a world without these transaction costs, every individual might as well be a sole proprietor.

In *The Problem of Social Cost*, Coase applies the concept of transaction costs to the resolution of problems of 'social benefit' and 'social cost' as mentioned in the previous section. Coase posits that if transaction costs are low (or zero), individual parties can internalize social benefits and costs via a bargaining process, independent of any government action such as the Pigouvian taxes mentioned in the previous section. This proposition, which was later branded Coase Theorem, came to be interpreted by many of his contemporaries as a critique on government intervention to account for social costs.[26] However, it was not Coase' intention to claim that bargaining processes are always preferable to government intervention. Coase sought solely to demonstrate that the idea of fair exchange is predicated on the ability of two parties to bargain with one another. In reality, the bargaining process involves so many varied transaction costs that the two parties rarely have equal ability to participate in the process. Thus, government should intervene in such cases in an attempt to reach the agreement that two parties might have reached if their bargaining power was roughly equal, that is, if they faced roughly equal transaction costs.

The concept of the transaction cost was expanded upon by a group of economists in the late 20th century who deemed it so important that it deserved its own school of thought – transaction cost economics. Transaction cost economics is distinguished from neoclassical economics by its interest in the transaction as the unit of analysis, not the firm or the production of goods and services. Transaction cost economics is concerned with finding 'efficient' outcomes not solely by measuring production costs, but by finding the organizational and institutional arrangements that minimize the sum of transaction and production costs.

Prominent transaction cost economist Oliver Williamson has expanded the field by applying the concept to organizational structures, labor markets, and assets with high degrees of specificity. Williamson describes how the degree of specialization and nature of work efforts affects the transaction costs of labor contracting in a journal article titled The Economics of Organization: The Transaction Cost Approach. [27] He develops a two-dimensional model that describes how different types of teams incur higher or lower transaction costs – with human assets on one axis and the measurability of the labor output on the other axis. This grid is adapted in the table below:

25, Coase, Ronald. *The Nature of the Firm*

26. Coase, Ronald. *The Problem of Social Cost.*

27. Williamson, Oliver. "The Economics of Organization" The American Journal of Sociology, Vol. 87 no. 3 (1981)

| | | Human Assets / Human Capital | |
|---|---|---|---|
| | | *Non-specific* | *Highly Specific* |
| **Ability to Meter Work** | *Easy* | Spot Market<br>(low transaction cost) | Obligational Market<br>(medium transaction cost) |
| | *Difficult* | Primitive Team<br>(medium transaction cost) | Relational Team<br>(high transaction cost) |

Table **1** – Labor Contracting and Transaction Costs – adapted from Williamson 1981

In other works, Williamson argues that a similar process is involved when any factor of production is highly specific – labor is just one example.[28] The specificity of a firm's assets affects not only the price of finished products but also the extent of the firm itself – the drive toward reducing contracting costs might drive a company producing a highly specific asset to become more vertically and horizontally integrated. Any transactions that can be internalized within the firm in a hierarchical setting decreases the costs that would be incurred if those transactions took place via contracting on an open market.[29] In any case, a general conclusion is that the more specific an asset is, the greater the likelihood of the market for that asset becoming highly monopolized. Complex organizations consisting of advanced technological components, physical delivery systems, and dedicated maintenance, customer service, and marketing specialists across wide geographies (like utilities) will seek to internalize their operations as opposed to contracting for services. The concept of asset specificity extends to the public sector as well: the provision of infrastructure is by its nature a complex undertaking involving many different stakeholders, each often advancing their own, sometimes competing objectives (like providing universal access to broadband internet versus minimizing costs of service to each consumer). When these parties attempt to engage in this activity individually, they are faced with extremely high transaction costs. These are among the situations in which public intervention might create solutions that minimize those costs.

28. Williamson, Oliver. *Markets and Hierarchies: Analysis and Antitrust Implications*

29. Ibid.

**Implementation Literature**

Literature regarding the implementation of public policy programs is drawn from the realms of public administration and political science – a departure from the economic theory that has been discussed so far. Eugene Bardach's 1977 book *The Implementation Game* offers a variety of ways to think about the implementation of policy, and a menu of items that can cause implantation to falter.

Bardach's *Implemenation Game* contains a variety of ex-post (after-the-fact) analyses of public programs whose implementation was failed in some way. A helpful definition is what constitutes failure. According to Bardach, failure occurs in policy implementation when, after the fact, any or all of the following conditions prevails:[30]

- There is underachievement of the policy's stated objectives
- The program was marked by delay
- The program incurred excessive financial cost

This definition of implementation will be crucial in determining the success of California's broadband deployment efforts in the discussion chapter of this paper. Just as important as the definition of implementation failure is the question of how the implementation failed. Implementation failure can result from a failure of any of eight parts of what Bardach terms the 'implementation machine':[31]

- Administrative and financial accountability mechanisms
- Willing participation of presumptive beneficiaries or clients
- Private providers of goods and services
- Clearances or permits by public regulatory agencies or elected officials
- Innovations in the realm of program conception and design
- Sources of funds
- Troubleshooters who iron out difficulties and assist in coordinating the more routine activities of the assembly process
- Political support that sustains and protects the assembly process

Bardach attributes failures of these program components to a number of "implementation games" including diverting resources, deflecting goals, dilemmas of administration, and dissipation of energies. Further failures can arise out of the bargaining process, adherence to unlikely scenario planning, or 'fixing' of the game from the very beginning.

Pressman and Wildavsky's 1973 work "Implementation" offers a few tools to diagnose problems in implementation. Also an ex-ante look at a failed program (Bardach uses much of the same source material),

30. Eugene Bardach. *The Implementation Game* (Cambridge, Mass: MIT Press, 1980), 36

31. Ibid.. 36

Pressman and Wildavsky's account of a failed economic development program in Oakland not only describes the institutional motivations behind disparate actions, but makes an attempt to quantify chances of program success given a set number of agreements, at any given level of confidence about one agreement's success. While Pressman and Wildavsky identify many issues responsible for the program's failure, they note that the generalizability of their findings is limited. "It is the fragmentary and disjunctive nature of the real world," they note, "that makes a 'general theory of the implementation process' unattainable and, indeed, unrealistic." Nevertheless, Bardach, Pressman, and Wildvasky's examinations of previous failures of implementation will provide helpful reference points in attempting to answer the research question of this thesis. To that end, the next section of this chapter briefly discusses some of the empirical findings of Bardach, Pressman, and Wildavsky regarding program implementation gone wrong.

## 2.2 EMPIRICAL LITERATURE

Both Bardach (via a meta-analysis) and Pressman and Wildvasky (via case study research) offer compelling stories about the problems plaguing the implementation of various public programs at the state, local, and federal levels during the 1960s-1970s. This section provides a short synopsis of three programs: 1) A reform of public mental health services in California, 2) a federal program to develop housing on federally-owned land in inner cities, and 3) a federal program aimed at economic development and reducing long-term unemployment in Oakland, CA.

### Mental Health Reform: The Lanterman-Petris-Short Act

The L-P-S act was passed in 1967 and was seen as a primary accomplishment of that legislative season. Nicknamed "the Magna Carta of the mentally ill" by its champion Frank Lanterman, a prominent Republican in the California State Assembly, the L-P-S act sought to restore rights to the formerly ill and promote a shift away from institutional care and toward community-based care. Almost immediately after its passing, the bill was met with resistance from county departments of public health, the State Department of Mental Hygeine, and the California State Employees' Association. Tensions arose over formulas for redistributing state mental health dollars from mental hospitals to local county budgets, and sensational stories by the press emerged as patients began relocating to community care facilities. The L-P-S act was implemented, albeit at the cost of a considerable amount of Frank Lanterman's political capital. Lanterman served as a 'fixer' of the implementation process and strayed considerably from his role as a legislature to ensure that the policy was carried out.[32]

32. Ibid. 22-27

**Housing on Federal Land: New Towns-in-Town**

"New Towns In-Town" was a program promoted by the US Department of Housing and Urban Development that sought to grant federally owned land in urban areas to local housing authorities to provide inexpensive public housing. Due to community resistance and stipulations attached to federal contributions, the project never came to fruition. Negotiating the terms of the land transfer and subsequent development required massive coordination and bargaining between federal officials and local planners, and agreement was simply never achieved. Researcher Martha Derthick focuses on this case as an illustration of the "limits of centralization", writing that the single most inclusive explanation for the project's failure is found in the disabilities of the federal government in working with local governments and communities. Bardach's diagnosis of this case differs slightly – he deems this case a failure due to failures in intergovernmental bargaining.[33]

**Federal Investments to Combat Poverty: EDA in Oakland**

In the mid-1960s, against the backdrop of economic insecurity and racial tensions gripping the nation at that time, the Economic Development Agency embarked on an experiment to combat poverty in Oakland via a host of federally funded work training programs, infrastructure projects, and private sector partnerships meant to ensure employment for long-term unemployed minorities. Three years into the project, EDA was $5 million overbudget, construction was not yet underway on cornerstone elements of the project, private partner World Airways was on the verge of withdrawing from hiring agreements, and no new jobs had yet been created in Oakland. Though the project did go on to achieve limited success, the chaotic implementation of the economic development project became a case study for the "complexity of join action" by Pressman and Wildavsky, researchers at the University of California.[34]

Problems affecting the program's implementation included disagreements over budget between regional (Seattle) and local offices (San Francisco) of the EDA, intractable planning issues posed by the US Navy in attempting to prevent any development next to its naval air station at Alameda, and initial missteps by the EDA toward Oakland's black community leaders – whose support would be key for the very population the project was attempting to benefit. While Bardach's analysis of EDA's Oakland project focuses on the various 'games' played between public agencies, Pressman and Wildavsky's initial case study focuses less on the games and more on the chaotic nature of the implementation – musing that with the amount of agreements necessary for implementation to process, it is a wonder that anything ever gets accomplished at all. Pressman and Wildavsky created a simple model tracking

33. Ibid. pp 45-47

34. Ibid. 52-57

decision points in the project and calculated estimated chances of project success given various likelihoods of agreement between parties.[35]

## 2.3 LITERATURES OF PRACTICE: BROADBAND POLICY THUS FAR

Now that relevant economic and policy implementation concepts have been introduced, the remainder of the literature review will focus on defining the service in question – broadband internet. In order to understand if the CASF program is truly meeting its objective of provisioning broadband to underserved rural residents, broadband technology itself must be further examined.

### The Internet: A Brief History

The seeds of the modern Internet were sown in the early 1960's, when researchers at MIT theorized about the social capabilities of networking using new ideas about packet-switching to exchange information.[36] These ideas were operationalized with the Advanced Research Projects Agency Network (ARPANET), funded by the US Department of Defense for coordination between universities working on defense contracts. By the early 1970s, the program had grown to include a multitude of campuses, and talk of a new application, "electronic mail," began generating headlines.

35. Jeffrey Pressman and Aaron Wildavsky, *Implementation: How Great Expectations in Washington are Dashed in Oakland,* University of California Press: Berkeley, 1973, pp. 107

36. Barry M. Leiner et. al., "Brief History of the Internet", The Internet Society, http://www.internetsociety.org/internet/what-internet/history-internet/brief-history-internet, accessed 1 October 2014

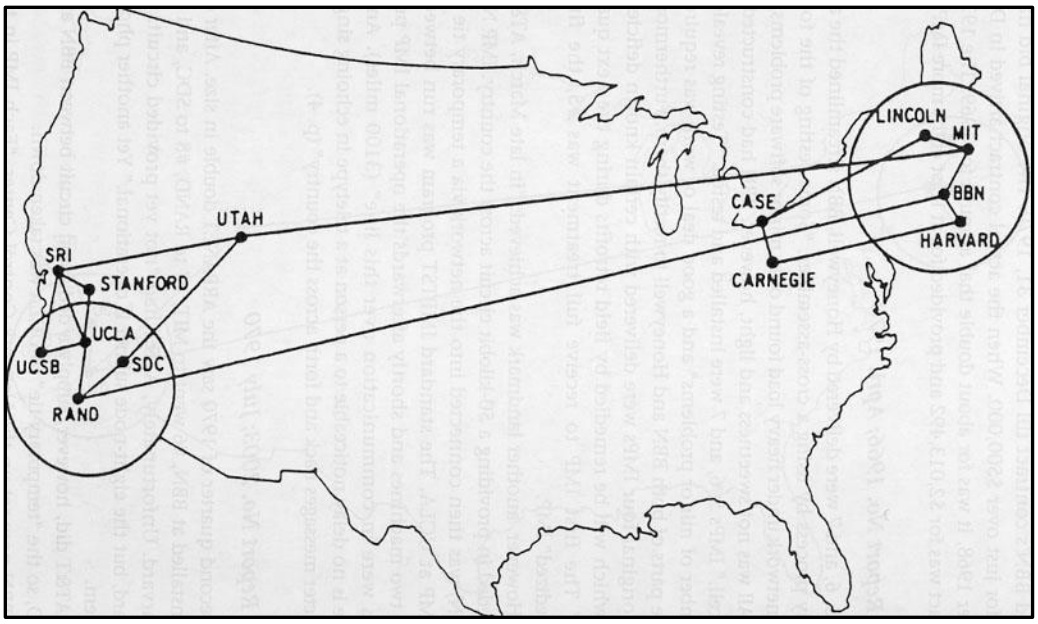


**Figure 1: The Internet in 1979**[37]

By the 1980s, ARPANET had expanded to more closely resemble the modern Internet, growing out of purely defense-related research purposes and gaining a wide user community. Standards such as TCP/IP (Transmission Center Protocol / Internet Protocol) were developed that allowed a common language for packet switching between entities of any type. By the beginning of the 1990s, access to the Internet was becoming rapidly commercialized. The end of the 20th century saw the proliferation of many of the Internet Service Providers (ISPs), early applications, and web services that were ubiquitous to early users of the Net – such as America Online (AoL), Netscape Naviagor, and Yahoo.com. While residential connections had so far been made primarily via telephone lines, residential customers began demanding high-speed, dedicated service toward the late 1990s. It is during this time that dedicated subscriber lines (DSL) and coaxial cable lines began being offered to residential subscribers in urban areas. These technologies remain some of the primary methods of high speed connections to the Internet today, joined with more recent technologies such as dedicated fiber-optic lines, as well as satellite-based and wireless tower-based connections.

### Broadband: Definition and Physical Infrastructure

While the term "broadband" has been used by consumers and the media to colloquially refer to any range of high-speed internet connections, the term has in fact been precisely defined by the federal government. The word "broadband" has its origins in the wide diameter copper cable that was historically required to convey information

37, Call, Lewis. Course Materials – History 354: History of Network Technology, California State Polytechnic University, San Luis Obispo, CA, http://cla.calpoly.edu/~lcall/354/, accessed 2 October 2014

at speeds faster than standard telephone lines, but "broadband" has evolved to include any range of technologies, wired or wireless, capable of achieving high rates of information transmission.[38] Broadband is defined by the Federal Communications Commission as any Internet connection that is capable of both receiving *and* sending information at a rate of 200 kilobits per second (kbps).[39] For an understanding of what this speed means to the consumer, imagine that you wished to download a contemporary pop song from a reputable online music vender. A three minute piece of music stored in a partially compressed format such as an .mp3 is likely to comprise about 4 Megabytes (MB) of data. One megabyte of data contains 1,024 kilobytes (kB), and each kilobyte in turn contains eight kilobits (kb) of data. Every kilobit contains 1,024 pairs of zeros and ones (binary digits), the most basic unit of computing. Thus, our pop song of interest, which is comprised of 32768 kilobits of data, would take 163.8 seconds or about two and a half minutes to download with a 200 kbps connection.

Of special importance within the FCC's definition of broadband is that a speed threshold is set both for information sent from the provider to the consumer (*downstream*) as well as information sent from the consumer to the provider (*upstream*). This shows an early understanding of the importance of the bidirectional nature of the Internet, but it also eventually determines what types of technologies are eligible for public subsidy in California and elsewhere. While the FCC's definition of 200 kbps downstream and upstream forms the minimum definition of what constitutes broadband, other agencies have defined higher thresholds for minimum levels of acceptable service in more recent years. The enabling legislation for the California Advanced Service Fund, the subject of this thesis, deems a neighborhood 'served' only if a provider offers connections at least 6 mbps downstream and 1.5 mbps upstream. Neighborhoods with some level of broadband available, but at slower speeds, are deemed 'underserved'.[40]

*Broadband Infrastructure: Middle Mile vs. Last Mile:*

The physical infrastructure that comprises a high speed internet connection can be broadly described in two categories: *last mile* and *middle mile* networks. *Last mile* infrastructure is used to refer to household and neighborhood-level connections that bind individual homes and businesses to local network connection points of Internet service providers. *Middle-mile* infrastructure describes the high speed, long distance connections that bind these local connection points to one another across regions and provide high-capacity links to the broader global Internet.[41] A useful metaphor for conceptualizing this system is the hierarchy of roadways in the United States.

38. James Alleman and Robert Crandall, *Broadband: Should we Regulate High-Speed Internet Access?* (Washington DC: Brookings Institution Press, 2002), 11

39. Federal Communications Commission, *Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996* (2000), CC Docket 98-146

40. California Public Utilities Commission, *Decision Implementing Broadband Grant and Revolving Loan Program Provisions* (2010), Rulemaking 10-12-008

41. Alleman and Crandall, *Broadband*, 161

*Middle-mile infrastructure* can be compared to the Interstate Highway System, providing high-throughput connections between cities and regions. Local network connection points can then be compared to the highway exits, with *last-mile infrastructure* representing the arterial and residential streets which branch out to individual homes and businesses. The CASF program, as discussed in an upcoming section, is focused on extending last-mile infrastructure to unserved areas, but, much like our system of roadways, congestion along the high-capacity connection may pose a problem regardless of the presence of quality connections to individual homes and businesses. This distinction will be key to the planning strategy and ultimate failure of the Golden Bear Broadband proposal and will form a substantial portion of this thesis' critique of the CASF program.

*Access to Broadband: Availability Rate vs. Adoption Rate*

The terms 'availability' and 'adoption' have their own critically distinct definitions when describing a household's access to broadband services in California. 'Availability' refers to the presence or absence of last-mile connectivity in a neighborhood, while 'adoption' refers to a household actually subscribing to such services. The related concepts *availability rate* and *adoption rate* are both used as measures of broadband access but they too have separate meanings. The availability rate is defined as the percentage of households in a given area of interest which are located in areas where broadband service exists (regardless of whether or not they subscribe to such services.) The *adoption rate* is defined as the percentage of households in a given area of interest which actually subscribe to such services, *out of those households to which the service is available*.[42] In practical use, the availability rate measures physical or geographic barriers to access while the adoption rate measures income or preference barriers to access. The CASF was primarily intended to increase availability rates in California regions, but elements of the program also target adoption rates, and a key portion of the equity analysis of the CASF program rests on this distinction. Refer to the glossary for definitions along with illustrative calculations of each of these access measures.

**Broadband as a Congestible Merit Good**

This thesis argues that broadband internet is a merit good subject to forces of congestion. Let us first examine the ways in which broadband internet is congestible: its consumption is both somewhat rivalrous and it also delivers a collective societal benefit. At any given level of investment in infrastructure by a broadband carrier, consumption of the connection is not rivalrous for the first few consumers; in fact, consumption only becomes rivalrous when it approaches a point of congestion. This point of congestion is defined in most cases by the amount of copper or fiber optic cables in the middle-mile infrastructure provided by the carrier. As consumption reaches the point of

42. Ryan Miller, Amy Lippus, and Alyssa Caldwell, *California Broadband Report: A Summary of Broadband Availability and Adoption in California as of June 30, 2011* (California Public Utilities Commission White Paper): 5

congestion, the service provider must decrease the flow of information that each user can utilize in order to accommodate demands of the additional users. This may be aptly compared to the slowdowns experienced on major highways at rush hour – vehicles must travel more slowly in order to increase the overall capacity of the network. You may have experienced this internet slowdown in your daily life in the form of a reduction in average speeds during peak hours of internet usage. This anecdotal experience with broadband's congestibility is backed up by a study performed in the UK[43] of actual speeds achieved at given times of day:

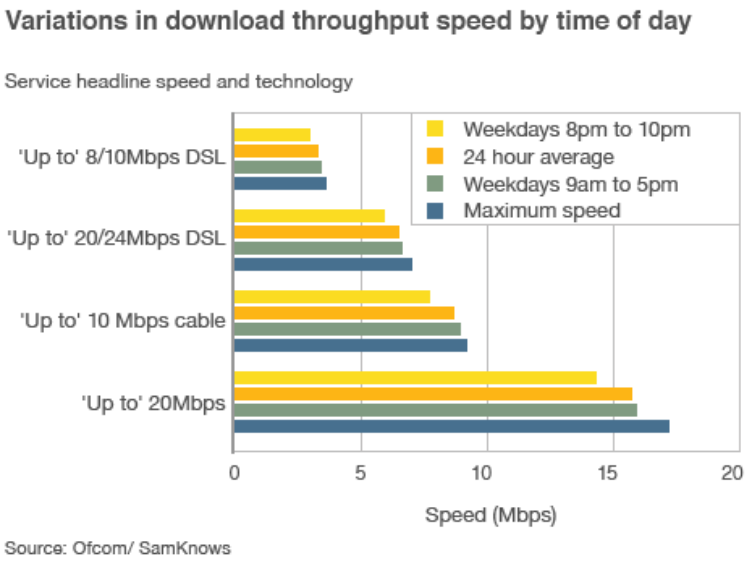


**Figure 2: Broadband Speeds At Different Times of Day[44]**

Access to broadband in the home can also be said to include significant external benefits to society, making it a classic merit good. These external benefits come in the form of the educational and awareness benefits associated with the unprecedented capability of Internet to distribute information, as well as the global value increase created when more users join an existing network according to network theory. Much as is the case with public education or public libraries, it may be argued that all of society benefits when each of its members can easily access basic information. High speed internet access enables such activities as video streaming, the ability to use interactive online tools, and videoconferencing with friends, professionals, or colleagues. Furthermore, governments may be able to operate at lower costs by offering services such as tax/fee collection, license renewals, or even provision of social services or monetary aid, using online platforms. The provision of student aid (*FAFSA*)[45] and the selection of

43. Jane Wakefield, "Why Does Broadband Speed Vary So Much?" *BBC Technology News*, July 28th, 2010. Accessed 10 May 2014. http://www.bbc.com/news/technology-10774406.
44. Ibid.
45. "Free Application for Federal Student Aid," US Department of Education, Accessed 10 May 2014, https://fafsa.ed.gov/

private health insurance plans (*healthcare.gov)*[46] are recent examples of the federal government offering critical services almost entirely through online platforms. In addition to the external benefits related to expanded access to information and government services, each additional user connected to the network creates more value for every other user according to network theory. While the theory was first developed to describe transportation and voice communication systems, it has been expanded to include social networking applications and Internet connectivity itself.[47] In an age where value is derived not only from distributing information to end-users but also from the creation of unique user-generated content, it follows that the value of each additional high speed internet subscriber to society is more than the price that user pays for his or her Internet subscription.

## 2.4 HISTORY OF STATE AND FEDERAL BROADBAND POLICY

The CASF program owes its existence to a nearly twenty-year history of government interest in high-speed telecommunications in both California and nationwide. The following sections outline federal and state involvement in regulating and promoting broadband from the 1990s to today.

### Federal Broadband Policy

Federal policy acknowledged broadband in the 1990's as the Federal Communications Commission (FCC) began to recognize its importance both as an informational tool and as a driver of economic development. The federal government then made a push for broadband services in the wake of the Great Recession of 2008-10, engaging the FCC along with allied agencies in a nationwide mission of information gathering and infrastructure building. This section outlines the federal government's involvement with broadband as it evolved from the 1990s to the federal stimulus bill in 2009.

*The Telecommunications Act of 1996*

The Telecommunications Act of 1996, the first major overhaul in federal telecommunications policy in more than 50 years when it was signed, had the intention of freeing up telecommunications markets for increased

46. "Health Insurance Marketplace," US Centers for Medicare & Medicaid Services, Accessed 10 May 2014, https://www.healthcare.gov/

47. Nicholas Economides, "The Internet and Network Economics" in *Internet and Digital Economics: Principles, Applications, and Methods,* ed. Eric Brousseau and Nicolas Curien (Cambridge University Press, 2008), 239.

competition,[48] but it was also the first time that rural broadband service was referenced by federal policy. Section 254(b)(3) of the Act, titled "Access in Rural and High Cost Areas," states:

> *Consumers in all regions of the Nation, including low-income consumers and those in rural, insular, and high cost areas, should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services, that are reasonably comparable to those services provided in urban areas and that are available at rates that are reasonably comparable to rates charged for similar services in urban areas.*[49]

The reference to "advanced telecommunications and information services," though vague in the original Act, came to be understood as broadband internet as per the 200 kbps minimum speed threshold defined by the FCC in subsequent reports.[50] While the FCC's initial support of broadband was limited to policing of providers to promote rural service investments, it was not until the Great Recession of the late 2000s that substantial amounts of money were made available to support the cause.

*The American Recovery and Reinvestment Act of 2009 (ARRA)*

Much as the Great Depression brought with it the great public works of the WPA and the vast social programs of the New Deal, the Great Recession of the late 2000s prompted a public response similarly focused on job growth and infrastructure investment. The ARRA stimulus bill of 2009 funded over $800 billion worth of tax breaks, social services, research, and infrastructure projects, of which many are still being planned or constructed today. Of relevance to the topic of broadband, however, was the allocation of $4.7 billion to the National Telecommunications and Information Administration (NTIA) to create and administer a grant program that would fund broadband projects in high-need areas.[51] That grant program eventually evolved into the Broadband Technology Opportunities Program (BTOP), which has funded 135 infrastructure projects totaling $3.5 billion to date.[52] The BTOP program, while groundbreaking in its direct federal funding of broadband infrastructure, is of course not the focus of this thesis. Also included in the NTIA's funding package was $350 million intended to develop and maintain maps that would inventory the state of broadband deployment nationwide. A small portion of this funding was used to by the NTIA establish a common database format for the collection of geographic data regarding broadband availability, and the majority of the funding was distributed to each state through the State

48. "Telecommunications Act of 1996," Federal Communications Commission, accessed May 10, 2014, http://transition.fcc.gov/telecom.html

49. United States Congress, Telecommunications Act of 1996 (104th Congress): Section 254(b)(3)

50. FCC, *Deployment of Advanced Telecommunications Capability to All Americans… …Pursuant to Section 706 of the Telecommunications Act of 1996* (2000)

51. United States Congress, *American Recovery and Reinvestment Act of 2009: Title II – Commerce, Justice, Science, and Related Agencies* (111th Congress):

52. "Broadband Technology Opportunities Program (BTOP) Quarterly Program Status Report," National Telecommunications and Information Administration – US Department of Commerce (2014), 1

Broadband Data and Development initiative (SBDD) so that each state could lead its own bi-annual mapping process to chart the expansion of broadband services. The common data format established by the NTIA continues to be used nationwide to measure the expansion of broadband, including in California, and forms the basis against which applications to the CASF program are judged. Due to its importance, those data guidelines are explained in detail in the following section.

*NTIA Broadband Mapping Project*

In order to implement the State Broadband Data and Development mapping initiative taken out by state agencies nationwide (including the CPUC in California)[53], the NTIA drafted a set of data standards to be used within the framework of the ESRI geodatabase format. Twice yearly, the state's lead agency requests geographic data and/or lists of customer addresses from major internet service providers in the state, and the data is compiled according to the following standards:

| **Feature Class** | **Geographic Data Type** | **Description** |
|---|---|---|
| Community Anchor Institutions | Point | Physical locations of schools, libraries, hospitals, etc. |
| Wireless Broadband Service | Polygon | Depiction of service area footprint for fixed wireless, mobile wireless, or satellite services. |
| Wireline Broadband Service | Polygon | Census Blocks within which exists wireline (DSL, cable, fiber) service (only for Census Blocks less than 2 square miles in total area). |
| Wireline Broadband Service | Line | Road segments along which exists wireline (DSL, cable, fiber) service (only for Census Blocks greater than 2 square miles in total area). |

**Table 2: Description of Broadband Data Types[54]**

| **Speed Code** | **Maximum Advertised Speed Tier** |
|---|---|
| 1 | Under 200 kbps (not broadband) |
| 2 | 200 kbps – 768 kbps |

53. "California Public Utilities Commission: Designee for the State of California," National Telecommunications and Information Administration, accessed May 20 2014, http://www2.ntia.doc.gov/grantee/california-public-utilities-commission

54. "Geodatabase Documentation," National Telecommunications and Information Administration, accessed November 28 2014 http://www.broadbandmap.gov/blog/wp-content/uploads/2011/02/Transfer_Model_Tech_Spec.html

| | |
|---|---|
| 3 | 768 kbps – 1.5 mbps |
| 4 | 1.5 mbps – 3 mbps |
| 5 | 3 mbps – 6 mbps |
| 6 | 6 mbps – 10 mbps |
| 7 | 10 mbps – 25 mbps |
| 8 | 25 mbps – 50 mbps |
| 9 | 50 mbps – 100 mbps |
| 10 | 100 mbps – 1000 mbps |
| 11 | 1000 mbps+ |

**Table 3: Coded Broadband Speed Tiers[55]**

Each feature contains a set of standardized attributes, the most relevant of which for planning purposes is the 'Maximum Advertised Speed' for that feature.

The nature of this data is described in such detail because it presents unique data issues that become highly relevant when judging existing levels of service in the process of ranking grant applications. This is not meant to discredit the efforts of the NTIA; any attempt at data standardization process is bound to have its drawbacks but the interoperability offered by the standardization is more valuable than these sacrifices. There is also a tradeoff between geographic accuracy and customer privacy. The use of Census Blocks to represent areas where service exists is one example of this issue: in many cases, the presence of one customer in the Census Block is not an indication of service within the entire block. The collection of line data for those Census Blocks which are larger than two square miles mitigates against this to some extent, but creates its own set of problems when attempting to translate between line data and polygon data. For wireless providers, who are allowed to submit free-form depictions of their service areas, there is an incentive to over-represent one's coverage area. Keep these distinctions in mind as the grant ranking process for CASF applicants is described in the results section of this paper.

To see this data represented on a national scale, visit the National Broadband Map website at http://www.broadbandmap.gov/technology.

[55] "Geodatabase Documentation," National Telecommunications and Information Administration, accessed November 28 2014 http://www.broadbandmap.gov/blog/wp-content/uploads/2011/02/Transfer_Model_Tech_Spec.html

*FCC Form 477 Collection*

As the SBDD mapping program commenced, the FCC began collecting data regarding the subscriptions claimed by each internet service provider by Census Tract, as part of its Form 477 reporting requirements. This data is aimed at measuring adoption of broadband whereas the previously-described NTIA-led efforts are aimed at measuring the availability of broadband. However, adoption collected by the FCC uses the same attributes for speed information established for geographic data by the NTIA, making cross-comparisons possible. Due to concerns about confidentiality, the FCC Form 477 data is collected only at the Census Tract level, however, which forces any comparisons between availability and adoption to be aggregated to this level. Generalized versions of the Form 477 data are available for download from the FCC's website.[56]

### 2.4.2 State Broadband Policy

As a technologically savvy and historically innovative state, the State of California recognized the critical importance of high speed networks since the early days of the Internet's appearance in everyday life. The California Public Utilities Commission has been at the forefront of advancing broadband policy since it became a priority following the 1996 Telecommunications Act. The CPUC is the state-level authority tasked with regulating the private companies which distribute electricity, natural gas, water, rail transportation, and telecommunications services to the residents of California.[57] The Commission was originally established as the "California Railroad Commission" in 1911 under an amendment to the California Constitution. Its regulatory authority then expanded to include natural gas, electric, water, and telephone companies under the 1912 Public Utilities Act.[58] Today, the Commission is the lead agency tasked with regulating communications industries and also with implementing communication policy. The remainder of this section will summarize early state involvement in broadband infrastructure by the CPUC and related agencies, culminating in latest iteration of the CASF program.

*California Emerging Technology Fund (CETF)*

The Emerging Technology Fund was created as a condition of mergers between telecommunications giants in the early 2000s. As a condition of SBC merging with AT&T, and with Verizon merging with MCI, the parties to the merger pledged to donate $60 million dollars over five years to mitigate against potential anti-trust concerns.[59] CETF is not directly involved with provision of household broadband services, but rather funds industry-related

56. "Local Telephone Competition and Broadband Deployment," Federal Communications Commission, accessed 10 May 2014, http://transition.fcc.gov/wcb/iatd/comp.html

57. "About Us," California Public Utilities Commission, accessed 10 May 2014, http://www.cpuc.ca.gov/PUC/aboutus/

58. "CPUC History and Structure," California Public Utilities Commission, accessed 10 May 2014, http://www.cpuc.ca.gov/PUC/aboutus/puhistory.htm

59 "History," California Emerging Technology Fund," accessed May 10, 2014, http://www.cetfund.org/aboutus/history

projects, researches trends in availability and adoption of high speed internet services, and monitors the implementation of such projects by other state and federal agencies.[60] CETF and its vocal president, Sunne Wright McPeak, continue to offer guidance and recommendations to broadband implementation programs statewide.

*Corporation for Educational Network Initiatives in California (CENIC)*

In the 1990s, California's institutions of higher education realized that their excellence would soon be predicated at least in part on high-speed internet connections with one another and with the world. Prestigious private institutions such as Caltech, Stanford, and USC partnered with the public UC and CSU systems partnered in 1996 to form the non-profit Corporation for Educational Network Initiatives in California or CENIC. These institutions banded together and made significant investments using state and federal funding to create the California Research and Education network, a system of middle-mile infrastructure that links almost every institution of higher learning in the state.[61] A system map of the CalREN backbone in the style of a subway map, offered on CENIC's website, is shown below:

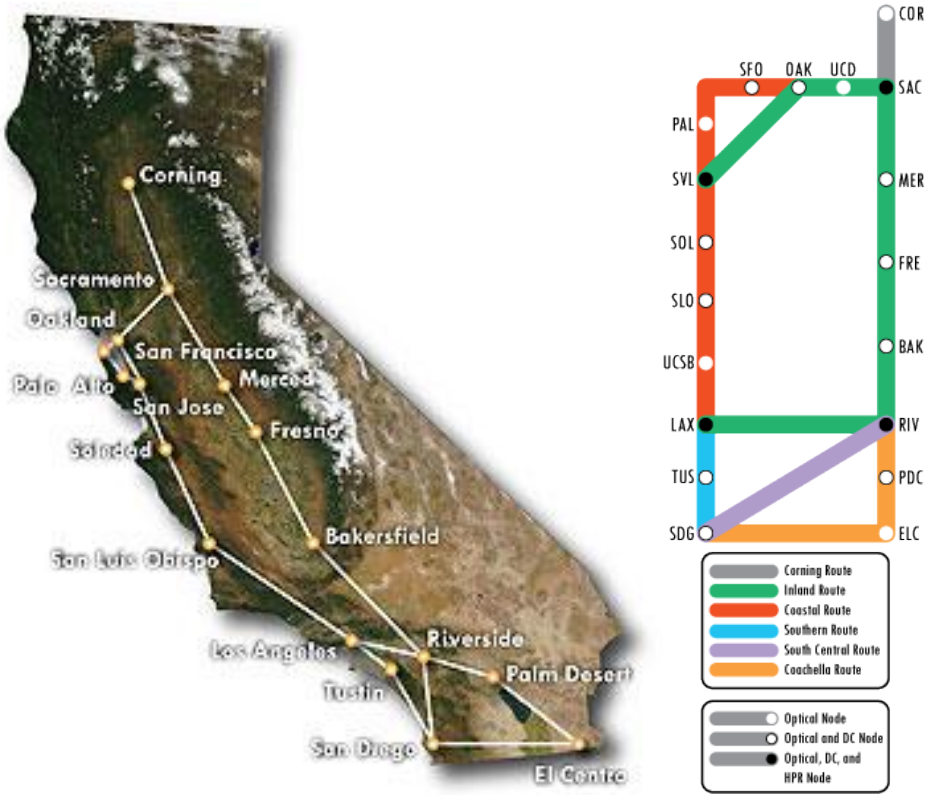


**Figure 3: Visualization of the CalREN Network**

60 "Mission," California Emerging Technology Fund," accessed May 10, 2014, http://www.cetfund.org/aboutus/mission

61. "CalREN: The California Research and Education Network," The Corporation for Education Network Initiatives in California," access May 10, 2014, http://www.cenic.org/page_id=66/

The organizational capacity of CENIC, along with the leadership of its venerable executive director Tom West, has been leveraged by northern California groups in the planning process for the CASF program. The corporation continues to be influential in both the higher education and the broadband planning worlds today.

*California Advanced Services Fund (CASF)*

The California Advanced Services Fund, the subject of this thesis, was initially formed by legislation in 2007 with the mission of 'bridging the digital divide'. The CASF is administered by the CPUC, and all projects must receive a majority vote of the Commissioners in order to receive funding. While the fund was established with a one-time appropriation of state funds, in 2008 CASF turned to a 0.25% surcharge on mobile telephone service for all mobile phone users in the State to continue its operations. Over the Fund's seven year history, the amount of this tax has changed in response to the financial needs of the program – today, the tax stands at 0.164%.[62] A scanned image of my mobile phone bill for April 2014 is included below:

| | |
|---|---|
| **Verizon Wireless' Surcharges +** | |
| Fed Universal Service Charge | .64 |
| Regulatory Charge | .21 |
| Administrative Charge | .88 |
| CA State PUC Fee | .02 |
| | **$1.75** |
| **Taxes, Governmental Surcharges and Fees +** | |
| CA State 911 Fee | .12 |
| CA Teleconnect Fund Surchg | .06 |
| CA State High Cost Fund (A) | .02 |
| Lifeline Surcharge – CA | .14 |
| CA Advanced Srvcs Fund (CASF) | .05 |
| CA Relay Srvc/Comm Device Fund | .02 |
| | **$.41** |
| **Total Current Charges for 530-[redacted]-6917** | **$45.16** |

+Percentage–based taxes, fees, and surcharges apply to charges for this line, including overage charges, plus this line's share of account charges.

**Figure 4: Mobile Phone Surcharges in California**

62. "California Advanced Service Fund (CASF)," California Public Utilities Commission, accessed 10 May 2014, http://www.cpuc.ca.gov/PUC/Telco/Information+for+providing+service/CASF/index.htm

The implementation of the CASF program has been complex and subject to influences from outside sources. Notably, the NTIA grant received by the CPUC in 2009 as a result of the ARRA stimulus bill allowed the Commission to offer funding to local regions for the purposes of planning for broadband infrastructure projects. The intent of these planning grants was to promote cooperation between local governments and local service providers that could generate project proposals that would produce maximum public benefit. Local regions formed their own 'regional consortia' comprised of representatives from multiple counties and applied for planning funds in 2009-2010. The image below shows the 14 regional consortia that received planning funds pursuant to the CASF grant program. Only nine of California's 58 counties are not a part of any consortia; these tend to be wealthier coastal counties where broadband access may not be as visible an issue.


**Figure 5: CASF Broadband Planning Consortia**

The CASF program created two funding categories: grants for areas deemed entirely unserved and low-interest loans for areas deemed underserved according to the state's broadband mapping efforts under the SBDD. The scoring criteria of the grant and loan programs will be further examined in the 'results' section of this thesis.

# 3 METHODOLOGY

In order to answer the question "how does the planning process for CASF projects impact the program's goal of serving high-need communities?", I take a three-part approach which draws on both publicly available information and institutional insights I gained as a project participant. First, explore the series of agreements that led to the Golden Bear Broadband proposal, and, in the vein of Pressman and Wildavsky, estimate the project's likelihood of success given the complexity of the agreements the project was predicated upon. Next, I examine the demographics and service availability of the communities that would have been served by the Golden Bear Broadband proposal – in order to see what the proposal looked like from the point of view of the agencies responsible for its funding. Finally, I examine the demographics of communities which had already received funding for CASF projects by the end of calendar year 2013.

Taken together, these three efforts provide an answer to all parts of the research question and shed light on my hypothesis presented in the introduction: that program design has been influenced by factors other than need for service. Revisiting the agreements that lead to Golden Bear's final design sheds light on how the program evolved to meet the needs of additional stakeholders while still attempting to deliver on the goal of serving high-need communities. The evaluation of the demographics and service availability of Golden Bear's final project area offers insight into how successfully the planning team crafted a project that met the funding agency's definition of "serving high-need communities". Finally, the evaluation of communities currently receiving funding for CASF projects provides an empirical metric about what the CPUC does consider "high-need communities", and provides a context against which the Golden Bear Proposal can be compared.

## 3.1 EVALUATION OF THE GOLDEN BEAR PLANNING PROCESS

In order to evaluate the planning process behind the Golden Bear Broadband proposal, I create a list of all the agreements between organizations that the final proposal was based upon. The construction of this list is based on two sources: publicly available documents such as press releases and Golden Bear's submitted application to CASF, and information I gained as a participant in this project, in consultation with individuals representing the various organizations involved in the planning process. As an employee of CSUC between 2011 and 2013, I was involved in planning the route for Golden Bear Broadband at the same time as I was involved in preparing the underlying data for and creating the scoring mechanism that would rank applications to the CASF program. This unique position offered me observations on both sides of the "implementation game," and I use personal observations where I can to complete the list of agreements.

After the list of agreements is compiled, I follow Pressman and Wildavsky's methodology for assessing the complexity of joint action by assembling each decision point in roughly chronological order and recording the cumulative number of agreements the project was based upon. I then calculate probabilities for ultimate project

success under various rates of likelihood that each agreement will be made, and kept. The purpose of this exercise is twofold: first, it sheds light on the sheer complexity of the program, and second, it offers a theory about how political influences might have ultimately impacted the project. To the extent that program design strayed from the goal of serving high-need communities, the reasons for this might best be found in the various agreements the planning team needed to keep with the stakeholders presented in this section.

## 3.2 EVALUATION OF THE GOLDEN BEAR PROPOSAL

As noted in the introduction, Golden Bear Broadband was (and remains) the largest ever single application to CASF in the program's history. The proposal's two last-mile components (fiber to the home along the Mendocino and Sonoma county coasts, fixed wireless towers in inland areas) covered a vast swath of 1,085 Census Block Groups. I compare the 1,085 Census Block Groups listed in Golden Bear's application to broadband availability data published by the CPUC at the same geography level, and join the CBGs to the same demographic information (income, poverty rates, educational attainment, and English comprehension) used by the CPUC as part of their evaluation of each CASF project. I use the CPUC availability data to distinguish between those portions of the Golden Bear project which meet the criteria of serving "high-need communities" and those that do not advance that objective. I then compare those portions of the Golden Bear project which do represent "high-need communities" with the project as a whole along the key demographics listed above.

## 3.3 EVALUATION OF COMMUNITIES CURRENTLY SERVED BY CASF PROJECTS

As of the end of calendar year 2013, the CASF program had authorized $80.37 million for 41 projects statewide.[63] Of the 29 projects which have been completed and are currently delivering service to end-users, only 25 strictly include last-mile infrastructure, while 4 completed projects involved middle-mile as well as last-mile components. For the purposes of evaluating the needs of only the end-users of these projects, I look only at those 25 projects solely consisting of last-mile infrastructure. Projects including middle-mile infrastructure, which can involve a wider set of benefits such as increased reliability due to network redundancy, would be inappropriate to examine for this exercise because their benefits can be spread far beyond the project areas themselves.

Project summary data was obtained from the CASF 2013 Annual Report, and Census Block Group level demographic data was then matched to each project area. A list of each project's cost and number of households served, a map of project locations, and a comparison of key demographics (used by CASF staff as part of grant scoring criteria) between these project areas and state averages are presented in section 4.3. The demographics

63. California Advanced Services Fund: Annual Report January 2013 – December 2013, pp. 3. Issued April 2014, accessed 30 May 2014 http://www.cpuc.ca.gov/NR/rdonlyres/4608A074-0A36-4E59-8BA1-E4D72E4512C7/0/CASFAnnualReport2013.pdf

analyzed are median household income, educational attainment measured both by high school diploma attainment for those 18 and older and bachelor's degree attainment by those 25 and older, poverty rate, English comprehension, and per capita income. [64]

64. "Decision Implementing Broadband Grant and Revolving Loan Program Provisions," Decision 12-02-015: California Public Utilities Commission, pp. 90

# 4 RESULTS

## 4.1 THE GOLDEN BEAR PLANNING PROCESS

The following section consists of a brief timeline of events in the planning process for the Golden Bear application, followed by a summary of key decision points and the series of agreements that lead to the project's final design.

### Planning Framework for CASF Projects

Before describing the specifics of Golden Bear Broadband's planning process, it is important to understand the state-level planning context that applied to all CASF applications at the time. Although CASF had been established in 2008, the influx of funds from NTIA via the ARRA stimulus bill allowed the CPUC to better fund its planning efforts for high speed internet expansion in the post-stimulus era. While many of the first applications for CASF funding (including some reviewed as part of this paper) were carried out entirely by private companies, the influx of funding received by the CPUC in 2009 allowed it to apportion money to promote planning for broadband at a regional level for the first time. By 2010, the CPUC began authorizing and funding Regional Broadband Planning Consortia throughout the state.[65] Each Consortium was to consist of various local governments coming together for the purposes of identifying areas of high need and assisting local companies with CASF applications, or creating applications of their own.

By 2011, the Corporation for Educational Networks in California (CENIC) had partnered with the Center for Economic Development at California State University, Chico (CSUC) to establish two Broadband Planning Consortia - the Northeastern California Connect Consortium (NECCC) and the Upstate California Connect Consortium (UCCC). The two consortia groups consisted of county and city level planning officials who supported CENIC and CSUC's vision for expanded broadband in the Northstate, often signing on the consortia with the understanding that particular communities within each county would eventually receive subsidized service as a result of the planning efforts. The table below summarizes the counties which CENIC and CSUC organized into these consortia. Refer back to Figure 5 to see a statewide map of these two consortia in relation to seven other consortia groups representing other portions of the state.

65. California Advanced Services Fund: Annual Report January 2012 – December 2012, pp. 8. Issued April 2014, accessed 30 May 2014 http://www.cpuc.ca.gov/NR/rdonlyres/89829126-2099-4FB4-94CD-529E92F035CA/0/CASF2012AnnualReport.pdf

| Planning Entity | Upstate California Connect Consortium (UCCC) | Northeastern California Connect Consortium (NECCC) |
|---|---|---|
| Counties | Lake | Butte |
| | Sonoma | Modoc |
| | Glenn | Lassen |
| | Colusa | Plumas |
| | | Shasta |
| | | Siskiyou |
| | | Tehama |

**Table 4: Counties in Regional Planning Consortia**

### Evolution of the Golden Bear Broadband Proposal

Early in the planning process, CENIC and CSUC had a vision for a Northern California Regional Middle Mile Infrastructure (NCRMMI) project that would build new fiber backbones providing high quality service and redundancy to all counties participating in the broadband consortia. Figure 6 below is an image featured on an NECCC/UCCC hand-out describing how this Regional Middle-Mile Infrastructure project would be the base for all broadband expansion in the northern counties, eventually supporting publicly-planned county backbones from which last mile service would be provided.

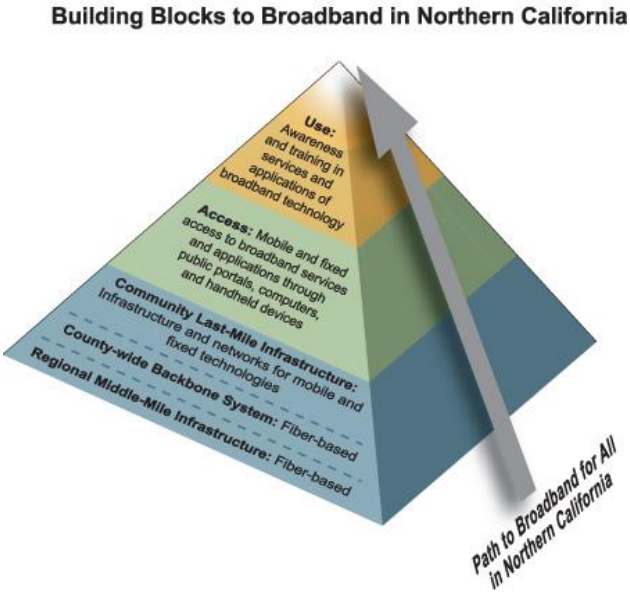


**Figure 6: NECCC/UCCC Strategy Hand-Out**

The plan was advanced as a solution to a perceived lack of access or capacity of existing middle-mile infrastructure throughout the Northstate. Planning around middle-mile infrastructure proved problematic: despite the advances in broadband availability mapping made by the CPUC as a result of the State Broadband Initiative, the mapping covered only last-mile services. To date, no federal or state mechanism exists that requires telecom companies to share the locations of their backbone infrastructure. Thus, the project proceeded with a murky view of existing middle-mile infrastructure – while some middle-mile operators such as Level 3 Communications happily shared their data and were interested in participating in the project, others, such as AT&T, refused to provide any information and would play an adversarial role for the remainder of the project's lifetime. Figure 7 shows the planning team's best idea of existing infrastructure as of Summer 2011when the NCRMMI vision was being advanced to gain public support throughout the northern Counties.

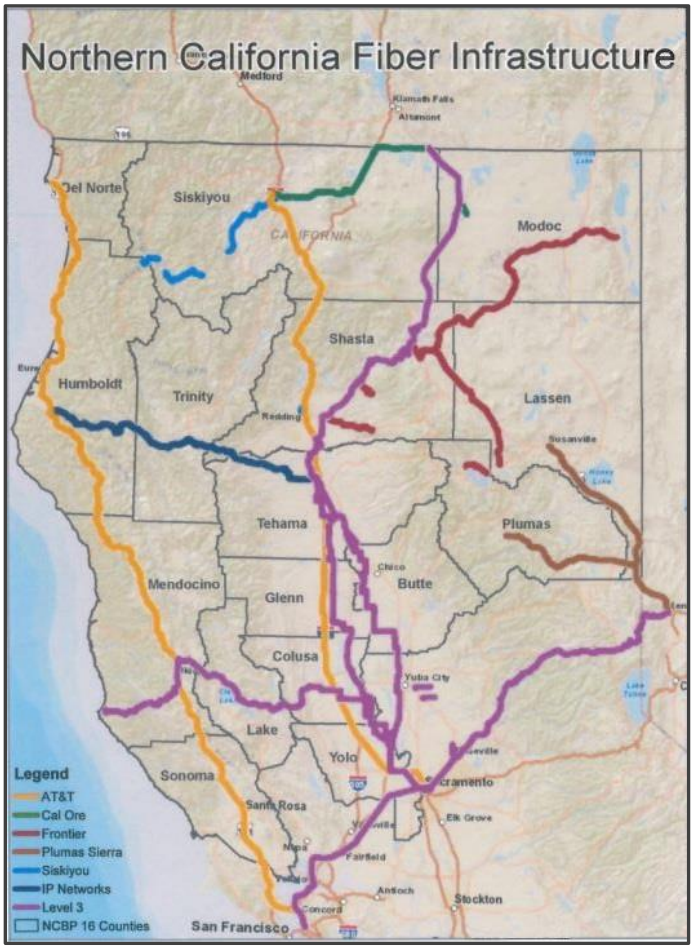


**Figure 7: Existing Fiber Infrastructure in Northern California; Summer 2011**

This map became very significant for the project's overall design as it shows an existing system of private infrastructure which follows a sort of hub-and-spoke pattern, with fiber backbones emanating from central points in Sacramento and the San Francisco Bay Area. While this type of spatial arrangement was likely the most cost

effective way for the network to develop, it also meant that many portions of the state lacked network redundancy. The planning team believed that an issue along AT&T's coastal route or along Level 3's Sacramento Valley route could leave hundreds of thousands of northern California consumers disconnected. This perceived deficiency lead the planning team to eventually create the 'redundant ring' approach embodied in the final iteration of the NCRMMI vision, shown below in Figure 8:

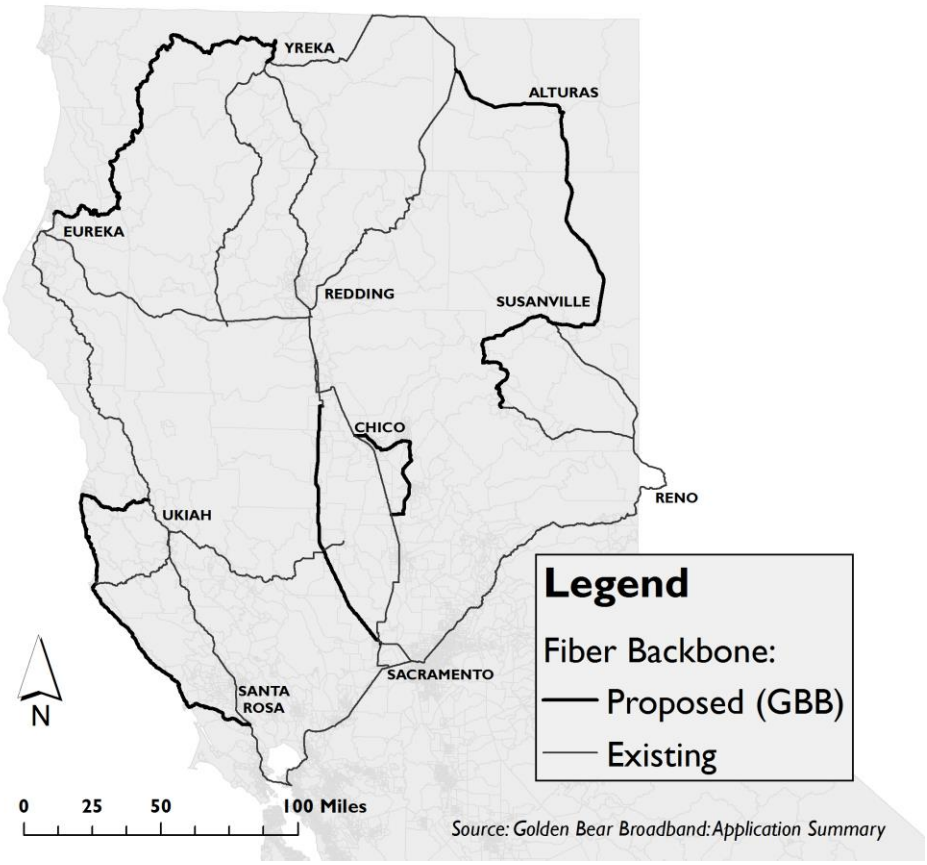


**Figure 8: Existing and Proposed Fiber**

The bold lines in Figure 8 show fiber middle-mile infrastructure that would either be owned and operated by Golden Bear Broadband or be leased from the co-operative existing telecom providers such as Level 3. This plan provided for increased redundancy for northern communities by connecting the northeastern portions of the state with existing fiber in Reno, and also providing more connections between the coast and the Sacramento Valley.

As the plan advanced, the program design underwent significant changes as a result of grant requirements and changing supporters. At this time, CASF applicants were required to hold a Certificate of Public Convenience and Necessity (CPCN), a certificate granted by the Commission to telecommunications providers who pledge to follow a strict set of guidelines allowing them to formally offer telecommunications services in the State of California. To satisfy this requirement, the planning team partnered with the Siskiyou Telephone company (Sis-Q-

Tel), which held a CPCN, and also offered much-needed private funding and a small amount of existing capital infrastructure in rural Siskiyou County that could be used as part of the application's private match when requesting funds from CASF.

The last-mile component of the project, long envisioned secondary to the overall plan, began to be fleshed out by the planning team once the middle-mile routes had been chosen. Identifying last-mile need was a more straightforward process due to the intensive data collection and mapping work performed by the CPUC, but the results of this work were at times challenged by members of the public as well as the planning team. As described in the literature review, the CPUC is tasked with collecting and distributing geographic data representing the service footprints and speeds of every internet service provider in the state. This data is provided in GIS form for public consumption and analysis, and can also be viewed by the general public without access to GIS software through an interactive online map. Figure 9 below shows a snapshot of served, underserved, and unserved areas in northern California taken from this online mapping tool.

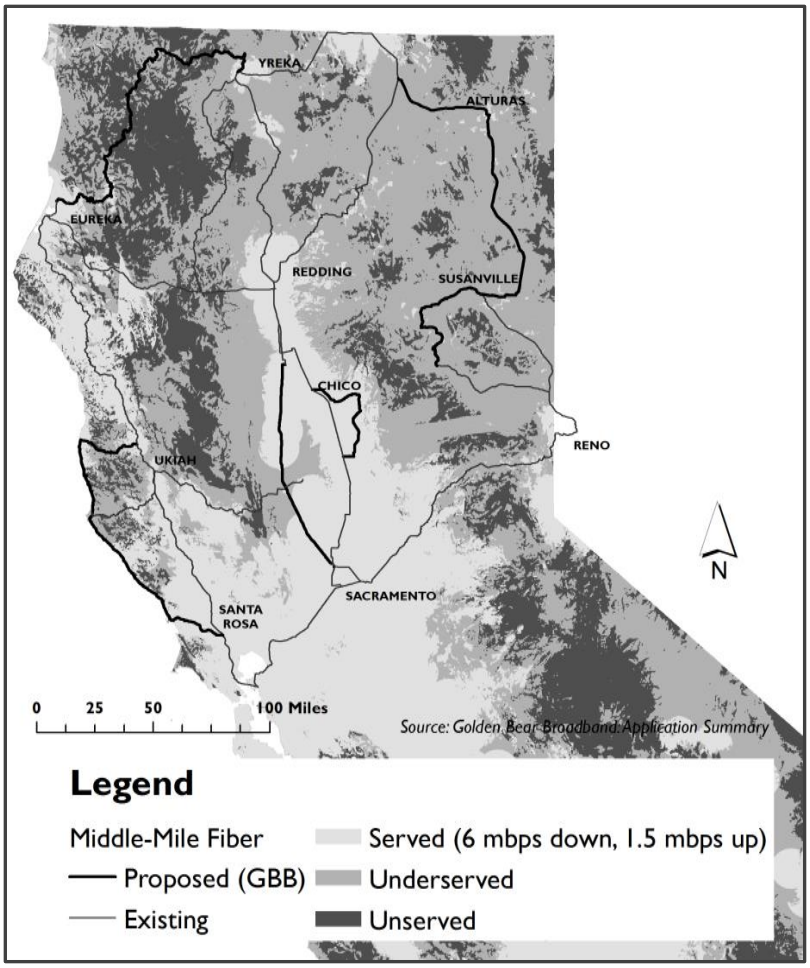


**Figure 9: Service Availability and Proposed Fiber**

As the CASF program exists to provide service to underserved and unserved areas, the availability information offered by these maps was crucial in the initial efforts to identify last-mile service areas that would be part of the Golden Bear proposal. The likelihood of the proposal passing would rely heavily on the amount of unserved and underserved households reached by the project. While the last-mile component of the project was designed primarily to reach the underserved and unserved areas identified by the Commission, as the planning team continued to receive public feedback, there was a growing perception that the service areas of some providers were being significantly overestimated. As the quality of the availability data began to be called into question, the planning team looked beyond just these availability maps in designing the project's layout.

The technology of the last-mile infrastructure funded by the project was initially intended to consist solely of fixed wireless towers, but a fiber-to-the-home component was included as a result of discussions with the Broadband Alliance of Mendocino County (BAMC). While Mendocino County was nominally a part of the Redwood Coast Connect Consortium, with separate planning efforts coordinated at Humboldt State University, representatives in Mendocino County began to feel alienated from Redwood Consortia planners and decided instead to endorse the NCRMMI vision advanced by the NECCC and UCCC. The BAMC worked with communities throughout the Mendocino and Sonoma County coasts to promote fiber-to-the-home as part of the Golden Bear proposal. These efforts culminated in an offer by the Sea Ranch Association of free right-of-way access through the community by Golden Bear in return for fiber-to-the-home throughout the community. The Golden Bear planning team accepted this offer and considered the donated right-of-way as part of its match in applying for CASF grant funds. The BAMC continued to play a vocal role in route planning for the remainder of the planning period.

By the end of 2012, the design of the Golden Bear Broadband proposal began to take its final shape. The NCRMMI middle-mile infrastructure would support last-mile service via fixed wireless broadcast towers through the Sacramento Valley and in the Sierra/Cascade foothills, and via a combination of fiber to the home and fixed wireless towers along the Sonoma and Mendocino county coastal areas. Figures 10 and 11 are internal planning documents produced in early 2013 for both of these segments of the application.

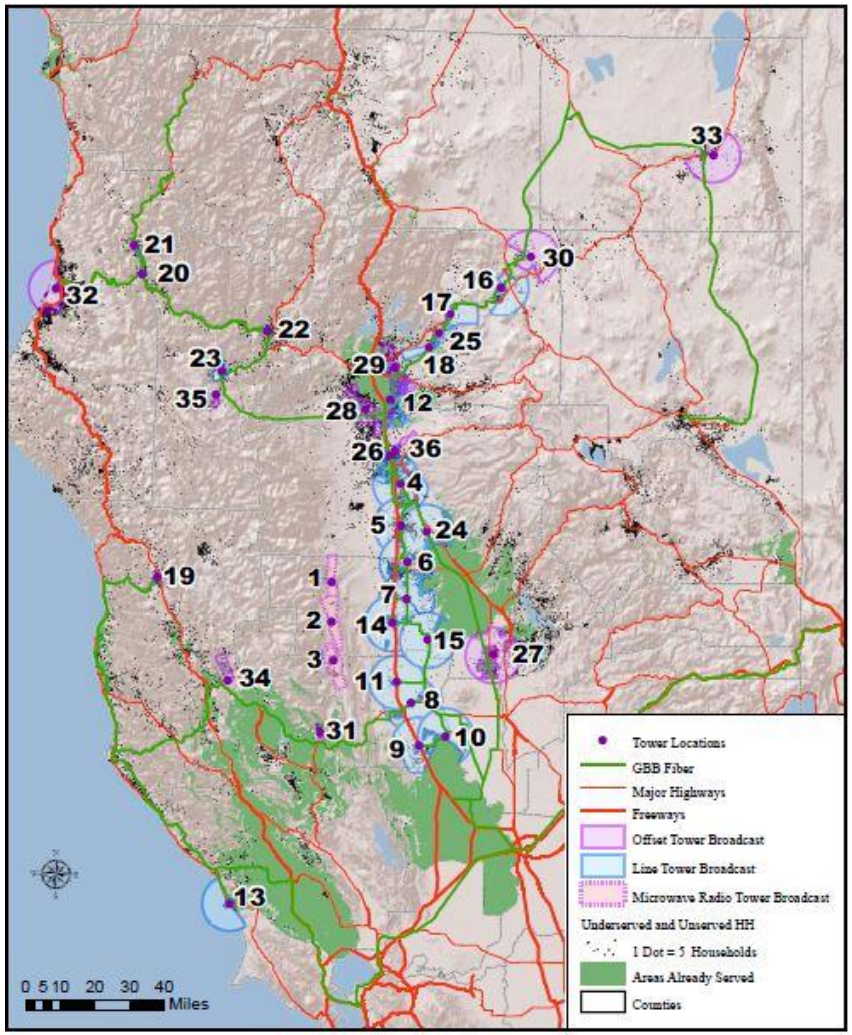


**Figure 10: GBB Last-Mile Component: Fixed Wireless Towers (inland)**


**Figure 11: GBB Last-Mile Component: Fiber to the Home (coastal)**

**Application Submission and Denial**

After the application was submitted in early 2013, numerous existing providers challenged the project, asserting that the project passed through many areas that were already served. Throughout the remainder of 2013, the planning team worked with CASF staff to address these challenges via design changes, building political support, and cutting costs.

In February 2014, The PUC denied the Golden Bear Proposal[66], citing the project's cost along with challenges from many incumbent providers. In the process of assembling this thesis, I asked staff from the PUC's Communications Division (consisting of the CASF team as well as other mapping and telecommunications experts) to provide a more detailed statement about the denial of the Golden Bear proposal. That statement is included below, in its entirety:

> The CPUC extensively reviews each application to ensure a fair evaluation for both the applicant and the challengers to proposed projects.
>
> In the case of the proposed Golden Bear project, its size, scope, and complexity, along with the seven challenges submitted by Internet service providers claiming they own infrastructure or offer service at "served" speeds in portions of the proposed project area, underwent significant CPUC review.
>
> Staff communicated extensively with Golden Bear personnel and other supporters. As part of this analysis, staff met in person with Golden Bear Broadband personnel on five occasions, also met with Golden Bear personnel via at least three scheduled conference calls, in addition to numerous non-scheduled phone calls and emails. Staff also met with last-mile providers in the region to discuss their last-mile capabilities and backhaul needs.
>
> Staff communicated in depth with each challenger. On July 24, 2013, staff conducted a site visit of AT&T's facilities in western Sonoma and Mendocino Counties.
>
> On August 20, 2013, staff met with Golden Bear Broadband personnel and supporters as part of a field visit that included stops in Mendocino, Occidental, and Point Arena.
>
> Staff concluded that a significant portion of the proposed project area replicated existing fiber-optic networks. Despite the existence of this infrastructure, staff noted a number of communities in the proposed Golden Bear project footprint remain unserved or underserved by last-mile providers, in some cases despite the presence of fiber interoffice transport facilities within those communities.

**The Complexity of Joint Action and the Decreasing Probability of Program Success**

Pressman and Wildavsky's detailed account of the failure of EDA's work programs in Oakland, described in the literature review, explores the failure of those programs by aggregating the key decision points in the program's

66. Written Statement provided by the Communications Division of the California Public Utilities Commission, 12 July 2014.

implementation. They find that even at very high success rates for individual agreements, the sheer number of cumulative agreements that the project was dependent upon virtually guaranteed program failure. Once agreements were made between participants in the project, the project could not change even as the political landscape and on-the-ground-realities in Oakland demanded a different approach. The planning process for the Golden Bear Broadband proposal can be seen in much the same way. Table 6 below summarizes key decisions and agreements in the planning process, in a format borrowed from Table 7 in Pressman and Wildavsky's "Implementation".[67]

| | Key Decision Points | Participants Involved | Cumulative # of Agreements |
|---|---|---|---|
| **1** | CPUC uses ARRA funds to create Regional Broadband Consortia account to support regional planning for CASF and other grants | NTIA, CPUC | 2 |
| **2** | CENIC and CSUC decide to partner to apply for Broadband Consortia Funds | CENIC; CSUC | 4 |
| **3** | CENIC/CSUC form the Northeastern California Connect Consortium (NECCC) | CENIC/CSUC, Counties of: Butte, Lassen, Modoc, Plumas, Shasta, Siskiyou, Tehama | 11 |
| **4** | CENIC/CSUC form the Upstate California Connect Consortium (UCCC) | CENIC/CSUC, Counties of: Colusa, Glenn, Lake, Sonoma | 15 |
| **5** | Northern California Regional Middle Mile Infrastructure (NCRMMI) plan, covering sixteen counties, becomes NECCC and UCCC's candidate for funding | CENIC/CSUC, NECCC, UCCC | 18 |
| **6** | Partnership with Sis-Q-Tel to obtain CPCN (providing grant eligibility) and existing infrastructure (providing required 5% match) | Sis-Q-Tel Wireless, CENIC/CSUC | 20 |
| **7** | Agreement with Level 3 Communications to use existing middle-mile infrastructure in Sacramento Valley as part of the NCRMMI project | Level 3 Communications, CENIC/CSUC | 22 |

67. Pressman and Wildavsky, *Implementation*, pp. 103

| | | | |
|---|---|---|---|
| **8** | Addition of Mendocino County into project area; county officials felt left out of Redwood Coast Consortia planning efforts | CENIC/CSUC, NECCC, UCCC, Broadband Alliance of Mendocino County (BAMC) | 26 |
| **9** | Decision to include last-mile component along with NCRMMI plan, offer service as Golden Bear Broadband via fixed wireless towers in the Sac. Valley and fiber-to-the-home along the Rte 1 Corridor | CENIC/CSUC (Now referred to as GBB Planning Team) | 27 |
| **10** | Agreement with PG&E to lease space along high-tension line corridor from Santa Rosa to Jenner and north along Route 1 Corridor | GBB Planning Team, Pacific Gas and Electric (PG&E) | 29 |
| **11** | Agreement with the Sea Ranch Community for free access to street right-of-way in return for fiber-to-the-home throughout the community | GBB Planning Team, BAMC, Community of Sea Ranch | 32 |
| **12** | Ability of GBB to meet project requirements according to CASF program guidelines | GBB Planning Team, CASF Program Administrators | 34 |
| **13** | Availability of CASF program funds, subject to continued ratepayer surcharge modified in SB 1040 | CASF Program, CPUC, California Legislature | 37 |
| **14** | **Final Decision by CPUC** | **CPUC** | **38** |

**Table 5: Decision Points and Cumulative Agreements**

Using the 14 decision points and 38 agreements described above, a probability of success can be calculated given various 'success rates' for each individual agreement. The results of this analysis are shown below in Table 7:

| Probability of Agreement on Each Clearance Point (in percent) | Probability of Success after 38 Clearances | No. of Agreements that Reduce Probability Below 50 Percent |
|---|---|---|
| 80 | 0.000792 | 4 |
| 90 | 0.0343 | 7 |
| 95 | 0.194 | 14 |
| 99 | 0.725 | 68 |

**Table 6: Probabilities of Success**

The table shows that even at an extremely high degree of success in agreements (99%), there is still only a 72.5% chance that the project will succeed. While in reality each agreement varies considerably in its overall importance to the project, the above table serves to highlight the complexity of the project overall – and its tendency to be unresponsive to change once the agreements have been made. The applications of these findings to future projects, and similarities and differences between this project and the EDA/Oakland work projects described by Pressman and Wildavsky, are discussed in the following chapter.

## 4.2 THE GOLDEN BEAR PROPOSAL

As part of its application for CASF funding, the Golden Bear Planning Team was required to submit the Census Block Groups representing the area that would receive last-mile service as a result of the project. Between the coastal fiber project in Mendocino and Sonoma counties, and the fixed wireless towers proposed to serve large swaths of interior northern California, the project in total promised to offer service to all or part of 1,085 Census Block Groups. This section summarizes demographics and service availability conditions in those areas.

Of the 1,085 Census Block Groups representing Golden Bear's project area, only in 205 of the block groups were a majority of households considered underserved or unserved by the Public Utilities Commission. In fact, 100 percent of households were considered completely served by the PUC in 592 block groups, just over half of the project area total. Figure 12 below displays the block groups representing the Golden Bear project area in two hatching patterns: a single hatch for those where less than half of the households were considered served, and a double hatch for those where more than half of the households were considered served at the time of the application.

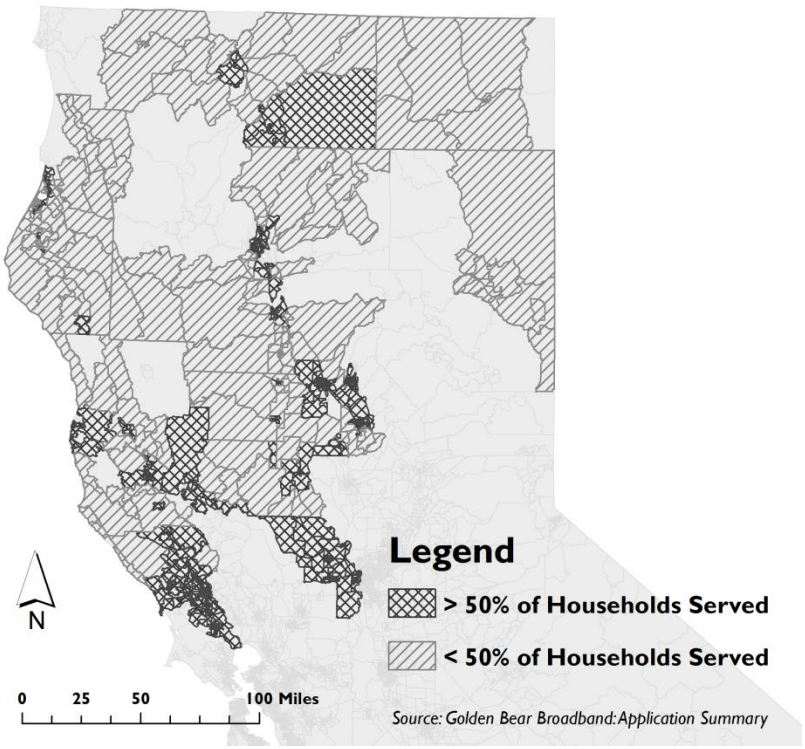


**Figure 12: Golden Bear Project Area Service Levels**

As can be seen, wide swaths of the project area (double-hatched areas) were already considered 50% or more "served" at the time of the application. The presence of such areas in the proposal suggests that project planners might not have been considering the CPUC's criteria for what constitutes "high need communities", or, they were forced to provide service to such areas as a result of the agreements made during the planning process. Table 7 illustrates this point further by comparing some demographic measures of the entire project area to those of only the single-hatched (high need) areas:

| | **All CBGs in Golden Bear Project Area** (Single + Double Hatched) | **CBGs in Golden Bear Project Area w/ 50% or fewer HHs 'Served'** (Single Hatch Only) | State Average |
|---|---|---|---|
| Median Household Income (2011 Dollars) | $52,303 | **$44,283** | $66,968 |
| Percentage of Population 18 or Over with a High School Diploma | 85.2% | **84.9%** | 79.9% |

| | | | |
|---|---|---|---|
| Percentage of Population 25 or Over with a Bachelor's Degree | 25.6% | **20.0%** | 29.5% |
| Poverty Rate | 15.8% | **17.0%** | 13.5% |
| Percentage of Population Speaking English "not well" or "not at all" | 4.6% | **3.9%** | 9.3% |
| Per Capita Income (2011 Dollars) | $26,328 | **$23,999** | $30,676 |

**Table 7: Comparison of Demographics Within GBB Project Area**

Examination of this table concludes that the truly 'high need' portions of the Golden Bear project area are high-need not only in terms of infrastructure access, but are also higher need than the rest of the project area *in terms of nearly every relevant demographic metric considered by CASF/CPUC*. Median household income in these block groups is more than $8,000 dollars less on average than the project area as a whole. More than 5% fewer college age adults have received degrees in these areas, and the poverty rate for these areas is more than a percentage point greater than that of the total project area.

While it is difficult to estimate the change in total project cost for a proposal that addressed only those block groups with 50% of fewer of their households served, it can be imaged that such a project would come out favorably compared to the Golden Bear Broadband proposal as submitted. Section 5.2 of the Discussion chapter postulates how such a proposal might have performed using CASF's grant scoring criteria. While this section has provided evidence to support my hypothesis that project design strayed from program objectives, the following chapter attempts to explain how the project planning process might have contributed to that outcome.

## 4.3 COMMUNITIES CURRENTLY SERVED BY CASF PROJECTS

As mentioned in the previous chapter, a total of 25 other last-mile projects had been completed using CASF funds by the time the Golden Bear Broadband application was submitted. These projects were much smaller in size, scope, and budget compared to the Golden Bear proposal, so it is important to reiterate that the purpose for

examining these projects is not to compare their cost-effectiveness to that of the Golden Bear project, but to better understand how CASF was meeting its policy goals before Golden Bear arrived on the scene.

The 25 last-mile projects completed by the end of 2013 received a combined total subsidy of nearly $7 million[68], out of the $159 million[69] collected by CASF for that same time period. Table 8 summarizes these 25 projects, and Figure 13, on the subsequent page, shows their locations. Note that project areas do not necessarily conform to Census Block Group boundaries.

| Project Name | CASF Funding Awarded | CBGs | Cost per CBG | Households | Cost per Household |
|---|---|---|---|---|---|
| Alpine | $95,919 | 2 | $47,960 | 381 | $252 |
| Alta/Blue Canyon | $56,628 | 4 | $14,157 | 236 | $240 |
| Birds Landing | $100,444 | 1 | $100,444 | 69 | $1,456 |
| Blanchard | $35,816 | 2 | $17,908 | 123 | $291 |
| Clovis | $30,077 | 2 | $15,039 | 125 | $241 |
| Comptche | $18,392 | 2 | $9,196 | 97 | $190 |
| Covelo | $54,000 | 2 | $27,000 | 300 | $180 |
| Crowley Lake | $286,398 | 2 | $143,199 | 450 | $636 |
| Del Norte | $68,168 | 4 | $17,042 | 313 | $218 |
| Easton | $49,869 | 2 | $24,935 | 9 | $5,541 |
| Grenada | $57,596 | 5 | $11,519 | 275 | $209 |
| Hopland | $61,952 | 2 | $30,976 | 328 | $189 |
| Laytonville | $54,000 | 1 | $54,000 | 500 | $108 |
| Livingston | $62,000 | 2 | $31,000 | 234 | $265 |
| Lodi | $137,416 | 2 | $68,708 | 35 | $3,926 |
| Mojave | $506,199 | 1 | $506,199 | 231 | $2,191 |
| Mt. Wilson | $2,420 | 1 | $2,420 | 15 | $161 |
| Pinyon | $174,000 | 4 | $43,500 | 382 | $455 |
| Poker Flat Project | $640,698 | 1 | $640,698 | 409 | $1,566 |
| Ponderosa - Auberry | $1,154,780 | 4 | $288,695 | 1043 | $1,107 |
| Prattville | $41,192 | 1 | $41,192 | 171 | $241 |
| San Bernardino | $168,761 | 3 | $56,254 | 3732 | $45 |
| Sea Ranch | $1,872,017 | 3 | $624,006 | 232 | $8,069 |
| Tranquility and W. Fresno | $1,154,495 | 4 | $288,624 | 585 | $1,973 |
| Warner Springs | $93,896 | 3 | $31,299 | 66 | $1,423 |

68. California Advanced Services Fund: Annual Report January 2013 – December 2013, pp. 3. Issued April 2014, accessed 30 May 2014 http://www.cpuc.ca.gov/NR/rdonlyres/4608A074-0A36-4E59-8BA1-E4D72E4512C7/0/CASFAnnualReport2013.pdfpp. 13-14

69. Ibid., pp. 10

| | | | |
|---|---|---|---|
| TOTAL | $ 6,977,133 | 60 | 10,341 |

**Table 8: Operational Last-Mile Projects using CASF Funds**

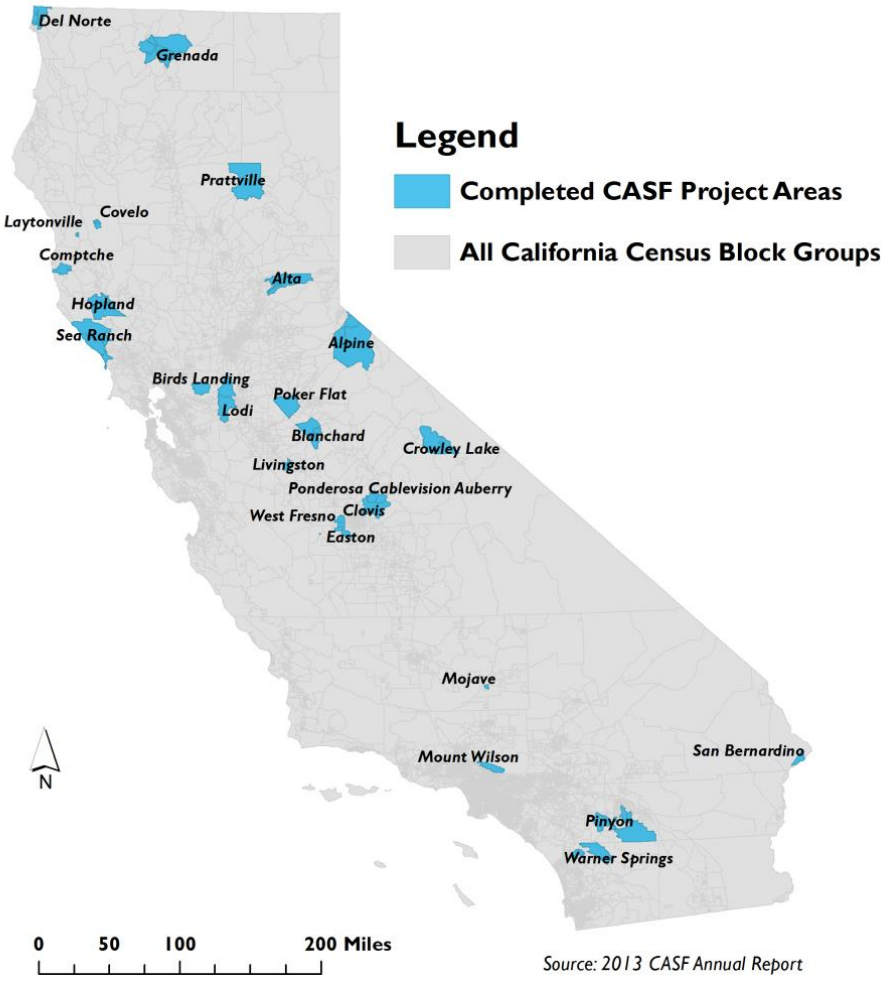


**Figure 13 – Locations of completed CASF last-mile projects**

The demographics of these project areas in some ways constitute "high need communities" when examining the metrics identified by the CPUC as being correlated with the Digital Divide.[70] The table on the following page shows how these metrics differ between project areas and state averages, with statistically significant variations (using a 95% confidence interval) marked with an asterisk.

70. CASF Application Tool Statewide Raw Data (Round 6 Data as of 06/30/12), CASF Infrastructure/Loan Account, CPUC http://www.cpuc.ca.gov/PUC/Telco/Information+for+providing+service/CASF/CASFGrantLoan.htm, accessed 12 May 2014

| | CASF Project Areas | | Non-Project Areas | | Correlation Coefficient | Significant? (95%) |
|---|---|---|---|---|---|---|
| | *Mean* | *Std. Dev.* | *Mean* | *Std. Dev.* | | |
| Median Household Income (2011 Dollars) | **$55,686*** | $25,694 | **$66,968** | $34,912 | -0.016 | ***Yes*** |
| Percentage of Population 18 or Over with a High School Diploma | **83.6%** | 15.4% | **79.9%** | 18.9% | 0.009 | ***No*** |
| Percentage of Population 25 or Over with a Bachelor's Degree | **19.9%*** | 13.4% | **29.5%** | 21.5% | -0.022 | ***Yes*** |
| Poverty Rate | **13.9%** | 12.6% | **13.5%** | 13.1% | 0.002 | ***No*** |
| Percentage of Population Speaking English "not well" or "not at all" | **5.5%*** | 8.7% | **9.3%** | 11.2% | -0.016 | ***Yes*** |
| Per Capita Income (2011 Dollars) | **$29,478** | $18,449 | **$30,676** | $19,461 | -0.003 | ***No*** |

**Table 9 – Comparison of Demographics of Project Areas and Non-Project Areas**

Do project-receiving areas represent "high need communities" when compared to the rest of the state? The answer appears to be yes, but not in all cases. While median household income in project-receiving areas was significantly lower than the rest of the state, both the poverty rate as well per capita income were not statistically different than state averages. Residents of project-receiving areas were less likely to hold a college degree than their counterparts statewide, but did not differ significantly in terms of high school graduation rates. Finally, project-receiving areas had significantly fewer residents who lacked in English comprehension.

After examining these first projects, it can be concluded that CASF has had some success in targeting communities which may be thought of as "high need" in terms of their income and education rates, beyond simply a basic lack of high speed infrastructure.

# 5 DISCUSSION

This chapter provides some context and offers some thoughts about the Golden Bear planning process, final proposal, the CASF program, and the future of subsidization of internet service.

## 5.1 GOLDEN BEAR AND THE FUTURE

As the largest proposal for CASF funding in the program's history, Golden Bear Broadband's planning process and final design can tell us much about the efficacy of the CASF program and its likelihood of future success or failure. This section of the discussion attempts to understand Golden Bear Broadband's flawed proposal against the backdrop of implementation literature discussed in Chapter 2.

The planning process for Golden Bear Broadband appears to have fallen victim to a multitude of 'implementation games', with a final program design that was flawed from the perspective of the funding agency, yet immovable by the time the application was submitted in 2013. Unlike CASF's first 25 projects, Golden Bear's project area as defined by the planning team did not stand out as particularly low income or even particularly high need in terms of service availability, due to the inclusion of large amounts of area where service had already been provisioned by existing firms (see Figure 12 and Table 9). The application started as simply a middle-mile infrastructure project, but experienced a major shift in goals when the last mile fiber and fixed wireless components were added to the project months before it was submitted in order to receive broader appeal from the PUC. Finally, the pattern of the final program design suggests that factors other than the "high need" status of communities went in to the design of the project's proposed service area.

One can draw parallels here between the failure to implement a grant-winning plan and the failures of implementation described by Bardach. As in the EDA's Oakland projects, a multitude of agreements between agencies and private corporations severely reduced the ability of the plan to adhere to its original mission – serving high need communities. As in HUD's failed New Towns projects, failures in coordination and bargaining between governmental organizations, such as Mendocino County's late-game decision to join the project, remained unpredictable variables throughout the project. Unfortunately, unlike in the case of the implementation of the L-P-S mental health reforms, this project had no "fixer" with the tools necessary to steer the project back on course when it should have been clear that the project would not be awarded grant funding.

Before dismissing the Golden Bear effort as a 'failure', it is worth discussing the legitimate accomplishments of the Golden Bear project. Importantly, the planning effort for Golden Bear Broadband produced a preliminary estimate of what it might actually cost to build sufficient middle-mile infrastructure to provide universal, reliable service in far northern California. Due to unique conditions in every communications market, it would be nearly impossible to estimate the costs of building such a network without actually performing the work of bargaining with all parties

involved. An article by Howard Shelanski (included as a chapter in Crandall and Alleman's *Broadband*) about the idiosyncratic cost structure of providing broadband services illustrates this point. The average prices of building or leasing bandwidth on middle-mile fiber loops, writes Shelanski, appears to have no basis in population density or other variables that one might expect to have some influence on cost. "It seems most improbable that these price differences can be explained entirely by cost differences," writes Shelanski, "the more likely explanation is that rate setting is an extremely delicate exercise."[71] An exercise presumably based on unknown information, uncertainty, and organizational structure – in other words, transaction costs. By carrying out much of the bargaining that would have been necessary to implement the project, the Golden Bear planning team has amassed a great deal of asset and firm-specific information and made crucial stakeholders aware of the public interest in expanding capacity and access across rural regions of the Northstate. It is hard to imagine a scenario where future service planning efforts, be they public or private, subsidized or unsubsidized, would not be helped by the information collected and the groundwork laid by the Golden Bear planning team.

Beyond the valuable information the project's planning effort produced, the Golden Bear project itself also served as the common vision that unified diverse interests into one common conversation. For the first time, the project brought county governments, community anchor institutions, and private sector representatives together to talk about the shared goal of increased about broadband access throughout the Northstate. This is just the sort of planning capacity the Regional Broadband Planning Consortia funding was intended to build. Golden Bear's rejected program design can now serve as the template to be improved upon in for future public efforts, and the planners of potential future projects now have a script to follow in negotiating with existing service providers, government agencies, and local communities.

## 5.2 CASF'S FIRST 25 PROJECTS IN PERPSECTIVE

As of Summer 2014, CASF has funded $7 million in grants to internet service providers in order to provide service to 10,341 formerly unserved households – an average subsidy of $675 per household. The income characteristics of the areas served so far by the program are not very different from those of California as a whole. While the median household income of these areas was significantly lower than the statewide average, the poverty rate and per capita income were not (see Table 9). Looking at these first 25 projects alone, it can be concluded that the CASF model is able to extend service to previously unserved households at a modest cost. However, in context, these successes begin to appear more muted.

First, the size and scope of these projects is limited. Of 25 project areas, all but 4 served areas of 500 households or less. A deeper examination of funding recipients reveals that the majority of funding recipients were well-established providers: 10 projects were awarded to AT&T (Alta, Blanchard, Comptche, Clovis, Easton, Grenada,

71. "Howard A. Shelanski, "Competition and Regulation in Broadband Communications," in *Broadband,* Alleman and Crandall (Washington DC: Brookings Institution Press, 2002), 183

Hopland, Lodi, Mt. Wilson Warner Springs), 6 to Frontier (Birds Landing, Livingston, Prattville, Alpine, San Bernardino, Del Norte), and 3 to Verizon (Pinyon, Sea Ranch, Crowley Lake).[72] These small projects were likely the 'low hanging fruit' for the program - where the availability of CASF funding was just enough to make the investment in these unserved pockets look attractive to nearby providers, with little to no public planning involved in the investment. The fact that over 90,000 households still lacked fixed broadband access at the beginning of 2014[73] suggests that the markets in those still-unserved areas are sufficiently thin that significant public organization will need to take place to plan for service expansion.

Second, the areas receiving CASF's first 25 projects were not uniformly "high need communities." While the absence of a fixed broadband service of 200 kbps in either direction is the main criteria used by CASF, demographic measures such as income and educational attainment are also factors in the decision-making process coded in the CASF enabling legislation. From a Rawlsian and infrastructure equity perspective, public investment ought to help first those areas with significantly lower incomes before addressing more middle-income areas. As the next two sections explore, this issue of neglecting the truly high-need communities is a theme present in the Golden Bear application as well as in the CASF program's overall design.

## 5.3 TAKING A STEP BACK: RE-EXAMINING THE CASF STRATEGY

At this point in the discussion, we have taken for granted that expanding broadband internet to high-need communities is an appropriate government intervention. I argue that this intervention is based on many factors, most importantly 1) the nature of broadband as a merit good, 2) the tendency for utilities to develop into natural monopolies, stifling growth opportunities for competing firms, and 3) an equity interest in providing equal opportunity to all Californian households, even in remote locations.

However, the mechanism by which this intervention is achieved in the CASF program is a particularly peculiar form of cross-subsidy. Recall from the literature review that the CASF program is funded by a variable surcharge on mobile phone users' monthly bills. The cross-subsidy relationship enshrined in CASF is thus one where mobile phone users subsidize rural homeowners. In a world where mobile phone use is considered a luxury (as it indeed was not many years ago), this might make sense from an equity standpoint. However, recent trends identified by the Public Policy Institute of California suggest that a growing segment of California's population might actually be

72. California Advanced Services Fund: Annual Report January 2013 – December 2013, pp. 3. Issued April 2014, accessed 30 May 2014 http://www.cpuc.ca.gov/NR/rdonlyres/4608A074-0A36-4E59-8BA1-E4D72E4512C7/0/CASFAnnualReport2013.pdf pp. 13-14

73. California Public Utilities Commission: "State of California Fixed Broadband Availiability as of December 31, 2013", accessed 02 October 2014, http://www.cpuc.ca.gov/PUC/Telco/Information+for+providing+service/Broadband+Availability+Maps.htm

using mobile phones as their primary internet connection. This segment of the population tends to be less wealthy, and less white, than their counterparts, according to PPIC's 2013 report. According to the PPIC, "Latino (60%) and lower-income cell-phone Internet users (55% with incomes under $40,000) are far more likely than whites (22%) and higher-income residents (20% with incomes of $80,000 or more) to say they use mostly their phones to go online."[74] To the extent that these users' mobile data plans are more expensive than the average bill due to greater usage, these populations are actually paying a greater share of their income into the CASF program than the average Californian. This raises the possibility that some of California's most disadvantaged communities are disproportionately subsidizing the provision of a service – residential fixed broadband - from which they will not benefit.

Another critique of the CASF program is its focus on promoting *access* over promoting *adoption*. The most recent California Broadband Reports produced by the CPUC show very low rates of household broadband adoption in inner city urban areas of Los Angeles and the San Francisco Bay Areas.[75] High speed internet service is ubiquitously available in these areas, yet residents in the area have not adopted the service, whether due to lack of income or lack of interest. No matter the ultimate cause, income, education level, and English language speaking ability have all been shown to be highly correlated with broadband adoption rates in urban areas. CASF, a program aimed at expanding *access*, not *adoption*, does not address the needs of these areas. If the purpose of the public intervention is to increase the availability of the internet in the home, then perhaps subsidies toward purchasing a subscription might be as appropriate as subsidies for rural network expansion.

The distinction between access and adoption gets to the very core of equity planning. A re-examination of Beatley's review of equity planning reminds us that issues of equity are often defined in terms of 'equality of opportunity' and 'equality of outcomes'.[76] I propose that broadband policies which promote broadband *availability* appeal to notions of 'equality of opportunity', while policies which promote broadband *adoption* appeal to less popular notions of 'equality of outcomes'. The plight of a household located in a rural area where no high speed service exists suggests a fundamentally different playing field in terms of opportunity than the plight of a household in an inner urban area with ample service availability, even if the *outcome* is that they do not subscribe to the service. Such perceptions are likely also colored by traditional conceptions about rural versus urban life. Put simply, the rural homeowner who lacks broadband access is more palatable to the public as a justification for public intervention than the unconnected urban dweller, even if the urban dwellers comprise the overwhelming majority of Californians who find themselves on the wrong side of the 'Digital Divide'. The CASF program might better achieve the program's goal of serving high-need communities by expanding the definition of "high-need communities" to those where broadband already exists, but residents are not able to afford it.

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74. "Big Gains in Californians' Use of Cell Phones, Tablets to Go Online," Public Policy Institute of California. Accessed 02 October 2014, http://www.ppic.org/main/pressrelease.asp?i=1376
75. Ryan Miller, Amy Lippus, and Alyssa Caldwell, *California Broadband Report: A Summary of Broadband Availability and Adoption in California as of June 30, 2011* (California Public Utilities Commission White Paper): 16-17
76. Beatley, "Equity and Distributional Issues in Infrastructure Planning," 215

# 6 CONCLUSION

This thesis examined the Golden Bear Broadband proposal for subsidized middle-mile and last-mile internet connectivity throughout rural northern California and evaluated the California Advanced Service Fund (CASF), the state agency that subsidizes internet infrastructure projects in California. Returning the research question - *how does the planning process for CASF projects affect the program's goal of serving high-need communities?* - this evaluation shows that it creates a system that may work well to serve the 'low-hanging fruit' of unserved households easily accessed by existing providers, but has not yet had success in funding large-scale projects that will be needed to close California's digital divide. While the project should not be considered a failure, the rejection of Golden Bear Broadband's application for CASF funds is an example of how crafting a project to satisfy the demands of all involved parties may cause program design to stray from its initial goals.

### Policy Recommendations

This thesis finds that California policymakers may wish to reform or replace the CASF program out of concerns for equity and the changing nature of the "digital divide". As growing numbers of lower income and minority Californians access the Internet primarily on mobile phones, the program's reliance on a mobile phone tax is becoming increasingly inequitable. Further, CASF or any future state efforts at promoting Internet access must begin a more concentrated effort toward growing adoption of broadband internet, not just expanding its availability. The decision to move toward subsidizing adoption will require robust debate about the State's interest in promoting equal outcomes (universal broadband adoption) on top of equal opportunities (universal broadband availability).

### Ongoing Efforts in northern California

As of fall 2014, efforts are already underway to implement smaller scale projects that approximate individual portions of the Golden Bear Broadband proposal. Proponents of expanded service along the Sonoma/Mendocino coast have joined forces with representatives of Marin and Napa counties to form a new regional broadband planning consortia representing counties north of San Francisco Bay.[77] The newly formed North Bay / North Coast Broadband Consortia is currently contracting with CSUC to develop a series of last-mile applications to CASF in a number of priority communities. Those interested in the effectiveness of CASF in bringing broadband to high need commnuities of the Northstate and/or in the legacy of the Golden Bear Broadband proposal should monitor the progress of this and other smaller efforts underway as of publication time.

77. "North Bay / North Coast Broadband Consortium", the Mendocino County Broadband Alliance. Accessed 28 November 2014, http://www.mendocinobroadband.org/nbncbc/

**Suggestions for Further study**

Any researcher interested in public involvement in closing the "digital divide" should monitor the progress of the CASF program and study its effects after the fund has delivered all the projects it intends to deliver. While my focus on the case study of Golden Bear Broadband and the policy backdrop of the California Advanced Services Fund provides an abundance of study material in terms of policy, planning, and implementation, it is still only a single proposal to one policy program in one province of one country. Public involvement and interest in Internet infrastructure planning appears to be on an upward trajectory both in the United States and abroad, and closing the "digital divide" may be one of the biggest urban planning efforts in this century. My study is limited in scope and does not compare the policies California is pursuing to those that any other state or nation is pursuing. There remains a great demand for comparisons of various policies and/or projects that compare the equity dimensions of *who pays* and *who benefits* for such networks. With or without the attention of planning professionals and academics, these projects are underway and are set to transform the way we connect with our world.

# 7 GLOSSARY

The following lists define technical terms relevant to high speed internet, and list the various state and federal agencies involved in the implementation of the CASF program.

**Relevant Terms:**

*Broadband Adoption* – the ratio of subscribers to potential end-users in a geographic area.
*Broadband Availability* – the presence or absence of broadband internet in a geographic area.
*Fixed Wireless (broadband technology)* – technology that transmits broadband internet wirelessly; requires that end-user have a receiver.
*Kbps* – Kilobits Per Second
*Last-mile (infrastructure)* – the portion of a network that connects the end user to a higher capacity backbone
*Middle-mile (infrastructure)* – the high-capacity portion of a network that connections regions
*Mbps* – Megabits Per Second

**Government Agencies/Programs:**

ARRA – American Recovery and Reinvestment Act
BAMC – Broadband Alliance of Mendocino County
CASF – California Advanced Service Fund
CETF – California Emerging Technology Fund
CENIC – Corporation for Educational Network Initiatives in California
CPUC – California Public Utilities Commission
CSUC – California State University, Chico
CED – Center for Economic Development at California State University, Chico
GBB – Golden Bear Broadband
GIC – Geographic Information Center at California State University, Chico
FCC – Federal Communications Commission
NECCC – Northeastern California Connect Consortium
NTIA – National Telecommunications Information Administration
UCCC – Upstate California Connect Consortium