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THE PERCEIVED IMPACT OF MUNICIPAL WIRELESS BROADBAND NETWORKS ON THE DIGITAL DIVIDE: A TALE OF FIVE CITIES

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ABSTRACT

The single pervasive theme of the 21st century has been decided: bridging the digital divide. A common belief is that simply delivering information and communication technologies (ICT) to communities lacking access to and skilled use of technology will suffice. Often solutions are developed without adequate consultation with the local community, leading to a design-reality gap. This dissertation examines the extent to which the use of ICTs like wireless mesh broadband via government-led deployments can conquer the digital divide.

Recently, public elites have decided to design, develop and implement city-wide wireless broadband networks (Mu-Fi) all while offering a cornucopia of benefits. Such benefits generally fall into three broad categories: promoting economic development, enhancing governmental services and narrowing the digital divide. While municipalities, with their provision of Wi-Fi public access, have the desire to make their citizens feel more included in the Information Society, these municipal actions have provoked a flurry of responses from concerned constituents, including Incumbent Local Exchange Carriers (ILECs), state legislators and the U.S. Congress. As armed rhetorical camps, both private and public elites are aggressively pushing their own agendas forward with little to no scientific evidence to support their claims. The debate is largely framed in polarizing terms: one side is imbued with a halo of positivism, the other with negativism. In this light, the purpose of this dissertation is to examine the impact of Mu-Fi on the digital divide, and thus contribute scientifically to the discourse. Specifically, I am interested in investigating how network aggregate indicators (NAI) affect quality-of-life aggregate indicators (QoLAI), and thus, mitigate the so-called digital divide. The main research question driving this study is: *Does a municipal wireless broadband network have a perceived measurable impact on the digital divide?*

This study adopts the term t*echnological enthusiasm* by drawing on several theoretical frameworks to inform this research. It is important to utilize multiple theories to account for the complexity of human nature and diverse perspectives when investigating the role municipal wireless systems play in promoting digital inclusion. Using qualitative methods, multiple case study research approach, several data sources from five U.S. Cities were used. The analysis aims to present an inter-disciplinary and holistic vision of Mu-Fi vis-à-vis a very complex, dynamic and evolving digital divide. By doing so, the author attempts to dispel (or promote) what the public perceives as a need and what public officials see as convenience and necessity. Specifically, data from these cities was used to evaluate the impact on the digital divide. The results from these data sets were compared in order to explore whether the relationship between NAI and QoLAI had an effect on the digital divide and if this effect varied across different organizational settings. The findings will show if these cities have failed or succeeded in achieving their digital divide objectives.

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ACRONYMS AND ABBREVIATIONS

ACS.....American Community Survey
CoP ..... Communities of Practice
FBI..... Federal Bureau of Investigation
FCC .....Federal Communications Commission
GIS..... Geographical Information Systems
ILEC.....Incumbent Local Exchange Carrier
ICT..... Information and Communication Technologies
IS.....Information Society
IT .....Information Technology
MCB ..... Mad City Broadband
Mu-Fi..... Municipal Wireless or Municipal Broadband Wireless Networks
NAI ..... Network Aggregate Indicators
QoLAI..... Quality of Life Aggregate Indicators
RFP.....Request For Proposals
SCOT..... Social Construction/Shaping of Technology Theory
TE ..... Technological Enthusiasm
US..... Universal Service
USCB..... United States Census Bureau
Wi-Fi..... Wireless or Wireless Fidelity
WISP.....Wireless Internet Service Provider

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CHAPTER 1: INTRODUCTION

1.0 Motivation

> Cities and counties throughout the country and around the world have begun to get it: Public wireless networks are an essential part of local quality-of-life and public-policy strategies.
> -- Esme Vos[1]

Aside from being a pretentious, non-scientific and biased remark, the above statement is open to question on at least three counts. First, information and communication technologies (ICTs) like municipal wireless broadband networks, and the uses to which they are put, are subject to social shaping and lend themselves to different possible outcomes. Second, it is unclear what constitutes a quality-of-life criterion. Third, the line between municipal wireless systems and universal service (i.e. public policy strategies) is blurry. The empirical evidence to support such a claim is simply not available. It is for this reason that the following research study was proposed. This study explores the role that U.S. government-led wireless broadband networks (i.e. Mu-Fi) play in alleviating the digital divide. Specifically, it focuses on describing various cities' complex processes of attempting to engage the digital divide, with minor impacts on quality-of-life measures via network aggregate indicators.

As we move further into the 21st century, several research communities are currently constructing definitions, analytical frameworks, and conceptual models to answer research questions raised by the digital divide (DiMaggio & Hargittai, 2002; Hoffman, D. L. & Novak, 2000; Kvasny, 2002; Kvasny & Truex, 2000; Kvasny L. & Trauth, Forthcoming; Norris, 2001; NTIA, 1999; Schement, J. & Forbes, 1999; U.S. Census Bureau, 2003). Some of these include, but are not limited to: What is the digital divide? What is morally good about bridging the digital divide? Is bridging the digital divide incontrovertible for furthering democracy and self-governance? How can we measure the digital divide over time? Concomitantly, there has been little in-depth analysis undertaken to ascertain if Mu-Fi systems are in fact efficient and sustainable endeavors in achieving digital divide goals as predicted by their proponents and public elites.

Increasingly, the Internet is becoming a cornerstone of American life, as much of the public, private, educational, and economic life of Americans have both online and offline components. As full participation in civic, commercial and social life is tied to Internet and computer literacy and access, high-speed access is becoming a necessity rather than a luxury (Tapia & Ortiz, 2006; Tapia, Stone et al., 2005). Some believe broadband

[1] Extract from CNet News.com Article, "City-wide Wi-Fi spending could hit $3 billion," 25 October 2006. http://news.com.com/2100=7351_3-6129655.html

infrastructure is vital for economic development, as well as for providing healthcare and government services, education and workforce training (Crandall, 2003; McLaren, 2002). Information technology has become central to our knowledge economy and is thus wedded to wealth, power, and prestige. People who have access to the Internet and the skills to use it are (1) more successful economically, with respect to education, jobs, earnings; (2) socially participate more in terms of political and civic engagement; (3) and receive more government services and other public goods than those who do not (Katz & Rice, 2002; Kennard, 2001; Oden, 2004; Tufekcioglu, 2003). The skills necessary to use information and communications technologies are not universally prevalent, yet seen as becoming more centrally necessary to navigate everyday tasks. Moreover, broadband adoption is highly dependent on socio-economic status (Ortiz & Tapia, 2006, *forthcoming;* Ortiz, Ulrich et al., *forthcoming*)**.** The gap between those who can afford broadband and those who cannot persists in the United States, despite growth in the total number of broadband connections (Turner, 2005; U.S. Census Bureau, 2003). The digital divide reflects ongoing social inequalities in the US, explained by both the lack of vision as well as entrenched social, economic and political systems (Bagasao, Macias et al., 1999).

In order to fill the gap, over 400 U.S. municipalities are stepping in to offer wireless broadband access, turning the top-down traditional means of supplying telecommunication service and policy on its head. Some of these cities are forming armed rhetorical camps, which promise an abundance of benefits such as digital inclusion, enhanced governmental services and economic development. Some believe these initial deployments, if successful, could provide the tipping point for a nationwide movement to make broadband affordable and accessible in every city. As a result, these municipal deployments have provoked a flurry of responses from concerned constituents, including Incumbent Local Exchange Carriers (ILECs), state legislators and the U.S. Congress. Incumbents are understandably expressing a number of concerns. Opponents argue that municipal broadband deployments compete unfairly against ILEC companies and undercut incentives for private infrastructure investments (Thomas, 2004). Nevertheless, municipalities have decided to enter the telecommunications realm because of the cost savings opportunities that new Wi-Fi technologies offer. In addition, these municipalities claim that Wi-Fi networks enhance economic development, provide additional tourism, support city services and personnel, and perhaps decrease the digital divide. In order to bridge the gap, cities are taking the mutated form of public-private partnerships and using the non-profit sector to provide low-cost equipment, training and service (Gillett, Sharon E., 2006).

Currently, there is no evidence that municipal broadband intervention directly results in a decrease in the digital divide (Gillett, S. E., Lehr et al., 2004; Thomas, 2004). However, a caveat needs to be spelled out immediately. As more and more cities are compromised, more and more public elites continue working, arguably misinformed, toward tempering the problem of the digital divide. Are municipalities really the savior or the ruin of the digital divide in the United States? Institutional Theory discusses the concept of mimetic isomorphism, whereby organizations embedded in the same or similar institutions adopt similar practices (Deephouse, 1996). This may explain the “explosive” growth of Mu-Fi

adoption as city governments see other city governments (who obviously share institutions) adopting Mu-Fi, thereby feeling compelled to implement Mu-Fi locally. The most difficult challenge of policy implementation remains on the horizon. Establishing effective and responsive federal, state and local legislation that furthers our free-market enterprise, while fulfilling the growing needs of consumers, will be quite a challenge in the 21st century. Specifically, testing the limits of competition in unbalanced markets and creating laws that promote economic development and universal service will require extremely informed and very competent policy makers and government officials. Interestingly, it is something of a paradox that the same technologies that are being glorified as providing the infrastructure for universal service and bridging the so-called digital gap may also be the vehicle for introducing greater societal disparities. It is in this context that this research becomes not only important, but necessary.

What is missing is an interdisciplinary and holistic approach that measures the impact of Mu-Fi on the digital divide. Hence, the goal of this dissertation is to fill that void by accomplishing this complex task. By doing so, this research study will scientifically contribute to the larger national discourse aimed at developing forward-thinking public policy. This dissertation is divided into the following sections:

Chapter Two includes an overview of Mu-Fi and a conceptualization of the phenomenon. It includes a quasi-historical account of government involvement in the delivery of telecommunication services, Mu-Fi stated goals, technological feasibility, business models, legislative status, as well as a discussion of the hopes and fears of Mu-Fi, from the very few empirical studies available.

Chapter Three includes a literature review on the digital divide and universal service. Chapter Four discusses the theoretical framework employed for this research study. Chapter Five presents the research strategy, methodology and data sources used in this study to explore the answer to the research question for a set of five Mu-Fi cities. In answering the research question of this study, this study explores the relationship between quality-of-life and Mu-Fi, as well as universal service and Mu-Fi. After establishing the nature of the relationship, the exploration will continue by establishing the importance of other factors such as social capital, public participation, privacy, information redlining, and so on, within the context defined in the theoretical section. It also describes the research plan in detail, such as project schedule, required resources, potential risks and barriers, as well as sponsors of this study.

Chapter Six presents a brief introduction of this study's results, including an overview of the five cities, a description of the themes unearthed during the interviews and the descriptive quantitative data. Chapters 7-11 describe the case study findings. Chapter 12 provides a synthesis across the case study chapters. Chapter 13 offers the qualitative analysis of the study. Chapter 14 includes a discussion and the implications of this thesis. The study concludes with Chapter 15, which highlights directions for future research and conclusions.

1.1 Research Aim & Motivation

The aim of this research is to investigate if municipal Wi-Fi actually has a perceived measurable impact on the digital divide. Specifically, the study describes a handful of cities' processes in attempting to engage the so-called digital divide, the complexity of that process and its impacts. The research question being addressed is: *Does a municipal wireless network have a perceived measurable impact on the digital divide?* The study focuses on the effects of qualitative network aggregate indicators (NAI) on quality-of-life aggregate factors (QoLAI) in the local community. The impact of municipal wireless broadband on the community is examined on a macro, organizational level of analysis.

The goal of this research is to investigate – on an organizational (city) level of analysis with societal implications, the particular ways that municipal Mu-Fis alleviate the digital divide in several communities. This dissertation hopes to make a contribution to the political and socio-economic zone of ambiguity, which currently characterizes the potential impacts of Mu-Fi systems. In doing so, this dissertation also reveals, (1) how the tumultuous sphere of Mu-Fi can be viewed using an interdisciplinary theoretical lens, (2) how Mu-Fi can be best understood in terms of different communities of practice or social worlds and how these differ / resemble one another, (3) key qualitative metrics that aggregate indicators on the digital divide, (4) the role of data in supporting (or dismantling) the frame created by public and private elites, and (5) the need for further socio-economic and political action.

In short, the aim is to undertake a pre-post test, multiple case study analysis evaluating five municipal wireless projects. The following cities were examined: Tempe, Arizona; Portland, Oregon; Corpus Christi, Texas; Federal Way, Washington; and Madison, Wisconsin. These U.S. cities were chosen because they have city-wide Wi-Fi networks deployed for at least 12 months, and have employed some form of public rhetoric linking project design, development, deployment or use to the digital divide and/or digital inclusion. This idea was inspired by a previous study, where a study was conducted using content analysis to examine the linkage between public rhetoric and digital divide arguments by public officials in 24 cities (Ortiz & Tapia, 2006).

1.2 Related Work

Little to no empirical evidence examines how ICTs become integrated in our socio-economic lives from a range of diverse perspectives regarding municipal wireless broadband networks (Lehr, W., Osorio et al., 2004). Although broadband technology is an area of research that has been investigated from various perspectives in health, sociology and labor studies, very few of these studies include the role of ICTs in a municipal context (Garvey, 2002; Jacobson, 1977). These studies tend to view technology as a black-box component with little to no discussion on the details of the artifact (e.g. the relationship between IT and the local community is not addressed) (Brown, Brudney et al., 1998; Goggin, Bowman et al., 1990). Conversely, a growing

number of social informatics studies examine the role of ICTs in a given social context (Benton Foundation, 1998; Graham, S., 2002; Liff & Steward, 2001; Uslaner, 2000).

Much of the research on the digital divide concentrates on physical access to the Internet (Bucy, 2000; Lentz, Straubhaar et al., 2000; Nielsen/NetRatings Enumeration Study, 2004; Sanderson, 2000). Others researchers see the divide as something more than digital; to them, the divide reflects pre-existing socio-economic and political disparities in society (Babb, 1998; Norris, 2001; Selwyn, 2003; Van Dijk & Hacker, 2003). In other words, the issue is not simply about connectivity, but about accessing, using and contributing to the Internet. Hargittai explicates what we know about inequality in access to and use of new digital technologies (Hargittai, 2002). Hargittai argues that a more thorough understanding of digital inequality requires placing Internet access in a broader theoretical milieu, and probing at a wider range about the impact of information and information technologies on social inequality. Pinkett argues that social and cultural considerations must be considered when looking for answers to digital-divide questions (Pinkett, 2000). Selwyn presents a theoretical exploration of the "digital divide," tracing its origins in the centre-left social inclusion policy agenda of the 80s and 90s, to its current status of political "buzzword" (Selwyn, 2003).

However, the area of municipal broadband has not yet fully been investigated or understood (Tapia & Ortiz, 2006; Thomas, 2004; Wiggins, 2005). Likewise, there is a growing amount of research investigating the issues of underrepresented groups in the research space of IT, but future research of the role of ICTs in a municipal broadband context would contribute to this discourse. Consequently, supplemental research from many perspectives is necessary to study the role of ICTs in the transformation of the nature of municipal broadband deployments, which will contribute to a better understanding of the long-term outcomes and consequences. Doing so requires the integration of concepts, constructs, theories, and methods to sustain and develop new interdisciplinary knowledge and information. Thus, this paper suggests a research study that fuses these disciplines, coupled with an in-depth investigation (statistical analysis and structured/semi-formal interviews) to understand the role of Mu-Fi systems in bridging the digital gap in a municipal broadband context. This research relies on a variety of diverse fields of research (see figure below).

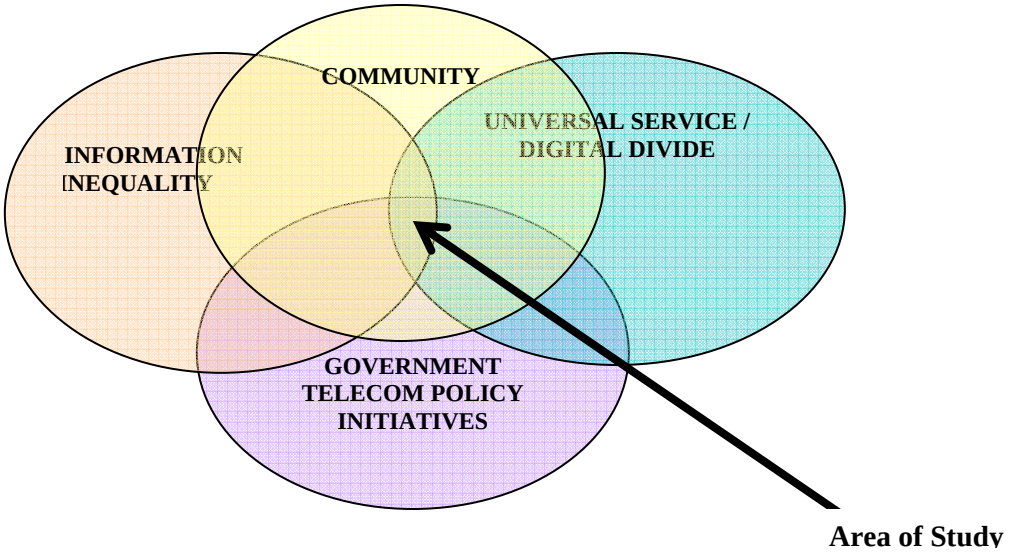


Figure 1: Proposed Research Study Space

The proposed area of study borrows from four disciplinary fields: telecommunications policy, social sciences, social informatics and science and technology research. At the intersection of these four fields is an interdisciplinary approach to a very complex and dynamic Mu-Fi sphere and digital divide phenomenon. Employing an interdisciplinary approach allows us to: 1) use methods and concepts from other fields, thereby creating a more "complete" dissertation that involves sociology, ICT, communications, etc.; 2) craft effective research design linking abstract concepts and questions with the empirical world's complexities; 3) challenge the often well-intentioned but flawed policy initiatives that impose technological solutions to perceived social problems (like the digital divide).

1.3 Research Design

In order to address this manifest need in the field, the results of the present research increase our understanding of how the design, use and deployment of municipal wireless broadband architectures can support (or not) digital divide arguments. In particular, this study provides insights on how qualitative network aggregate effect quality-of-life factors possibly reducing the digital divide at an organizational (city) level with societal implications (see Figure below).

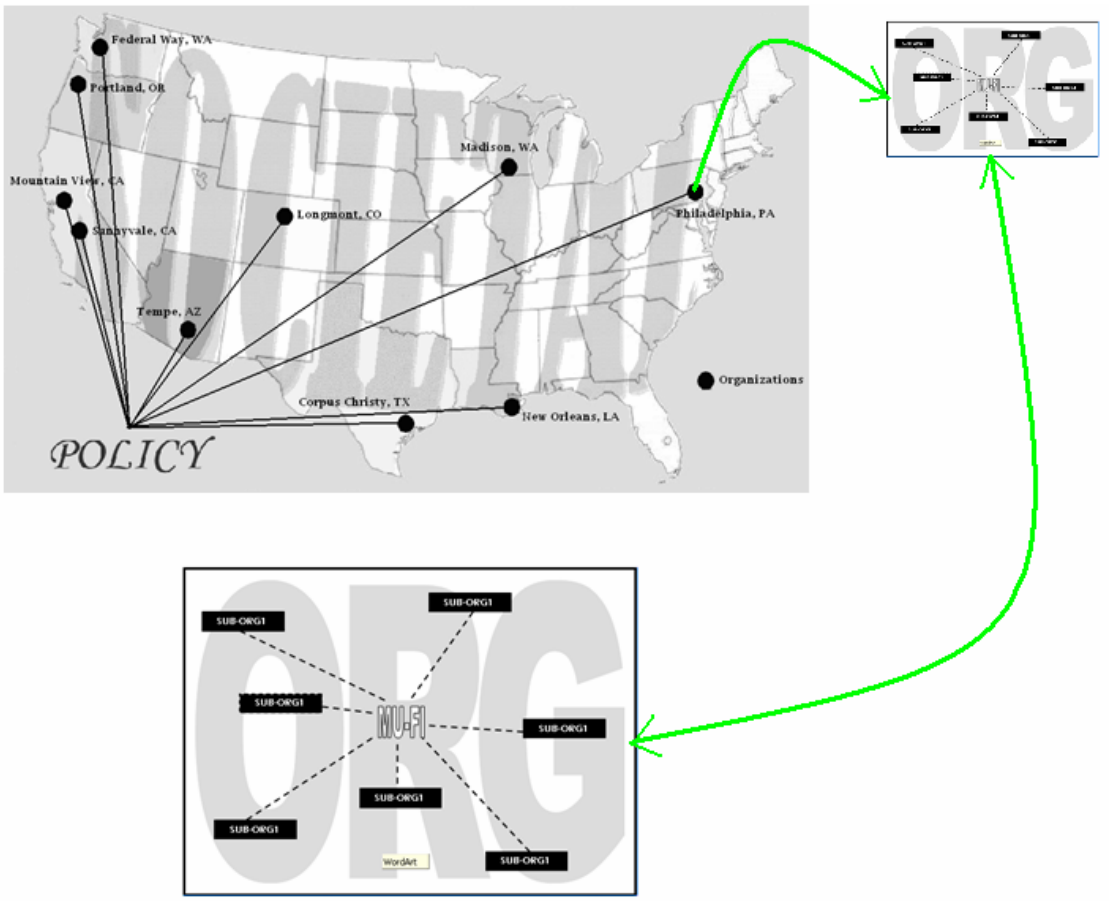


Figure 2: Societal/Organizational-City Level of Analysis

Considering the aim is to evaluate the success of several organizations and sub-organizations in reaching their digital divide goals, the research design is purely qualitative: The study employs this methods research design and evaluates how quality-of-life measures have been affected after the launch of the municipal network. Each city is evaluated to determine whether or not digital divide goals were achieved.

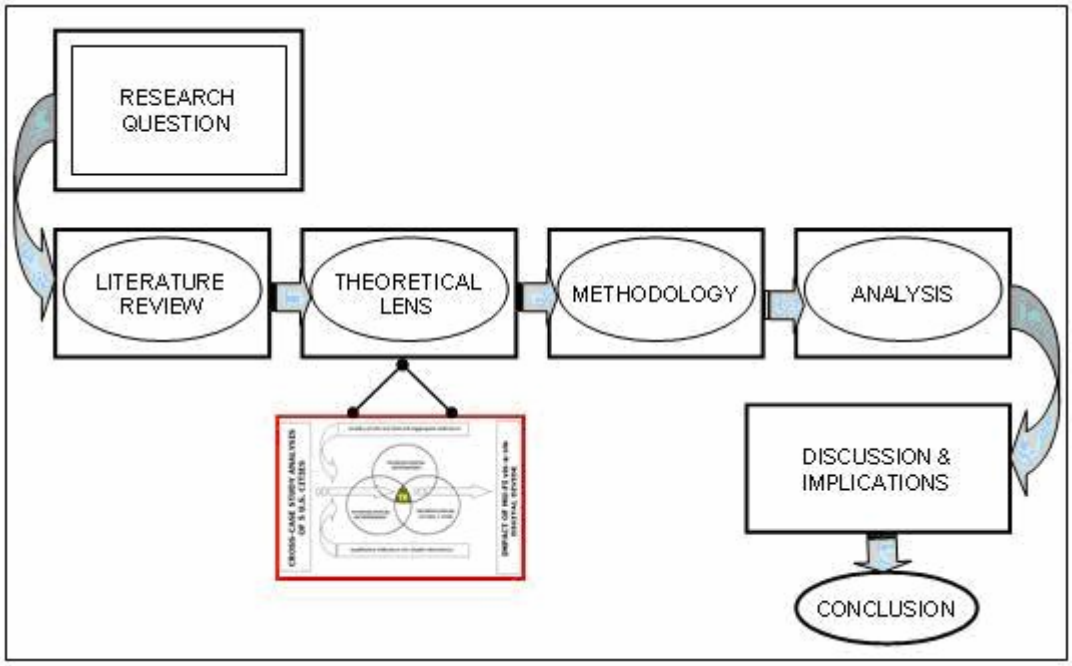


Figure 3: Research Design

The design is a qualitative evaluation of both quality-of-life and network-aggregate indicators. Qualitative data were collected only once. Qualitative evaluations are perceptual and attitudinal in nature. These qualitative indicators measure the "how" "when," "who" and "where" of this study. *Grosso modo*, the objective is to see how cities attempt to engage the so-called digital divide, and, thus, dispel (or promote) what the public perceives as a need and what public officials see as convenience and necessity. Ultimately, the study aims to understand if public elites were using the digital divide rhetoric as an excuse to build their systems.

For the theoretical basis, this dissertation draws on substantive-autonomous-deterministic theories, while adopting the term *technological enthusiasm*. First, the theory serves as the initial theoretical backbone of this research for discussing how utopian-deterministic philosophies are embedded in technologies like Mu-Fi, which shape how public elites deploy them and how people use them. Secondly, in assessing Mu-Fi networks as a tumultuous sphere, the focus is on understanding how different participants frame the digital divide.

1.4 Importance of Study

Findings from this research study hold significance for the IST academic community and society at large. First, from the perspective of academic discourse, this study contributes to the scientific knowledge of the nature of the socio-cultural context of Information Communication Technologies (ICT) usage, which relates to living, working and learning in an information society. This will contribute to the understanding of how ICTs shape and transform society and how society simultaneously shapes and transforms ICTs. In

addition, this study will highlight how ICTs can be used to transform and facilitate, rather than hinder, universal participation in the IS.

Second, because of the rapid expansion of ICTs and the emergence of the Information Society, it is important to study its effects on people and their relationships. In the literature, it has been argued that technological changes in post-industrial society have considerable potential for changing the way in which the digital divide can be bridged. This remains to be tested. There is a vast amount of literature on the digital divide. Media, science, policy and market communicate their statistics, points of view, concerns and their good intentions to address the issue quickly and profoundly. Amidst this sense of urgency, it is tempting to reduce speed and offer a couple of strategic reflections. At least three key elements seem to be missing from the mainstream debate: the dynamic perspective on diffusion of innovations, the multidimensional nature of access and the imbalance in available information on the information highway. It is important to investigate how to address this issue.

Third, little to no research has been conducted on municipal wireless broadband systems as they relates to QoL measures. This research proposal aims to establish a link between QoL measures and these hotly contested telecom projects. This is important to study because the vision laid out by municipal administrators more often than not challenges both current IS literature and the telecom industry (Baller Herbst Law Group 2005). Three issues remain. First, the ongoing commitment to focus on making unscientific claims continues to be a problematic issue. Second, little research has been conducted which examines quality of life and universal service measures in alleviating digital divide issues via municipal wireless networks. Also, writing this pre/post, multiple case study allows us to explore myriad cities attempting to address the digital divide.

Finally, the research is unusual since it is a pre/post test, multiple case-study approach using qualitative methods. The current study incorporates qualitative research methods (formal, semi-structured, in-depth interviews). The study aims to evaluate a contemporary phenomenon within a real-life context.

1.5 Research Assumptions

The basic premises upon which this research rests are listed below:

1. Access to and skilled use of the Internet is linked to social, political and economic prowess in the US (Tapia & Ortiz, 2006).

2. Access to and skilled use of the Internet is not evenly distributed across all populations in the US. A digital divide exists (various definitions of the digital divide are discussed in the literature review) (Tapia & Ortiz, 2006).

3. Access to and skilled use of information and information technology are considered basic tier services in a heterogeneous and highly contested Information Society (Tapia & Ortiz, 2006).

4. Various levels of government have sought to narrow the digital divide via policy and programs at all governmental levels (Tapia & Ortiz, 2006).

5. A lack of understanding of the digital divide, quality of life, and universal service, and the effects of the government actions on this divide cause the need for research to understand why the divide exists, how to measure it, and how government interventions affect the divide.

6. Higher quality-of-life and network aggregate measures lessen the digital divide.

7. City-wide deployments are organizations. The different stakeholder groups within these organizations can be viewed as sub-organizations within these organizations.

8. Technology is socially constructed, because it refers to users who engage in the use of Mu-Fi, and about their perceptions of the problems and/or solutions at hand.

1.6 Chapter summary

Clearly, Mu-Fi networks are a growing trend requiring further examination and study. These networks are here to stay, but the main question moving forward in the next several decades is, will they respond to the needs for which they are being built? Thus far, this question remains unanswered. Four models are emerging for municipality-owned networks: economic development; government applications; digital inclusion; and a hybrid model of networks, where municipalities have the authority to create wireless broadband systems with two or more of these models. So far, as this study demonstrates, different states have different positions on which model is perhaps best suited for building, owning and operating these networks. It's quite clear that the telecom companies view the creation, operation and ownership of these networks as their turf; however, states and municipalities have a say about who ultimately gains control, since at least part of any given network's infrastructure must be located on city- and state-owned properties.

Aside from the issue of who creates these city-wide wireless networks, this thesis focuses on the issue of their capacity to alleviate the digital divide. Considering that government-led wireless networks are relatively new phenomena, there is not a great deal of data available to verify or refute this belief. It is my hope that this study aids in answering this very important question. In order for countries to remain competitive in the 21st century's digital global economy, it is imperative that their citizenry have not only easy access to information via the Internet, but high-speed access. Unfortunately, the US is falling further and further behind on both fronts, so Mu-Fi networks could arguably help bridge this gap and add to America's global competitiveness. However, access to the Internet only addresses part of the digital divide; the other part of the problem among the poor and underprivileged is access to computer equipment, training, content-relevant information, effective public-private alliances, and a plethora of other strategies. It's clear that creating municipal broadband networks is not enough to bridge the digital divide; bringing Internet access to the masses also involves confronting the messy, convoluted, and complex components that make-up this divide. Chapter two takes an in-depth look at the literature available, as well as a brief history of municipal wireless networks.

CHAPTER 2: CONTEXT

2.0 Introduction

The first part of this section reviews and discusses private and government entry into the telecommunications market in the 20th and 21st century, paying particular attention to the role of local municipalities in the design, deployment and use of wireless broadband services. The section then presents general overview of Mu-Fi within the literature. This overview includes a discussion on technological feasibility, business models, formal/stated goals of Mu-Fi and arguments for and against Mu-Fi. Then, a synthesized definition is given providing a foundation for the research to be presented later. Two significant elements in the definition of Mu-Fi, one fearful and one hopeful, are stressed: an abundance of rhetoric condemning Mu-Fi rollouts and a deterministic view that Mu-Fi networks will create a more equitable society.

2.1 Telecommunications in the 20th Century: A Public-Private Sector Success Story

While European countries are in the process of privatizing government-owned national telecommunications carriers, the US is attempting the opposite strategy. Historically, the US has depended on the private sector, to a large extent, for its delivery of telecommunications services (Crew & Kleindorfer, 1996). Telecommunications has remained almost untouched by the American government and somewhat exclusive to the private sector (Eisenach, 2001). However, historically the U.S. government has provided other services to its citizens, such as delivering mail and electricity.

The invention of the telegraph and telephone occurred during the same historical period when countries were coping with critical changes triggered by the Industrial Revolution. People leaving the countryside and working in the industrial economy in the late 19th and early 20th centuries witnessed the emergence of new industrial undertakings, namely electricity, railroads, and, needless to say, the various "trusts" (Voth, 2003). Governments around the globe had difficulty crafting quick and sustainable policy responses to these controversial phenomena. The responses generally ranged from the adoption of antitrust laws (the Sherman Act, for example) and regulation, on one hand, to government ownership of industry on the other (Wood & Anderson, 1993). In much of what we know as Europe today (and the rest of the world too), government ownership was the solution for everything from steel mills to airlines – including, usually, telecommunications networks, which were often operated by the same entity that managed the post office. According to Eisenach, the response to the monopoly problem morphed into three types in the United States (Eisenach, 2001):

- Government ownership of some "natural monopolies," including the postal service, some electricity production and distribution, lighthouses, garbage collection services and weather satellites (Foster, 1992).

- Government regulation of other "natural monopolies," including the airline market and railroads, usually through industry-specific regulatory commissions at the federal and/or state level (Bailey & Panzar, 1981; Derthick & Quirk, 1985).
- Antitrust law and regulation applied directly to the rest of the economy (Derthick & Quirk, 1985).

Telecommunications fell into the middle category. In 1934, Congress created the Federal Communications Commission (FCC) by passing the Telecommunications Act of 1934. The FCC was created, in part, for regulating the price and entry into telecommunications (i.e. telephone and telegraph) markets (FCC, 1993). Together with state public utility commissions (PUCs), the FCC applied standard price entry regulation to the telecom market, affording monopoly franchises and regulating the prices those monopolies could charge. To ensure affordable telecommunications services for all, both the states and the federal government also developed a variety of "universal service" programs, including "geographically averaged" rates that forced urban areas to subsidize rural ones, subsidized loans for telephone cooperatives and other rural providers, "life-line" programs for low-income individuals and, more recently, an "e-rate" program in the 1990s, which provided data services to schools and libraries (Hudson, 2004).

For most of the 20th century, America's telecommunications network was judged as one of the best in the world. Historically, the U.S. government has played an active role in the telecom market, both as a regulator and as a provider of subsidies. It has not, however, chosen to compete directly in the marketplace.

2.2 The Role of the U.S. Government in the Telecommunications Business in the 21st Century

As we progress deeper into the 21st century, a new technological revolution is transforming the market for telecom services, blurring previously clear distinctions between products such as local and long distance telephony, or telephony and cable television. Since the arrival of the Internet, communications services generally have converged into a single marketplace of digital bits (Gillett, S. E., Lehr et al., 2004). The focus of this new marketplace is on broadband services – high-speed, “always-on” connections that combine Internet access and other data applications (Voice-over-Internet Protocol (VoIP) for instance) (Firth & Mellor, 2005; Graham, T. & Ure, 2005).

Entry in the telecom marketplace is coming from many directions, including cable companies (e.g. Time-Warner), wireless Internet Service Providers (e.g. EarthLink and Metro Fi) and electric utilities like Texas Utilities (owner of local phone service provider TXU Energy) for instance (Lehr, W. & McKnight, 2003; Thomas, 2004). It is believed that when such entry is initiated by private companies, it contributes to the development of competition and ultimately reduces government regulation. Indeed, this is the vision of the Telecommunications Act of 1996 and the intent of the policies pursued by the FCC under the Act (Telecomm Act of 1996, 2006).

Thus, convergence is contributing directly to deregulation. On the other hand, it seems paradoxical that convergence is also luring government entities like municipal electric utilities, municipally owned cable television systems, and municipally owned wireless broadband networks into telecommunications markets (Allen, 1985; American Public Power Association, 2005; Bar & Park, 2006). It appears these entities see themselves as following one of the basic tenets of "reinventing government," namely the idea that venturesome governments should find venues to participate in the marketplace in creative ways and raise capital through innovative techniques. In many ways, these governments are acting more like the private sector. Just as for private business, then, venturesome government utilities see the appearance of competition in telecom markets as opportunities for growth and expansion. Deregulation in the electricity marketplace, for instance, creates incentives for growth as government-owned electric utilities search for ways to block new entrants in their local marketplaces.

The pace of government entry into telecommunications and Internet services markets is rapid and increasing (Thomas, 2004). Government-owned entities already offer virtually every type of telecommunications and Internet-related service, from cable TV and local dial tone to ISP service and broadband networking. Furthermore, government entrants into these businesses are increasingly adding wireless broadband to their delivery packages.

The most common communications service offered by local governments is cable television (Allen, 1985; Jacobson, 1977; Rizzuto & Wirh, 1998). A significant number of municipalities have entered the cable television market as either the exclusive provider or to compete with ILEC cable TV companies. As shown in Figure 4, municipal participation in the cable TV business grew rapidly with the explosive growth of cable television during the early 1980s.

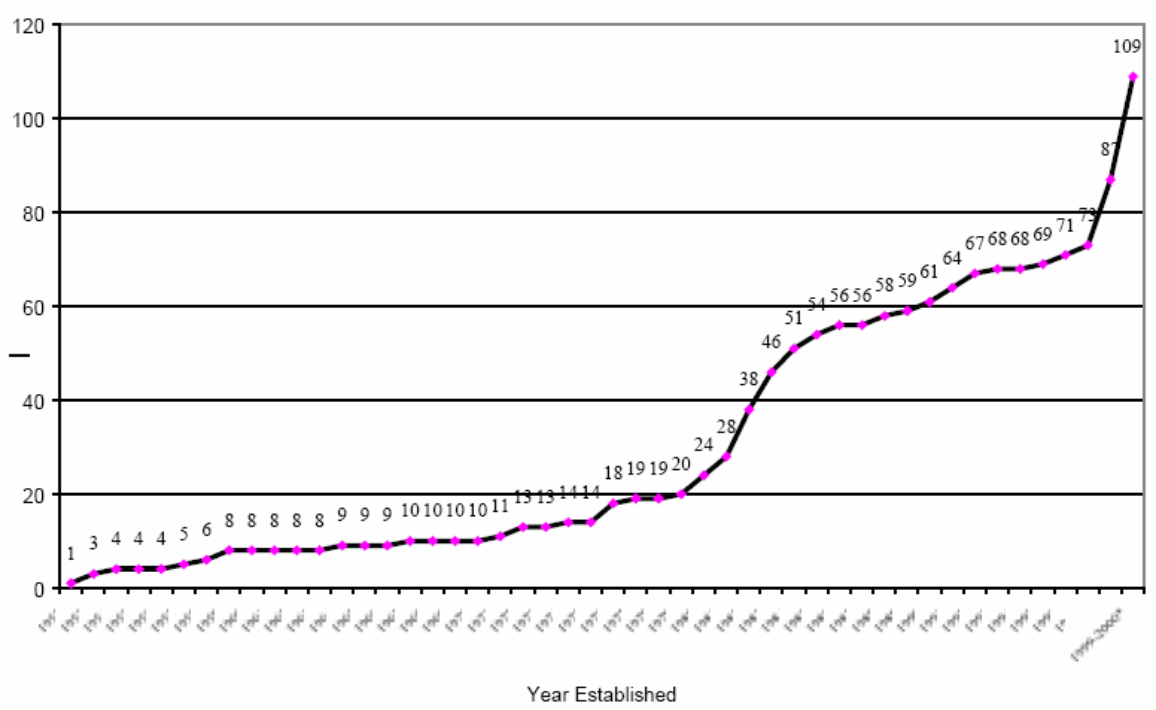


Figure 4: Municipal Cable TV Systems[2]

A second phase of rapid growth began in the 1990s and continues to accelerate. As depicted in Figure 4, the number of municipally-owned cable companies increased by nearly 50 percent from 1990 to 1998, from 60 systems in 1993 to 87 systems in 1998, with more than half of the new entries in 1998 alone. Data compiled by the National Cable Television Association (NCTA) shows this growth trend appears to be accelerating: NCTA reports there were 109 systems operating in 2000, with another 24 in the pipeline (Eisenach, 2001).

Similarly, municipal electric utilities are also expanding into more traditional telecommunications services, such as fiber leasing, local dial tone and long distance telephone service, and into new services, such as advanced broadband and even ISP services. The American Public Power Association (APPA) reports that as of 2000, 58 municipal utilities were leasing fiber, 18 were providing local telephone service and 10 were offering long distance (American Public Power Association, 2005).

Moreover, it is important to note that state and local governments in the US have ventured into the telecommunications space, frequently with limited results. A significant amount of tax dollars have been invested in state-owned fiber networks, namely in Iowa and North Carolina; these have not completely met expectations (Couper, Hejkal et al., 2003). Nevertheless, municipal governments are still rapidly deploying such telecom networks. Conversely, a number of states are in the process of privatizing or contracting out their telecom networks. As discussed below, such efforts generally

[2] Source: American Public Power Association, Annual Directory & Statistical Report (1999, 2000); Public Power (1997, 1998)

reflect the realization by policymakers that states generally are not well-positioned to participate effectively in the rapidly-changing telecom marketplace.

2.3 Enter Mu-Fi: Municipal Wi-Fi Mesh Broadband Networks

Increasingly, the Internet is becoming a cornerstone of American life, since much of the public, private, educational, and economic lives of Americans have both online and offline components. As full participation in civic, commercial and social life is tied to Internet and computer literacy and access, high-speed access is becoming a necessity rather than a luxury.

Information technology skills and access are beginning to be seen as public goods because like education and libraries, they are capable of providing positive externalities associated with economic growth and democratic governance (American Library Association, 2003; Mossberger, Tolbert et al., 2003). Critical technological skills raise the level of human capital in the economy, particularly in the context of a knowledge-based economy. Because computer and information technologies are tools for participation in the economy and the political arena (Westen, Fall 2000), this provides a strong case for government intervention to provide access to all citizens, not just the affluent. In this context, broadband Internet access is seen by many governments as a public utility, similar to that of water, gas, electricity and waste, rather than a luxury. If this is truly the case, then one could argue that the patchwork of private companies now offering broadband access in the US are exacerbating the problems in rural and urban pockets of poverty in the same way other forms of private utilities have done so in the recent past. This leads to the assertion that treating broadband Internet access as a public utility has the potential to alleviate some of the causes and symptoms of poverty and social exclusion. This demands to be tested (Ortiz & Tapia, 2006; Tapia & Ortiz, 2006).

This great need for access to and skilled use of the Internet was clearly recognized during the 1990s, when the U.S. government championed the Internet and used its power and influence to encourage its growth. The Internet's initial rapid diffusion in the U.S. in the 1990s was influenced by a wide range of federal policies: the privatization of the Internet early in the decade; the decision to exempt online sales from federal tax; Commerce Department grants for projects that brought new communication technologies to low-income communities; and the federal "E-rate" policy of subsidizing investments in Internet technology by public schools and libraries (DiMaggio, Celeste et al., 2004). These efforts followed a long tradition of the federal government to address issues such as access to electric power, transportation, telephones and other services. As these services became basic necessities, the U.S. government historically has moved to provide access across the entire nation. Unfortunately, providing access to the Internet for the U.S. population is apparently fundamentally different than providing services such as telephones and electricity (Ortiz & Tapia, *forthcoming*).

Moreover, broadband access is commonly believed to be essential for all, yet is not available to all (Tapia & Ortiz, 2006). The skills necessary to use information and

communications technologies are not universally prevalent, yet seen as becoming more centrally necessary to navigate everyday tasks. In order to fill the gap, municipalities are stepping in to offer wireless broadband access, turning the top-down traditional means of supplying telecom service and policy on its head. These municipal actions have provoked a flurry of responses from concerned constituents, including fixed-line operators, state legislators and the U.S. Congress. Currently, pending legislation exists on both state and federal levels to address this issue (Tapia & Ortiz, 2006; Tapia, Stone et al., 2005).

Computerization and Internet use are also associated with higher wages (Freeman, 2002; Goss & Phillips, 2002). Internet users tend to consume more information offline than nonusers, and to be more active in other ways as well. Robinson and Shah found that informational use of the Internet had a significant, positive impact on community participation (Robinson, Kestnbaum et al., 2000; Shah, McLeod et al., 2001).

While the US has made significant gains in broadband adoption, it still lags far behind other countries (Bleha, 2005; Tapia & Ortiz, 2006). In 2000, the OECD said the US ranked third in Net users connecting at high-speed among the top-30 world economies. The next year it fell to fourth. In 2005, the US ranked 16th in per-capita broadband penetration, trailing such countries as South Korea, Canada, Japan, and Sweden (Bleha, 2005). And fast connections in the US are slower than in many other countries. A top-of-the-line cable modem in the US carries five megabits per second, while broadband connections in Asian countries like Japan and South Korea are often 20 times faster. In fact, South Korea is the world leader in broadband access. Unlike the US, this is due in part to multiple companies offering most of the country DSL lines, and government encouragement and sponsorship. Unsurprisingly, recent commentary has characterized U.S. broadband among the "slowest, most expensive, and least reliable in the developed world, and the United States has fallen even further behind in mobile-phone-based Internet access" (Bleha, 2005). These dismal statistics have not gone unnoticed. President Bush announced that he wanted to make universal, affordable broadband access available by the year 2007 (Bleha, 2005). Unfortunately, President Bush's promise of broadband for all was not kept.

It is of little surprise, therefore, that broadband Internet access is becoming essential, yet Americans face relatively high prices for that access compared to other industrialized nations. In this context, municipal governments are attempting to provide broadband service. Additionally, according to Mu-Fi elites, duopolies and market failures are the key triggers for intervention (Ortiz & Tapia, 2006; Tapia & Ortiz, 2006).

As a result of all these factors, over 375 cities in the US have announced plans to deploy wireless mesh broadband networks. Municipal wireless broadband networks can be defined as a government and community effort with the goal of designing, developing, implementing and using wireless broadband for a specific coverage area, for specific users at a particular moment in time. As a public entity charged with providing high-quality services for citizens, some municipalities feel compelled to act, and providing readily available low-cost mesh networks is one strategy (Tapia, Stone et al., 2005).

Essentially, local governments are deploying wireless broadband for three reasons: to bridge the digital divide, enhance inter- and intra-governmental applications and promote economic development.

Furthermore, while local governments do not have control over state and federal policies, they do have control over local government policies that can influence communications infrastructure deployment, business and residential demographics that shape demand, and the nature and quality of existing infrastructure (Gillett, S. & Lehr, 1999). Given existing municipal assets such as buildings, rights of way and structures that can house wireless antennas, another advantage and incentive for municipalities is the lower cost of broadband infrastructure deployment. Municipalities have also seen ubiquitous low-cost broadband as a means of increasing education opportunities and tourism (Gillett, S. E., Lehr et al., 2004).

Municipalities may also enter the broadband market based on the incentives they derive from their position as broadband service consumers. In addition to low cost, wireless broadband solutions have also been touted as an answer to providing portable and mobile Internet access for municipal employees. Widespread yet inexpensive Internet access by municipal employees has advantages for citizens, such as faster response times and written records of communications, but also improves the quality-of-work for employees (Sawyer & Tapia, 2005; Sawyer, Tapia et al., 2004).

Finally, ubiquitous Internet access may also help municipalities to achieve broader objectives, such as improving inter- and intra- governmental communications and promoting workforce development (Gillett, S. E., Lehr et al., 2004). Unsurprisingly, these efforts have raised a number of concerns from Incumbent Local Exchange Carriers (ILEC), policy makers and academic researchers (Firth & Mellor, 2005; Gillett, Sharon E., 2006).

Additionally, the rise of municipal wireless broadband efforts can be credited to historical and socio-economical factors. Historically, wired technology has dominated the communications horizon since the beginning of the telegraph. In the world of wired networks, cables run over telephone poles or underground in order to provide services through physical connections to individual buildings. Although wired fiber optic cables are a far more secure broadband network medium, they are not cost effective, considering the significant amount of labor required to set up, build and maintain them (Gillett, S. & Lehr, 1999; Gillett, S. E., Lehr et al., 2004; Gillett, S. e. a., 2003). Over the next few years, cost-saving wireless technologies have predictably replaced wired technologies. As demand increases and more users join the wireless community, wireless technologies become faster, more robust and cheaper (Lehr, William & Sirbu, 2004). More recently, the Telecommunications Act of 1996 failed to anticipate for the development of wireless technologies (Bleha, 2005; Lehr, William & Sirbu, 2004). Existing laws do not apply to broadband or VoIP services because of their designation as advanced services by the Act. In short, the perceived failure of the Act and the empty promises of the private sector stimulated the creation of community wireless broadband.

Furthermore, social factors gave municipal governments the means to deploy pervasive local networks. The digital divide reflects persistent gaps in access to the Internet based on race, ethnicity, education and income. Generally, white Americans are more likely than African-Americans and Latinos to have access to the Internet. Americans with a college degree are more likely to have access, as are those Americans who earn more than $30,000 (Mossberger, Tolbert et al., 2003; Ortiz & Tapia, 2006; Pew Internet and American Life Project, 2000; U.S. Department of Commerce, 2000).

Moreover, broadband adoption is highly dependent on socio-economic status. The gap between those who can afford broadband and those who cannot persists in the US, despite growth in the total number of broadband connections. According to a 2003 U.S. Census Bureau survey of homes with an Internet connection, almost 60 percent of households with annual incomes above $150,000 have a broadband connection, while less than 10 percent of households with incomes below $25,000 do (Turner, 2005; U.S. Census Bureau, 2003). The digital divide reflects ongoing social inequalities in the US, explained by both the lack of vision as well as entrenched social, economical and political systems (Bagasao, Macias et al., 1999).

The slower adoption of broadband service in the US is likely due in part to economic reasons (Tapia & Ortiz, 2006). The price charged by telecomm and cable operators is quite high (Cooper, 2004). Prices for broadband access via wired media (DSL or cable) have steadily risen to around $60 per month, making broadband connectivity too expensive for many lower income households. Broadband Internet access is becoming essential, yet Americans face relatively high prices for that access as compared to other industrialized nations. For example, before Chaska, Minnesota, built its city-wide wireless network, both Sprint and Time Warner (local ISPs) provided Internet access to citizens at a rate between $40- $50 per month. Currently, Chaska offers broadband Internet service for less than $20 a month (Tropos Networks, 2004).

2.3.1 Technological Feasibility

The mass market development of new wireless technologies like Wi-Fi (Wireless Fidelity, or 802.11a/b/g) has enabled local governments to set up broadband Internet access. According to Bar and Galperin, the proliferation and adoption of wireless technology was successful for three reasons (Bar & Galperin, 2004). First, the FCC did not require a license for the 2.4 GHz and 5 GHz spectrum, the airwave spectrum in which Wi-Fi works. Second, standardization as specified by the Wi-Fi Alliance and the IEEE organization led to an interoperability standard. Third, "the resulting large scale production of Wi-Fi chipsets resulted in low unit costs for Wi-Fi equipment, fueling the technology's integration as standard equipment in laptop computers and allowing widespread diffusion of Wi-Fi access points for private and public use" (Bar & Galperin, 2004; Bar & Park, 2006).

(Wire-line) Broadband

In January 2005, per capita broadband access in the US ranked 16th in the world (Bleha, 2005). While broadband access within the US continues to rise, penetration rates are lagging behind those of the rest of the industrialized world (Weiss, 2005). But broadband itself is a broadly defined term. According to the FCC, the threshold for a service to qualify as broadband is 200 kbps – modest compared to the 1.5 to 3 mbps speeds typically offered through major DSL and cable providers (FCC, 2005). Smaller industrialized nations, led by Japan and South Korea, are enjoying broadband two to four times the speed of typical American service at half the price. Combined with the fact that less than 60 percent of residents in a major American city like Philadelphia have access to any broadband, some consider the broadband debate in the US to be an ominous crisis that jeopardizes the nation's global competitiveness.

Some argue that broadband as a technological artifact is alluring insofar that its supposed potential will offer the nation improved quality of education and health services, improved connectivity of government with society, and to provide jobs and prosperity (Lehr, W. & McKnight, 2003; Lehr, W. & Osorio, 2005; Lehr, W., Osorio et al., 2004; Lehr, William & Sirbu, 2004). To them, broadband offers the subscriber improved educational opportunities, entertainment diversity, and improved access to peers and to information and LAN networking options (Wales, Sacks et al., 2003). Also, improved efficiency, improved connectivity, access to operation-specific applications that enable new ways of doing business and new business models (Precursor Group, 2001), which may impact on company location in much the same way as transport networks did in the 20th century (OECD, 2001). Together, these supposed potential benefits at the national, individual and organizational levels contribute to something of a consensual view that broadband should be promoted (American Public Power Association, 2005; Meinrath, 2004; Xavier, 2003). Others believe it is more of a consensual hallucination (New Millennium Research Council, 2005).

However, with broadband taking off at least amongst elites in some countries, it is timely to ask: will broadband truly deliver these benefits, and will it also deliver unwanted outcomes? Some researchers have argued (namely, (Firth & Mellor, 2005; Katz & Rice, 2002) that (1) the impact or the perception of the impact of the Internet may be due to the worldview developed in response to previous technologies; and (2) a more comprehensive evaluation of the benefits and problems of broadband is still lacking within this research discipline. It is important to note that broadband does not act on the economy by itself, but in conjunction with other IT and associated organizational changes.

According to Lehr, et al, data already shows that between 1999 and 2002, American municipalities with broadband access did better at significantly stimulating growth in employment and improving business development in general than those without it (Lehr, W. & Osorio, 2005). Fueled by reports from the New Millennium Research Council (NMRC) and the Brookings Institution, which forecasted that failure to improve broadband could adversely impact the U.S. economy, studies were gathered from individual communities providing broadband (Cedar Falls, IA and Lake County, FL are

just two examples) as well as Census data on business activity. It was an introductory attempt to applying controlled econometric techniques to national-scale data. The results were analyzed in terms of employment and wages, rent and property values as well as industry structure and mix. The analysis unequivocally revealed that "broadband access *does* enhance economic growth and performance, and that assumed (and oft-touted) economic impacts of broadband are real and measurable" (Lehr, W. & Osorio, 2005).

Wire-less Broadband (Wi-Fi)

Wi-Fi and WiMAX (802.16), enable broadband Internet access without requiring a spectrum license from the FCC, such as is required for cellular telephone service providers (Battiti, Conti et al., 2003; Lehr, W. & McKnight, 2003). WiMAX is a wireless standard designed to extend wireless Internet access across greater distances, as well as to provide last-mile connectivity to an ISP or other carrier (Alvarion, 2004a). These technologies are especially useful in bringing broadband access to low-density areas; the proliferation of Wi-Fi broadband networks has dramatically expanded the range of architectures, technologies and frequencies inside and outside the home. Analogous to the notion of wired access such as DSL or cable, Wi-Fi can provide connection speeds of up to 54 megabytes per second. It is this convergence of wireless and wired networks and the trends toward ubiquitous that computing are making wireless services an increasingly important component in, a complement to, and potential substitute for more traditional telecom access infrastructure.

The widespread popularity of wireless computing spurred the development of wireless Internet service providers (WISPs) (Henry & Luo, 2002; Rao, 2003). This new type of service provider embraced the standard to create an entirely new business model, building out public wireless broadband infrastructures to provide wireless Internet access to traveling business users and to the general public (Battiti, Conti et al., 2003). Today, that model is evolving as other service providers, telecomm and mobile operators, eager to enrich their "benefits package" with wireless Internet connectivity, make public access wireless service available to their clientele. Users are becoming accustomed to the freedom and portability that wireless broadband affords. They are demanding, and receiving, high-speed wireless Internet access in all the environments where they work and play. The low cost barrier to wireless broadband networks and the ease with which establishments can install them has helped spur growth.

Today, Wi-Fi access points can be found everywhere: waiting areas in international airports, convention facilities in world-wide hotel chains, fast food restaurants in California, and recreational vehicle parks. These public access "hotspots" are springing up at a very rapid rate to meet the connectivity demands of users who, accustomed to wireless access, demand easy-to-access, ubiquitous connectivity when they travel away from their homes or offices. These hotspots, within the US and the vast majority throughout the world, use 802.11b/g[3] equipment. They provide high-speed wireless

[3] Wi-Fi cards implement the engineering protocol IEEE 802.11b/g standard which extends the 802.11 standard by introducing a higher-speed Direct Sequence Spread Spectrum (DSSS).

Internet access through a variety of providers, including WISPs, traditional service providers, telecoms, mobile operators and aggregators on either a fee-paid or "free" basis (Alvarion, 2004a).

Although wireless networks are growing at a staggering rate (Calvagna, Morabito et al., 2003; Henry & Luo, 2002), wireless public access is not without challenges. Concerns over security (Baard, 2005; Schiesel, 2005) and the difficulty of establishing a wireless connection frustrate many users (Calvagna, Morabito et al., 2003). The lack of roaming agreements forces users to maintain multiple accounts or one-time service charges so they can access the Internet from any public hotspot. Another issue is that Wi-Fi is competing with legacy wireless (cellular) networks to support nomadic and data-centric applications (Crandall, 2003; Gillett, S. & Lehr, 1999; Williamson, 2004). These issues represent significant challenges to a widespread public embrace of wireless public access networks.

Wi-Fi Mesh

Unlicensed bands are open to any user, but interference is possible. Usage of a wireless broadband device on unlicensed spectrum cannot be prioritized by user and there are no legal penalties for causing interference or jamming the band (Barranca, 2004). However, unlicensed spectrum is free to the public. In contrast, licensed spectrum can be purchased by telecom providers, or set aside for special government purposes. Though Wi-Fi solutions were originally created for LANs in buildings, cities have been using the technology to create metro-scale wireless broadband networks since 2002. However, since each Wi-Fi access point requires a wired connection to the Internet (via DSL, cable, Ethernet, or fiber), deploying a traditional Wi-Fi network across a community can drive capital and operating expenses quite high. As a response to this need, Wi-Fi mesh solutions were created. Wi-Fi mesh solutions use standardized technology in combination with proprietary mesh protocols to reduce the number of access points with a wired backhaul connection to the Internet. Only a certain number of "gateway nodes" with wired connectivity to the Internet are required, as the mesh technology allows regular access points to route traffic to the "gateway nodes." While mesh technology decreases capital and operating expenses associated with a metro-scale network, both Wi-Fi and mesh have advantages and disadvantages. For instance, both have similar coverage area and speed strengths. However, for Wi-Fi, each AP requires connectivity to the Internet. For Wi-Fi mesh, intermesh technology is proprietary, so different mesh solutions cannot be mixed together (Barranca, 2004).

2.3.2 Business Models

Chicago, Miami, Philadelphia and San Francisco are just a few of the latest major metropolitan areas that are embarking on the Mu-Fi path, using specific business models tailored to their own organizational needs. In other words, not all Mu-Fi systems are designed and built the same. Some Mu-Fi business models propose spending public

funds to deploy the necessary equipment to provide Wi-Fi service throughout their cities. Other municipal projects are designed to incorporate public-private partnerships with commercial service providers, while others appear to be the sole effort and financial responsibility of the local government. News of these municipal business models has appeared in the *Wall Street Journal*, the *New York Times*, and the *Washington Post*, along with a host of trade publications and local newspapers (Schiesel, 2005; Weiss, 2005).

Four business models are being used in community wireless broadband deployments with different focus, funding, and objectives: the community network model, the cooperative wholesale model, the private consortium model and the public utility model. Understanding these four models is essential in order to appreciate the depth and breadth of Mu-Fi systems.

Community Network

The community network model is focused on providing free or low-cost wireless broadband access. Two hybrid models have emerged from cities using this model, but both share a key trait: free Wi-Fi access. This model most often supports wireless hot zones or city-wide networks and is being used in Hermosa Beach, California, and Austin, Texas. The first hybrid involves the city or a non-profit organization (NPO) acquiring funding from taxpayer revenue, foundation grants, donations from citizens and businesses. Additional revenue is received from advertising on a splash page. The second model involves a non-profit community group or government entity that acquires funding to educate business owners about the benefits of deploying a Wi-Fi hotspot. The non-profit NPO (or government agency) acts as a catalyst, gets funds, educates and encourages the organic build-out of a Wi-Fi network in downtown areas. Since the city or NPO is not funding the network deployment, the need to use city funds is substantially lower (Tapia, Stone et al., 2005).

The advantage to the community network model is free access to broadband. The model supports targeting certain areas for revitalization by attracting people to downtown areas. Since the network is most often provided as an amenity, little focus is given to building a universally available, secure, and reliable network. Therefore, the city government usually chooses not to use the network to support mobile applications for public safety and public works functions. However, many of the state bills only pertain to cities that provide wireless broadband access for a fee. Since most community networks offer free service, municipalities are able to proceed without meeting those state requirements (Tapia, Stone et al., 2005).

Public Utility

The public utility model requires a local government to establish a new community department or combine with existing water, gas, and/or electric utilities departments to deploy, operate and manage broadband service for its citizens. The broadband utility's

capital cost is funded through taxpayer dollars and revenue bonds. The public utility installs the network, markets the service, and provides customer support and billing. In addition, the local government may choose to provide both fixed and mobile broadband to its agencies. This model is most often used when private providers choose not to offer broadband service in a city for financial reasons. Chaska, Minnesota, has used the public utility model to deploy a city-wide Wi-Fi mesh network (Tapia, Stone et al., 2005).

The public utility model affords local governments the ability to control a number of variables involving broadband access. Since governments have easier access to capital through tax dollars, bonds, and other revenue sources, municipalities do not always face the same capital scarcity that private sector providers do. With a clear funding strategy, public utility networks can be built quickly by a city interested in providing broadband service to its citizens. Cities are also able to control the price of broadband access to the end user through this model, even subsidizing enterprise fund losses with general fund monies (Stone, Maitland et al., 2005; Tapia, Stone et al., 2005).

However, this model's dependence on taxpayer dollars can make it both politically unattractive and almost financially impossible for most city leaders. Since this model requires head-to-head competition between the local government and private sector providers, little opportunity is left for local government to partner with for-profit firms to operate and manage the network. Cities are, thus, hesitant to enter direct competition with private sector providers (Stone, Maitland et al., 2005; Tapia, Stone et al., 2005).

Private Consortium

The private consortium model involves one or many private sector provider(s) offering broadband service to end users. Funded by private investment, the provider offers access to both city government and to citizens for a monthly fee. The provider is responsible for operating and maintaining the network and providing technical support, customer service and billing. The vast majority of broadband networks in the US are built to support this business model. Since the private sector bears the responsibility for funding the network deployment and maintenance costs under this model, no taxpayer funds are required and no city employees are needed to provide service. Businesses provide the service where they can do so profitably, thereby creating local jobs (Tapia, Stone et al., 2005).

Opportunities for partnerships exist between the local government and the private provider under this model. Private firms often need access to city assets, including street lights and traffic lights, to deploy a wireless network. Cities often provide these assets to private providers at low fees in exchange for low-cost wireless broadband access. Some wireless broadband providers agree to revenue sharing agreements with the city, creating a new revenue stream for the local government. Since the network is professionally monitored and can be secured, government agencies, including public safety, can use the network for mobility applications. In addition, many states have created tax incentives for private providers who extend broadband networks into rural areas. However, deciding where to deploy broadband networks under this model is often based on building business cases and return on investment models. Such profit-driven decisions

can limit the addressable markets for broadband providers and prevent the deployment of ubiquitous broadband networks (Stone, Maitland et al., 2005; Tapia, Stone et al., 2005).

Cooperative Wholesale

The Cooperative Wholesale model provides two options for local political leaders. The first is a city-owned model in which the city makes a "build versus buy" decision regarding broadband service. The city builds a broadband network to meet its broadband and telecom needs. Funding for the network comes from taxpayer dollars, state and federal grants, foundation grants, and/or bonds. After securing funds, the city issues an RFP for the design, deployment, and management of the network (Tapia, Stone et al., 2005).

After the network is deployed and the city has completed in sourcing its broadband needs, the excess capacity is sold to private providers (WISPs, ILECs, CLECs, MSOs, dial-up ISPs) at wholesale prices. The private providers then compete for business and residential subscribers while providing marketing, technical support, customer care, and billing. Free cash flow (or the total positive cash flow remaining after network upgrades and maintenance) generated from the wholesale fees can be used to fund a number of programs including economic development and digital-divide initiatives (Stone, Maitland et al., 2005; Tapia, Stone et al., 2005).

While the first model meets many municipal leaders' needs, it still requires taxpayer dollars and city employees to be successful. Instead of the city funding and managing the network, the community can create a non-profit organization to raise funds; outsource design, deployment and management to private company; and develop socio-economic programs that are funded by free cash flow from the network. The wholesale approach also ensures cooperation between the public and private sectors while reintroducing competition into the Internet access market, a move that can drive down prices and lead to innovative, value-added applications and content. Since the local entity builds out one neutral host network, scarce assets such as towers and light poles are maximized. This model also allows both the government and the private sector to maximize their strengths.

In sum, Mu-Fi systems are being developed, designed and deployed in various ways. Because each city has unique requirements, different business models are summoned on a case-by-case basis. Similarly, a variety of feasibility studies exists and must be conducted prior to embarking on the Mu-Fi path. For example, when crafting a sound financial model, key questions must be addressed, such as: What is the cost to deploy, upgrade and maintain the network? What is the city's return on investment? The city must also examine capital expense assumptions (e.g. coverage area, capacity required within the coverage area, density of access points, etc.). Operating expense assumptions (e.g. personnel requirements, technical support) and revenue assumptions (e.g. type of service to be offered, price points, churns rates) all need to be closely examined (Tapia, Stone et al., 2005).

2.3.3 Formal (Stated) Goals of Mu-Fis

According to the literature, two trends are converging: growing interest in municipal networking as a response to perceived market failure (inadequate investment/competition in broadband last-mile facilities); and revitalized interest in wireless last-mile technologies (Wi-Fi and 3G, for instance) (Clark, D. & Gillett, 2002; Gillett, S. e. a., 2003; Lehr, William & Sirbu, 2004).

More than 2,000 cities and towns in the US power their homes, business and streets with "public power" (i.e. electricity that comes from non-profit, community-owned and operated utilities) (American Public Power Association, 2005). These utilities serve about 43 million Americans while simultaneously providing new infrastructure their citizens demand, such as municipal broadband networks. For many public power systems, municipal broadband services are a natural extension of their public service (i.e. last-mile connectivity) responsibilities. Many claims have been made about Mu-Fi systems, including the promise of faster, more reliable and affordable communications systems that can deliver data, voice, and video within a community/municipal network as well as out of the Internet. The literature suggests that Mu-Fi systems have the potential of offering inexpensive, high-speed, wireless broadband connections to neighborhoods, local businesses and public institutions (Barranca, 2004; Garvey, 2002; Gillett, S. & Lehr, 1999; Gillett, S. e. a., 2003; Rao, 2003). Because they are capable of speeds many times faster than cable modems, the networks operate with low-cost, easy-installation rooftop antennas. Sophisticated software makes these antennas highly intelligent, ensuring that connections between the nodes on the network are reliable and efficient. These networks do not require digging up streets to lay cables, investment in large towers, or expensive broadcasting equipment. The argument is that as more users join the network, it becomes less expensive and more robust. At first glance, the cost to citizens, businesses and municipalities is small when compared to old wired systems, which makes these networks particularly valuable to rural and low-income areas where wired service providers often do not operate.

Proponents urge policymakers to allow this technology to expand so that Mu-Fi can create next-generation media systems that serve all citizens. Specifically, they envision that Mu-Fi systems will arguably achieve three objectives: municipal applications, economic development and promotion of digital equality (i.e. bridge the digital divide).

<u>Arguments of municipal applications</u>

- Government agency connectivity can increase efficiency and service. For example, wireless networks have the potential of facilitating e-government initiatives such as online voter registration, directions to polling stations, bill paying, access to tax service, public service announcements, and remote/mobile

employee access (Clark, D. & Gillett, 2002; Meinrath, 2001; Strover & Straubhaar, 2000).

- First responders, such as police officers, firefighters and EMS personnel, can send data, audio, and digital real-time video back to command centers for evaluation and rapid-action planning (Bar & Park, 2006; Meinrath, 2001).
- Wireless nodes can enable intelligent traffic management and serve as self-reporting sensors on water and electricity meters, or as monitoring devices for earthquake activity, water quality, air pollution, wildfires and even traffic patterns (Lehr, W., Osorio et al., 2004; Meinrath, 2001).

Arguments of promoting economic development

- Wireless communication infrastructure can enhance civic/community services (e.g. a more robust job creation mechanism) (Gillett, S. & Lehr, 1999; Lehr, W. & Osorio, 2005; Lehr, William & Sirbu, 2004).
- Telemedicine can be achieved; doctors can use the network to gather, transfer and monitor information to patients with limited mobility (Meinrath, 2001; Stone, Maitland et al., 2005).
- Mu-Fi projects can promote local business support by establishing cost-effective marketing strategies and new ways to present points of sale to target customers, as well as offer the prospect of a more productive, mobile workforce with on-demand, real-time information access at all points across the municipality (Clark, D. & Gillett, 2002; Stone, Maitland et al., 2005).

Arguments of narrowing the digital divide

- Affordable, low-cost wireless can offer disadvantaged school high-tech resources, as well as opportunities for adult education and distance learning (Meinrath, 2001, 2004; Rao, 2003).
- Local grassroots groups such as churches can offer communities religious services and spiritual resources via Webcasts (Meinrath, 2001).
- Local libraries can become a hub of access to free, highly useful information about parks, swimming pools, beaches, sports facilities, airports, train stations, and other public access areas. This wealth of information would benefit from this information on a wireless network (Meinrath, 2001, 2004).

2.3.4 Mu-Fi Legislation

As municipal wireless broadband deployments have become more high profile in the past two years, private-sector providers understandably express a number of concerns. It has been argued that cities providing wireless broadband service have a number of unfair advantages, including: an unlimited base from which to raise capital; the ability to act as a regulator for local rights of way; are tax exempt; and, tower permitting, own the public infrastructure necessary for network deployments, including street lights. To local opponents, Mu-Fi will cost more than the cities anticipate, resulting in money and

attention being diverted away from other public interests. Second, it is feared that if these networks are allowed to flourish, the municipalities will have unfair regulatory and economic advantages (Thomas, 2004).

As a result, many telecommunications companies have sought legislative relief at the state level to regulate or restrict a municipality's ability to provide wireless broadband services to the public. With no guidance from the Telecommunications Act of 1996, the Supreme Court sided with the FCC and various incumbent local exchange carrier (ILECs) lobbyists in *Nixon v. Missouri Municipal League*, which allows states to bar their subdivisions from providing telecom services. The opinion gave states the authority to determine when and where municipalities can deploy communications services (Tapia & Ortiz, 2006).

Currently, most states have proposed, passed or have pending legislation that prohibits municipalities from providing telecommunication services, either directly or indirectly. In some cases, state legislatures have prevented municipalities from expanding existing networks. In other cases, state legislatures have not overtly prohibited the development and deployment of municipal broadband networks, but they have created organizational and bureaucratic barriers causing these networks to be curtailed, reconfigured or resized (Tapia & Ortiz, 2006).

As of January 2006, 15 state legislatures prohibited or restricted municipalities from providing telecom services, directly or indirectly. Some of these states include: Arkansas, Florida, Missouri, Minnesota, Nebraska, Nevada, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, and Wisconsin. In some cases, such as Nebraska, state legislatures have enacted barriers preventing municipalities from expanding existing Wi-Fi networks. In other cases, state legislatures have not overtly prohibited the development and deployment of municipal Wi-Fi networks, they have created nearly insurmountable organizational and bureaucratic barriers so that these networks have effectively been outlawed. State legislators argue that the public funding and support of municipal Wi-Fi networks will unfairly impact competition in municipal markets between traditional private telecom providers and new ventures funded in part with public tax funds.

Due to states' restrictive legislative battles, the federal government has also joined the Mu-Fi crusade. Considering the inadequacies of the 1996 Telecommunications Act, federal officials have decided, in part, to redraft the legislation. In preparation for this legislative overhaul, four bills dealing with municipal broadband have been introduced in Congress. In some ways, the four bills mirror the spectrum of options that are reflected in state legislation. As of June 12, 2006, there were approximately a dozen bills relating to Internet and broadband adoption that were introduced in Congress. Some of these bills include: Internet Freedom and Nondiscrimination Act of 2006 (HR 5417), Internet Freedom Preservation Act (S. 2917), Prepackaged News Story Announcement Act of 2005 (S. 967), American Broadband for Communities Act (S. 2332), Broadband Rural Revitalization Act of 2005 (S. 497), Broadcast Ownership for the 21st Century Act (HR 1622), Fairness and Accountability in Broadcasting Act (HR 501), Internet Non-

Discrimination Act of 2006 (S. 2360), Media Ownership Reform Act of 2005 (HR 3302), etc. Below is a description of the main bills relating to municipal broadband in Congress.

- H.R. 2726[4] *Preservation Innovation in Telecom Act of 2005,* introduced by Rep. Pete Sessions (R-TX), this bill proposes state and federal barriers to Mu-Fi. In essence, it prohibits municipal officials from providing telecommunications, cable or information public services, except to rectify market failures by ILECs to provide such service infrastructures. This legislation is viewed as the most prohibitive of the four federal bills.

- S. 1294[5] the *Community Broadband Act of 2005,* was introduced by senators Lautenberg and McCain. The bill would amend the Telecommunications Act of 1996 by preserving and protecting the ability of local governments to provide broadband capability and services. The bill would prohibit any state policy, regulation, or other legal requirement from restricting or prohibiting any public provider from providing, to any person or public or private entity, advanced telecommunications capability or any service that utilizes such capability. However, the bill protects incumbents by mandating that the municipality not discriminate against a telephone company project when it acts as both a competitor and the franchising authority.

- S. 2686[6], the *Communications, Consumer's Choice and Broadband Deployment Act of 2006,* introduced by Sen. Ted Stevens (R-AK), seeks to amend the Communications Act of 1934. The bill's goal is to reform existing communication laws affecting broadband and video access, the universal service fund, video franchising, wireless spectrum, community Internet, and network neutrality.

- S. 1504[7] *The Broadband Investment and Consumer Choice Act of 2005,* was introduced by Sen. John Ensign (R-NV). The bill would require cities to inform private providers of plans to build a municipal broadband network; allow bids from private sector companies to deploy, own, and operate the infrastructure; and give preference to non-governmental organizations in the required bid process. Essentially, it creates a market-driven marketplace and eliminates government-driven competition.

- HR 5252[8] The *Communications, Opportunity, Promotion, and Enhancement (COPE) Act of 2006,* was introduced by Rep. Joe Barton (R-TX), the House Energy and Commerce Committee Chairman, and Rep. Bobby Rush (D-IL). This sweeping telecommunications bill is designed to update U.S. laws to address

[4] See The Library of Congress, House Bill 2726 IH. http://thomas.loc.gov/cgi-bin/queryz?c109:H.R.2726:
[5] See The Library of Congress, S. 1294. http://thomas.loc.gov/cgi-bin/bdquery/z?d108:s.01294:
[6] See The Library of Congress, S. 1294. http://thomas.loc.gov/cgi-bin/bdquery/z?d109:S.2686:
[7] See The Library of Congress, S. 1294. http://thomas.loc.gov/cgi-bin/bdquery/z?d109:S.1504:

[8] See The Library of Congress, House Bill 5252. http://thomas.loc.gov/cgi-bin/queryz?c109:HR05252

changes in voice, video and data services. The bill would allow phone companies to enter the national broadband market without requiring permission or approval from local sectors. Additionally, the bill would authorize the FCC to enforce principles it has issued that call on broadband Internet providers to allow consumers unfettered Internet access and allow them to run any Internet-based applications.

It is important to understand the potential socio-economic impacts of such legislation. Rep. Sessions' bill, for instance, could prohibit all future municipal deployments unless the network is already in operation when the bill becomes law. As a result, many cities have accelerated the timetable for their initiative to insure that their network is grandfathered in ahead of the law (cities like Kutztown, Pennsylvania, for instance). While streamlining innovative initiatives can provide benefit to communities, many cities may choose less-than-optimal business models, financial assumptions, and technology solutions in order to beat the legislative deadline. This acceleration, then, could have the opposite effect that lawmakers intend. Instead of urging municipal leaders to carefully consider and plan their broadband initiative, they are urged to rush through to make sure their community's broadband needs are met. It is important to highlight that the intent of the legislation proposed is to ensure cooperation and communication between the public and private sectors when considering wireless broadband networks for public access. While legislators have been grappling with ways to restrict municipalities from owning and operating wireless broadband networks, city leaders have been creative in developing business models that support their community's motivation for deploying the network. The aforementioned federal bills are forcing municipal officials to act and provide last-mile connectivity to their citizenry.

Thus, most municipalities are caught between citizens, local businesses and their own employees, all of whom demand high-quality, affordable, universal broadband Internet service; and their state legislators and incumbent telecom companies, which seek to keep the offering of telecom services out of public hands, yet cannot, or will not, comply with local citizen and business demands. In some cases, municipalities have entered into public-private partnerships, which do not offer broadband service directly. Instead, they offer rights of way, government employee contracts and other incentives to either an outside non-profit or local Internet service provider to offer the service on their behalf. These negotiations usually result in hybrid organizations, which offer service to consumers at reduced prices and cover more square miles, thereby reaching underserved populations while simultaneously complying with some of the more restrictive state policies.

2.3.5 Arguments against Mu-Fi

Whether Mu-Fi projects are desirable – compatible with private sector competition or better than private alternatives – remains a concerted debate. Incumbent cable TV and telecom companies have often opposed municipal entry into communication services as representing an unfair form of government-subsidized competition. Certainly such

deployments have not gone unnoticed by private carriers and have created a conflict of interest; this conflict or problem has been defined by many as a revolution. By most accounts, the revolution has been under way for roughly four to five years. The telecom's retaliation has largely taken the mutated form of anti-municipal legislation, i.e.- state bills in Illinois, SB 499; Ohio, HB 591; Pennsylvania, HB 30; and Texas, HB 789.

The New Millennium Research Council (NMRC), a consulting group that produces reports to the issues and challenges confronting policy makers in the telecom field, has been the unofficial voice and strongest supporter of anti-municipal legislation (New Millennium Research Council, 2005). In February 2005, the NMRC released its most commonly referenced publication to date, entitled *Not In The Public Interest – The Myth of Municipal Wi-Fi*" (New Millennium Research Council, 2005). The extensive multiple-author, telecom-supported report outlines the major criticisms against municipal broadband networks. Given the paucity of investigative research on the topic of municipal Wi-Fi, the NMRC examined the practicality and impact of municipal governments turning Wi-Fi networks into public utilities. As cities debate whether to spend millions in taxpayer funds on Wi-Fi networks, the NMRC's report provided policymakers with a critique of key issues that to date have not been part of the public discourse. The contributing experts identified several key concerns regarding these city-funded networks, including: unanticipated cost overruns by the city that place the burden on taxpayers; the negative impact on broadband competition caused by municipal entry; and, questionable assertions regarding the "build it and they will come" claim, since economic development is not perceived as a guaranteed result of municipal Wi-Fi deployment. The authors concluded that it is vital for city leaders and citizens to carefully evaluate the inputs and outcomes of municipal Wi-Fi projects, because beneath the positive media coverage and glowing press pronouncements are troubling signs that these publicly held networks can result in less than anticipated outcomes.

2.4 Summary: Fears & Hopes of Mu-Fis

Governments are getting involved in the telecom market for a variety of reasons. As suggested above, some rationales for government involvement, such as claims that a government-supported telecommunications service will operate more efficiently than private companies, seems farfetched at best to many.

The transformation now under way in the telecom market is leading many local governments to enter the telecom business via Mu-Fi. This research finds that the rate of government entry into telecom/broadband market is surprisingly high, and increasing. Opponents believe such entry will not achieve its desired goals of lower costs and more rapid deployment of ubiquitous computing systems. To them, government entities are not well suited to compete in the dynamic world of telecommunications. Governments that have already entered the telecom business have been saddled with financial losses and obsolete, legacy technologies. Furthermore, government entry in the marketplace slows the development of private-sector competition.

One thing is certain: this chilling effect created by proposed restrictive legislation has had several effects. For instance, while some municipalities may speed up network deployment to "beat" the enactment of restrictions, others may either roll back their plans or abandon their proposed projects altogether. Still, other municipalities may create new business plans in which ownership of the network is transferred to private partners, and some may sell off municipal rights-of-way in exchange for discounted/wholesale services.

Third, major criticisms to the restriction and prohibition of municipal networks by ILECs, private providers, politicians and their supporters introduced in this article are that the implementation of wireless networks has negative, unproductive characteristics. Numerous high-profile pieces of legislation suggest that a fundamental disconnect exists between public officials and private carriers. Many Wi-Fi projects have now become major undertakings in cities across the country, significantly increasing the complexity of policy decisions. Lawmakers are becoming notorious for regulating how cities use, design, and implement such networks.

Finally, some argue that U.S. broadband penetration lags behind other developing nations that have the good fortune of more reliable, robust and pervasive high-speed Internet infrastructures. I believe this criticism, pointing to the negative effects of an underestimated technological space, is a serious one. All negative characteristics must be weighed against the positive ones. For U.S. municipalities, the positive outcomes are yet to be scientifically ascertained as they are manifested in the successive waves of specific social, economic, and political contexts.

The federal government must decide if it's going to ban state and local governments from implementing wireless networks, or if it will allow them in the public interest. This critical issue is important for the economic welfare of the US; increased high-speed

Internet penetration is an important issue that demands further study and a timely resolution. Serious issues remain unsolved for and against municipalities providing affordable, widespread high-speed Internet access. Clearly, the data points to the US falling further and further behind the rest of the industrialized world in high-speed access. In a technological-based global economy, this could foreshadow America's failure to keep pace with the emerging, booming economies of China, India and the rest of the industrialized world in the foreseeable future. Whatever the best route is, it's clear that America must increase high-speed Internet access, and the data suggests the least costly way is through Wi-Fi networks.

CHAPTER 3: REVIEW OF RELEVANT LITERATURE

3.0 Introduction

In recent years, discussions of universal service have been overtaken by those relating to the digital divide. Both the digital divide and universal service are opposite but equal debates: the digital divide is a political, rhetorical device and universal service is a policy tool. The first part of the section refers to the background of the term "the information society," focusing on its information-rich, socio-technical dimension distinguishing it with the concept of the industrial society. The section then moves into definitions of the digital divide and universal service concepts as used by some of the main scholars in the field. Both the digital divide and universal service are explored vis-à-vis the development of the Internet and the Information Society. The section ends with a discussion about future research in the field.

3.1 The Problem of Information in the Information Society

Information is vital in today's digitally heterogeneous and highly contested information society. Increasingly, our society is centered around information. It appears obvious to loudly declare the 21st century as the age of "information rights" (Grigorovico, Schement et al., 2006). As we progress further into the high-tech millennium, the role of government should be to extend these rights to all its citizenry by providing tools to support the provision of basic tier-information services. In the 21st century, one can argue that without information rights, people cannot fully exercise their rights as citizens unless they are able to access and effectively use ICTs. Just as highways were a critical infrastructure component in the last century, Internet access appears to be an essential part of our infrastructure in the 21st century.

Such concerns for information rights in contemporary societies find a strong resonance in the writings of Mark Bovens, who believes we have long had a policy framework in place designed to protect citizens. Telephony was afforded by a publicly-owned corporation until the 1980s, which was under "universal service obligations" to ensure, through cross subsidies, that poorer and marginalized citizens were included in the network grid. As the universal service responsibility was abandoned, one can argue that information rights also declined (Bovens, 2002).

But what is information, how is it measured and what problems does it pose in the new information/knowledge economy? These are just a few of the questions being posed by Grigorovico, Schement and Taylor (Grigorovico, Schement et al., 2006). According to them, "it may be faulty to use a single standard of measurement at all." They posit that there is no single socio-economic or political model that has been successful at measuring

information and information technology. I argue that if finding a universally accepted definition/metric of information is problematic, then searching for the true calling of the information society is even much more difficult. As a result, the idea of an "information society" is not without controversy. Robert Darnton, one of the preeminent French history scholars, argues "an early information society" was present in 18th century Paris. News, he argues, is not just "what we read in newspapers or see and hear on news broadcasts." It is "…stories about what happened. It is a kind of narrative, transmitted by special kinds of media" (Darnton, 2000). Darnton's interest in news media led him to ask: "How did you find out what the news was in Paris around 1750?" The answer, he says,

> "…was not to read the newspaper, because papers with news in them – news as we understand it today, about public affairs and prominent persons – did not exist. The government did not permit them ....To find out what was really going on, you went to the tree of Cracow. It was a large, leafy chestnut tree, which stood at the heart of Paris in the gardens of the Palais-Royal" (Darnton, 2000).

According to Darnton, it is there where one would find people someone who would tell you the news of the day. He believed that every society, and by implication, every historical period, "develops its own ways of hunting and gathering information," and that examining these reveals a great deal not just about communication patterns, but about power and political relations in each society. To him, this is the quintessential definition of an information society.

Others view the information society through a 40 year-old lens with its roots in post-industrialization in the 1960s and 1970s. To them, the beginning of the information society is marked by the end of industrial capitalism and the advent of a service economy. Part sociology, part technology, mostly futurology, its proponents draw attention to science and technology as key societal components, the distinctive important of information embedded in technology, the decline of manufacturing jobs, and the increase of information work and globalization. In *The Coming of Post Industrial Society* (1974), Daniel Bell argued knowledge and information would replace labor and capital as central economic factors. Emerging from the post-industrialist body of literature itself is the notion of an "Information Society;" a process in which an industrial society is transformed to an knowledge-based, information society (Kumar, Krishan, 2005).

Given the fact there is currently no generally accepted definition of what constitutes an "information society," I will borrow Castells' notion. According to him, an information society is one in which the creation, diffusion, and manipulation of information plays a critical role in the economy (Castells, 1996; Putnam, Robert D., 2000; Schement, J. R. & Curtis, 1997). It is characterized by the increased role and rapid growth of ICTs, brought about by global information-interaction infrastructure enabling effective information exchange among different cultures (Kumar, Krishan, 2005). The objective of an information society is to provide access to local and global knowledge, while satisfying societal needs offered by information services and products. At a meta-level, it can be viewed as both an engine and mirror. It is considered an engine of social, economic and

cultural change in the 21st century and beyond (Dutton, Peltu et al., 1999; Kvasny, Forthcoming). The more information is acquired, the more knowledge (arguably, wealth) is created through the economic exploitation of learning (Castells, 1989). It is also a mirror in that it is a tool to gaze at a society's digital competitive edge and gauge the level of information, telecommunications and technological infrastructure in that society.

Certainly, conceptualizing the information society will probably be one of the greatest challenges in the 21st century. This is certainly true as no single measurement allows us to effectively measure it at a macro level of analysis. Nevertheless, examining the challenge and tension of the information society is crucial to understanding democracy, what it is and what it could be. There are several questions that this challenge raises: How will the information society transform personal and professional relationships? What will be the role of the home in the 21st century? What is the proper balance between privacy and security in an Information Age? These are just some of the questions that ought to be explored as scholars continue to do research and development around the information society. One thing is certain: access to and skilled use of information and information technology will continue to be seen as public goods because, like education and libraries, they are capable of providing positive externalities associated with economic growth and democratic governance (Mossberger, Tolbert et al., 2003). Because critical technological skills raise the level of human capital in the economy, particularly in the context of a knowledge-based economy, access to and skilled use of information-related tools will be indispensable for fully participating in the economy and the political arena. This may provide a strong case for government intervention to provide access to all citizens, not just those who are already advantaged.

3.2 The Problem of the Information Society around the Distribution and Usage of Information.

There are lessons to be learned from the development of the railroad infrastructure vis-à-vis the information society, given that railroads were touted as technological vehicles that had the potential of reuniting the entire human race.

In the US, hegemony on the part of the private sector or the federal government can have detrimental effects on infrastructure, and there is perhaps no better example of this than the railroads of the 19th and 20th centuries. The railroad blueprint also lends credence to the idea that capitalists are only interested in public welfare if that welfare produces significant benefits to them. On the contrary, the railroads also demonstrate the adverse effects that excessive U.S. government regulation can have on an industry. Lessons learned through the railroads are directly relevant to National Information Infrastructure (NII)[9] development, since there are significant similarities:

A nation's infrastructure is the basic building block for all that it can (or can't) accomplish: educating its citizens, quality of life, GNP, employment, literacy, technological advancement, and competing in a global economy. During the Industrial

[9] A government initiative used to develop policies that affected information access via telecommunication.

Revolution in the US, the federal government played an integral role in driving growth of the US economy by building and maintaining the nation's infrastructure. The construction of cities, municipalities, bridges, roads, ports, a postal system, and later, electricity distribution, were critical for building, maintaining and expanding the fledgling U.S. economy. In the early 21st century, the US continues at breakneck speed to move away from a manufacturing-based society to a highly technological and information-based economy. Anderson & Schement have aptly characterized the similarities between both railroad and communication technology (Anderson & Schement, 1995). Specifically, they assert the following points:

1. Railroads were vital to the industrialization process and information has become a critical economic resource.
2. Railroads redefined the process of distribution, whereas communication technology is redefining the daily operations of business.
3. Railroads changed the perception of time and distance just as the convergence of communication technology has broken down time and distance barriers.
4. The assimilation of railroads and communication technology into society has changed lifestyle patterns.
5. Railroads and communication technology require specific skills in order for an individual to be a productive member of the workforce.
6. Railroads and communication technology have infiltrated our culture, altering the fabric of language, writing, and entertainment.
7. In both cases, an integrated system which serves all is most desirable for the overall growth of the nation.

One of the fundamental flaws in the Information Society is the frame employed to create a more equitable and leveraged society vis-à-vis the distribution and usage of information (Schement, J., 1999; Schement, J., Horrigan et al., Forthcoming; Schement, J. R. & Curtis, 1997). It is important to understand what is being debated and what is cursory. Some characterize the uneven allocation of information resources as a politically-charged rhetorical frame: the digital divide (i.e. the actual phenomenon). Others see federal universal service programs as playing an important role in overcoming the technological and cost barriers in delivering information and telecom services to low-income communities (i.e. the technical/perennial term and public policy label). In lay terms, this section examines both sides of the issue.

3.2.1 The Digital Divide Problematized

In actuality, the digital divide is built upon a vision of society. The Internet is seen as a vehicle that provides for the communication, creation and dissemination of information and education (Bucy, 2000; Lazarus, Lipper et al., 2000; Lentz, Straubhaar et al., 2000). This medium is also influential in providing access to opportunities and resources that are unavailable through other, conventional sources. Many positive qualities of the technology center on the Internet's ease of use and the unlimited amount of information housed on it. However, the benefits of the Internet do not appear to be enough to

motivate the utilization of this technology by all. The disparity in the amount of people participating and not participating with the Internet and accessing ICTs is being labeled the "digital divide" (Hoffman, D. & Novak, 1998; Norris, 2001; Selwyn, Gorard et al., 2001). Since ICTs are increasingly becoming a basis of our knowledge societies and economies, the digital divide means that the information "have-nots" are left without the option of participating in our country's social strata by way of new jobs, e-government, healthcare, and education.

There are several basic assumptions upon which the digital divide concept is built. First, the gap is created by several factors, including lack of access to and poor uses of technology, poverty, low spending on education, poor school environments, and inadequately trained teachers (DiMaggio & Hargittai, 2002; Hoffman, D. L. & Novak, 2000; Norris, 2001; Servon, 2002). More often than not, the information "have-nots" are in developing countries, and in disadvantaged groups within countries (Freire, 2000; Tapscott, 1998). Pippa Norris understands the divide as a broad, tripartite social structure (Norris, 2001). For technological utopianists, the digital divide is thus the opportunity for the information "have-nots" to use ICTs to improve their well-being. Other researchers, namely van Dijk and Hacker, argue that some forms of the digital divide will not disappear with increased access to ICTs alone (Van Dijk & Hacker, 2003). The "hardware orientation" – the technological deterministic position that grants computers and Internet connectivity with *a priori* powers – has dominated most policy solutions dealing with the digital divide. Van Dijk and Hacker also forcefully reject the similar utopian argument. Secondly, the debate is largely framed in polarized terms: the *digiraties*/domination and those being left behind/subjugation. Thirdly, the digital divide frame places hope and trust in the infrastructure. It is the quintessential neo-economics story: those who have it want it and those who don't have it, don't want it.

3.2.1.1 Evidence of a Digital Divide

In 2004, the percentage of households in the US that reported having Internet access reached 74.9 percent, according to the Nielsen/NetRatings Enumeration Study (Nielsen/NetRatings Enumeration Study, 2004). This percentage has increased significantly since 2000, when only 41.5 percent of American households were reported to have access to the Internet in the home (NTIA, 1999, 2000). Although household Internet penetration in the US is rising, there are still a significant number of people who do not have access to this important technology. In addressing the digital divide, Kvasny and Truex state that as new technology is deployed, classes of users are advantaged while others are disadvantaged (Kvasny & Truex, 2000). In an effort to address and reduce this additional source of inequality, this digital divide must be fully studied and understood (Cleary et al, forthcoming). According to DiMaggio and Hargittai:

> "This concern about inequality, and about the possibility that the new technology might prove to exacerbate inequality rather than ameliorate it, is focused on what analysts have called 'the digital divide' between the online and the offline, the information 'haves' and 'have-nots'" (DiMaggio, Hargittai et al., 2001).

Although the NTIA found that more Americans than ever before were connected to the Internet, the data clearly showed a persistent digital divide between the "information-rich" and the "information-poor." Upper-income households are still much more likely to have Internet access and PCs at home (NTIA, 2000). Furthermore, whites are more likely than African-Americans or Hispanics to have Internet access.

Babb investigated home computer ownership and Internet use among low-income individuals and minorities. She found that African-Americans and Hispanics were less likely to own computers, even after adjusting for income and education, and termed this finding, consistent across seven different data sets under examination, "the single most important finding" of her study (Babb, 1998).

In 1997, Hoffman and Novak also examined racial differences in Internet access and use and found that, overall, whites were significantly more likely than African-Americans to have a computer in their households and were also more likely to have PC access at work (Hoffman, D. & Novak, 1998). Whites were also significantly more likely to have ever used the Web at home, whereas African-Americans were more likely to have ever used the Web at school. As one might expect, increasing levels of income corresponded to an increased likelihood of owning a home computer, regardless of race. But, while income explained race differences in computer ownership and Web use, whites were still more likely to own a home computer than were African-Americans and to have used the Web recently, even controlling for differences in education.

Not surprisingly, increasing levels of education lead to higher levels of access, use, home PC ownership, and PC access at work. But Hoffman, Novak, and Schlosser found that these levels were higher for whites than for African-Americans and persisted even after adjusting for education (Hoffman, D. L. & Novak, 2000). Also not surprisingly, higher income corresponded to higher levels of access, use, home PC ownership, and PC access at work. At incomes below $40,000, whites were more likely than African-Americans to have Internet access, to own, or to use a PC, whereas the gaps greatly diminished at incomes above $40,000.

Hoffman, et al, reported that men were still more likely to have ever used the Internet than women, but that, consistent with other surveys, the gender gap was closing rapidly (Hoffman, D. & Thomas, 1999). However, white men and women were more likely to have access, to use, and to own PCs than their African-American counterparts. Furthermore, although the percentage of white men and women owning a PC has increased, it has not increased for African-American men and women.

While some researchers suggest that the gender gap in Internet use appears to be closing over time (Maraganore & Morrisette, 1998), other researchers have identified an enlarging gender divide among Internet users (Hoffman, D. L. & Novak, 2000). Both camps are clearly in contention. However, both agree with Clark and Gorski that the gender gap is created out of the inequitable practices in education that are preparing tech-confident, tech-savvy and tech-valuing men to fit into high-salaried technology industry

jobs, while women are discouraged, and maybe even forbidden, from seeing technological occupations as attainable (Clark, C. & Gorski, 2002).

The digital divide is still and evermore so a continued concerted debate for two principle reasons: first, no clear policy solution has yet closed the social inequities between the ICTs' haves and have-nots (Sanderson, 2000; Servon, 2002); second, the Internet is arguably racing toward critical mass and not scaling economically (Hoffman, D. L. & Novak, 2000). In fact, the digital divide's basic meaning has arguably metamorphosed into many differing conceptions, definitions, ideologies, frameworks and philosophies over its short history (Bagasao, Macias et al., 1999; Berghman, 1995; Gordo, 2000; Hargittai, 2002; Lenoir, 1974; Schiller, 1996). The digital divide discourse is profoundly contentious as it highlights the inequitable social distribution of ICT universal service in a globe that moves gradually towards Manuel Castells' revelation of a worldwide "network society" (Castells, 1989, 1996). The inability to possess ICT skills is to be a point in a network without links. And, disconnected points in a network not only will not survive, they just might as well not exist. The gap, therefore, is not about the technological artifact per se (i.e. laptops or municipal Wi-Fi connections); instead, the divide is an allegorical euphemism that probes societal inequitable gaps between those that use, develop, support and implement ICTs. As ICT advancements mushroom at an incremental rate and as our societal dependency on ICTs solidifies, the possibility to leave others behind escalates. This socio-technical quandary poses an ethical question, "Why and how should we help the have-nots?"

It is unascertained whether this digital divide is caused by economical issues (e.g., cost of access), education, or deeper social issues (e.g., perception of the use of the Internet). If mere access to information services does not affect the digital divide (or even exacerbates it), then new understanding is required to assist public policy development and cyber infrastructure implementation and dissemination. Without such an understanding, tax-exempt funding could be misappropriated.

3.2.1.2 Closing the digital information gap?

The following question is raised in the literature: is the "digital gap" disappearing? Clearly, the US has moved from a Clinton administration that was highly attentive to digital divide concerns, to a Bush administration that is largely ignoring it. This political conversion has generated various evaluations of the evidence for and against a divide between those who have access and those who do not in terms of hardware ownership and Internet access (Compaine, BM., 2001). Some researchers have categorized the divide into three groups: the global divide perspective, the social divide perspective and the democratic divide perspective. The global divide refers to the discrepancy of Internet access between developing and industrialized communities; the social divide involves the divide between information poor and rich in each country; the democratic divide indicates the difference between those who do, and do not, use the online digital resources to educate themselves, mobilize and partake in civic services (Gordo, 2000; Norris, 2001; Payne, 2005; Van Dijk & Hacker, 2003).

While there have been multiple studies of the digital divide, they have mostly focused on technological access, rather than on the more complex issues of technological skills, with some notable exceptions (DiMaggio & Hargittai, 2002; Gordo, 2000; Lazarus, Lipper et al., 2000; Mossberger, Tolbert et al., 2003; Oden & Strover, 2002; Servon, 2002; Van Dijk, 2001; Warschauer, 2002, 2003). Dimaggio, et al, have set out the following research agenda:

> "Expand the focus of research from the 'digital divide' between 'haves' and 'have-nots' (or between users and non-users) to the full range of digital inequality in equipment, autonomy, skill, support, and scope of use among people who are already online" (DiMaggio, Celeste et al., 2004).

The social problem of technological inequality has its roots in more than access to technological divides and services. Information inequality, in response to the traditional term "digital divide," finds that in addition to persisting gaps in access to information and communication technologies, gaps in skills and usage may be a larger social problem (DiMaggio & Hargittai, 2002; Gordo, 2000; Lazarus, Lipper et al., 2000; Mossberger, Tolbert et al., 2003; Oden & Strover, 2002; Servon, 2002; Van Dijk, 2001; Warschauer, 2002, 2003). Individuals representing different social groups based on age, gender, race, ethnicity, socio-economic status, etc. have differing access and ability to obtain, understand, create and use information. In some cases, control over information is seen as an essential aspect of autonomy, social mobility and empowerment on par with human or social capital (Norris, 2001; Oden, 2004; Putnam, Robert D., 2000; Schiller, 1996). These scholars have stressed the cultural, educational, political and socio-economic aspects of the digital divide and believe that while access is being addressed, many other gaps are widening. From this point of view, government and industry have focused too narrowly on addressing the access issue by providing devices to schools and communities. Since these policy makers have not defined the digital divide in terms of skills and competence, they have not invested in training, teaching and technical assistance that would better address the issues.

The access divide is not enough to truly understand the problem. The key issues are technical competence and information literacy. Technical competence is the ability to operate a computerized or electronic device, such as using a word processor, sending e-mail, and using spreadsheets and databases. Information literacy is the ability to recognize when information is needed and to locate, evaluate and effectively use the required information. According to Mossberger's study, one fifth of her population reported needing assistance using a mouse or keyboard (Mossberger, Tolbert et al., 2003). One third of her respondents felt they needed help negotiating their way through information sources on the Web and in databases. The skills divide replicates the access divide; those who lack skills are older, less-educated, poor, and predominately African-American and Latino. This same pattern of disparity characterizes both technical competence and information literacy (Mossberger, Tolbert et al., 2003).

3.2.1.3 Approaches, Assumptions and Disagreements

There are a variety of suggested approaches to addressing the digital divide that are expressed in different terms and add to the multifarious nature of this issue. Even so, the discourse is guided by two main voices: those who believe technological access is our inalienable right, and those who have seen access to ICTs as more than digital – in other words, it is social, political and economical. One group views the digital divide through the lens of a decades-old policy commitment to the principle of universal telephone service. The core belief among this group is that since the market drives the rapid proliferation of new technologies, there must be inherent value in those new technologies, which will eventually bring its value and economic opportunity to all social classes (Compaine, BM., 2001; Thierer, 2000). The end product of this point of view is that access is becoming a non-issue as information and communication technologies saturate the entire market and costs drop. Those who do not use information and communication technologies choose not to use them.

For some researchers, the first step in this process is to recognize the race, gender, socioeconomic status, language, and disability digital divides as symptoms of racism, sexism, classism, casteism, and so on. For those researchers, the divides are a set of problems that cannot be fixed by introducing more computers or more, or faster, Internet access into an inherently inequitable system. The digital divide is socio-historical, socio-political, and socio-cultural in nature, and can only be dismantled through movements that address it on those levels. Until the digital divide is understood, critiqued, and addressed through the lens of an evolving dynamic, these technologies, which some refer to as societal equalizers, will at best uphold current inequities, or at worst deepen them. These proponents call for a major systemic shift in thought and action. These actions should include, but not be limited to: Providing more effective and more complete community training on how to use computers and the Internet in progressive, sound ways; Informing educators and government officials at all levels about the complexity of the digital divide so that they can develop strategies for examining and establishing a broader interpretation of “access”; and crafting legislation that addresses greater access to computer instruction and courses for people disenfranchised by the digital divide.

The contrasting point of view finds that in addition to persisting gaps in access to information and communication technologies, gaps in skills and usage may be a larger social problem (DiMaggio & Hargittai, 2002; Gordo, 2000; Lazarus, Lipper et al., 2000; Mossberger, Tolbert et al., 2003; Oden & Strover, 2002; Servon, 2002; Van Dijk, 2001; Warschauer, 2002, 2003). To this group, the divide is about equitable access, where “access” is broadly defined, and the end of the digital divide can be imagined as those actions that lead to and maintain a future in which all people, regardless of personal, social, political, or cultural identity, enjoy equal access to information technology. To them, we will never fully understand the breadth and depth of the digital divide if we do not examine it within these contexts.

While some believe individuals on the negative side of the divide may simply lag behind majority adoption patterns due to traditional patterns of technology usage or delayed

market forces (Compaine, B., 2000; Compaine, BM., 2001), it is more likely that systemic hindrances prevent the adoption of a communications in tune to the rest of society. I agree with van Dijk and Hacker's position, that these gaps do exist, that they are social ills, and that innovations and markets alone will not fix them (Van Dijk & Hacker, 2003). After all, the divide is not the false dilemma between two distinct groups, but is a wide-ranging index of differing levels of access to information, tools, and possession of literary abilities. Like several of the aforementioned articles, I too assume that we have social responsibilities to those who wish to adopt ICTs, but cannot. "The fundamental task of future society will be to prevent structural inequalities in the skills and usage of ICTs from becoming more intense" (Van Dijk & Hacker, 2003). Battling structural inequalities requires varied, dynamic, and evolving solutions implemented in different social, domestic, and vocational spaces and times.

3.2.2 Universal Service Defined

In today's digital knowledge economy, universal service to information technology is the precursor of ubiquity. In many ways, it is an enabling policy tool for allowing citizens to fully (and realistically) participate in fundamental societal activities. Without access to the information provided by telecommunication networks, it is far more difficult to maintain a high number of informed and involved voters. This is analogous to how a lack of federally-supported legislation promoting rural access to telephone lines would have had negative societal consequences. Similarly, access to information technology like the Internet via broadband is a public good, because like education and libraries, it is capable of providing positive externalities associated with economic growth and democratic governance (Mossberger, Tolbert et al., 2003).

The term "universal service" (US) represents the technical definition behind "universal service." US is about grating access to the telephone (or blanketing an area with Wi-Fi nodes for Internet availability) in a community; US entails more than physical access to a device, but individual/domestic adoption and usage. It is comprised of a wide array of definitions, frameworks, philosophies, approaches and connotations. Some see it as a new, politically correct term referring to the introduction of "special features" for "special groups of users" in the design of a specific product. For others, US allows for what Human-Computer Interaction designers call "good user-based design," wherein the needs of all potential users (both consumers and producers of information) are addressed. Moreover, some believe that universal service has its historical roots in the U.S. Communications Act of 1934, covering telephone, telegraph, and radio services, and aiming to ensure adequate facilities at reasonable charges, especially in rural areas, and to prevent discrimination on the basis of race, color, religion, national origin, or sex. I argue that the roots of "universal service" run deeper than these latest communication developments, and are older than the opening of the Erie Canal in 1825.

Universal service to IT services offers broader socio-economic and political benefits; IT has become central to our knowledge economy and is thus wedded to wealth, power, and prestige. There is a strong common belief that people who have access to and the skills to

use the Internet are (1) more successful economically, with respect to education, jobs, earnings; (2) socially participate more in terms of political and civic engagement; and (3) receive more government services and other public goods than those who do not. (Katz & Aspden, 1997; Katz & Rice, 2002; Oden, 2004; Oden & Strover, 2002; Tufekcioglu, 2003). Increased access to the Internet also provides greater access to education, income and other resources (Benton Foundation, 1998; Bucy, 2000; Hoffman, D. & Thomas, 1999; Strover, Chapman et al., 2004; Strover & Straubhaar, 2000)

3.2.2.1 Universal Service in the 20th Century

The goal of universal telephone service has never been simple to define. Research has focused on what exactly this goal is and how it might be achieved (Sawhney & Jayakar, 2005). Most policies surrounding universal service are strongly oriented toward the infrastructural aspects of telephony. This focus is reflected in the measures used for universal service: telephone penetration rates, whereby availability of service is described as physical access to the telephone network. This said, it is "one of the great and worthy pillars of telecommunications policy" (Beckman, 1995). It is built on an elaborate body of regulatory, technical, and historical practice.

Historically, the term "universal service" lies behind the 20th century debate of "universal service." The term "universal service" first appeared in 1907 (AT&T Annual Report, 1907, cited in Mueller, 1993, p. 353) when Theodore Vail, then president of AT&T, introduced it as the company's top corporate goal. However, Vail's original design of universal service was far different from the modern "expression of liberal egalitarianism" (Mueller, 1993). When faced with growing competition from independents for the nationalization of the telephone, Bell management began to adopt the "universal service doctrine" to defuse the criticism of their monopolistic actions. From 1907, AT&T's annual published reports hammered away at the notion that "only a system that was universal, interdependent and intercommunicating could realize the telephone's potential" (Mueller, 1993, p. 363). According Vail, competition had led to a "broken" network because of lack of interconnectivity among other competing networks. Thus, Vail's vision of universal service was an integrated/interconnected network, allowing all telephone users to communicate with one another.

By the same token, however, Bell management posited that government intervention, via public regulation, could be an acceptable surrogate for effective competition. Understanding that "a nation-wide telephone monopoly" would not be allowed without "some degree of public regulation," Bell managers favored regulatory commissions that adopted a judicial stance and were therefore less susceptible to public pressure (Federal Communications Commission, 1939, p. 475, cited in Smythe, 1981, p. 144). Congress acquiesced to Vail's argument, permitting AT&T to imbibe the independents via sublicensing. The 1921 Willis-Graham Act protected the new monopoly from future antitrust suits.

Between 1907 and 1975, AT&T guaranteed universal service; "the interconnection of all localities and telephone users into a single system" (Mueller, 1993, p. 367). It could be argued that the original universal service policy was driven less by the needs of the citizenry and more by the interests of AT&T itself (Preston & Flynn, 2000).

The 1934 Communications Act is frequently referenced as the basis for many subsequent constructions of universal service goals. Its preamble summons for government regulation,

> "…to make available, so far as possible, to all people of the United States, a rapid, efficient, nation-wide, and world-wide, wire and radio communication service with adequate facilities at reasonable charge" (Communications Act of 1934, 47U.S.C.A. 151 et seq.).

Nonetheless, since the act makes no reference to the actual term "universal service," it has been argued that "there is nothing in the text of the Act which can be construed as mandating or even suggesting a policy of subsidizing telephone penetration" (Mueller, 1993, p. 354). While this may be so, the 1934 act also appointed RCA, AT&T, and Western Union as "common carriers" in their respective fields of radio, telephony, and telegraphy, as a trade-off for guaranteeing the monopoly position in their markets (Preston & Flynn, 2000).

Furthermore, the U.S telecommunications empire comprised a dominant private monopoly regulated by a permanent commission, the FCC. In theory, this gave rise to the first definitions of universal service within the federal U.S. telecommunications policy-making context. In practice, the duties and rights attributed to AT&T by its common-carrier status meant that universal service was well defined as common carriage. It is important to stress, however, that the ultimate objective of universal service policy from this period was not necessarily to place a telephone in every U.S. home, but rather to ensure that every potential subscriber would, via rate averaging, receive the same treatment. Universal service, in essence, was about putting the "service" in universal service. The "universality" of the policy was constrained by those able to afford the charges arrived at by average pricing (Preston & Flynn, 2000).

3.2.2.2 Universal Service in the 21st Century

As we moved from an industrial to a post-industrial society in the 20th century to an information society in the later 20th and into the 21st century, the universal service debate remains a hotly contested telecommunications issue. According to Schement & Forbes (1999), a universal service policy should provide three broad levels of value to every society adopting its premise: political, economical and social.

Politically, every nation requires an informed and involved citizenry, something possible only if its citizens have access to information about their government and the opportunity to participate in political discourse. Even if the importance of political information is

obvious, it is extremely difficult to become an informed citizen since there are two dimensions to political communication – reception and distribution. Economically, information networks distribute economic goods and services, and add value to transactions. Networks carry information that becomes input into other products and services as well as transmitting information that itself has value as an independent entity. Thus, the economic benefits of an interconnected information infrastructure accrue to the individuals on a network, to the network owners, and to society as a whole. Without basic communications service, a person is less likely to contribute to the pool of positive effects generated from multiple interactions on the network (Dutton, Peltu et al., 1999). Socially, in the first decade of the 21st century, it seems reasonable to suggest that access to an interconnected information infrastructure is crucial because individuals need access to information for self-development, for help in developing and maintaining social relationships, and for the benefits derived from those relationships.

Analogous to the telephone in the 20th century is the notion of access to and skilled use of ICTs like the Internet. Just like the FCC's universal service policy was seen as a prerequisite for ubiquitous telephony, the lack of access must also be defined as a major barrier to the full exercise of citizenship rights in a democratic information society. The fact that ICTs like the Internet has become pervasive, that it is structurally integrated into modern life, and that it is difficult to operate in an information society without one, make access to it a political issue. The digital global information economy now comprises a social space where communication is increasingly mediated by electronic means, where access to or accessibility via the Internet is increasingly taken as a given, assumed for the conduct of many types of economic and social exchanges that underpin all three dimensions of Marshall's rights[10]. On this basis, I argue here that access to the Internet should be explicitly identified as a social right (Tambini, 2003).

3.2.2.3 Measuring Universal Service: Then and Now

In measuring the effectiveness of telecommunications policies like the universal service program, we quickly learn that areas of low population density tend to have lower telephone penetration, coupled with widely dispersed demand requirements (Sawhney, 1992). The universal service vision for the telephone was conceptualized (both domestically and internationally) into measuring this demand for service and the communications technology penetration level. Specifically, two measures were used: the number of main telephone lines (MTL) and main telephone lines per 100 inhabitants (Brooks, 1975).

As universal service moves into the information age, its context has forever changed, yet its message is still the same. In essence, universal service is about guaranteeing

[10] The classic text on citizenship is T. H. Marshall's Citizenship and Social Class (1950), wherein he defined citizenship as full membership of a given society. Delivered as the Alfred Marshall lecture in 1949, T.H. Marshall took as the basis of his essay his namesake's assertion that "there is a kind of basic human equality associated with the concept of full membership of a community—or, as I should say, of citizenship" (Marshall, 1950, p. 8). There are two basic aspects of citizenship for Marshall— duties and rights. I focus on the latter. Marshall distinguishes three basic dimensions to citizenship rights— civil, political, and social.

communication ubiquity, both within the home and beyond. However, universal service carries a good deal of telephone-related conceptual "baggage" that needs unpacking if it is to be a useful principle for the Internet. If this is not addressed, universal service will continue to be a 1930s solution to a 21st century problem. Measuring it in the information age requires a research design capable of identifying the societal effect of policy and impact of organizational/municipal design over time. Universal service needs to be forward looking to help build the broadband networks of the future in a manner that fulfills the vision of the Constitution.

3.2.2.4 Schement's Universal Service Four Cs Model

Simply put, universal service is about allowing all citizens to reach every possible technological destination. It is also an understanding of key tools an individual needs to gain full access and thus enter into the local, national and global information expressway. At the community or municipal level, it is important to highlight that a successful design, implementation and use of information technology like Internet access depends on four primary components of access: connectivity, capability, content and context.

Connectivity

The first step toward access requires connecting to the network which, in turn, requires high-speed interface technologies – DSL, cable modem, wireless, T1.5, DS3, routers, and so on. Peripherally, Internet access demands a computer or a laptop with a network-interface connection. The quantity and quality of access points to telecom networks in a community is equally important. The availability of access gateways – namely public libraries, public hotspots, cyber-cafes, cyber-parks, schools, community technology centers, and recent municipal wireless broadband deployments, increase the number of connection portals to the local citizenry and are a critical component of access mediation. Nevertheless, connectivity to broadband telecom service by itself will not guarantee economic and social sustainability for local communities. Interestingly, most of the "broadband digital divide" commentary emanating from the 1990s viewed universal service through the lens of a decades-old policy commitment to the principle of universal telephone service. The core belief among this group is that since the market drives the rapid proliferation of new technologies, there must be inherent value in those new technologies, which will eventually bring its value and economic opportunity to all social classes (Compaine, 2000; Thierer, 2000). The end product of this point of view is that access (i.e. connectivity) is becoming a non-issue as information and communication technologies saturate the entire market and costs drop. Neo-classical economists would believe that those who do not use information and communication technologies choose not to use them. The contrasting point of view finds that in addition to persisting gaps in access to information and communication technologies, gaps in skills and usage may be a larger social problem (Oden & Strover, 2002; Strover 1999).

Capability

The utility of any technology derives directly from the skills of users and the delivery capacity of local communities. Technological skills raise the level of human capital in the economy, particularly in the context of a knowledge-based economy. Computer and information technologies are tools for participation in the economy and the political arena. This makes a strong case for government intervention to provide access to all citizens, not just those who are already socially advantaged. Key issues involved are technical competence and information literacy. Technical competence is the ability to operate a computerized or electronic device such as using a word processor, sending e-mail, using spreadsheets and databases. Information literacy is the ability to access, evaluate, organize and use information in order to learn, problem-solve, make decisions in formal and informal learning contexts, at work, at home and in educational settings. According to Mossberger's study (2003), one fifth of her population reported needing assistance using a mouse or keyboard and one third of her respondents felt they needed help negotiating their way through information sources on the Web and in databases. The skills divide replicates the access divide, those who lack skills are older, less-educated, poor, African-American and Latino. Both technical competence and information literacy are key characteristics of life-long learners which, in turn, are strongly connected with critical and reflective thinking. Communities need resources in the form of funding, staff, devices, etc. in order to ensure successful delivery capabilities to their local user groups.

Content

While we live in an era of manifold content, access to it is more complex. Content is interdependent upon the other three C's. Once individuals and communities become connected and have the capabilities and necessary skills to use the Internet, they need a reason to use it. In other words, for access to be meaningful, available information must address users' concerns and circumstances. Content that is specific to marginalized communities faces significant barriers, including the lack of neighborhood-level information such as housing, childcare, and transportation news. The inadequate content for culturally diverse populations, including non-English speaking Internet users, is quite problematic. If the content that is made available to users is irrelevant, useless or simply nonexistent, it will be far more difficult to encourage and sustain use among and across communities. Relevant content is necessary because it provides a forum for interacting within local communities as well as a window to the outside world. Granovetter argues that the more bridges (i.e. users in two or more communities) exist in a municipal context and the greater their degree, the greater their capacity to increase social capital (Granovetter, 1973). Community leaders need to focus on those bridges (e.g. weak ties) and use them as mediators for promoting universal participation between and among diverse communities. The availability and relevance of content presents a unique challenge to local communities.

Context

Context represents the unique foundation upon which access can be accomplished and upon which any development strategy exists. Because no two communities are alike, the history, socio-economic demographics, geography, political, and cultural setting varies from community to community. These include quality of life measures like education (graduation attainment levels, literacy rates); public safety (crime rates); health (infant mortality, health insurance coverage); economic (number and types of business establishments, unemployment rates, and poverty); and social (voter turnout, life expectancy rates).

By conceptualizing telecom services like broadband technology as a pluralistic domain that includes the broader context in which the technology is embedded, we connect society's complex infrastructures and human behavior to form a socio-technical network. Drawing from the Social Shaping of Technology and Actor-Network Theories, we see broadband as a socio-technical ensemble, in which technology and organizations cannot be treated as separate entities. There exists a complex web of mutual dependency between all relevant social groups, devices, expertise and information. Bijker uses the term socio-technical ensemble to denote this network of objects, infrastructures, and humans and the roles they play (Bijker, 1995). These elements of the ensemble, whether human or technical, must work together to produce a functioning whole.

3.3 Chapter summary

In the US, technology has been socially connoted and denotes a utopian belief. Put differently, technology is perceived as an artifact that betters society as it enhances civic services, promotes socio-economic progress and improves individual conditions. Much of the technological progress we have experienced since the mid-1940s, with the introduction of the television and now the Internet, was under the idea of creating a wired nation; it was this notion that drove public policy debates during the later half of the 20th century. This idea of a "wired nation" was the precursor of the "if-you-build-it-they-will-come" allegory. The latter belief is the basic idea of providing the ICT infrastructure to anyone and expecting users to automatically recognize the artifact, use it and create new information generated from the artifact. Historically, the problem with such a construction is that they have failed for the most part (for instance, the dot.com bubble bust in the late 1990s). The reason is simple: most citizens are unable to foresee future outcomes and are imbued with a halo of optimism.

Interestingly, the digital divide debate that emanates from the mid-1990s varies widely from very recent discussions of this phenomenon. This is due, in part, to the fact that the whole debate is a symptom of a rapidly changing socio-technical terrain. While the proposed Mu-Fi initiatives could have a major impact on bridging the digital divide, it is important to realize that the digital divide increasingly is less about physical access (i.e. connectivity) and more about socio-economic disparities that exist in both the digital and non-digital worlds (i.e. universal access to the Internet). As we progress into the new millennium, the way we think about a technology in the information society is just as important as the technology. To put this into a broader perspective, it should be noted that public language has a deeply rooted assumption. These assumptions are frames of reference that set the tone, affect modes of thinking and ultimately transform public discourse.

Given that most local government involvement in Mu-Fi is relatively recent, the data needed to definitively characterize the depth and breadth of the phenomenon is scarce. From this literature review, I borrow the constructs of the information society, the digital divide and universal service in order to evaluate the impact of these networks at an organizational level with societal implications.

If the US is to regain a competitive edge in the global economy, it must bridge the gap between the technological haves and have nots by providing not only the necessary skills to use the Internet to its full potential, but also the means of accessing it and the equipment to do so. Anything less will result in a technological lower class that will have a debilitating effect on America's economy and society in the 21st century and beyond.

CHAPTER 4 THEORETICAL FRAMEWORK

4.0 Introduction

I began this journey assuming this would be a qualitative, interpretive research study using socio-economic development and multiple Information and Communication Technology (ICT) theories, but I was forced to change my theoretical plan because of what the data revealed[11]. As the data revealed more of the phenomenon, I realized it was important to consider other theoretical perspectives. Analytical induction, which explains human behavior by recognizing key social processes, informed by the theoretical framework of *technological enthusiasm*, seemed to fit the research questions and accompanying data. The epistemology is qualitative, interpretive and critical, reflecting the belief that knowledge is socially constructed and contextualized.

This chapter explicates the rationale for analytical induction, epistemology and theory extension. Then, it explores how substantive – autonomous – deterministic theories complement *Technological Enthusiasm (TE),* the term adopted for this research. By overarching each of these theories, this chapter provides the main analytical tool via TE. It explores content and dynamics of TE; contextually influential factors of philosophical and theoretical nature are investigated in particular. Against an intriguing background of interaction between vision and contexts, I argue that cities express their TE in accordance with distinct models of each theory.

4.1 Rationale for Analytical Induction (Structured Form of Grounded Theory)

In order to explore Mu-Fi and their claims of bridging the digital divide, this study employs an analytical induction (structured form of grounded theory) methodology of inquiry. Grounded theory describes the manner in which theory develops from data collection and analysis (Bowers, 1988). It was developed by Glaser and Strauss (1967), who identified an opportunity to move away from the traditional construct of verifying theory (Glaser & Strauss, 1967). In contrast to experimental design, grounded theory does not conform to the expectations of a pre-determined hypothesis, because theory is constructed rather than tested (Annells, 1996; Bowers, 1988; Charmaz, 2006; Glaser, B., 1978; Mey & Mruck, 2007; Morse & Field, 1995; Robrecht, 1995; Strauss, A. & Corbin, 1998; Strauss, A. L., 1978, 1982; Thompson, 2005). The theory is, thus, grounded in the data from which it was generated rather than being drawn from a pre-existing body of

[11] Initially, I had assumed Actor Network Theory was key to this study but I realized the crucial feature of this research was not the theory of nets/networks and , but the actor part of the term. Actor network theory is not enough to underline the multiple realities of the Mu-Fi experience.

theory (Glaser, B., 1978). Grounded theory does not claim to be capable of generalization; it is descriptive, not prescriptive (Glaser & Strauss, 1967). Rather than being finite, precise and prescriptive, grounded theory is a dynamic method that has continued to develop over the past few decades (Creswell, 1998).

The objective of analytical induction is a strategy that involves the scanning the data for categories and developing typologies (Creswell, 1998). Analytical induction is particular to qualitative studies and is a way of dealing with observational data using an iterative process of developing categories. While pure grounded theory and analytical induction are advocated for theory development and testing, there are few examples of this being employed. This research study is a vivid example of how this approach can be carried out.

The emic perspective of analytical induction adopted for this study explores the data using the categories and themes that emerge and develop from the words of the participants themselves. These themes are unique to this research and provide a framework for understanding the post implementation impact of Mu-Fi. Since there were no existing studies about the impact of Mu-Fi on the digital divide or related fields, this study creates emergent theories (Strauss, A. & Corbin, 1998).

4.2 Rationale for Epistemology

The epistemology for this research study is qualitative, interpretive and critical. Qualitative research is grounded in the ideals of description, narrative, and experience (Merriam, 1998). When trying to understand the complex lives of people – culture, context, lived experiences, and intricacies of a specific case – qualitative methodology provides the opportunity for thorough, deep involvement. Through interviews, observation, and immersion, this study develops a rich, thick description and understanding of the subject matter (Merriam, 1998). Qualitative research helps the reader to understand participants' stories and behaviors (Strauss, A. & Corbin, 1998).

The study is interpretative for several reasons: it attempts to understand the deeper structure of phenomena within its cultural/contextual situation; it reveals the story behind the statistics; and it lends itself to multiple degrees of open-endedness. This study also performs the critical role of critiquing the status quo by exposing structural contradictions and distortions in belief systems and social practices by calling for changes in practices.

As mentioned above, this epistemology was most appropriate for this particular study. All cities differ in their approaches to designing, implementing and using municipal wireless broadband networks for alleviating the digital gap. In order to understand thoroughly each unique city and their respective situations, deep, rich data was collected through qualitative methodological strategies. By understanding the stories of these cities, the research provides empirical data and practical implications for practitioners, policy analysts, government officials, and telecom decision makers.

4.3 Rationale for Theory Extension

Since the extension of theory is achieved through discovery from the ground, it was necessary to revisit this study's research question. The research question attempts to address a very dynamic, messy, tumultuous and complex phenomenon. Once reexamined, this research needed a meta-level theoretical approach that defined key concepts and explained phenomena between these concepts. From philosophical and scientific standpoints, theory development is embedded in an ongoing reflection on the possibility of employing trans-disciplinary frameworks at a meta-level (Hirschheim & Klein, 2003; Kuhn, 1996).

Theory development or extension is not only an object of study; it is also a general research methodology. It is used to define a model to serve as a basis for empirical-based research. I contend an extension of theory is required to accurately describe the impact of municipal broadband systems. An extension of theory is vital in explaining how public elites are attempting to bridge the digital divide, and, thus, address the research question.

Moreover, because this research has a "how" focus, evoking the notion of Ockham's Razor - "Plurality should not be assumed without necessity" - (Ariew, 1976; Sober, 1975; Thorburn, 1918), I argue that the broad research community must devote additional time to the "how" questions in tandem with theory extension models in order fully grasp the prefix "so what" of research.

This study employs the extension of theory by borrowing existing work from substantive-autonomous-deterministic-optimistic theories, namely **technological utopianism**, **technological determinism** and **ICTs for development**.

4.4 Technological utopianism

Based upon the general definitions of substantive-autonomous-deterministic theories, this research regards technological utopianism as defining elements of TE. Hence, TE refers to both positivist and idealist elements; positivist in that it seeks to provide descriptions of and explanations for observed phenomena, and idealistic in that utopians believe that designing, developing and implementing technologies fosters a panacea for a new form of social life.

Technological enthusiasm has been a generalized phenomenon and can be shown by references to studies on the history of the technological determinism/utopianism Included in the genre are the studies offered by Hughes, Bijker, Castells, Segal, Nye, and Wright (Bijker, W. E., 1995; Castells, 2001; Hughes, 1989; Nye, 1990; Segal, 1985; Wright, 1992).

Technological utopianism does not refer to a technology, per se, but to the analyses that the use of technologies plays a significant role in shaping an idea or perfect world.

Bernard Gendron explicates the utopian belief system in his work *Technology and the Human Condition* (Gendron, 1977). He considers the following authors utopians: Buckminister Fuller (1969), John Maynard Keynes, and Arthur Clarke (1964) (Keynes, 1972).

Technological utopianists argue that technology will improve our quality of life. Technological utopianism is a form of analyses that places the use of some particular technology; computers, Wi-Fi access, or the Internet, as the central enabling element of a utopian vision. Technological utopianism does not refer to a set of technologies, but it refers to analyses that specific technologies play a key role in shaping a utopian social vision, where their use easily makes life enchanting and liberating for nearly everyone. The most essential characteristic of the utopian argument is the elimination of scarcity. According to Segal (1985), "the ethos of technology shapes the values" of the citizens into a worship of effectiveness and efficiency manifested in public discourse (Segal, 1985). To Segal, utopians were not dreamers, but well-educated Protestant males with some technological knowledge, what we would now call members of the Establishment. He wrote that technological utopianism is "the belief in the inevitability of progress and in progress precisely as technological progress" (Segal, 1985:1).

John Maynard Keynes (1972) continues in the same vein:

> "When the accumulation of wealth is no longer of high social importance, there will be a great change in the code of morals. We shall be able to rid ourselves of many of the pseudo-moral principles which have hagridden us for 200 years, by which we have exalted some of the most distasteful of human qualities into the position of highest virtues…The love of money as a possession—as distinguished from the love of money as a means to the enjoyments and realities of life—will be recognized for what it is, a somewhat disgusting morbidity, one of those semi-criminal, semi psychological propensities which one hands over with a shudder to the specialists in mental disease" (Keynes, 1972:329).

Another example of technological utopianism can be found in the works of Buckminster Fuller (1969):

> "As 100 percent of humanity achieves, or nears, physical-survival success, past history's seemingly inexorable reason for war (not enough for both of us) will have been eliminated…where there was abundance, competition was unnecessary and unthought-of …Though wars were precipitated by and identified by irrelevant and superficial preoccupying 'causes' which were popularly sloganable, wars have always occurred because of the underlying inadequacy of vital supplies. We will always have war until there is enough to support all humanity (Fuller, 1969:290)."

Technological utopians conceived of a society comprised of more than tools and machines alone as a means of achieving a "perfect" society in the near future. This

society would not merely be the product of its inventions, but it would also have a dramatic effect on all aspects of society: its government, mores, norms and values. Shortages will be eliminated, resulting in a utopian society. This utopian view is no less deterministic than the dystopian view espoused by the members of the Frankfurt School and Ellul, Ferkiss and Mumford. According to this view, technology plays the largest role in how societies evolve. Technological utopians believed emerging technologies would be the panacea to sociological ills.

In a Mu-Fi context, technological utopianism is a key rhetorical device used by public elites to frame digital-divide discourse. Specific technologies, such as wireless broadband, are key elements of utopian visions. With little or no articulation of the complex relationships, the costs associated with actually implementing such a vision, or the political struggles that will certainly ensue, the government invites public identification with and participation in the mobilization of support for the expansion of municipal wireless network into every facet of peoples' lives - in their homes, workplaces, and schools.

4.5 Technological determinism and mythic conceptualizations

In the substantive – autonomous – deterministic literature, there is a division between technological utopianism and technological determinism in relation to the mythic conceptualizations of technology. For utopians, technology is an ideal; and a vision upon which society is built. For determinists, technology determines socio-historical and socio-cultural structure and values.

Technological determinism is the belief that technology drives history, and thus determines societal progress. In *Autonomous Technology*, Langdon Winner explores the possibility that technology is out of our control, that it has consciousness and free will—and that if technology has free will, perhaps we do not. It may be a stretch to consider your toaster to be conscious, but what if we consider technology as a whole? Is a cell conscious? What if your toaster, cell phone, refrigerator and PDA are like cells to some greater, conscious being? Winner coins the term "form of life." He argues that technologies have inherent biases (i.e. agency), and perhaps they do have lives of their own. Nevertheless, Winner (1986) in his famous work *Do Artifacts Have Politics?* rejected the technological determinist's framework and claimed that technologies should be judged not only for their utilitarian effects on organizational efficiency, but for their symbolic representations of power and authority. Robert J. Thomas argued in his work *What Machines Can't Do* that social and technical systems are responsible for organizational structuring and change, and that the relationships among technology and organization are mediated by the exercise of power (1994:5).

Proponents from this school of thought believe technology is a key governing force in society (see Merritt Roe Smith); social progress is driven by technological innovation, which in turn follows an "inevitable course" (see Michael L. Smith); technological development determines social change (see Bruce Bimber); technical forces determine

social and cultural changes (see Thomas P. Hughes); technology determines history (see Rosalind Williams). *Grosso modo*, technological determinism is a reductionist doctrine reasoning that a society's technology determines its cultural values, social structure, and/or history. Most interpretations of technological determinism share two general ideas: the development of technology itself follows a path largely beyond cultural or political influence; and technology in turn has "effects" on societies that are inherent, rather than socially conditioned.

Technological determinism stands in opposition to the theory of the social construction of technology (see Thomas P. Hughes, Wiebe Bijker, Trevor Pinch and Bruno Latour), which holds that both the path of innovation and the consequences of technology for humans are strongly if not entirely shaped by society itself through the influence of culture, politics, economic arrangements, and the like. Technological determinism has been largely discredited within academia, especially by science and technology studies. Paradoxically, it remains the dominant view within most news media and popular culture.

However, as stated by Tapia & Sawyer (2005),

> "…technological determinism is mythic. This elevation of a relatively simple theory to become a myth is both subtle and profound. In mythic terms, the values of ICT are framed as a (if not the) means forward, out of the crises and complexities of contemporary policing."

While the technological dystopians provide an interesting counterargument to the magical visions of the utopians, both sides perceive technology and social change in a rather superficial, limited way. Both views assume simplistic notions about technology and human behavior (Kling, R. & Lamb, 2000; Kling, Rob, McKim et al., 2002) and are thus restricted in what they can afford in terms of social realities via ICTs.

Both the utopian and dystopian visions of a global digital economy are driven by technological, deterministic beliefs. Whether for or against, technological determinism depicts technology as an exogenous developmental idea that coerces and determines social relationships and organizations (Williams & Edge, 1996). Technology is treated as given, and it is believed that it provides an effective vehicle for societal change. Technology is seen to imply a particular direction, determined solely by the components that make up the technology (Negroponte 1995). The beliefs of technological determinism are particularly dominant in the public discussions of government officials and private carriers, which assumes that directions of technological change are predestined, and by their very essence need specific social changes (Williams & Edge, 1996). The lack of complication provided by such a view fails to recognize the complexities in design, development and use and recurring failures to deliver desired outcomes (Dutton & Peltu, 1996; Dutton, Peltu et al., 1999).

The causal simplicity of technological determinism offers precision and carries significant appeal regarding social consequences of computer usage saturation. However, there are substantial limitations to this approach; significantly, the lack of realism that is

common to this type of method has its drawbacks. First, it assumes that technology is "the premium mobile of change" (Webster, 1995), while simultaneously assuming it is distinct from sociological principles. This perception is disingenuous; since it dissocializes key elements of social change by extricating technology from its context in society, while simultaneously arguing this independent force is a catalyst for driving social change. Secondly, technological advances, as evidenced by the rapid proliferation of: cell phones; wireless networks and technology; the saturation of computer use, distribution and education; global positioning systems (GPS); and the growth (albeit slower than other developed countries) of broadband Internet access, are all clear indications of a qualitatively, dramatically altered and transformed society (Lyon, 1988; Webster, 1995). But, as Webster observes, "The blunt point is that quantitative measures - simply more information - cannot of themselves identify a break with previous systems" (p. 25).

Conversely, recognizing technology's limitations is vital to how it manifests changes in society. In lieu of presuming that technology's influence proceeds according to a predetermined road map, some researchers have hypothesized about the context in which it is produced and implemented. The social shaping approach is a generic label for approaches, which are committed to opening the black box of technology for sociological analysis (Bijker, WE & Law, 1992; Bijker, W. E., 1993, 1995; Latour, 1992; MacKenzie, 1990; MacKenzie, D. & Wajcman, 1985; Pinch & Bijker, 1987). This theory suggests that technology's potential and limitations are directly proportional to the political and sociological conditions surrounding its origins and deployment.

Nevertheless, the social shaping approach has been derided as inadequate (Bijker, W. E., 1995), since it offers scant consideration of technology's impact on a country's culture. Bijker's recent work amalgamates both social shaping and the "impacts" themes into what he labels "socio-technical ensembles." Of further concern is the necessity to venture beyond the conditions in which technology is produced and to recognize how people conceive it; their comprehension of it, their feelings toward it, and the reasons they decided to implement it. As Dalbohm and Mathiassen point out, "Technology is what its users perceive it to be" (Dalbohm & Mathiassen, 1996). In lieu of a cookie-cutter approach, context is critical in how it is positioned and dispersed; these veracities challenge predictions that are based on the technologies' abilities (Dutton & Peltu, 1996; Dutton, Peltu et al., 1999).

Consequently, it becomes obvious that the association between social and technical elements is inseparable, as opposed to a pair of distinct variables.

After collecting qualitative data in this study, then, do we interpret the limited success as a basis for future research studies, or do we confront the starkness that increasingly, Mu-Fi developments and deployments, at least in terms of bridging the digital divide, are unlikely to bring significant value? If the former is true, then our findings are where the value lies, but if the latter is true, what evidence is required to change one's beliefs from focusing on the first? What happens if the next research study also fails to find significant value?

4.6 ICTs for Development: Tech Craze or Earnest Hope?

A growing amount of literature on ICT, quality of life and development reveals that an unacceptable number of ICT projects fail to meet high expectations (Bhatnagar & Bjorn-Andersen, 1990; Bhatnagar & Odegra, 1992). An examination by Heeks and Davies (1999) discloses that the majority of ICT-based initiatives are totally unsuccessful; partially successful in that major objectives are not attained or that there are major letdowns; so initial success that cannot be sustained for over a year; or a test program that cannot be carried out on a large scale (Heeks & Davies, 1999). Heeks (2002b:101) believes that the "high rates of failure" is due to design-reality or "design-actuality" gaps, i.e. a disconnect between system conception and deployment reality (Heeks, 2002b). Heeks opines that a significant disconnect exists between reality and the techniques that government and its allies have used to deploy ICT projects in society.

Despite low rates of success, ICTs and the Internet have been built up by politicians, telecom executives, in academia and by the mass media. The outlook by these proponents bears scrutiny. The viability of ICTs is uncertain in the minds of many, since ICTs and their successful application are dependent on the context in which they are deployed, but their appeal is debatable.

Regarding Mu-Fi networks, ICTs are becoming a necessity for growth, transforming ICTs in development into an endpoint in lieu of a tool for obtaining higher developmental goals. The main goal is deploying technology to the greatest number of people so that they can realize its benefits. The main obstacle becomes widespread access to ICTs, and in this case, Mu-Fi. There are substantial costs associated with the pro-technological outlook. Another downside is that significant investment in ICTs translates into lower resources for other areas.

Chowdhury (2000) articulates the drawbacks of unrealistic expectations regarding the viability of ICTs; specifically the question of access (Chowdhury, 2000). Inayatullah and Milojevic (1999:78) have expressed reservations about promoting technology when the issue of widespread access has not been addressed. "The ICT hype merely replaces the classical opiate of religion and the modernist idea of progress" (Inayatullah & Milojevic, 1999). Loader (1998):6) also questions the build up of ICTs, citing the false notion that technology is above politics and the question of values (Loader, 1998). However, ICTs do have a role to play in improving quality of life in societies; however, it is wise to temper expectations about the potential of ICTs, quality of life and development.

A position between wholly embracing ICTs in development and those dismissing them out of hand has been articulated in the work on "knowledge societies" by Robin Mansell (Mansell, 1999, 2001, 2002; Mansell, Samarajiva et al., 2002; Mansell & Steinmueller, 2002; Mansell & Wehn, 1998). Although Mansell emphasizes government's role in fostering an environment where ICTs' benefits can be successfully applied, he places more importance on social infrastructure vis-à-vis physical infrastructure, where learning

and training are top priorities. This paper embraces Mansell's position, that ICT policy has a role to play in economic development, but key priorities and widespread access must be prioritized.

Mansell (2001) cautions against unrealistic expectations of the Internet's capabilities, reasoning that institutional and infrastructure must be addressed first. Sussman (1997) agrees, suggesting that ICTs' abilities to transform society have been overstated. Proponents of the latter view urge decision-makers to exercise restraint, lest they burden new ICTs with unrealistic expectations; resulting in disillusionment when the applications fail to be the panacea they are billed to be (Sussman, 1997).

However, I suggest asking not only whether a particular problem is amenable to any improvement through the introduction of ICTs, but assuming the answer is positive, how to shape the broader environment in ways that may make particular applications and services as useful as possible in combating the existence of at-risk communities. Wolfe (1996) calls it the "integrated approach to development" (Wolfe, 1996).

At the outset, it is important to recognize that the causal relationship between ICTs, like municipal Wi-Fi ventures, quality of life and development is complex and that ICTs are certainly no panacea to solving the problem of the digital divide. The enthusiasm with which public elites have rushed into Mu-Fi programs often seems to overshadow the question of precisely how Mu-Fis contribute to bridging the digital divide and promoting economic development. Exclusive emphasis on Mu-Fi projects, at the expense of in-depth analysis and evaluation of the broader socio-economic context, is likely to result in unanticipated failures and wasted resources. Unfortunately, technological change moves so quickly that it often surpasses substantive analysis, leading to an overreliance on anecdotal evidence as a justification for Mu-Fi endeavors. Kumar and Bjorn-Andersen (1990) and Markus and Bjorn-Andersen (1987) suggest that ICT-based initiatives embody the ideals and values of those responsible for their design. These may be at odds with the cultural norms of marginalized communities (Kumar, K. & Bjorn-Anderson, 1990; Markus & Bjorn-Andersen, 1987).

In the words of Alvares and Calas:

> "It is necessary then, to articulate multi-disciplinary and dynamic models capable of considering concurrently the multiple…realities, subjectivities and political agendas enabled by information technologies….These approaches should recognize the context in which these new realities are appearing, and should also be dynamic and proceed beyond simplistic dichotomies" (Alvares & Calas, 1996).

I argue that in order to retain the hope that ICTs can play a pivotal role in bridging the digital divide, improving quality of life and fostering development, it is necessary not to succumb to the seductive "hype" and "craze" that surrounds these technological programs.

4.7 Theoretical Framework: Technological Enthusiasm

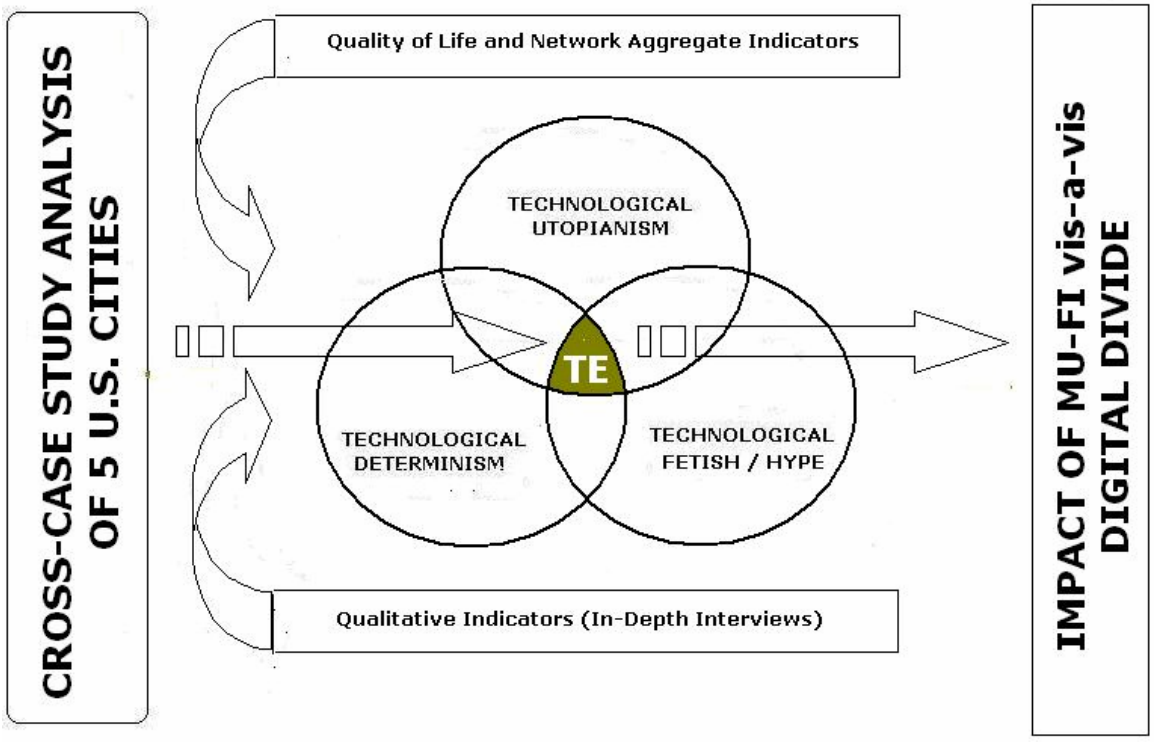


Figure 5: Theoretical Framework

Having identified my research question, the related gap in the literature, the research method for this study, and various substantive , autonomous, deterministic, and optimistic theories, I now turn to the theoretical framework employed for this dissertation (see Figure 5). In order to analyze this convoluted and very local Mu-Fi space, this dissertation adopts the term "**technological enthusiasm**" (TE) to denote a particular view. TE refers to the tendency of public elites, in their quest for digital equity, to idealize their technological ventures, suppress dissent and pursue the unalloyed good of technological progress.

An insufficiency of current theoretical frameworks to address the research question of the study was evident from a review of the existing research and literature on Mu-Fi networks relating to the digital divide. Studies of Mu-Fis alleviating of the digital divide are rare. A thorough literature review failed to locate research that examines the role municipalities play in bridging the digital divide via Wi-Fi services. Not only is there a dearth of existing literature and research, there is also a paucity of any theoretical application of this work to the specific domain of inquiry. Given the relatively nascent nature of this line of research, this omission is not surprising.

Connecting TE to substantive – autonomous – deterministic – optimistic theories like technological determinism, technological utopianism and ICTs for development will

clarify what TE entails. All these theories are share a common bond with a movement whose advocates focus on technology as instruments that will bring a new social order. This framework does not seek to classify or compare these theories. This framework draws on existing models of substantive, autonomous, and deterministic theories as a foundation to propose a suitable conceptual theoretical framework to address a new research problem. This framework attempts to draw on the strengths and advantages of multiple theories in an attempt to offer a new approach to unexplored terrain and, thus, offer a unique perspective of viewing how cities attempt to engage the dynamic and complex digital-divide debate.

This new theoretical framework is useful for several reasons:

1. None of the individual theories identified in this theoretical framework are new. What is new to the Mu-Fi arena is the application of this combination of theories in the digital-divide context. This framework and the study within which it will be used offers a new way of contextualizing and examining Mu-Fi belief constructs.
2. Individually, these theories are incomplete and cannot satisfactorily explain the kernel of truth about Mu-Fi networks. Collectively, they contribute conceptual clarity to interpretation of the Mu-Fi debate.
3. TE allows us to determine a particular pattern of policymaking and to discover why government-led broadband initiatives began to emerge in the US, and continue to mushroom today.
4. This new theoretical framework can explain both simple and complex behaviors of public elites.

Through a qualitative methods approach, the study seeks to make known tacit and otherwise unavailable constructs that underpin the success of Mu-Fi networks in tackling the digital divide. Specifically, TE seeks to determine if Mu-Fis have had any impact on the digital divide.

4.8 Chapter summary

The purpose of this chapter is two-fold: first, the chapter aims to introduce the concept of "technological enthusiasm," that is, the tendency of public officials to hype and idealize technological ventures in the name of technological progress. Since the literature on Mu-Fi has neglected to reveal the social origins of such endeavors, this chapter suggests that in order to address this literature gap, one needs to take a TE approach in understanding the premises, assumptions and growth of Mu-Fi systems.

Secondly, the theoretical framework introduced seeks to enable an exploration of how Mu-Fi proponents make and account for their judgments about potentially bridging the digital divide via Wi-Fi. This study attempts to illustrate how stakeholders account for their evaluation of local Mu-Fi initiatives. Central to this study is capturing the qualitative contextual factors that may impact the digital divide via Mu-Fi networks.

Using an analytical induction approach, this thesis argues that Mu-Fi in the US has been stimulated by a set of loosely linked advocates guided by deeply rooted philosophical views of technology. It identifies three theories, and shows how they support and add value to TE, characterized core beliefs in these ideologies and examined the superficial yet monolithic nature of TE.

Although it can be argued that ICTs in the hands of the general public are crucial tools for positive social change, this theoretical approach supports the notion that it is a necessary but insufficient determinant of social change. This study argues that technological enthusiasts, like mass media and public elites, have become major promoters of the Mu-Fi movement, and their views have a substantive, autonomous and deterministic flare.

The chapter concludes by suggesting that this new technological framework offers a compelling rationale for understanding the emergence, growth, development, diffusion and configuring of Mu-Fi systems. Thus, this sets up the qualitative-interpretive-critical research methodology and agenda this dissertation aims to accomplish.

CHAPTER 5: METHODOLOGY

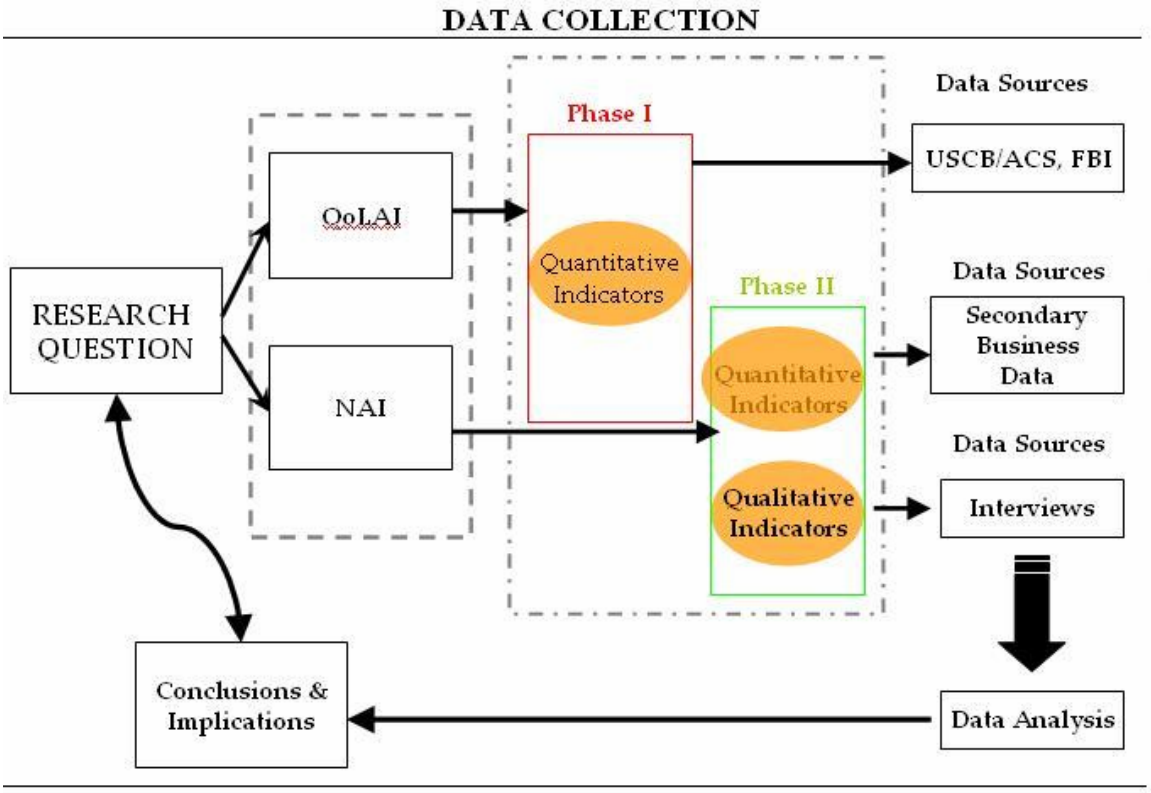


Figure 6: Methodological/Data Collection

5.0 Introduction

This section concerns the methodology and methods used in the research. It begins by describing the research objectives and questions, which blend interests in social informatics, telecom policy, social welfare and ICT research. A description of the methodological approach undertaken is outlined: a pre-post test, multiple-case study using qualitative methods of data collection is presented. The qualitative methods include 49 in-depth interviews for both sets of indicators. Finally, the project schedule is presented (please refer to figure above).

5.1 Research Objectives

The objective of this research study is to determine if Mu-Fis have had a perceived impact on the digital divide. Specifically, it examines how network aggregate indicators

affected quality-of-life aggregate indicators following the implementation of a Mu-Fi. The goal, thus, is to use qualitative data to support (or disprove) if Mu-Fis are impacting the digital divide. The descriptive quantitative data in Chapter Six are used to support the qualitative findings. Qualitatively, this is achieved by way of interviews with key informants.

On the basis of previous literature, the following relationships are taken as given:

- Higher quality-of-life indicators reduce the digital divide.
- Higher universal service metrics reduce the digital divide.
- Both quality-of-life and universal-service factors mediate the effect of Mu-Fi networks on the digital divide, when controlling for municipal characteristics.

5.2 Research Question

In order to address the research objectives, the overarching research question examined is:

1. Does a municipal wireless network have a perceived measurable impact on the digital divide?

5.2.1 Criteria for Choosing Indicators

Qualitative indicators were selected because they met the criteria below.

- **Validity**. The indicator measures a factor that is discussed in the quality of life or universal service/access body of literature.
- **Availability**. The indicator is readily available on a monthly, semi-annual and/or annual basis.
- **Stability and reliability**. The data will be compiled using a systematic and fair method, and the same method can be used each year.
- **Representativeness.** The indicators as a group cover important dimensions of the research question being addressed.

5.2.2 Quality of Life Aggregate Indicators (QoLAI)

Quality of Life (QoL) can be described as people's individual well-being and/or welfare (Chamberlain, 1985; Oppong, Ironside et al., 1988). To date, there is no general consensus on an operational definition of QoL among researchers. Ziegler & Britton argue there are at least two dominant views within this research domain (Ziegler & Britton, 1981). The most common perspective focuses on the problem of defining QoL in terms of specific ontologies to measure various perceptions of human-life situations. From this view, QoL indicators usually include satisfaction with life, happiness or life

stress; job satisfaction; environmental quality; and personal relationships (Bach & Smith, 1977; Chamberlain, 1985; Filson & McCoy, 1993; Hughey & Bardo, 1987; Oppong, Ironside et al., 1988).

The alternative school of thought tends to view QoL in terms of broader social indicators (Ziegler & Britton, 1981). These indicators are used to gauge progress toward goals and are often integrated into an evaluation model of the social system. This approach attempts to include distinctive elements of social well-being into a set of social models. These socio-economic indicators include domains involving work, education, standard of living, family, recreation, neighborhood, health, and others (Diener & Eunkook, 1997; Hsieh & Liu, 1983).

Unfortunately, efforts to establish universally accepted goals have not been successful (see Ziegler and Britton 1981). Nevertheless, both the micro- and macro-levels of analysis have been found to be associated with a better QoL (Miller, Voth et al., 1984). Consequently, the levels of analysis of QoL research studies have ranged from a national level to a organizational/city level (Lewis & Lyon, 1986). For the purposes of this study, this research adopts a macro view of QoL as a local theme at the city level of analysis (Miller, Voth et al., 1984).

Qualitative indicators address the following questions: How? When? Who? Where? Which? What? Why? In this study, eleven (11) qualitative QoL indicators were selected. They were classified by education, economy, public safety, and social categories. The indicators are:

- **Education**
  - Perception of education and schooling effect
  - Perception of literacy
- **Economy**
  - Perception of new jobs added
  - Perception of users using the network to find jobs
  - Perception of users using the network to find housing
- **Public safety**
  - Perception of crime
  - Perception of general public safety
  - Perception of emergency first responders improvements
- **Social**
  - Perception of general satisfaction with community
  - Perception of “sense of community”
  - Perception of local government services

5.2.3 Network Aggregate Indicators: Using a Universal Service Framework

Using Schement’s Universal Service Framework, network aggregate indicators are characterized into four dimensions of access: connectivity, capability, content and

context. In this study, thirteen (13) qualitative NAI indicators were selected. The indicators are:

- **Connectivity**
  - Perception of broadband quality and price
  - Perception of geographical barriers to getting online
  - Perception of device transfer mechanisms
- **Content**
  - Perception of available tailored content
  - Perception of users as content consumers and content producers
  - Perception of user's consumption/production of content
  - Perception of groups helping users create content
- **Capability**
  - Perception of training and general education venues available to users
  - Perception of influence/impact of training on users
- **Context**
  - Perception of place-based interactions
  - Perception of context-based, multimedia applications
  - Perception of context-awareness tools used

Although the goal of the research study was to gather qualitative information on all four categories, interviews with informants quickly revealed that content, capability and context specific data was more difficult than the study had anticipated. Private incumbents rarely collected this data; city officials did not know such indicators existed. Thus, the study focused mostly on connectivity.

5.3 Methodological Approaches

5.3.1 Pre/Post Test, Multiple Case Studies Approach

The research design that informs this dissertation is a multiple case study because case studies rely on analytical generalization considering that "the investigator is striving to generalize a particular set of results to some broader theory" (Yin, R. K., 2003). Also, the case study is the method of choice when the phenomenon under study is not easily distinguishable from its context, like a project in an evaluation study (Creswell, 1998). The case study, as defined by Yin, investigates a "contemporary phenomenon within its real-life context, addresses a situation in which the boundaries between phenomenon and context are not clearly evident, and uses multiple sources of evidence" (p. 23) (Yin, R., 1984). In a case study, the starting and end point is the comprehension of the case as a whole in its real-world context. However, in the course of analysis, the case will be faceted by different perspectives of inquiry.

Although the analysis starts from January 2007 and goes as far back as the inception of each Mu-Fi deployment, time here is not merely a chronology of events but also a social construction. Instead of attempting to provide the reader with all the relevant historical

details so as to highlight the structural and contextual backdrop where Mu-Fi systems operate, the study looks at a single point in time (i.e., January 2007 thru December 2007).

As already argued in this thesis, Mu-Fi deployments are a national, large-scale movement where the utopian rhetoric surrounding these deployments is tied to a better QoL and a more equitable society, which makes this issue of measuring over time more interesting and challenging. Additionally, the nascent nature of Mu-Fi systems makes the study of perceived measurement over time even more compelling considering countries such as South Korea, France, Australia, et al. have taken a much more aggressive governmental (i.e. national) approach to tackling the digital divide head-on.

In order to understand how QoL and universal service measures evolve over time, the data collection method the study employs is in-depth interviews from key stakeholders.

5.3.2 Overview of Aggregate Indicators

Aggregate indices can help us understand this convoluted and very local municipal wireless space by synthesizing a complex array of information (e.g. QoL indicators and universal service components). However, little to no research has been conducted on specific aggregate indicators.

Conventionally, the use of scalars (aggregate indices) or matrices (indicator profiles) is a controversial and long-standing methodological problem. Because the goal of an indicators matrix is to aggregate the indicators to form an overall impression and summary of the issue at hand, some researchers argue that there is a significant amount of information that is lost in the simplification process. The ongoing debate about the appropriateness of aggregate indicators falls into two camps.

Proponents of aggregate indicators believe that there are several necessary reasons for aggregation. First, the obvious advantage of an aggregate metric is its production of a single or a few numbers. Aggregate indices reduce the clutter of too much information, thereby helping to communicate information succinctly and efficiently (Alfsen & Saebo, 1993; Callens & Tyteca, 1999; Gustavson & Longeran, 1999; Heycox, 1999; van den Bergh, 1996). According to Meadows (1998, p. 22), “aggregation is a must in order to keep from overwhelming the system at the higher levels of the hierarchy.” Heycox (1999, p. 191) reflects this and states that “a complex, information-rich world requires frameworks that organize data to reveal succinct views and interrelationships.”

Opponents cite equally persuasive arguments. They argue that such indices can lead to incorrect conclusions. Development of the aggregation equation almost always requires more assumptions and arbitrary decisions, and thus, aggregate indices are frequently criticized by those who believe that the assumptions can lead to a loss of information (Meadows, 1998) and introduce serious distortions (Alfsen & Saebo, 1993). Critics caution that the distortions can lead observers to misinterpret the data. As Meadows (1998, p. 4) states, “if too many things are lumped together, their combined message may

be indecipherable." Similarly, another problem with aggregate indices is that it is challenging for them to capture the interrelationships between individual variables (Heycox, 1999). Gustafsson (1998, p. 259) warns against reductionistic views, encouraged by aggregate indices. To him, it is unrealistic to expect aggregate indices to capture this type of complexity.

In sum, the two views are not to be viewed as an ontological battle between right and wrong. In reality, they are somewhat complementary. A meta-level of indicator aggregation is necessary in order to increase the awareness of the problem. But, even given the many benefits of aggregate indices, no single matrix can possibly answer all questions. Multiple indicators will always be needed, as well as intelligent and informed use of the ones we have. Nevertheless, it can be argued that aggregate indices do have a role in assisting policy decision-makers. This latter view is adopted by this research paper.

5.3.3 Introducing the Aggregate Model

Following an extensive review of literature, this study employs an aggregate model as a tool to re-conceptualize the Mu-Fi network experience (i.e. network aggregate indicators) and learning outcomes (quality of life aggregate indicators). The model presents three linear and interrelated components including (a) Network Aggregate Indicators for the five case studies, (b) QoL Aggregate Indicators for the five case studies, and (c) the effect of NAI on QoLAI. At the time of the dissertation research, the model had not yet been tested in its entirety in other areas of research; although specific components of this model had been cited in several other studies (see Chapter 2). Before proceeding, the following points will be underscored about this aggregate model:

1. The model should not be misconstrued as a positivistic approach to predict a logical flow of activities that lead to predetermined outcomes. The model is dynamic and its outcomes are defined by many factors.
2. Some elements of the model are not meant to represent precise cause-effect relationships but rather illustrate fluid and ongoing interactions between elements.
3. Both NAI and QoLAI elements are not necessarily discrete and may overlap or interconnect with one another.

Using this model, the study will determine whether NAI had an effect on QoLAI. In other words, the study examines, for example, if having more Wi-Fi nodes or increased access to Mu-Fi leads to reduced crime, increased median earnings, increased school enrollment, etc. Though these are certainly interesting questions and can become full journal articles in the future, this is not the main research question of the study. The main research question is to determine if Mu-Fi has a perceived impact on the digital divide. The goal is to use qualitative data to support (disprove) if Mu-Fi impacts the digital divide.

5.3.4 Criteria for choosing cities

Municipalities were included in this study if they met the following criteria:

1. Must be located in the US.
2. Must have already deployed a wireless broadband system that uses a Wi-Fi or Wi-Fi mesh technological infrastructure.
3. Must have launched the Mu-Fi project network by December 31, 2006.
4. Must be in operation for public access and municipal use, not just municipal use.
5. Must be a government-led,[12] city-wide wireless broadband network initiative and not a county-wide, state-wide or city hotspot.
6. Must geographically cover at least 50 percent of the city by December 31, 2007.
7. Must be listed as a "Place" under the U.S. Census Bureau's American Community Survey data coding tables and a "City Agency" under the FBI's Uniform Crime Reports.

Ten cities met these criteria and were to comprise the pre/post test, multiple-case studies project. The cities chosen represent a typology of sorts of different community strategies and successes when dealing with Mu-Fi networks. The researcher believes the results from the data sets will differ because of different societal settings. During the initial analysis of the research study, the cities were examined quantitatively before and after implementation of the network using descriptive statistics (please refer to Chapter Six for a complete analysis). This part of the investigation looked for changes in the quantitative, QoL indicators mentioned above. The following 2006 population estimates were taken from the U.S. Census Bureau.

1. **Tempe, AZ** (Estimated Population: 161,143)
2. **Mountain View, CA** (69,276)
3. **Sunnyvale, CA** (128,902)
4. **Longmont, CO** (81,818)
5. **New Orleans, LA** (454,863)
6. **Portland, OR** (533,427)
7. **Philadelphia, PA** (1,463,281)
8. **Corpus Christi, TX** (283,474)
9. **Federal Way, WA** (83,088)
10. **Madison, WI** (221,551)

Due to the nature of this research study, it is important to note that although initial contact was made with cities via e-mail data availability (i.e. willingness to participate), confidentiality issues (access to data) and unmet criteria (i.e. missed deadline of

[12] By government-led, I mean approved, supported, operated, owned and/or maintained by the city. For example, Vivian, Louisiana, does not qualify under these criteria as this city-wide network is a private venture by Fastline ISP (a local broadband provider in Vivian).

December 31, 2007) reduced the sample size to five cities. The final list of cities studied in this thesis are:

1. **Tempe, AZ**
2. **Portland, OR**
3. **Federal Way, WA**
4. **Corpus Christi, TX**
5. **Madison, WI**

5.4 Methods of Data Collection

A qualitative research design is chosen for this research study in order to focus on the socially constructed nature of the Mu-Fi experiences. In this thesis, semi-formal/structured interviews with key informants will provide new insights on how the program has been perceived and valued.

5.4.1 Qualitative Data (Structured / Semi-Formal / In-depth Interviews)

Interviews were structured and semi-formal; almost like conversations, using a broad interview guide. Interviews were used as a way of understanding the depth and breadth of these community broadband deployments at the individual level of analysis. The interviews were conducted only once during Phase II, following implementation of the network. The interviews allowed me to personally interact with the participants and, therefore, to obtain deep and personal answers about the research space. Each interview was conducted over the phone and lasted about one hour. The interview guide contains several categories – basic access, expectations, general technical knowledge, usage behaviors, and general perceptions of municipal systems. The discussions were dependent on the responses from the participant; a fair amount of individual adjustment was allowed for in each interview. Participants were asked to give examples to clarify their answers. The sample consists of approximately 75 interviews (age, race, and ethnicity were not determined). The first interviews were conducted with the following two organizations:

- Government Project Administration Office
- Broadband Provider

The latter interviews focused on the following organizations:

- Chamber of Commerce
- Public Safety Department
- Employment Services Department
- Economic/Community Development Department
- Public School District Office
- Public Health Center

- Public Library
- Parks & Recreation Cultural Center, Community Center
- Tourism Office

The following is a complete list of the 49 interviews conducted during this study:

ID	Gender	Type	Occupation	City
TE-5140	M	Government	Deputy Manager of Information Technology	Tempe
TE-5141	M	Government	Development Services Manager	Tempe
TE-5142	F	Public School	Public Information Manager for School District	Tempe
TE-5143	F	Government	Community Services Representative	Tempe
TE-5144	M	Government	Neighborhood Services Assistant	Tempe
TE-5145	F	Community	Executive Director of Community Group	Tempe
TE-5146	F	Government	City Council Sub-Committee member	Tempe
TE-5147	M	Government	Application Services Manager	Tempe
TE-5148	M	Provider	Spokesperson	Tempe
TE-5149	M	Community	Development Services Supervisor	Tempe
PO-6020	M	Government	Project Coordinator	Portland
PO-6021	M	Community	Director Community Mu-Fi Initiatives	Portland
PO-6022	M	Community	Vice President of Media Community Programs	Portland
PO-6023	M	Community	President of Technology Advocacy Group	Portland
PO-6024	F	Government	Director of City Development Sector	Portland
PO-6025	M	Government	Chief of Staff for Community Political Office	Portland
PO-6026	M	Community	Executive Director for Technology Services Group	Portland
PO-6027	M	Community	Director of computer technology center	Portland
PO-6028	M	Community	Community Strategist for Telecom Services	Portland
PO-6029	F	Provider	Spokeswoman	Portland
CC-7510	F	Community	Director of Partnerships and Development	Corpus Christi
CC-7511	F	Government	Digital Community Developer	Corpus Christi
CC-7512	F	Government	Director of Community Development Services	Corpus Christi
CC-7513	M	Community	Dean of Computer Science Department	Corpus Christi
CC-7514	M	Community	Head of Economic Development Group	Corpus Christi
CC-7515	M	Provider	Director of Business Development	Corpus Christi
CC-7516	F	Government	Manager of Neighborhood Services	Corpus Christi
CC-7517	M	Community	School District Director for Information Technology	Corpus Christi
CC-7518	F	Community	New Community Services Program	Corpus Christi
CC-7519	M	Government	Information Technology Project Manager	Corpus Christi
FW-8200	M	Government	City Project Manager	Federal Way
FW-8201	M	Government	Director of Economic Development	Federal Way
FW-8202	M	Community	Manager of Local Small Business Center	Federal Way
FW-8203	M	Community	President of Economic Development Agency	Federal Way

FW-8204	F	Government	City Council member	Federal Way
FW-8205	F	Community	Director of Community Relations Center	Federal Way
FW-8206	F	Community	Executive Director of Community Group	Federal Way
FW-8207	F	Government	Director of Neighborhood Services	Federal Way
FW-8208	F	Government	Manager of Community Support Services	Federal Way
FW-8209		Provider	INTERVIEW NOT CONDUCTED	Federal Way
MA-9740	F	Provider	Public Relations Representative	Madison
MA-9741	F	Government	Executive Dir of New Community Services Program	Madison
MA-9742	F	Community	Web Librarian for Public Library	Madison
MA-9743	M	Community	Technician for Community Services Program	Madison
MA-9744	M	Community	President of Wireless Advocacy Group	Madison
MA-9745	M	Government	Spokesperson for the Mayor	Madison
MA-9746	M	Government	Information Technology Professional	Madison
MA-9747	M	Government	City Council Member	Madison
MA-9748	M	Government	Director of Information Technology Department	Madison
MA-9749	M	Community	Technical Director for Local Community Group	Madison

Table 1: List of Interviewees

5.5 Data analysis approach

A qualitative approach was conducted via in-depth interviews, which were digitally recorded and transcribed. These transcriptions paraphrase what participants said while maintaining the maximum detail of responses. Transcripts were cleaned up to delete comments such as “um”, “you know”, “oh”, mispronunciations, pauses, and word emphasis that involves interpretative translation. The aim was to enable the researcher to transfer the meaning from the recorder to paper without missing significant points made by the participants (Creswell, 1998). As seen in this chapter, the documents were to be analyzed and coded for emergent themes.

Furthermore, themes were classified into categories. From the interviews, relevant comments and opinions were extracted from each transcription and reorganized within the different categories by interpretation. As Gilbert (1993) suggests, an interpretation is required, since participants are expressing in a natural way to them, embedded in a symbolic fashion. Without such symbolic interpretations, descriptions would be no more than meaningless narratives of actions and events. Throughout the analysis, the findings illustrate the study’s findings with quotes from the interviews. Participants’ names were changed and a generic “occupation title” (see Table 1 above) were used to maintain anonymity (Penn State University Policy RA14). Similarly, when presenting quotes from questions in the interview guide, I called them “Subject # XX” for respondents.

5.6 Data Sources

Approach	Measure	Dimension	Indicator	Data Source
Qualitative				
	QoL			
		Education		
			Perception of education and schooling effect	Interview data – Public School District Office
			Perception of literacy due to broadband	Interview data – Public School District Office Interview data – Public Library
		Economy		
			Perception of new jobs added due to broadband	Interview data – Chamber of Commerce Interview data – Community/Economic Development Department Interview data – Employment Services Department
			Perception of users using the broadband to find jobs	Interview data – Chamber of Commerce Interview data – Community/Economic Development Department Interview data – Community Center Interview data – Public Library
			Perception of users using the broadband to find housing	Interview data – Chamber of Commerce Interview data – Community/Economic Development Department Interview data – Community Center Interview data – Public Library
		Public Safety		
			Perception of crime	Interview data – Public Safety Department
			Perception of general public safety	Interview data – Public Safety Department
			Perception of emergency first responders improvements	Interview data – Public Safety Department
		Social		
			Perception of general satisfaction with community	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Community/Economic Development Department
			Perception of “sense of	Interview data – Community Center

			community”	Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Community/Economic Development Department
			Perception of local government services	Interview data – Community Center Interview data – Community/Economic Development Department Interview data – Public Library
	Universal Service			
		Connectivity		
			Perception of broadband quality and price	Interview data – Community Center Interview data – Community/Economic Development Department Interview data – Public Library
			Perception of geographical barriers to getting online	Interview data – Community Center Interview data – Community/Economic Development Department Interview data – Public Library
			Perception of device transfer mechanisms	Interview data – Community Center Interview data – Community/Economic Development Department Interview data – Public Library
		Content		
			Perception of available tailored content	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library
			Perception of users as content consumers and content producers	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library
			Perception of user’s consumption/production of content	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library
			Perception of groups helping users create content	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library
		Capability		

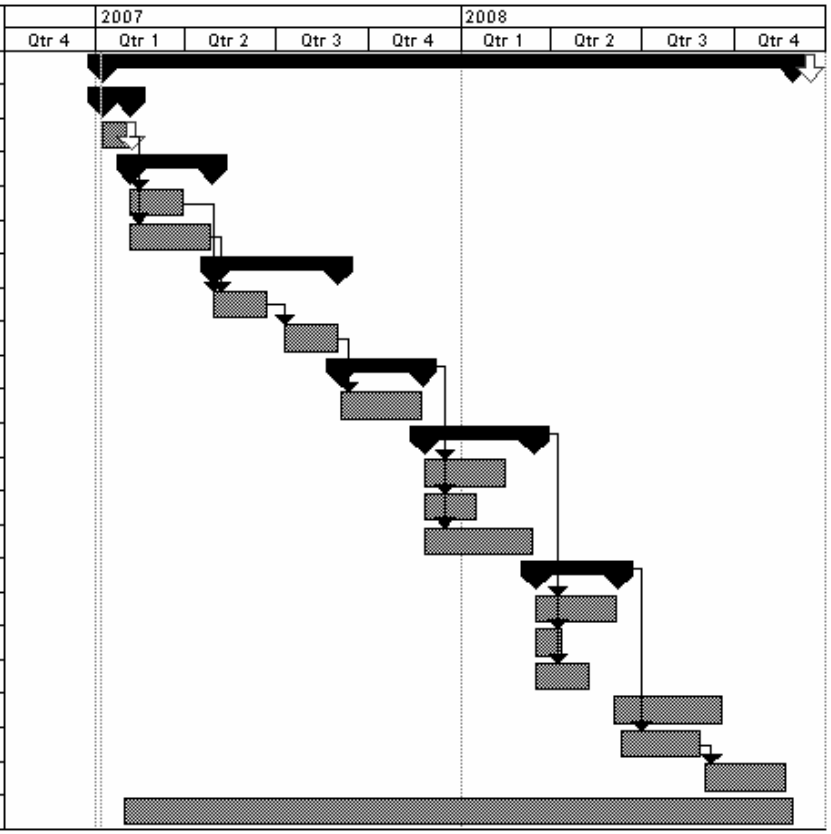
			Perception of training and general education venues available to users	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library
			Perception of influence/impact of training on users	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library
		Context		
			Perception of place-based interactions	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library
			Perception of context-based, multimedia applications	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library
			Perception of context-awareness tools used	Interview data – Community Center Interview data – Tourism Office Interview data – Parks & Recreation Cultural Center Interview data – Public Library

Table 2: Data Sources

5.7 Project Schedule

Figure 7 below describes the specific plan and timeline used to conduct this research:

ID		Task Name	Duration	Start
1		24 Months to Final Dissertation Defense	495 days	Mon 1/8/07
2		Instrument Development and Refine	20 days	Mon 1/8/07
3		Interview Guide	1 mon	Mon 1/8/07
4		Data Collection Phase I	60 days	Mon 2/5/07
5		Pre QoL Indicators Collection	2 mons	Mon 2/5/07
6		Interview Data (US/Qual)	3 mons	Mon 2/5/07
7		Interim Data Analysis I	90 days	Mon 4/30/07
8		Open-Coding	2 mons	Mon 4/30/07
9		Analyze/Interpret Data	2 mons	Mon 7/9/07
10		Data Collection Phase II	60 days	Mon 9/3/07
11		Interview Data (US/Qual)	3 mons	Mon 9/3/07
12		Interim Data Analysis II	80 days	Mon 11/26/07
13		Transcribe	3 mons	Mon 11/26/07
14		Refine Open-Coding	2 mons	Mon 11/26/07
15		Analyze/Interpret Data	4 mons	Mon 11/26/07
16		Final Data Analysis	60 days	Mon 3/17/08
17		Transcribe	3 mons	Mon 3/17/08
18		Refine Open-Coding	1 mon	Mon 3/17/08
19		Analyze/Interpret Data	2 mons	Mon 3/17/08
20		Post QoL Indicators Collection	4 mons	Mon 6/2/08
21		Develop Recommendations for Public	3 mons	Mon 6/9/08
22		Final Reports, Papers and Publications	3 mons	Mon 9/1/08
23		Committee Feedback & Reviews	24 mons	Mon 1/29/07



5.8 Methodological Limitations

It is worth entertaining a brief discussion of the methodological issues concerning this dissertation. The principal limitations of this study are:

- The limitations of this study are emblematic of most interview research. The complex observable facts may be simplified by the responses gathered. Thus, my methodology espousing semi-formal, structured interviews of key informants might be harshly criticized by all those reviewers who advocate a more traditional research design such as formal face-to-face interviews, surveys or questionnaires.
- Choosing to examine Mu-Fi systems over a year, poses an honest question: is one year sufficient in order to gage the impact of Mu-Fi systems on local quality of life issues? As shown by other studies, QoL improvements might take years to become evident. Because the public rhetoric surrounding these deployments is tied to the QoL construct, it is important to begin a study in this regard. Because governmental data on Mu-Fi systems are still unavailable, this research study is even more critical. As a result, qualitative indicators are necessary in order to gage the impact of these networks at this point in time.
- As may be commonly experienced in this type of study, there may be unexplored levels of analyses and uneven use of the data collection technique. One needs to acknowledge that it is impossible to find the same roles, titles and functions across all 10 cities. For instance, I interviewed the Parks & Recreation Cultural Center Director and the Computer Technology President in City X, whereas in City Y the same person fulfills both roles as Community Center Executive Director.
- Because there is no universally accepted measure of QoL, the comparability of data is a further limitation. In other words, obtaining a single "true" measure of QoL is probably impossible. First, as we have seen, the most comprehensive definitions of QoL are multidimensional, incorporating different levels and units of analysis. Second, the nature and forms of QoL change over time. New surveys currently being tested will hopefully produce more direct and accurate indicators across and within countries.
- Since this study has focused on the role that Mu-Fi systems play on addressing the digital divide, the results are limited to this specific technology in this particular setting in this period of time.

CHAPTER 6: RESULTS - INTRODUCTION TO CASE STUDIES

6.0 Overview of case study chapters

The case study procedures, including data collection and analysis methodologies, are discussed in detail in the previous chapter. This chapter explores the findings from a detailed cross-case analysis addressing the main research question[13] of this study.

The case studies in the following chapters are interesting, rich and diverse accounts of five cities' attempts to design, deploy and use Mu-Fi broadband programs. They also denote a large gamut of primary data for this study. The case study chapter design provides a way to explore and understand a municipality's goal in establishing successful Mu-Fi policy, and is consequently a way of addressing, in part, the main research question.

In total, five cases were studied. Five other cases were excluded from the final analysis because when last reviewed, those municipalities were still implementing their wireless networks. Therefore, no results were available for the analyses. Participants in the remaining cases meet all the criteria listed in Chapter Five.

This chapter begins with a general description of the five case studies in this research project – Tempe, Arizona; Portland, Oregon; Federal Way, Washington; Corpus Christi, Texas; and Madison, Wisconsin. Then, the qualitative themes unearthed from the case studies are illustrated. Next, the case study chapters describe via interviews the differences between their Mu-Fi designs and implementation strategies. Each theme that emerged from the data is examined individually. These individual illustrations end with a cross-case comparison of all emergent themes that have been unearthed in the study. The intent is to compare different themes and patterns among the five examined municipalities. This examination leads to an understanding of which particular themes or groups of themes most influence Mu-Fi's impact on QoL.

The approach adopted for this research is a comparative analysis deriving from the coding of data from the case study models. In this way, its overarching goal is on using the emergent themes, patterns or categories to compare across the case studies. In doing so, it unearths grounded theories about the relationships among themes, thereby discovering patterns in Mu-Fi structures and drawing lessons about ways to improve such efforts.

[13] The main research question, *Does a municipal wireless broadband network have a measurable impact on the digital divide?* is covered in Chapter 1.

Moreover, it is important to note that each chapter also ends with network and QoL indicators, especially how these indicators changed following implementation of the wireless system. By gaining a better understanding of what makes a city a quality place to live, the study provides valuable information about all five municipalities, as academicians, researchers, incumbents, public elites and policy officials attempt to improve services to residents from marginalized neighborhoods.

The following areas are explicated in-depth as the approach to presenting the data: organization approach, data presentation, use of quotes and syntax.

Approach for organizing the data. The data collected incorporates 49 interviews with key informants, totaling some 300 pages of text. Techniques such as computer-aided text analysis are suggested to deal with large volumes of data in qualitative research texts (see Yin, 1994). However, the transcribed texts in this research unfolded in a clear-cut structure and proceeded in good order and, thus, were easy to compare to one another. When the principal investigator attempted to explore a specific theme, it did not take time to target the appropriate transcribed text.

Data Presentation. The most common responses to questions listed on the interview guide were summarized by theme. These emergent themes were identified from open coding to represent the same meaning that might be expressed in various ways. The themes evolved into a stable set of categories that denoted more abstract concepts. These themes attach greater explanatory power to concepts which might relate to a particular phenomenon or to answer such questions as "when", "why", "where", and "with what." In addition, figures and tables are used to summarize findings and provide visual comparison across cities. The themes and their descriptions are presented in Table 3.

Use of quotes. Themes are underpinned by data evidence and are supported by selected quotes from the interview participants. The use of quotes in presenting the findings increases the transparency and validity of research reporting. As stated by Sandelowski, "it allows the reader to track the researcher's steps from the data collected to the presentation and subsequent interpretation of the findings" (Sandelowski, 1994). Quotes were purposefully selected to enhance understanding of specific emergent themes.

Presentation syntax. The syntax in presentation accounts for the context of time and place. Usually, the findings are shown in the past tense, reflecting that the data was collected in the past. But where the situation did not change when the dissertation was being written, the present tense is used because they still exist now.

6.1 Case Study 1: Tempe, Arizona

Tempe**,** a city in Maricopa County, Arizona, is a major suburb of Phoenix. Located immediately southeast of Phoenix, Tempe is the most densely-populated city in the state. According to a 2006 U.S. Census Bureau, Tempe's estimated population was 161,143,[14] including 50,000 students.

As of 2004, the racial makeup of the city was 77.51% White, 3.66% African-American, 2.01% Native American, 4.75% Asian, 0.29% Pacific Islander, 8.49% from other races, and 3.30% from two or more races. Hispanics and Latinos of any race comprised 17.95% of the population. Of Tempe citizens 15 years and older, 44% have never been married, 41% are currently married, 1.4% are separated, 3.3% are widowed and 10.0% are divorced[15].

An overwhelming number of Tempe residents 25 years and over, 90.1%, have a high school diploma or higher. Over 40% of Tempe's residents over the age of 25 hold a bachelor's degree or higher. Another 14% have a graduate degree. Tempe's unemployment rate is an estimated 4.3%[16].

The median income for a household in the city was approximately $42,361, and the median income for a family was $55,237. In 2004, men had a median income of $36,406, versus $28,605 for women. The per capita income for the city is approximately $22,406. As of 2004, about 7.5% of families and 14.3% of the population were below the poverty line, including 13.6% of those under age 18 and 5.1% aged 65 or over. The reason for the high percentage below the poverty line is the large number of university students living in Tempe, and is not reflective of the overall income in Tempe[17].

Tempe is home to many software engineers, scientific researchers, photographers, marketing professionals, lawyers and venture capitalists. The city also houses the head offices of US Airways (formerly America West Airlines) and the main campus of Arizona State University,[18]the single largest campus in nation in terms of students. The top five employers in Tempe (besides ASU) are Salt River Project, Wells Fargo Loan Services, Honeywell, Motorola Computer Group IESS, and Wells Fargo Banking Services[19]. A recent report by economist Richard Florida titled *Rise of the Creative Class* shows that Tempe is an interesting place for this new breed of workers to reside.

The city has identified a list of objectives for its wireless network venture. Some of the overarching goals include: (a) provide ubiquitous wireless broadband coverage over entire 40 sq. mile area of Tempe; (b) provide an alternative to DSL and cable modem for

[14] See http://en.wikipedia.org/wiki
[15] See http://www.city-data.com/city
[16] Ibid
[17] See http://en.wikipedia.org/wiki
[18] Ibid
[19] See http://phoenix.about.com/cs/govtcity/p/tempe.htm

Tempe residents; (c) offer free Wi-Fi service in Tempe's downtown retail corridor for visitors; (d) promote usage of the Tempe City Web site and e-government applications by offering free "anywhere" access to Tempe.gov; (e) promote usage of online services by offering free "anywhere" access to ASU.edu; (f) build a border-to-border wireless municipal network that would provide total mobility for Tempe municipal employees; (g) enhance the ability for public safety employees to protect and serve through the use of broadband wireless technology; and (h) promote economic development in the city by making Tempe a smart place to be, and the best place to live, work and play.

Below is the required Phase 1 Wi-Fi coverage grid for Tempe:

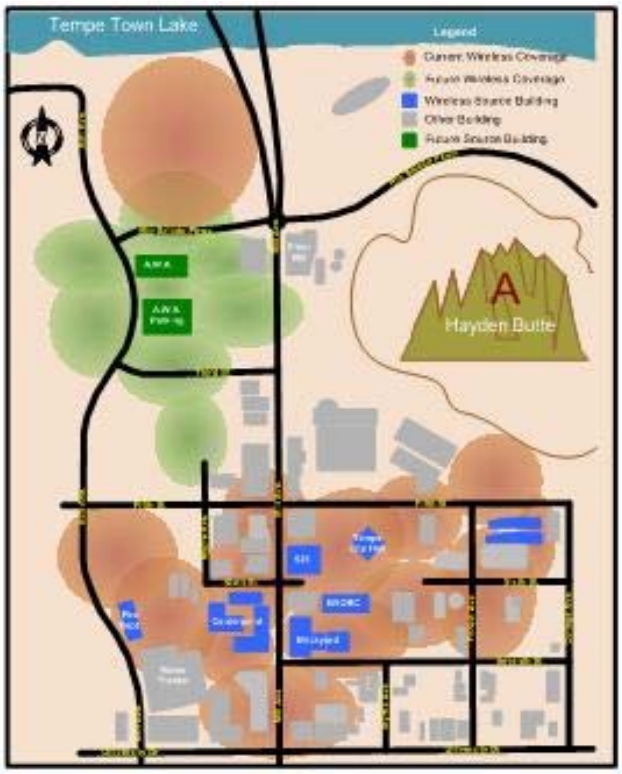


Figure 8: Tempe Wi-Fi Grid[20]

Network Aggregate Indicators (NAI) Chart for Tempe (Chart 1)

	Pre	*Post*
Network Aggregate Indicators (NAI)	**2006**	**2007**
% of population with Internet access via Mu-Fi	0	24.2%
# of subscribed users/residents via Mu-Fi	0	39,030
# of nodes/access points via Mu-Fi	0	34
Average broadband price[21]	$49.99	$19.99

[20] Source: www.tempe.gov/wifi

[21] Average broadband price is based on data from different major providers compared by speeds and bundle discounts. Price listed here is not official. It is my "best effort" based on website data, conversations with subjects and what they said they're paying.

# of device transfer mechanisms[22]	4	4
# of training and general education venues[23]	52	52

Quality of Life Indicators (QoLAI) Chart for Tempe (Chart 2)

	Pre	*Post*
Quality of Life Aggregate Indicators (QoLAI)	**2006**	**2007**
Total educational attainment levels	98,239	101,541
Total school enrollment	60,136	60,846
Average household income	60,383	59,954
Median Earnings[24]	24,995	24,733
Unemployment Rate	4.2%	4.8%
Units Owner occupied	32,303	32,730
Units Rent occupied	32,838	36,891
Total vehicle ownership	67,930	68,002
Poverty Status	6,091	6,971
Violent crime rates	1060	1201
Hate crimes incidents	5	9
Divorce incidents	161,004	161,871
Total Households With Food Stamps	2,923	3,178
Telephone service [25]	93.6%	93.9%

2006 Hate Crime Statistics for Tempe (Chart 3)

	Race	*Religion*	*Sexual Orientation*	*Ethnicity*	*Disability*	*Total*
Tempe	5	2	2	1	0	5

2006 Violent Crime Statistics for Tempe (Chart 4)

	Murder and Negligent Manslaughter	*Forcible Rape*	*Robbery*	*Aggravated Assault*	*Total*
Tempe	4	72	326	658	1060

[22] A device transfer mechanism includes community, grassroots and advocacy groups that provide free or low-cost computer equipment to local residents.
[23] General education venues are schools, universities, libraries, or any other facility that provides an appropriate educational environment for which residents and teachers can interface.
[24] Median earnings in the past 12 months (in 2005 inflation-adjusted dollars) --
[25] % Occupied Units With Phone Service

6.2 Case Study 2: Portland, Oregon

Portland, Oregon, is a city located at the confluence of the Willamette and Columbia rivers[26]. With a 2006 population of 514,000,[27] it is Oregon's largest city, and the third largest in the Pacific Northwest, after Seattle, Washington, and Vancouver, British Columbia. Approximately 2 million people live in the surrounding metropolitan area (MSA), the 24th-largest suburban population in the US. According to the U.S. Census Bureau, the city has a total area of 145.4 mi,² 134.3 miles of which is land, and 11.1 miles is water.[28]

As of 2006, the city's racial breakdown was as follows (for people reporting one race alone): 83% white; 6% African-American; 1% Native American and Alaska Native; 7% percent Asian; less than 0.5% Native Hawaiian and Other Pacific Islander, and 2%were some other race. Eight percent of the people in Portland were Hispanic and 74% were white, non-Hispanic.[29]

In 2006, Portland had 228,000 households. Each household averaged 2.3 people, and the average family size was three.[13] Families made up 52% of Portland's households. This figure includes both married-couple families (38%) and other families (14%). Non-family households comprised 48% of Portland's total households. Most of the non-family households were people living alone, but some were comprised of people living in households where no one was related to the homeowner. Out of 223,737 households, 24.5% had children under the age of 18; 38.1% were married couples living together, 10.8% had a female householder with no husband present, and 47.1% were non-families. Individuals comprised 34.6% of all households, and 9% had someone living alone aged 65 years or older.

Among the most common occupations in Portland were: management, professional, and related occupations at 42%; sales and office occupations at 25%; service occupations at 16%; production, and transportation, and material moving occupations at 10%. Median household income was $42,287. In 2006, 18% of people were living in poverty. Twenty-six percent of related children under 18 were below the poverty line, compared to 10% of people 65 years and over. Twelve percent of all families and 32% of families with a female householder and no husband present had incomes below the poverty level.[30]

MetroFi is Portland's provider of free wireless Internet access; the company has a signed agreement with the city to design, build, and operate free municipal Wi-Fi networks for residents, visitors, and city workers. MetroFi is able to provide free 1Mbps downstream and 256k upstream access speeds in these communities through online advertising, supported by local and national advertisers. While the service is provided at no cost to

[26] See http://en.wikipedia.org/wiki
[27] See http://factfinder.census.gov/servlet
[28] See http://en.wikipedia.org/wiki
[29]See http://factfinder.census.gov/servlet
[30] See http://factfinder.census.gov/servlet

users, reliability and availability are still very important. Domain name resolution (DNS) and IP address assignment (DHCP) services play an important role in availability, as well as management of the network. For example, each wireless access point requires an IP address, facilitated by DHCP for internal management.

One of the challenges facing MetroFi is expanding the footprint of free wireless "hot zones" in Portland from coffee shops to the entire city. Despite the obstacles facing this new and untested business model, MetroFi pushed ahead, building out the network in Portland. In addition to scalability, the new DNS/DHCP solution also needed to be highly reliable and redundant, as well as easily installed and maintained. This seemed like a tall order, but then MetroFi learned of the Infoblox[31] appliance-based solution. MetroFi liked what it saw in Infoblox and deployed the Infoblox devices as a fault-tolerant, high-availability (HA) pair to ensure resiliency and nonstop delivery of external DNS and internal IP address assignment services. One serves as an authoritative device and the other as a back-up. In the unlikely event of failure of the authoritative device, the back-up device takes over, ensuring seamless operation.

The Portland wireless network went live in early December 2006, with over 70 access points covering much of the downtown area. Since then, the network has continued to expand, with current reach at about 95% of the city. The Infoblox appliances appear to perform flawlessly, with no downtime as of Summer 2007. MetroFi will use Infoblox appliances in all new network deployments, and will replace general-purpose servers and software with Infoblox appliances in its existing networks.

MetroFi provides wireless access to Portland residents in two ways. For $19.95 per month, users can get speeds of 1Mbps with a 256Kbps upload channel without advertising, or users can get a free version of the service by accepting advertising. Since its December 2006 launch, MetroFi announced that its network has 19,900 registered users.[32]

Below is a map of required Phase 1 Wi-Fi coverage for Portland[33]:

[31] Infoblox appliances are designed to provide the foundation for next-generation core network services.
[32] See http://www.metrofi.com
[33] Although Portland's broadband network is supposed to be finished by summer 2008, there's only 15 to 20 percent coverage, mostly in the downtown area. MetroFi has told the city that it will not continue with the project unless the city makes a financial contribution in the form of an anchor tenancy. The city says that MetroFi should live up to its agreement to build a network without municipal funding. In the end Portland might have to forego the MetroFi deal or get someone else to run the network and expand it, or close it down.

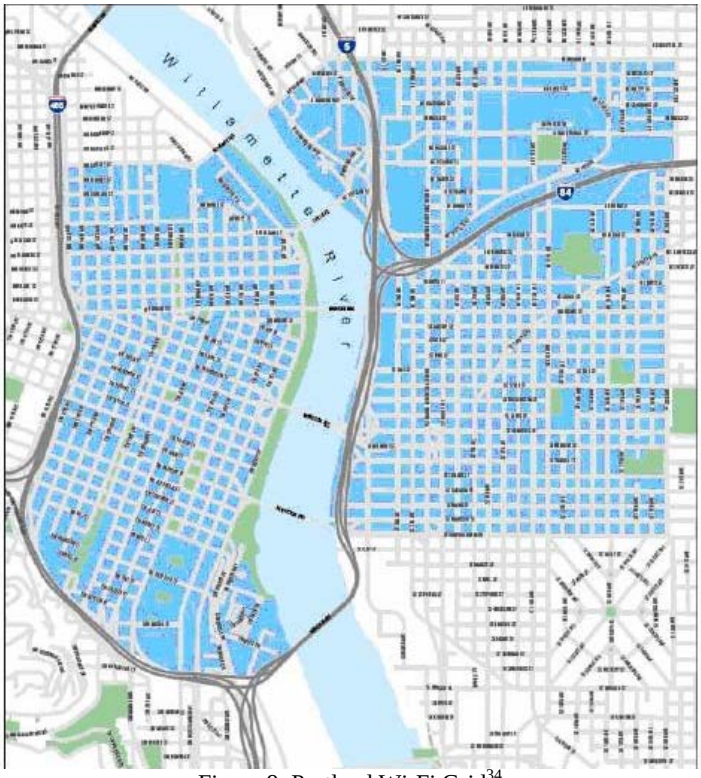


Figure 9: Portland Wi-Fi Grid[34]

Network Aggregate Indicators (NAI) Chart for Portland (Chart 5)

	Pre	*Post*
Network Aggregate Indicators (NAI)	**2006**	**2007**
% of population with Internet access via Mu-Fi	0	3.1%
# of subscribed users/residents via Mu-Fi	0	16,000
# of nodes/access points via Mu-Fi	0	330
Average broadband price	$49.99	$19.95
# of device transfer mechanisms	8	8
# of training and general education venues	70	70

Quality of Life Indicators (QoLAI) Chart for Portland (Chart 6)

	Pre	*Post*
Quality of Life Aggregate Indicators (QoLAI)	**2006**	**2007**
Total educational attainment levels	360,234	361,846
Total school enrollment (unavailable)	123,819	123,450
Average household income (unavail.)	-	--
Median Earnings	31,903	30,534
Unemployment Rate	7.0%	7.3%
Units Owner occupied	132,393	132,387

[34] Source: www.pdc.us/unwire

Units Rent occupied	102,982	102,741
Total vehicle ownership	250,502	247,847
Poverty Status	47,822	47,941
Violent crime incidents	3858	3798
Hate crime incidents	37	42
Divorce incidences	416,232	416,874
Total Households With Food Stamps	28,980	28,740
Telephone service	94.6%	94.6%

2006 Hate Crime Statistics for Portland (Chart 7)

	Race	*Religion*	*Sexual Orientation*	*Ethnicity*	*Disability*	*Total*
Portland	35	6	20	11	0	37

2006 Violent Crime Statistics for Portland (Chart 8)

	Murder and Negligent Manslaughter	*Forcible Rape*	*Robbery*	*Aggravated Assault*	*Total*
Portland	20	325	1137	2376	3858

6.3 Case Study 3: Federal Way, Washington

Federal Way is located in the southwestern corner of King County, Washington State, situated between two major cities; it is situated 25 miles south of downtown Seattle, and 8 miles north of downtown Tacoma. The city is connected to the region by three exits along Interstate 5, as well as access points to state highways. Federal Way also has eight miles of Puget Sound waterfront. Its location provides easy access to Sea-Tac International Airport (12 miles) and the ports of Seattle and Tacoma. Its proximity to Puget Sound has a favorable influence on the city's climate, resulting in mildly temperate conditions.[35]

Federal Way began in the late 1800s as a logging settlement. By the 1920s, Federal Highway 99 was complete, linking Federal Way to the economic centers of Seattle and Tacoma. By the end of the 1950s, the city featured a number of housing areas and a 10-block commercial district with a shopping center and family-oriented theme park.

[35] See http://www.cityoffederalway.com/Page.aspx

During the 1960s, residential development continued, and the city became home to many Boeing engineers and Weyerhaeuser executives.[36]

As part of the Washington State Growth Management Act of 1990 (GMA), Federal Way, along with other Puget Sound suburban cities, have identified Potential Annexation Area's (PAAs) as areas of unincorporated King County that they feel could best be serviced by them. Federal Way has indicated interest in Auburn Hills (east of the city to the Auburn city limits), Lakeland (south and east of the city to the King/Pierce County border and east to the Auburn city limits), and Star Lake (north and east of the city to the Kent city limits). In 2004, the city annexed the Northlake, East Redondo, and Parkway neighborhoods into the city, adding over 2,700 people and nearly 1 square mile (2.57 km²) of area. Other possible annexation areas include the Jovita and Camelot neighborhoods.[37]

As of 2006, there were 81,711 people, and 31,437 households with an average size of 2.63 people per household. The population density was 3,959/sq. mile, and the racial makeup of the city was: 68.8% white, 7.9% African-American, 0.9% Native American, 12.3% Asian and about 11% from other races. The city's Hispanic and Latino population stood at 7.5%. The median income for a household in the city was $49,278, and the median income for a family was $55,833. Men had a median income of $41,504, compared to $30,448 for women. Federal Way's per capita income was $22,451. Approximately 6.9% of families and 9.3% of the population were below the poverty line, including 12.5% of those under age 18 and 6.5% of those aged 65 or over. Among people over age 25, 89.3% were high school graduates, and 26.2% held a bachelor's degree.[38]

Network Aggregate Indicators (NAI) Chart for Federal Way (Chart 9)

	Pre	*Post*
Network Aggregate Indicators (NAI)	**2006**	**2007**
% of population with Internet access via Mu-Fi	0	3.5%
# of subscribed users/residents via Mu-Fi	0	2,900
# of nodes/access points via Mu-Fi	0	14
Average broadband price	$49.99	$19.95
# of device transfer mechanisms	2	2
# of training and general education venues	31	31

Quality of Life Indicators (QoLAI) Chart for Federal Way (Chart 10)

	Pre	*Post*

[36] See http://www.cityoffederalway.com/Page.aspx?page=176
[37] See http://en.wikipedia.org/wiki
[38] Ibid

Quality of Life Aggregate Indicators (QoLAI)	2006	2007
Total educational attainment levels	52,673	52,741
Total school enrollment	22,739	22,510
Average household income (unavail.)	-	--
Median Earnings	31,563	32,781
Unemployment Rate	5.9%	6.1%
Units Owner occupied	18,562	18,990
Units Rent occupied	12,522	12,021
Total vehicle ownership	41,324	41,246
Poverty Status	4,093	4,941
Violent crime incidents	315	320
Hate crime incidents	4	3
Divorce incidences	67,534	67,910
Total Households With Food Stamps	3,922	3,780
Telephone service	94.8%	94.9%

2006 Hate Crime Statistics for Federal Way (Chart 11)

	Race	*Religion*	*Sexual Orientation*	*Ethnicity*	*Disability*	*Total*
Federal Way	1	1	1	2	0	4

2006 Violent Crime Statistics for Federal Way (Chart 12)

	Murder and Negligent Manslaughter	*Forcible Rape*	*Robbery*	*Aggravated Assault*	*Total*
Federal Way	6	55	153	101	315

6.4 Case Study 4: Corpus Christi, Texas

Corpus Christi, Texas, is a coastal city on the Gulf of Mexico, and the county seat of Nueces County. The city, the eighth largest city in the state, is located in the region known as South Texas. Since 2003, the city has earned numerous awards including: Digital City; one of the best cities to stretch your paycheck; and one of the least depressed cities in the nation.[39] Corpus Christi is home to the fifth largest port in the

[39] See http://en.wikipedia.org/wiki

nation, and has the fifth lowest cost of living in the US.[40] The city has a total area of 460.2 square miles, of which 154.6 square miles is land, and 305.6 square miles is water. The city has a warm subtropical climate similar to those of northern Florida cities such as Gainesville, Daytona Beach, and Jacksonville, except that Corpus Christi is located in a semiarid region, so less rainfall occurs than in Florida.[41]

As of the 2000 Census, there were 277,454 people, 98,791 households, and 70,437 families residing in the city. The population density was 1,794.2 people per sq. mi. There were 107,831 housing units, at an average density of 697.3 per square mile. The estimated population in 2006 was 283,474 (+2.2% change compared to 2000). In 2006, the racial makeup of the city was 38.50% white, 4.67% African-American, 0.64% Native American, 1.28% Asian, 0.08% Pacific Islander, and 18.58% from other races. Hispanic or Latino of any race were 54.33% of the population.[42]

There were 98,791 households, 36.1% of which had children under the age of 18; 50.9% were married couples living together; 15.4% had a female householder with no husband present; and 28.7% were non-families. Individuals constituted 23.2% of all households, and 7.9% had someone living alone aged 65 years or older. The average household size was 2.75, and the average family size was 3.27.[43]

Median income for a Corpus Christi household was $36,414, and the median income for a family was $41,672. Men had a median income of $31,863, compared to $22,616 for women. Per capita income for the city was $17,419. Approximately 14.1% of families and 17.6% of the population were below the poverty line, including 22.9% of those under age 18, and 15.5% of those aged 65 or over.[44] As of December 2006, the unemployment rate was 4.6%.[45] Major Corpus Christi employers include Christis Spohn Health System, Columbia Health Care Corp., the U.S. Military, First Data Corporation and Walmart.[46]

Corpus Christi officially launched its $7 million city-owned Mu-Fi network on December 5, 2006, during a ribbon cutting ceremony, which marked the final phase of the project by bringing coverage to more than 100 square miles of the city with multiple applications to public and private users, including residents, businesses, visitors, public safety officers and utility workers. Tropos teamed with prime contractor Northrop Grumman to build the city's Wi-Fi networking system. Corpus Christi's metro-scale Wi-Fi network provides coverage to 90% of the city's 277,000 residents across more than 100 square miles of the city.

Until very recently, Corpus Christi used its wireless network for intra- and inter-government services. Some of these services included: (a) aerial video surveillance (the ability to fly a video camera over a fire or police incident for routine surveillance); (b)

[40] See http://community.txed.state.tx.us/communities/commpages/63.htmhttp
[41] Ibid
[42] Ibid
[43] Ibid
[44] Ibid
[45] See http://recenter.tamu.edu/Data/empct/PA480300.htm
[46] See http://www.coastalbendhealth.com/specials/horizons2000/growth_change/employers.html

automated meter reading system (a five-year program to upgrade the city's water and gas meters); (c) automated vehicle location (to use global positioning satellites to pinpoint location, elevation, and velocity for public safety and enhance job performance, personnel safety, situational awareness, and can aid in time critical scenarios); (d) point to multipoint for access and backhaul (to enable the affordable deployment and upkeep of the network); and (e) resulting building inspections in the field with Wi-Fi (to enable inspectors to complete on-site data entry of inspection results and contractors to have real-time access to those results while they are on job sites). Other applications include: code enforcement/neighborhood improvement, a document management and imaging system, in-car video policing systems, emergency disaster response and notification services, and miscellaneous telemedicine applications.

Below is the Wi-Fi coverage map for Corpus Christi[47]:

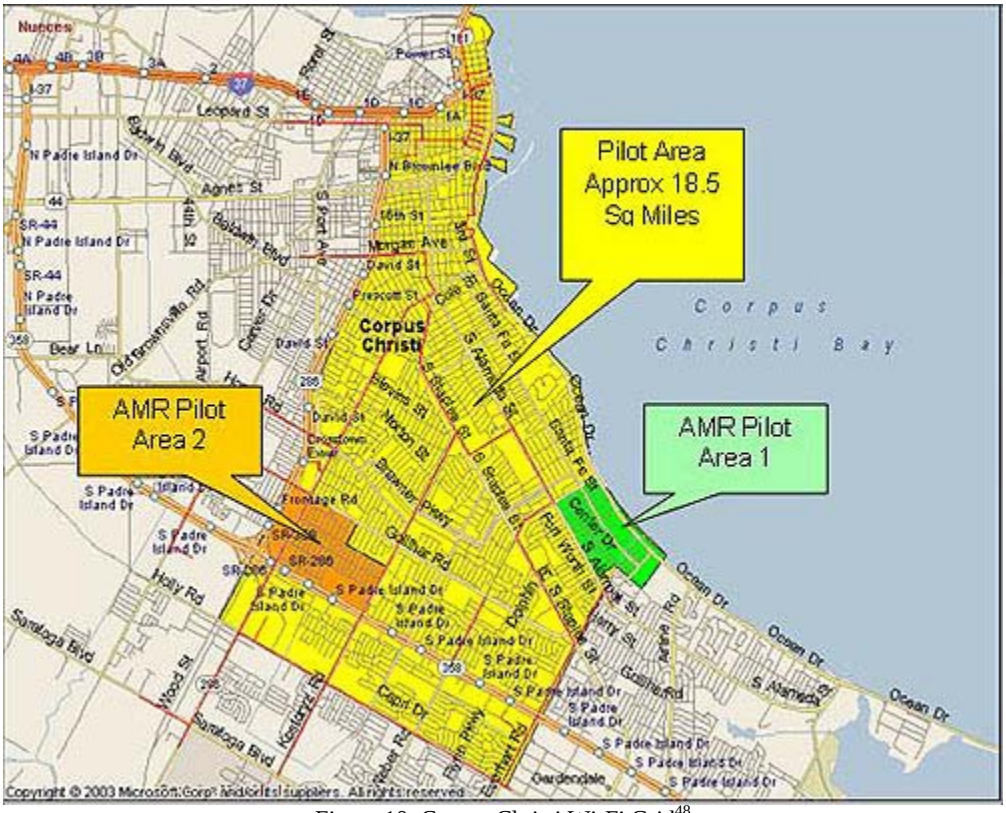


Figure 10: Corpus Christi Wi-Fi Grid[48]

Network Aggregate Indicators (NAI) Chart for Corpus Christi (Chart 13)

	Pre	*Post*
Network Aggregate Indicators (NAI)	**2006**	**2007**

[47] Corpus Christi has taken over the networks built by EarthLink, which abandoned the municipal wireless market in late 2007 (http://www.earthlink.com)

[48] Source: www.cctexas.com

% of population with Internet access via Mu-Fi	0	10%
# of subscribed users/residents via Mu-Fi	0	27,390
# of nodes/access points via Mu-Fi	0	340
Average broadband price	$49.99	$19.95
# of device transfer mechanisms	16	16
# of training and general education venues	51	51

Quality of Life Indicators (QoLAI) Chart for Corpus Christi (Chart 14)

	Pre	*Post*
Quality of Life Aggregate Indicators (QoLAI)	**2006**	**2007**
Total educational attainment levels	171,405	170,980
Total school enrollment	86,722	88,840
Average household income (unavail.)	-	--
Median Earnings	24,502	24,112
Unemployment Rate	6.0%	6.4%
Units Owner occupied	62,212	62,103
Units Rent occupied	41,332	41,869
Total vehicle ownership	125,722	124,873
Poverty Status	21,209	21,641
Violent crime incidents	2048	2089
Hate crime incidents	2	4
Divorce incidences	212,564	212,019
Total Households With Food Stamps	14,903	15,586
Telephone service	95.1%	95.0%

2006 Hate Crime Statistics for Corpus Christi (Chart 15)

	Race	*Religion*	*Sexual Orientation*	*Ethnicity*	*Disability*	*Total*
Corpus Christi	3	1	1	0	0	2

2006 Violent Crime Statistics for Corpus Christi (Chart 16)

	Murder and Negligent Manslaughter	*Forcible Rape*	*Robbery*	*Aggravated Assault*	*Total*
Corpus Christi	8	217	481	1342	2048

6.5 Case Study 5: Madison, Wisconsin

Madison is the capital of Wisconsin and the county seat of Dane County.[49] It is situated 77 miles west of Milwaukee, and 122 miles northwest of Chicago.[50] The city, home to the University of Wisconsin-Madison, had a 2006 population of 221,551, making it the second largest city in Wisconsin, after Milwaukee, and the 77th largest in the US.[51] In December 2006, Mayor Dave Cieslewicz announced that the city had won the Digital Cities Survey number one ranking in its population category for the second consecutive year. The survey ranks cities based upon their innovative uses of digital and online technologies to better serve the general public and streamline operations.[52]

According to the U.S. Census Bureau, Madison has a total area of 84.7 square miles; 68.7 of it on land and 16.0 of it is water. The city is often described as *The City of Four Lakes*, comprising the four successive lakes of the Yahara River: Lake Mendota ("Fourth Lake"), Lake Monona ("Third Lake"), Lake Waubesa ("Second Lake") and Lake Kegonsa ("First Lake"), although Waubesa and Kegonsa are not actually in Madison, but immediately south of it.[53]

As of the 2000 Census, there were 208,054 people, 89,019 households, and 42,462 families residing in the city. The racial makeup of the city was 83.96% white, 5.84% African-American, 0.36% Native American, 5.80% Asian, 0.04% Pacific Islander and 1.67% from other races. The Hispanic and Latino population stood at 4.09% of any race. Out of 89,019 households, 22.1% had children under the age of 18, 37.0% were married couples living together, 7.8% had a female householder with no husband present, and 52.3% were non-families. Individuals made up 35.3% of all households, and 7.1% had someone living alone aged 65 or older. The average household size was 2.19, and the average family size was 2.87. The median income for a household in the city was $41,941, and the median income for a family was $59,840. The per capita income for the city was $23,498. Approximately 5.8% of families and 15.0% of the population were below the poverty line, including 11.4% of those under age 18 and 4.5% of those aged 65 or over.[54]

Wisconsin state government and the University of Wisconsin-Madison remain the top two major Madison employers. However, the economy has been evolving from a governmental based economy to a consumer-services and high-tech economy, particularly in the health, biotech and advertising sectors. Since the early 1990s, the city has experienced a steady economic boom and has been comparatively unaffected by recession. Many businesses are attracted to Madison's exceptional skill base. According to city-data.com, 48.2% of Madison's population holds a bachelor's degree or higher, and *Forbes* magazine reported in 2004 that Madison had the highest percentage of Ph.Ds in

[49] See http://en.wikipedia.org/wiki
[50] Ibid
[51] Ibid
[52] See http://www.ci.madison.wi.us
[53] See http://en.wikipedia.org/wiki
[54] Ibid

the nation. In 2006, *Forbes* listed the city as having the lowest unemployment: 2.5%, less than half the national 2004 average.[55] As of December 2006, the city's unemployment rate was 2.8%.[56]

Below is a map of Madison´s wireless coverage zone[57]:

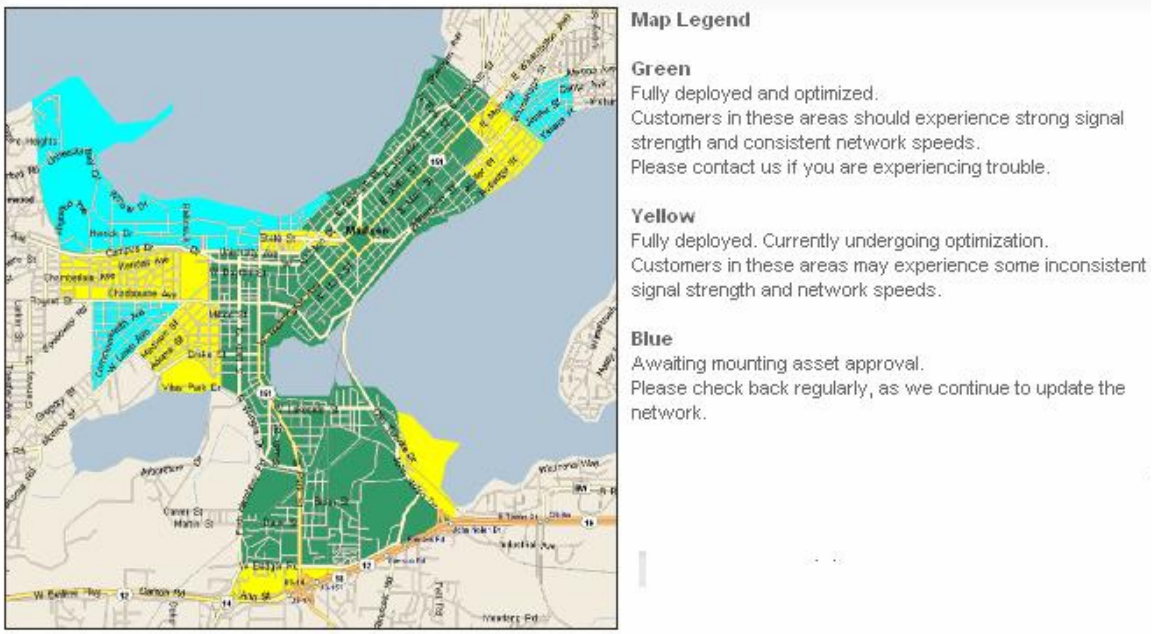


Figure 11: Madison Wi-Fi Grid[58]

Network Aggregate Indicators (NAI) Chart for Madison (Chart 17)

	Pre	*Post*
Network Aggregate Indicators (NAI)	**2006**	**2007**
% of population with Internet access via Mu-Fi	0	1.4%
# of subscribed users/residents via Mu-Fi	0	3,000
# of nodes/access points via Mu-Fi	0	30
Average broadband price	$49.99	$25.00
# of device transfer mechanisms	3	3
# of training and general education venues	55	55

[55] Ibid
[56] See http://recenter.tamu.edu/Data/empct/PA550250.htm
[57] Madison is resisting the anchor tenancy trend with the build-out of a muni network that not only makes no anchor tenant commitment to the network provider but also requires the partner to pay for mounting antennas on city property.

[58] Source: www.madcitybroadband.com

Quality of Life Indicators (QoLAI) Chart for Madison (Chart 18)

	Pre	*Post*
Quality of Life Aggregate Indicators (QoLAI)	**2006**	**2007**
Total educational attainment levels	128,463	128,516
Total school enrollment	63,546	64,970
Average household income (unavail.)	-	--
Median Earnings	33,722	33,012
Unemployment Rate	5.0%	4.9%
Units Owner occupied	47,452	47,036
Units Rent occupied	48,354	49,437
Total vehicle ownership	120,985	121,692
Poverty Status	10,562	10,980
Violent crime incidents	839	796
Hate crime incidents	3	4
Divorce incidences	168,816	166,369
Total Households With Food Stamps	4,711	4,987
Telephone service	92.8%	92.7%

2006 Hate Crime Statistics for Madison (Chart 19)

	Race	*Religion*	*Sexual Orientation*	*Ethnicity*	*Disability*	*Total*
Madison	2	1	0	2	0	3

2006 Violent Crime Statistics for Madison (Chart 20)

	Murder and Negligent Manslaughter	*Forcible Rape*	*Robbery*	*Aggravated Assault*	*Total*
Madison	2	80	329	428	839

6.6 Overview of Descriptive Quantitative (Background) Data

Although new studies concerning the popularity of Mu-Fi networks are regularly emerging, less is known about the effect of such networks than most might think. At least two major challenges face researchers interested in learning more about the QoL issues through governmental data sources: the availability of relevant data, and the other is operational in nature.

Operationally, different terms mean different things to different people. Data at the "Place" level of analysis listed at the USCB but not at the BLS. MSA data is not released annually from BLS, for instance, but it is by the FBI. Aside from issues stemming from the operationalization of specific terms, the researcher must address the lack of availability of appropriate or adequate data. The U.S. Census Bureau, the Bureau of Labor Statistics, the Centers for Disease Control and Prevention, and the FBI are the four primary agencies collecting data on QoL.

The decennial U.S. Census collects information on QoL measures, though such data may not always be timely. For instance, given the rapid demographic changes experienced in recent years, the decennial data collection approach of the U.S. Census is no longer acceptable as a source for the housing and socio-economic data. To meet the needs and expectations of the country, the U.S. Census Bureau developed the American Community Survey (ACS), a survey that collects detailed socio-economic data every month and provides tabulations on these data on a yearly basis. As a result, the study relies on the ACS for collection of QoL measures. It is important to mention that since the ACS is a sample survey rather than a census of the population, some differences in results between the two can be expected. The ACS consists of a larger sample size, but includes only those households in geographic areas with populations greater than 65,000. The ACS published data at the place-level (i.e. city level) (U.S. Census Bureau, 2004).

The Federal FBI is a federal criminal intelligence agency, and the primary investigative arm of the U.S. Department of Justice (DOJ). Currently, the FBI has investigative jurisdiction over violations of more than 200 categories of federal crimes, making it the de-facto lead law enforcement agency of the U.S. government. The FBI collects data annually that includes data sets at the city-agency level for violent and hate crime information under its Uniform Crime Reports.

Both ACS and FBI data are available over time. The ACS releases data for the previous year every spring. The FBI-Uniform Crime Reporting Program publishes preliminary figures for the current year by mid-December, and final data are available every spring.

6.7 Basic quantitative findings from each case study

The quantitative research analyses on QoL and network aggregate indicators are discussed below in light of the aggregate model employed for this research study.

6.7.0 Network Aggregate Indicators (NAI)

The following section examines NAI for 2007:

6.7.0.1 Percent of Population with Internet Access (Chart 21)

In 2007, the average percentage of population with Internet access across the five cities was 46 percent, with a standard deviation of 12 percent. Portland, Oregon had the highest percent (62%), and Corpus Christi had the lowest (32%). Tempe, Arizona measured 39%; Federal Way, Washington measured 43%, and Madison, Wisconsin was at 54%. *See chart below*.

	Average
Tempe, AZ	39%
Portland, OR	62%
Federal Way, WA	43%
Corpus Christi, TX	32%
Madison, WI	54%

(Blue- lowest Red- highest)

6.7.0.2 Number of Subscribed Users/Households (Chart 22)

In 2007, the average number of subscribed users/households across the five cities was 17,664, with a standard deviation of 15,707. Tempe had the highest (39,030) and Federal Way the lowest (2,900). Portland had 16,000 users/households, Corpus Christi had 27,390, and Madison had 3,000.

In order to accurately compare the two means, the numbers had to be standardized to the fixed population size for 2007. Comparing only the raw means does not take into consideration the size of the state; therefore the means are not accurately comparable.

When comparing the number of subscribed users/households by population rates per 100,000, Tempe still had the highest (24,220), but Madison then dropped to the lowest (1,354). Portland had a rate of 3,112; Federal Way measured 3,549; and Corpus Christi's rate was 9,871. *See chart below*.

	Average	Per 100,000 population
Tempe, AZ	39,030	24,220
	16,000	3,112

Portland, OR		
Federal Way, WA	2,900	3,549
Corpus Christi, TX	27,390	9,871
Madison, WI	3,000	1,354

6.7.0.3 Number of Nodes/Access Points (Chart 23)

In 2007, the average number of nodes/access points across the five cities was 149.6, and the standard deviation was 169.4. Corpus Christi had the highest number (340), and Federal Way the lowest (14). Tempe measured 34; Madison 30, and Portland measured 330.

When comparing the rates per 100,000, Corpus Christi still had the highest with a rate of 122.5, but now Madison had the lowest (13.5). Tempe had a rate of 21.1, Portland rate was 64.2, and Federal Way had a rate of 17.1. *See chart below*.

	Average	**Per 100,000 population**
Tempe, AZ	34	21.1
Portland, OR	330	64.2
Federal Way, WA	14	17.1
Corpus Christi, TX	340	122.5
Madison, WI	30	13.5

6.7.0.4 Average Broadband Price (Chart 24)

In 2007, the average broadband price across the five cities was $49.99 per month with a standard deviation of 0. All five cities had the same average broadband price in 2006. *See chart below.*

	Average
Tempe, AZ	$49.99
Portland, OR	$49.99
Federal Way, WA	$49.99
Corpus Christi, TX	$49.99
Madison, WI	$49.99

6.7.0.5 Number of Device Transfer Mechanisms (Chart 25)

In 2007, the average number of device transfer mechanisms across the five cities was 6.6, with a standard deviation of 5.7. Corpus Christi had the highest number with 16, and Federal Way had the lowest with 2. Tempe had 4, Portland 8 and Madison, 3.

When comparing rates per 100,000, Corpus Christi still had the highest number (5.8), but now Madison had the lowest (1.3). Portland had a number of 1.5, Federal Way had 2.4, and Corpus Christi had 5.8. *See chart below.*

	Average	Per 100,000 population
Tempe, AZ	4	2.5
Portland, OR	8	1.5
Federal Way, WA	2	2.4
Corpus Christi, TX	16	5.8

Madison, WI	3	1.3

6.7.0.6 Number of Training and General Education Venues (Chart 26)

In 2007, the average number of training and general education venues across the five cities was 51.8 with a standard deviation of 13.9. Portland had the highest with 70 and Federal Way had the lowest (31). Corpus Christi had 51, Madison had 55 and Tempe had 52.

When comparing rates per 100,000, Federal Way had the highest number (37.9) and Tempe had the lowest (4.9). Portland now had a number of 13.6, Corpus Christi 18.4, and Madison 24.8. *See chart below.*

	Average	**Per 100,000 population**
Tempe, AZ	52	4.9
Portland, OR	70	13.6
Federal Way, WA	31	37.9
Corpus Christi, TX	51	18.4
Madison, WI	55	24.8

6.7.0.7 Mean and Standard Deviation (rounded to nearest tenth) for Network Indicators for 2007 (Chart 27)

Indicators	**Mean**	**Standard Deviation**
Percent of population with Internet access	46	12%
Number of subscribed users/household	17,664	15,707
Number of nodes/access points	149.6	169.4
Average broadband	49.99	0

price		
Number of device transfer mechanisms	6.6	5.7
Number of training and general education venues	51.8	13.9

6.7.1 Quality of Life Aggregate Indicators (QoLAI)

The following section examines QoLAI for 2006:

6.7.1.1 Educational Attainment Levels

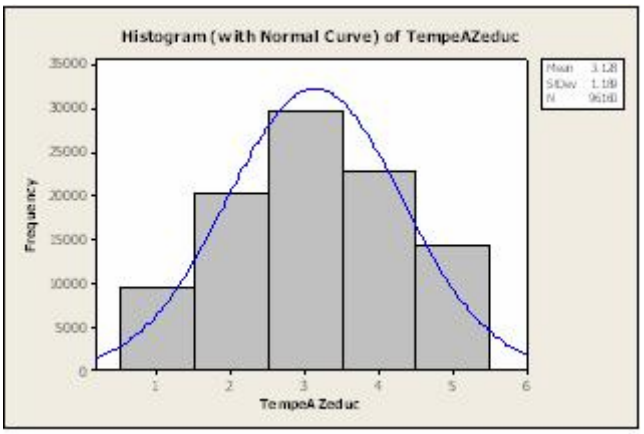
To describe this aspect of the populations of Tempe, AZ; Portland, OR; Corpus Christie, TX; Federal Way, WA; and Madison, WI; it was necessary to first create a rank to describe this variable. This rank consisted of five categories, each denoting a certain level of educational attainment. The data was retrieved from the ACS report from 2006.

The first category, denoted by a one, represents those individuals who have achieved an educational level below a high school diploma. The second category represents individuals who discontinued their education after receiving their high school diploma. This category is represented by a two. The third level of education attainment, denoted by a three, consists of individuals who have taken some college courses, but who have not earned a Bachelor's degree, and individuals who have earned an Associate's degree. The fourth level consists of individuals who have earned their Bachelor's degree. This category is represented by a four. The final level of educational attainment, represented by a five, consists of individuals who have earned a Graduate degree or a Professional degree. This variable, with possible values ranging from one to five is one of multiple variables which we are using in an attempt to quantify an individual's QoL.

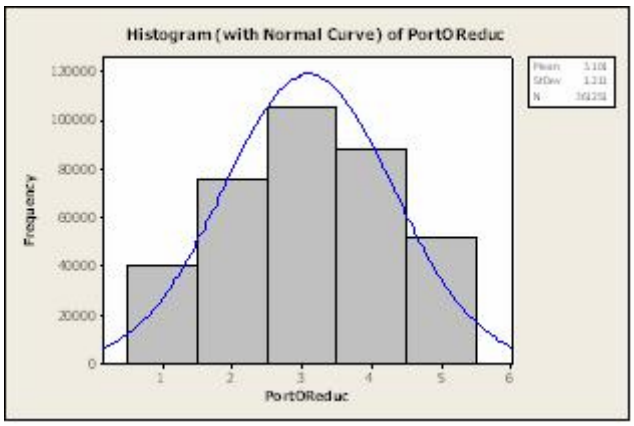
As we are using this as a basis for measuring the change in educational attainment over time, the following is solely a descriptive of these populations, as of 2006, in the aforementioned cities. The findings revealed that Corpus Christie, TX (2.593) to have the lowest level of educational attainment out of the five cities, while Madison, WI had the highest (3.372). These numbers are the mean scores of the cities based on the scale of one to five; one denotes the lowest level of educational attainment and five the highest.

Tempe, AZ, with a 2006 population of 96,160, scored a mean of 3.1282. This means that the average individual living in Tempe, AZ in 2006 had received a high school diploma and had taken some college courses or attained an Associate's degree. The standard deviation is 1.189, meaning that two-thirds of the population falls between the scores of 1.9392 and 4.3172, which is to say that this fraction of the population has at least a high school diploma and up to a Bachelor's degree. The distribution represented here follows

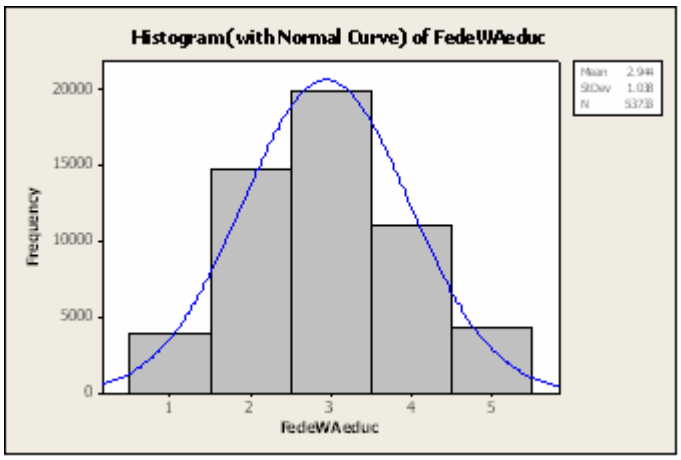
the normal curve and is what one may expect to see given a normal distribution. *See Chart 28 below.*



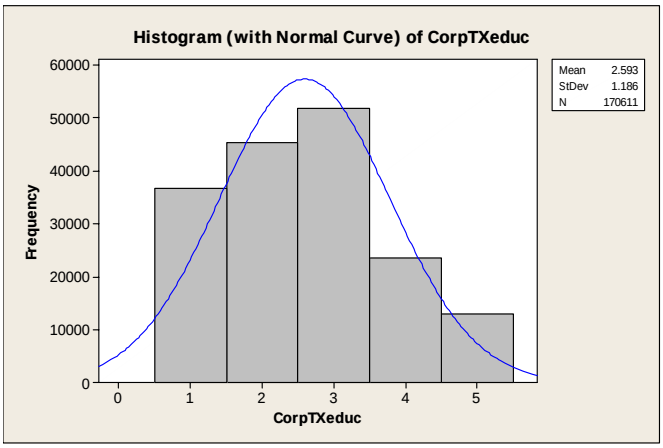
Portland, OR with the largest population of our study (361,251) has a mean of 3.101 and presents a nearly normal distribution. The mode and mean occur in the same category (3), which creates the normal distribution effect. For a large population such as this, one would expect to see a normal distribution as the distribution tends to become more spread out with a large sample size. The standard deviation for Portland is 1.211, meaning that approximately two-thirds of the population falls between a mean score of 1.89 and 4.312. *See Chart 29 below.*



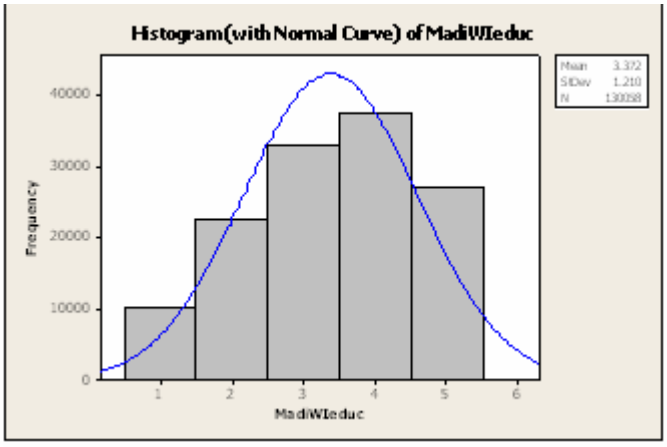
Federal Way, WA had the smallest population in the study, with a population of 53,733. This city has a normal distribution; the mode is the middle category (3) and the mean is very close by at 2.944. An interesting note is that Federal Way has the smallest standard deviation in the study (1.038), which means that a very large majority of this population falls between categories two and four. There is very low incidence of the extremes (1 and 5), denoting that very few individuals here have neither less than a high school education nor more than a Bachelor's Degree. *See Chart 30 below.*



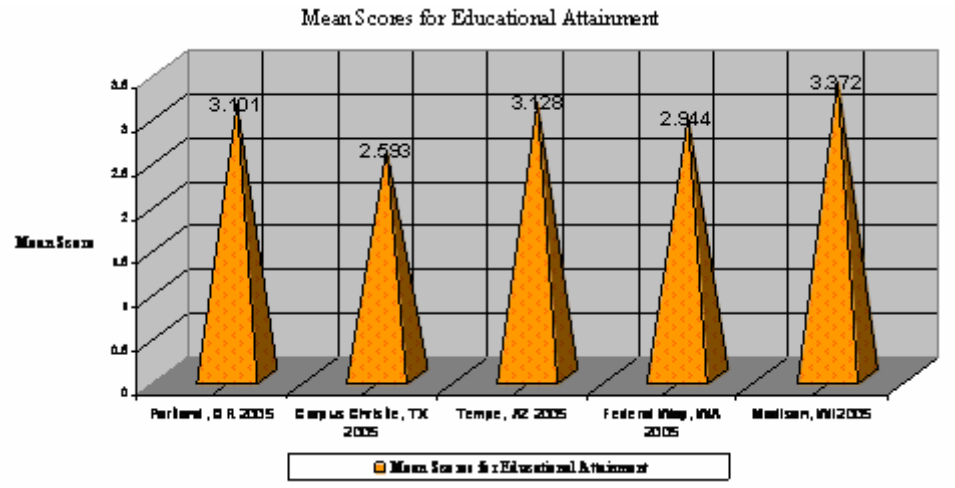
As mentioned earlier, Corpus Christi, TX scored the lowest of the five cities in this study in terms of educational attainment. The mean for Corpus Christi was 2.593 for a population of 170,611, denoting that the majority of this population falls into the lower half of the distribution, making this also a right-skewed distribution. The interesting thing to note here is that the mode and mean do not occur in the same category. The mean was pulled down due to the high number of individuals falling in the first category of Less than High School. See *Chart 31 below.*



The last city in our study is Madison, WI. The population is 130,058 and the mean score of educational attainment is the highest in the study at 3.372, denoting that the average person in Madison has taken some college courses. The mode here occurs in the fourth category, attainment of a Bachelor's Degree, which makes this distribution slightly skewed to the left. As this is where the University of Wisconsin is located, one might expect the average level of educational attainment to be higher relative to other cities. *See Chart 32 below.*



Mean Scores for Educational Attainment for Five Cities for 2006 (Chart 33)



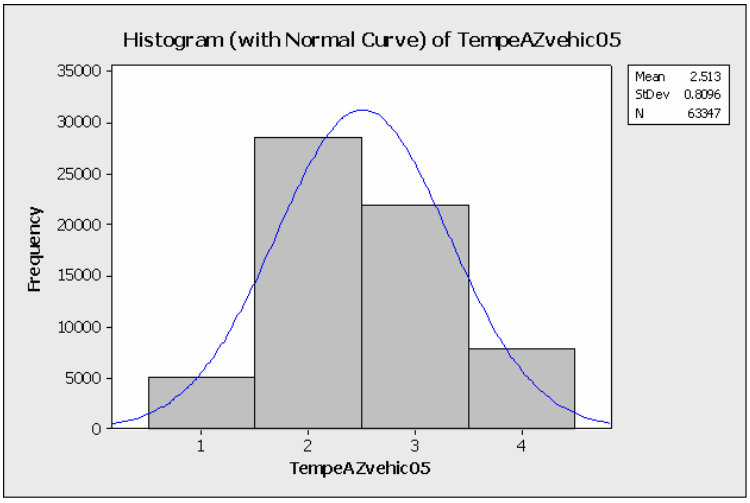
6.7.1.2 Vehicle Ownership Levels

Data for this variable was collected from the ACS for 2006 for all five cities. The variable was ranked from 1 to 4 as follows:

1. No Vehicles Available
2. One Vehicle Available
3. Two Vehicles Available
4. Three or More Vehicles Available

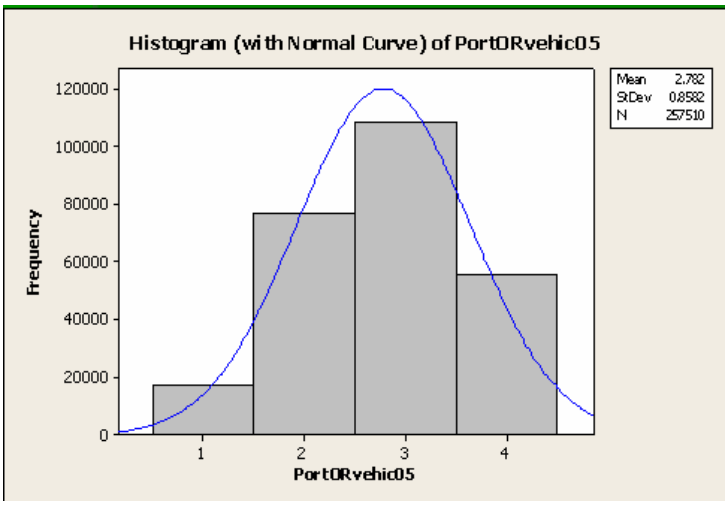
Tempe 2006

Out of the five cities in our study, Tempe, AZ had the lowest mean score for vehicle ownership in 2006, scoring 2.513 on a scale of 1 to 4. Population size was 63,647 in 2006 and the standard deviation of 0.8096, which was similar to the other cities in the study. The average Tempe individual had access to one vehicle in 2006. *See chart 34 below*.



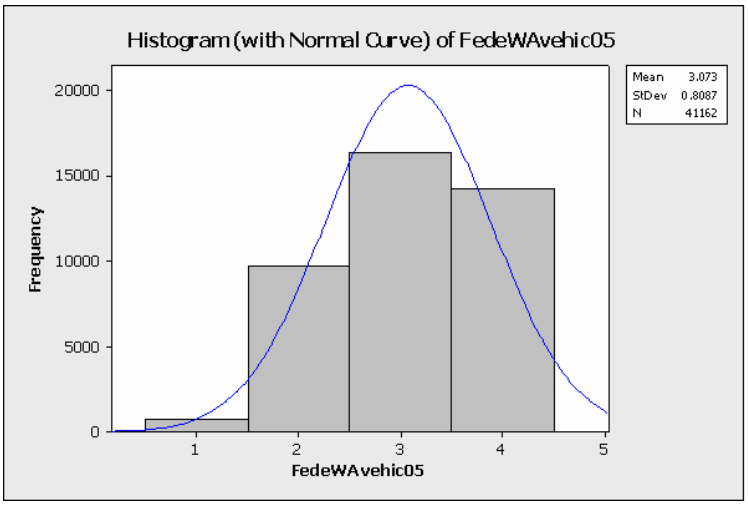
Portland 2006

In 2006, Portland, OR scored a mean of 2.782 on our scale of 1 to 4 denoting vehicle ownership. The city's population increased from 227,233 in 2004 to 257,510. In addition to a significant population increase, the mean score for vehicle ownership also increased from 2.453 in 2004. These statistics reveal that in 2004, the average person in Portland, OR had access to one vehicle or more. *See chart 35 below*.



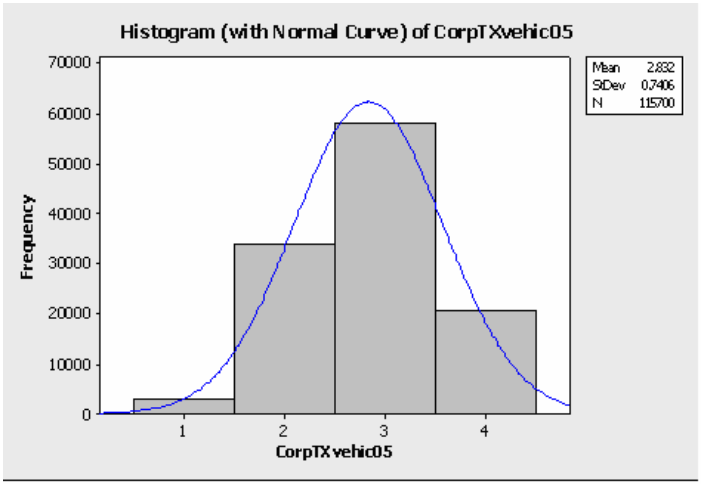
Federal Way 2006

In 2006, Federal Way, WA had the highest mean score for vehicle ownership out of our five-city study with a mean of 3.073. This represents that in 2006, the average person in Federal Way had access to two vehicles. Federal Way also had the smallest population in this study (41,162). *See chart 36 below*.



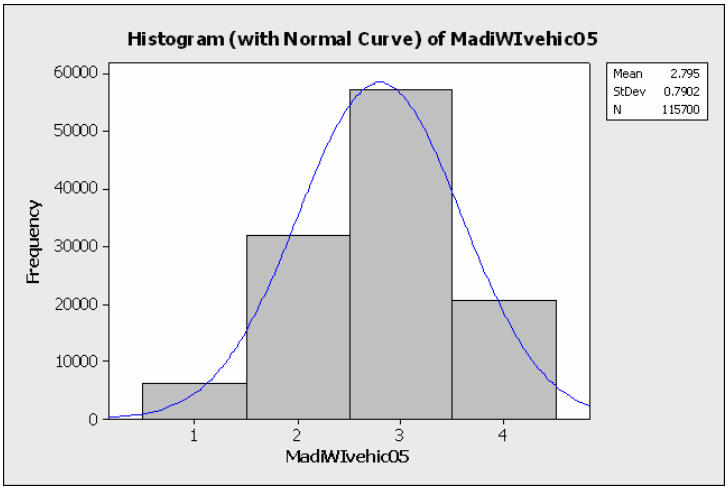
Corpus Christi 2006

In 2006 with a population of 115,700, Corpus Christi, TX scored a mean of 2.832 on the scale of 1 to 4 in our variable of vehicle ownership. This mean score represents a marked increase over the previous two years (2.435 for 2003 and 2.452 for 2004). The standard deviation of 0.7406 denotes that about two-thirds of the population falls between a mean score of 2.0914 and 3.5726, showing that these individuals have access to at least one vehicle with a good number having access to two vehicles. *See chart 37 below*.

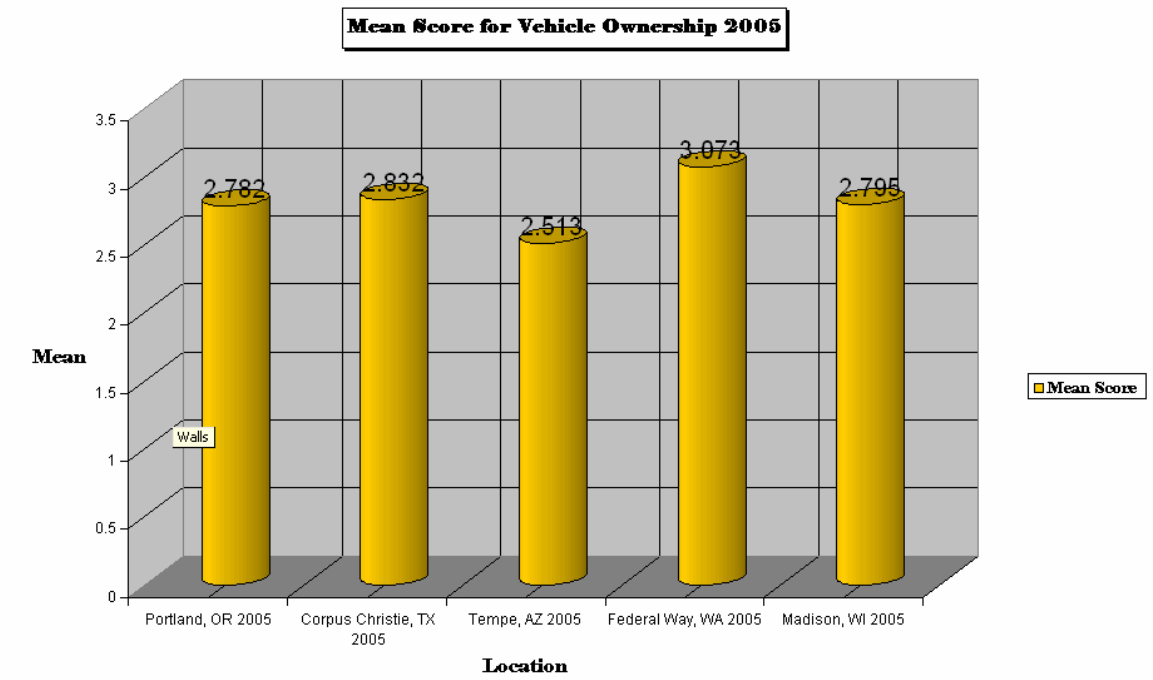


Madison 2006

In 2006, Madison, WI scored a mean of 2.795 in the variable category of vehicle ownership. With a standard deviation of .7902 for a population of 115,700, one can deduce that roughly 84% of the population had access to one or more vehicles. The ACS did not collect data for Madison until 2006, therefore there is no comparison data from past years. *See chart 38 below.*



Below is the mean scores of vehicle ownership for 2006 for all cities (chart 39)



6.7.1.3 Median Earnings

In 2006, the average median earnings across the five cities was $28,243, with a standard deviation of $3,746. Federal Way had the highest mean earnings ($32,097), and Tempe having the lowest ($23,660). Corpus Christi had a reported median earning of $24,829, Portland $30,438, and Madison $30,194.

In order to accurately comparing the two means, the numbers had to be standardized to the fixed population size for 2006. Comparing only the raw means does not taking into account the size of the state and therefore the means are not accurately comparable. When looking at median earnings per 100,000, Federal Way still had the highest average earnings ($39,281), but Portland's adjusted proved ($5,921). Following standardization, Tempe's median earnings rate was $14,682 per 100,000; Madison had a rate of $13,628; and Corpus Christi $8,948. *See chart 40 below.*

	Average	Per 100,000 population
Tempe, AZ	$23,660	$14,682
Portland, OR	$30,438	$5,921
Federal Way, WA	$32,097	$39,281

Corpus Christi, TX	$24,829	$8,948
Madison, WI	$30,194	$13,628

(Blue- lowest, Red- highest)

6.7.1.4 Poverty Status

In 2006, the average poverty status (income in past 12 months below poverty) across the five cities was $18,696, with a standard deviation of $18,244. Portland had the highest ($49,085) and Madison the lowest ($4,798). Tempe's poverty income was $6,781, Federal Way's was $10,824, and Corpus Christi had a poverty income of $21,993.

When comparing poverty by the rates per 100,000 population, Federal Way moves to the highest ($13,246), and Madison still had the lowest ($2,165). Portland had a rate of $9,549 per 100,000, Corpus Christi's rate was $7,926 and Tempe had a rate of $4,208. *See chart 41 below*.

	Average	**Per 100,000 population**
Tempe, AZ	$6,781	$4,208
Portland, OR	$49,085	$9,549
Federal Way, WA	$10,824	$13,246
Corpus Christi, TX	$21,993	$7,926
Madison, WI	$4,798	$2,165

(Blue- lowest Red- highest)

6.7.1.5 Total school enrollment

In 2006, the average total school enrollment across the five cities was 70,684, and the standard deviation was 36,467. Portland had the highest number (122,358), and Federal

Way the lowest (22,592). Tempe had a total school enrollment of 58,381, Madison 66,466, and Corpus Christi 83,623.

When comparing the rates per 100,000, Tempe now had the highest average school enrollment (36,229), and Portland fell to the lowest (23,805). Federal Way had a rate of 27,648, while Corpus Christi had 30,139 and Madison had a rate of 30,000 per 100,000 population. *See chart 42 below.*

	Average	Per 100,000 population
Tempe, AZ	58,381	36,229
Portland, OR	122,358	23,805
Federal Way, WA	22,592	27,648
Corpus Christi, TX	83,623	30,139
Madison, WI	66,466	30,000

(Blue- lowest Red- highest)

6.7.1.6 Telephone service availability

In 2006, the average percentage of occupied units with telephone service across the five cities was 94%, with a standard deviation of 1.3%. Corpus Christi and Federal Way had the highest percentages (95.3% and 95.4%, respectively), and Madison had the lowest (92.5%). Tempe had an average of 93% and Portland had 94.7%. *See chart 43 below.*

	Average
Tempe, AZ	93.0%
Portland, OR	94.7%
Federal Way, WA	95.4%

Corpus Christi, TX	95.3%
Madison, WI	92.5%

(Blue- lowest Red- highest)

6.7.1.7 Unemployment rate

In 2006, the average unemployment rate across the five cities was 5.82%, with a standard deviation of 1.23. Portland had the highest unemployment rate (7.90%), and Tempe had the lowest (4.80%). The remaining three cities had similar rates: Federal Way, 5.60%; Madison, 5.00%; and Corpus Christi; 5.80. *See chart 44 below.*

	Average
Tempe, AZ	4.80
Portland, OR	7.90
Federal Way, WA	5.60
Corpus Christi, TX	5.80
Madison, WI	5.00

(Blue- lowest Red- highest)

6.7.1.8 Divorce Rate

In 2006, the average divorce rate across the five cities was 17,352 with a standard deviation of 7,251. Tempe had the highest with a rate of 23,313, and Federal Way had the lowest at 8,395. Corpus Christi's divorce rate was 23,181, while Madison's rate was 14,519. Portland data is not available for 2006. *See chart 45 below.*

When comparing rates per 100,000, Tempe had the highest divorce rate with a rate of 14,467, and Madison had the lowest (6,553). Federal Way's rate was 10,274, and Corpus Christi's rate was 8,355.

	Average	Per 100,000 population
Tempe, AZ	23,313	14,467
Portland, OR	N/A	N/A
Federal Way, WA	8,395	10,274
Corpus Christi, TX	23,181	8,355
Madison, WI	14,519	6,553

(Blue- lowest Red- highest)

6.7.1.9 Units-Owner Occupied

In 2006, the average occupied units that were rented across the five cities was 47,115, with a standard deviation of 31,916. Madison had the highest number (48,104) and Federal Way had the lowest (12,808). Tempe had 34,733 units rented, Portland 99,122 and Corpus Christi 40,821.

When comparing rates per 100,000, Madison had the highest units rented with a rate of 21,712, and Corpus Christi had the lowest (14,713). Tempe's rate was 21,554, Portland's was 19,282, and Federal Way's rate was 15,675. *See chart 46 below.*

	Average	Per 100,000 population
Tempe, AZ	34,733	21,554
Portland, OR	99,112	19,282
Federal Way, WA	12,808	15,675

Corpus Christi, TX	40,821	14,713
Madison, WI	48,104	21,712

6.7.1.10 Units-Rent Occupied

In 2006, the average units that were owner occupied across the five cities was 57,525, with a standard deviation of 43,068. Portland had the highest with 129,055 units, and Federal Way had the lowest (19,053). Corpus Christi had 62,338, Madison had 45,020 and Tempe 32,160.

When comparing rates per 100,000, Portland was highest among owner- occupied units at 25,108, and Tempe was lowest at 19,957. Federal Way's rate was 23,318, Corpus Christi's was 22,468, and Madison's had a rate of 20,320. *See chart 47 below.*

	Average	**Per 100,000 population**
Tempe, AZ	32,160	19,957
Portland, OR	129,055	25,108
Federal Way, WA	19,053	23,318
Corpus Christi, TX	62,338	22,468
Madison, WI	45,020	20,320

6.7.1.11 Households with Food stamps

In 2006, the average of households with food stamps across the five cites was 10,642, with a standard deviation of 11,202. Portland had the highest number of households with food stamps (28,657) and Federal Way and Madison had the lowest (3,384 and 3,893, respectively). Corpus Christi had a rate of 14,605, and Tempe had 2,675.

When comparing rates per 100,000, Portland still had the highest number of households with food stamps (5,575) and Tempe had the lowest, with 1,660 households. Federal

Way had a rate of 4,141 households, Corpus Christi 5,264, and Madison was lowest at 1,757. *See chart 48 below*.

	Average	Per 100,000 population
Tempe, AZ	2,675	1,660
Portland, OR	28,657	5,575
Federal Way, WA	3,384	4,141
Corpus Christi, TX	14,605	5,264
Madison, WI	3,893	1,757

6.7.1.12 Hate Crime

In 2006, the average rate of hate crimes across the five cities was 10.20, with a standard deviation of 15. Portland had the highest number (37) and Corpus Christi had the lowest (2). Tempe's rate was 5, Federal Way 4, and Madison had 3.

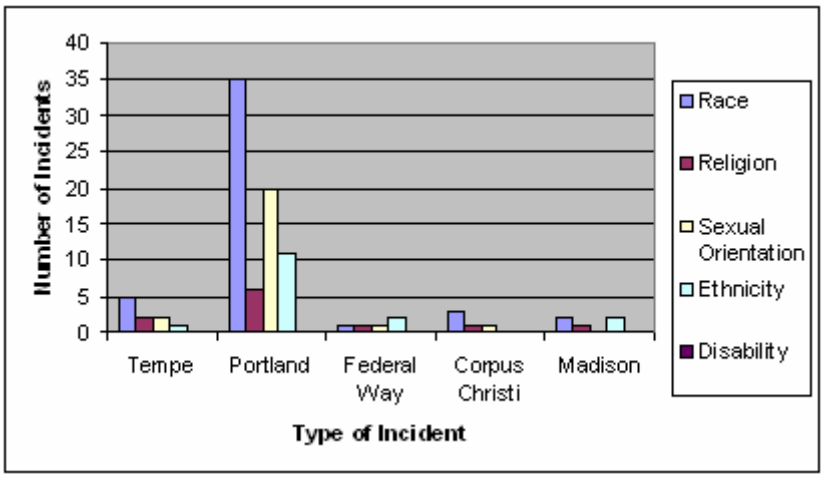
When comparing rates per 100,000, Portland again had the most hate crime rate at 7.19, and Corpus Christi had the lowest rate with .72 crimes. Tempe's hate crime rate was 3.10, Federal Way's rate was 4.89, and Madison had the lowest rate of 1.35. *See chart 49 below*.

	Average	Per 100,000 population
Tempe, AZ	5	3.10
Portland, OR	37	7.19
Federal Way, WA	4	4.89
Corpus Christi, TX	2	0.72

Madison, WI	3	1.35

Hate Crime Statistics for Five Cities (chart 50)

	Race	*Religion*	*Sexual Orientation*	*Ethnicity*	*Disability*	*Total*
Tempe	5	2	2	1	0	5
Portland	35	6	20	11	0	37
Federal Way	1	1	1	2	0	4
Corpus Christi	3	1	1	0	0	2
Madison	2	1	0	2	0	3



6.7.1.12 Violent Crime

In 2006, the average rate of violent crimes across the five cities was 1,624, with a standard deviation of 1,398. Portland had the highest number of violent crimes at 3,858, and at 315, Federal Way had the lowest. Tempe's rate was 1,060, Corpus Christi's was 2,048, and Madison's violent crime rate was 839.

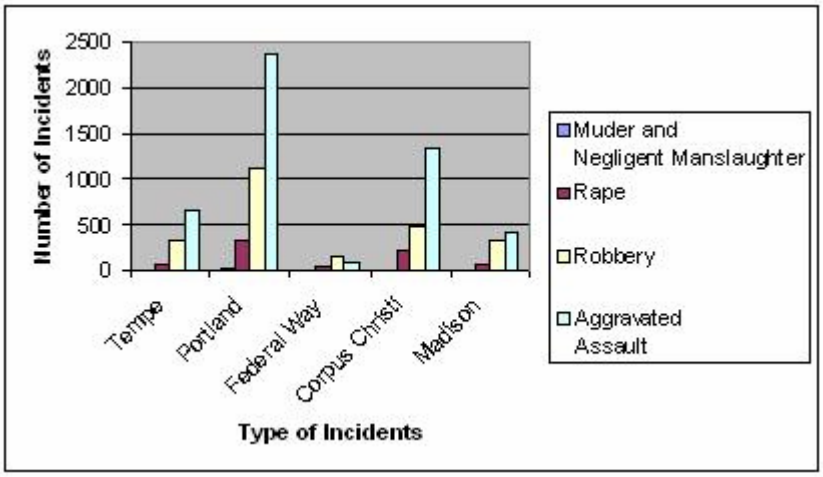
When comparing rates per 100,000, Portland again had the highest number of violent crimes with a rate of 751, and Madison had the lowest rate with 379. Tempe's rate was 658, Federal Way's rate was 386, and Corpus Christi's rate was 738. *See chart 51 below*.

	Average	**Per 100,000 population**

Tempe, AZ	1,060	658
Portland, OR	3,858	751
Federal Way, WA	315	386
Corpus Christi, TX	2,048	738
Madison, WI	839	379

2006 Violent Crime Statistics for Five Cities (chart 52)

	Murder and Negligent Manslaughter	*Forcible Rape*	*Robbery*	*Aggravated Assault*	*Total*
Tempe	4	72	326	658	1060
Portland	20	325	1137	2376	3858
Federal Way	6	55	153	101	315
Corpus Christi	8	217	481	1342	2048
Madison	2	80	329	428	839



6.7.1.14 Mean and Standard Deviation (rounded to nearest tenth) all cities for Quality of Life Indicators (chart 53)

Indicators	Mean	Standard Deviation
Median Earnings	28,243	3,746
Poverty Status, income in past 12 months below poverty	18,696	18,244
Total school enrollment	70,684	36,467
Telephone service, number occupied units with phone	94.14	1.30
Unemployment Rate	5.82	1.23
Divorce Rate	17,352	7,251
Units Owner Occupied	57,525	43,068
Units Rent Occupied	47,115	31,916
Households with Food Stamps	10,643	11,202
Hate Crime Rate	10.20	15
Violent Crime Rate	1,624	1,398

6.8 Quantitative Limitations

The following points address some of the quantitative limitations:

- Because the study was designed as a pre-port test, the quantitative findings are not too significant. However, the objective of this study was never to rely on basic quantitative data to prove or disprove the perceived impact of Mu-Fi on the digital divide. The overarching goal of this thesis was to use qualitative data to see if these government-led projects had any impact on the digital divide vis-à-vis QoL and network aggregate indicators. The two main reasons the study depended mostly on qualitative and not quantitative data were: 1) to promote (or dispel) public truths (or myths) disseminated by popular media and media outlets that Mu-Fi was enhancing QoL for American communities; 2) to show that one year is not enough to conclusively say this networks are bridging the digital divide. It takes years, if not decades, to fully assess and develop matrices that measure impact. By using a qualitative research approach, this dissertation is able to promote (or dispel) any myths (or truths) about the perceived impact of these systems on fostering digital inclusion.
- According to McMillian, correlation is not causation. The correlations that were reported in this dissertation represent necessary but insufficient conditions to establish cause-and-effect relationships between the Mu-Fi system and both QoL and UA measures (McMillian, 1996). An in-depth, multi-year quantitative study needs to be undertaken to ascertain if Mu-Fi has narrowed the digital divide.
- By introducing qualitative data in any study, generalizability will probably be weak, this being a characteristic of the nature of qualitative research, whose purpose is to provide insights into a specific phenomenon by using methods that are unique to that study.

As previously indicated, the ACS is a sample, not a population survey. As a direct result, the data taken from the ACS are not a true representation

6.9 Qualitative Findings

Below is a description of the qualitative findings of this research study.

6.9,1 Overview of emergent themes

The primary recurring themes extracted via open coding of the transcripts are listed below in Table 3.

Theme	*Brief Description*
1) Unanticipated social, political, and technological complexity	The design, implementation and use of a municipal broadband network for the purposes of lessening the digital divide is a complex phenomenon and this complexity is evidenced in the multiplicity of theoretical orientations that have been proposed to explain the phenomenon. The complexity is also evidenced in city structures themselves.
2) Variable mismatch between city's intentions and populace's needs	The development and exponential growth of municipal wireless broadband projects in the United States was driven by the need to respond to community concerns, namely, education, economy, public safety, and social.
3) Inability to anticipate future costs/needs and maintenance	Availability of resources (or lack of investment in appropriate resources) threatens the survivability of Mu-Fi initiatives.
4) Multiple relationships with conflict, coop. and interdependence	The development Mu-Fi systems and its role in tackling digital divide issues is a result of many relationships with conflict, cooperation, and interdependence among different stakeholders
5) Well-targeted, Mu-Fi strategies require diverse policy mixes	The efficiency and effectiveness of municipal wireless deployments can be understood by comparing the digital inclusion strategies implemented by different cities.
6) Cities are merely momentum players	The voices and experiences of all stakeholders, though highly codified, help us understand the knowledge base from which they intend to promote local economic development, enhance civic services, lessen the digital divide, and eventually generate human capital via these high tech systems.
7) Inability to grasp the policy arena	There is a need for effective integration of policy across community sectors (ILECs, grassroots, private, NGOs), and also between tiers of local government.

8) Using the digital divide as an excuse to build their systems	This theme manifested itself in frequent debates about the overarching goal of the network and in the perceived benefits and reality to community cohesion.

Table 3: Emergent themes from in-depth interviews and their descriptions

6.9.2 Description of themes

THEME 1: Complexity (unanticipated social, political, and technological complexity)

The design, implementation and use of a municipal broadband network for the purposes of lessening the digital divide is a complex phenomenon and this complexity is evidenced in the multiplicity of theoretical orientations that have been proposed to explain the phenomenon. The complexity is also evidenced in city structures themselves.

Moreover, the complexity of the digital divide is evidenced by its multiple frameworks and methodologies cited in the literature (i.e. qualitative, quantitative, ethnographic, critical, and contextualized). It is only by identifying and integrating the diversity, scope and complexity of the digital divide that policies can be designed to overcome it. It involves developing a convergent platform, adopting the driver technology, crafting a sound business model, managing the diffusion, and evaluating the efficacy and efficiency of that process.

The majority of Mu-Fi initiatives focus on the access (i.e. connectivity) component of the digital divide (or universal service) while ignoring (purposely or not is still in question) the fact that the digital divide is a complex discourse with a multi-tiered policy problem. If cities are providing a Wi-Fi in order to connect their citizenry to the Internet, but neglect the other more convoluted components of this divide, there may be a design-reality gap.

Similarly, cities are very local, dynamic, erratic, and convoluted structures. Solutions offered to cities that take the mutated form of silver-bullet approaches should be explored. Most of these solutions turn out to be short-lived endeavors.

This theme exposes the unforeseen social, political and technological hurdles faced by cities. Most public elites saw the glass as half full: most viewed the obstacles as a simple problem. Some viewed their Mu-Fis as the goal of creating a bright future for their citizens. Other cities had open-ended outcomes; Mu-Fis were viewed as an experiment of sorts. For instance, for Madison, the complexity was political, social & technological. For Corpus Christi, it was political & social. For Portland, it was mostly political; the city's form of government was a major obstacle.

THEME 2: Responsiveness to the community (variable mismatch between city's intentions and populace's needs)

The development and exponential growth of Mu-Fi projects in the US was driven by the need to respond to community concerns; namely, education, economy, public safety, and social issues. This theme is about enhancing the delivery of city services and answering a perceived civic need via government applications like wireless services.

At times the wants of local governments for ubiquity of service and the needs of users (i.e. high expectations) are not the same. Public elites are often interested in the hype of staying ahead of other cities from a technological diffusion standpoint while failing to explore and invest in technological adoption and usage models for their local citizenry. This design-reality gap (akin to a needs-wants analysis) is needed in order to ensure these networks are indeed delivering the promise of universal service and ushering in an era of true social equity for the masses.

In theory, these networks are a panacea of sorts, but in reality, on the ground it's a different story. The reality of what local governments are offering and what citizens are actually receiving demands in-depth examination. This theme investigates this gray area of ambiguity and exposes any and all conflicts.

This theme reveals the disconnect that existed between what users wanted versus what cities provided. For example, Tempe residents desired a stronger partnership with their public system (Open, 2-way communication) where as for Portland their success was measured by the number of users connecting to the broadband service; there was a clear lack of communication with community leaders.

THEME 3: Reaction to availability / lack of resources (inability to anticipate future costs/needs and maintenance)

Government and non-profit agencies, telecom providers and grassroots members understand that one of their *raison d'être* is to demonstrate that it has sound financial planning and management when creating and approving project proposals. It must tactfully demonstrate to its target audience (i.e. customer/clients/residents) that it uses (or intends to develop) resources for the purpose for which these projects were created. Specifically, it must show the project(s) achieves intended deliverables and desired outcomes. As far as this thesis is concerned, interviews have shown that the way in which public elites react to the availability/lack of resources varies among cities.

For Mu-Fi proponents interested in achieving digital inclusion, resources include (but are not limited to) advocacy and support groups, computer technology centers, homeless shelters, economic development agencies, public schools, small business owners, cultural and recreational facilities, and countless others. These kinds of resources are crucial since they monitor the growth and success (in part) of Mu-Fi projects. Only by having a clearer picture of these resources can the basic problems facing Mu-Fi projects be identified, appropriate action be taken to solve them, and thus strengthen its development and usage. Until this happens, the availability of resources (or lack of investment in appropriate resources) will continue to threaten the viability of Mu-Fi initiatives. And thus, government-led broadband systems will continue to be under tremendous pressure to diversify their sources of funding, and to become more creative in their efforts.

This theme exposes the inability of public elites to anticipate future costs, needs & maintenance of the project. It reveals the issue of resource allocation as a municipality-community contested space. As the Portland case will reveal, the city altered its municipal project after redefining the digital divide. Madison built their Mu-Fi and later abandoned the digital divide focus. Similarly, Federal Way built their project and later abandoned it. For Corpus Christi & Tempe, both cities changed focus to public Wi-Fi and sought funds to support their new focus.

THEME 4: Patterns of relationship building / potential for partnerships (multiple relationships with conflict, coop. and interdependence)

The development of Mu-Fi systems and their role in tackling digital-divide issues is a result of many relationships with conflict, cooperation, and interdependence among different stakeholders. Partnerships enhance diversity, broaden expertise and maximize the potential impact of the project's deliverables to the targeted communities. Partnerships enhance grassroots involvement, while helping to empower communities.

As Mu-Fi projects begin to morph and change into complex public-private partnerships,[59] it becomes interesting to explore the levels, types and dimensions of relations that are ultimately crafted from this particular business model.

This theme shows the many relationships (active / sleeping / nominal) with conflict, cooperation, and interdependence among different stakeholders. Out of fear from being surpassed by the competition (other cities) prompted these cities to form partnerships that were hastily arranged and poorly thought out and conceived. For Tempe and Corpus Christ, there were active partnerships with school districts, local universities, small businesses, technology centers and several key non-profit organizations. In the case of Portland, there were many sleeping partners, namely, local grassroots serving as device transfer gateways for residents. For Madison, the city itself was the nominal partner to MCB.

THEME 5: Diversity/Richness of Approaches (well-targeted, Mu-Fi strategies require diverse policy mixes)

The efficiency and effectiveness of Mu-Fi deployments can be understood by comparing the digital inclusion strategies implemented by different cities. In other words, a diversity of approaches is a critical ingredient in helping us understand more fully the costs (and potential benefits) of closing the digital divide via Mu-Fi programs.

It can be argued that well-targeted and effective municipal wireless broadband strategies require a diversity of approaches and policy mixes that may often challenge telecom

[59] It is important to note that not all Mu-Fi networks adopt a public-private approach. However, for the purposes of this research, all cities probed in this study have adopted such business model.

policy emanating from state legislation that currently seems to define the overarching goals of local municipal broadband interventions.

This theme is not the same as Theme one, which is about exploring and unveiling the complexity of attempting to engage the tumultuous sphere of the digital divide via Mu-Fi networks. Theme five is about employing different strategies to ensure the success of narrowing the gap (i.e. how is the city attempting to address and redress the problem?). Theme one is a question of "what," whereas Theme five is interested in exposing the "how."

This theme shows that a diversity of approaches is a positive. In fact, thriving Mu-Fis require lots of ideas & approaches. This said, however, the data reveal that Wi-Fi's "novelty" blinded government officials and suggest Mu-Fi fails to deliver "progress" to cities. For Madison and Federal Way, their Mu-Fis were framed as an access issue and ended as access issue. For Portland, their project started as a quasi-US strategy and ended as an access only issue. For Tempe and Corpus Christi, their initiatives were framed as an access project, but ended with content, context and capability components.

THEME 6: Knowledge Base / Core Competencies (cities are merely momentum players)

Many public officials have been momentum players and simply do not have the core competencies or knowledge base to successfully build and roll out Mu-Fi networks for their residents. The voices and experiences of all stakeholders, though highly codified, help us understand the knowledge base from which public elites intend to promote local economic development, enhance civic services, lessen the digital divide, and eventually generate human capital via these high-tech systems.

Core competencies are key factors or enablers for sustaining and maintaining any project, at the very least because of their performance and benchmarking factors. As more and more communities decide to embark on the government-led path of deploying wireless networks, the public has the right to know not only how they intend to guarantee the longevity of the system, but what core competencies the city possesses to ensure such longevity.

In essence, this theme exposes that cities merely begin the process. However, it also shows that core competencies are critical in sustaining and maintaining Mu-Fis. The data suggest that people, a Mu-Fi's greatest asset, were neglected. Subjects felt their feedback went unheeded or ignored. Public elites' Mu-Fi knowledge remains defined, contextualized & framed by government. As the analysis will show the primary drawbacks to this approach are: a) a project with a primary goal of promoting itself, b) knowledge produced by elites, for elites and power structures and c) the façade that a cookie-cutter approach works everywhere.

THEME 7: Integration of Policy Initiatives (inability to grasp the policy arena)

In 2006 and 2007, policy issues were at the forefront. According to Greg Richardson, the founder and managing partner with Civitium, the leading consultant to municipalities developing Mu-Fi initiatives, questions about what role cities had in broadband initiatives and what that role looked like were defined in 2004 and 2005. He states that different questions define 2006 and 2007, including, "whether their initiatives will succeed or fail, whether the technology works, whether cities are going about the process correctly, and whether cities are making the right policy decisions."

I continue my effort to understand the policy arena around the development and deployment of U.S. municipal broadband networks. There is a need for effective integration of policy across community sectors (ILECs, grassroots, private, NGOs), and also between tiers of local government.

This theme explores the an inability to grasp current issues and policies surrounding Mu-Fi, and an inconsistency among the many tiers of local & state governments. In 2006 and 2007, state and federal policy issues were at the forefront. The data show that at the city level, policy was an after thought. Cities discussed creating policy after Mu-Fi benefits were realized. There was a tendency to "play down" policy implications and oversimplify the complexities that might result in wasted resources and unrealistic expectations. This said, nonetheless, the data also show that cities did understand that integrating policy is critical to the success of their technological initiatives

THEME 8: Community Identity and Participation (using the digital divide as an excuse to build their systems)

Municipalities have decided to enter the telecom realm because of cost savings opportunities that new Wi-Fi technologies offer. Municipalities are making claims that Wi-Fi networks would enhance community identity, promote economic development, provide for additional tourism, support city services and personnel, and increase civic engagement.

This theme manifested itself in frequent debates about the overarching goal of the network and in the perceived benefits and reality to community cohesion.

This theme is different from Theme three, which explores the city-resident relationship in terms of product-benefit. Theme eight is about exploring "town gown arguments" made by public elites and understanding how participants feel this network will enhance their city's image (i.e. will it make their city appear more tech-savvy and tech-friendly? Is the project "forcing" residents to crossover from have-nots to haves?).

This theme exposes the notion that the digital divide was an excuse to implement Mu-Fis, and to promote a city's "cutting edge" reputation. It justified a city's

futuristic thinking. For Tempe, their Mu-Fi makes the city "a smart place to be." For Portland, their Mu-Fi "keeps Portland weird" – the city's motto. For Corpus Christi, respondents said the city comprehends Mu-Fi's value by switching from public safety to digital inclusion approach.

6.10 Summary of case study chapters

Each case study includes a short description of the city (local economy, history, demographics, employment, etc.) and the area(s) where the wireless program is currently being deployed. Brief details are also provided about each Mu-Fi program - when they began, who is involved in the organization, what applications are envisioned in the program.

Each case study tells a unique story of why and how a city integrated the concept of Mu-Fi into its existing infrastructure. The case studies provide a general overview of factors that are believed to contribute to increasing QoL, including geographic and demographic aspects of the municipality. Each provide key information on why Mu-Fi networks were created by city officials and critical background information on whether they may accomplish the goals of digital inclusivity and better QoL as touted by public elites.

This snapshot allows the reader to see that no two case studies are alike; each presents its own unique and very different levels of difficulty and dynamics to the challenge of establishing and maintaining a viable Mu-Fi network in a major metropolitan area. By examining each case separately, the reader is able to see which examples are successful initiatives, which are not, and the reasons for each.

The next section will delve into the themes that emerged from the interviews for each of the case studies analyzed.

CHAPTER 7: TEMPE, ARIZONA

7.0 Introduction

This chapter aims to show the findings of Tempe's wireless broadband network in relation to its impact on the digital divide. The overt aims of this Wi-Fi project were to increase digital inclusion, continue to foster a high-tech environment and promote economic development. The extent to which this goal was fulfilled has been investigated through analyzing a sample of key city stakeholders. Data was obtained from 10 interviews who were very familiar with the wireless network. The interview guide included both closed and open-ended questions.

The focus of this chapter is threefold. First, it determines the high-tech issues in Tempe, which allowed the group to continue their work in this regard by adding the wireless broadband project. Second, by identifying these issues, the chapter assesses success of the design, implementation and use of the network and ascertains which components directly affected the ensuing outcome. Third, it establishes a basis for assessing digital cities with high-tech agendas since the Wi-Fi network was the first documented deployment in the US.

This section explores the eight themes revealed during the interviews. As in all design practice, that which is learned from case studies adds to our understanding. Case studies help us compare what values are being applied and what worldview is being advanced.

7.1 Themes

One way of evaluating whether Tempe fulfilled its goal in terms of impacting the so-called digital divide was to identify key themes that emerged from the interviews. Subjects pointed out that complexity, responsiveness to the community, reaction to resource shortages, patterns of relationship building, diversity/richness of approaches, stakeholders' knowledge base, effective integration of policy, and the perceptions of the project enhancing community identity and participation were relevant themes and contributed to a better understanding of the so-called digital divide and QoL factors.

- **THEME 1: Unanticipated social, political, and technological complexity**

This theme helps us understand the multiple definitions and confusing terminology that exists for the digital divide. It also helps us see the dynamicity and multifarious nature of

city structures, technologies like Wi-Fi and telecom providers. Below are vivid examples of this complexity.

For Tempe, the deployment was planned using a "phased" approach. The city was divided into five zones; each zone representing 1/5 of the total area, or about eight square miles per phase. One or two people were involved in setting up the contractual agreement with Mobile Pro (the Internet Service Provider[60]). In a way, the actual Wi-Fi negotiations became a for-profit endeavor. The company set it up for-profit to sell their services in Tempe. City officials surmised the Request-for-Proposals (RFP) would allow them to negotiate the ability for Tempe to use that service free of charge and to own the equipment if in fact the company ever decided to withdraw from the city. As Subject # TE-5147 said: "We would have our own internal network within the city."

In terms of the quality of the network, there was anecdotal evidence of pockets of no coverage throughout the city. For example, when the project began, the third-party provider said it would have the entire city covered, but of course there were obstacles to overcome in the beginning, as certain access points or nodes were down (not turned on). To address this, the vendor measured the signal across Tempe, identifying specific dead zones. With this specific data, the vendor decided to invest in and install more hardware over a period of six months to help reduce the number of dead zones in the city. Following these improvements, Mobile Pro returned to city council and presented the new coverage map, but it still contained some areas with no connectivity; these areas were mainly in the heart of our industrial areas.

It appears that designing a sound and strategic deployment plan is no easy task. As one respondent cultural services manager mentioned, "…providing coverage is not as clear cut as we think it might be." (Subject # TE-5143).

For the service that was available, when first introduced it was very sporadic. The first rollout was in the downtown campus area, adjacent to the Arizona State University (ASU) campus. When Subject TE-5145 was asked if the downtown as well as city hall areas were well covered, she replied, "Absolutely. Yes, Yes." When probed further, she felt coverage was very sufficient when first introduced, but as the service was launched to cover the whole city, which encompasses 40 square miles, there were areas where reception was erratic and spotty. An information technology expert (Subject # TE-5148) said, "…you could move a foot and get a lot better reception than you get two feet away." To resolve this problem, the vendor added an additional 220 antennas to improve signal strength in problem areas. Respondents agreed that the additional antennas seemed to improve overall signal strength. However, several participants mentioned the fact that some of city's spotty coverage zones are located in low income neighborhoods.

Another issue that became evident was the cost of the network. There are people in Tempe who can't even afford the modest fee established by public elites to access the Internet. One respondent's son lives in downtown Tempe, near city hall. Although he

[60] Telscape just recently bought the network from Gobility, which purchased it from Kite Networks late last year and Mobile Pro the year prior to that.

can get reception, he cannot afford the fee with his current job. Reception is also a problem; he gets reception in some rooms of his house, but not in others. Though this serves as anecdotal evidence that the network requires further upgrades, it is important to note that city officials have made a commitment to improving the delivery of service. Citizens are encouraged to inform the city about areas with coverage problems. I find it interesting that city officials recognize the service's weakness in terms of availability and usage, and that they offer to ameliorate these problems. The city's commitment to ironing out the problems has not gone unnoticed among Tempe's citizens. As Subject # TE-5145 stated: "I think the city understands they need to work out some kinks and they certainly are not resistant to it."

Aside from increased signal reception, there are some geographical barriers to effective reception and service. However, it is important to note that these barriers have been reduced significantly after the provider added additional infrastructure to increase the network's signal strength. In order to address future geographical barriers, the city is beginning to build a number of tall buildings that may help with network reception somewhat. It is important to note that Tempe has only one mountainous area in the entire city; the rest of the city is favorable for an effective network; there aren't many tall trees or other topographic impediments to effective connectivity.

A senior city official, Subject # TE-5140, who is involved in the project, summed up the project thusly:

> "We're landlocked on all sides. We have other major metropolitan cities surrounding us…We're 40 square miles … and a very large portion of our city is Arizona State University, which, [is] mostly student housing. Our requirements for this network was to cover the entire city, so it was geographically feasible. I would have to say, there really aren't any geographical barriers."

City officials claim that Tempe is a pioneer in city-wide broadband access, since the city was one of the first to roll out a Mu-Fi network. Most respondents feel Tempe's location, in the middle of the desert, played a role in early adoption. Although Tempe has several high points within the city, for the most part it's totally flat. As a result, an antenna high on a lamp pole can only transmit to the extent that one transmits with the device. Participants argue this is not true of big cities around the country, many of which have hilly terrains, dense trees, and so forth.

When it comes to content delivery, Tempe does not offer anything other than a splash page that's available to anyone in the city with a computer and access to the wireless network. This splash page gives citizens free access to tempe.gov, one of the city's stipulations in its contract with the vendor. Aside from this point, as one respondent stated:

> "…we are not involved in providing even the service from the Wi-Fi, it's totally …. a private endeavor. the contract the city has is really only for the use of the light poles in Tempe to provide the service, and for allowing them to do that, we get municipal use, and we also are guaranteed to be able to provide our

> government service, tempe.gov, to anybody for free, as well as asu.edu to the community for free, so those are really the only two things that we provide to the community." Subject # TE-5149

Interestingly, the city has not conducted any studies that analyze usage behavior patterns that look at users as content consumers and content producers. The city does not envision the city taking on this project. Public elites consider this to be a more of an academic role, and think that perhaps ASU would take on that role in the future. However, the city's project manager admits he gets calls from many people conducting such studies, but so far he has not received any of these reports.

Furthermore, some participants are wary about attributing an increase or decrease in QoL factors to the success of the network. These participants argue there are many factors at play, and some believe the messy social fabric of communities is not easy to untangle. A city official from the Development Services Department stated,

> "In the last years we've had some tech companies locate here and new office buildings keep going up, and new jobs are added, but I don't know if you can attribute that to the wireless network any more or less that you can attribute to the school district or good parks or good streets. However, I can without a doubt tell you that we have buildings and companies here because we built a lake…and there's no question because there's a direct correlation because I have contracts and documents and I have private partnership agreements and maintenance agreements for the lake where we have private people paying money to keep the lake there, but I don't have a contract or a document that says Google is going to move here and they're going to contribute [amount omitted] here to keep the network up and running. It's not a tangible thing I can put my hands on, that I could point to with any confidence… I can tell you the wireless network is a lot more ephemeral; it's out there but gosh, so few people use it. Honestly!" (Subject # TE-5146)

The city's notion of the discourse surrounding the digital divide seems to be generational. The goal is to first connect the emerging and growing younger generation that knows nothing about technology, but views it as boundless and limitless. To them, the target audience is the generation where technology has been used for a little while, maybe not using it to its fullest capabilities, but able to use many of the applications. Another important population, but one that appears to take on more of a secondary focus group, is the senior population, which is not yet quite as comfortable with technology. Since Tempe is a college town, city officials believe offering this service to students is vital. The city sees a great deal of technological capabilities coming out from Tempe's students, and the constant flow of fresh ideas emanating from ASU appears to drive the system.

One final observation: it appears walls and roofs of buildings diminish the strength of wireless signals. Wi-Fi signals from most consumer wireless equipment are designed to connect with Access Points in close proximity. As a result, they sometimes do not

possess sufficient transmission power to penetrate buildings to communicate with outdoor city-wide Wi-Fi Access Points. The provider integrated Home Wi-Fi Access Point (200BG-AP) so residents can connect to the city-wide network via 802.11 b/g Wi-Fi and standard Ethernet, thus delivering in-home wireless service with this all-in-one device. Citizens can pay for this peripheral by contacting their local provider.

As noted in this section, Tempe's complexity in the form of network issues, differing and contracting definitions of the digital divide, and challenging political strategies show evidence of this theme.

In a similar fashion to this theme in the Tempe case study, the extent to which the city has responded to community needs is examined in the following section.

- **THEME 2: Variable mismatch between city's intentions and populace's needs**

This theme helps us understand how Tempe has responded to the needs of its residents by offering wireless services. Specifically, it allows the reader to observe a possible design-reality gap. This approach is helpful in ensuring these networks are indeed keeping their promises of bridging the digital divide.

Respondents confirmed that Tempe is committed to assuring that the community has access to the following department applications via the network: Police (uploading reports, downloading graphics and access to email); Fire (On-scene cameras and telemedicine and GIS information on trucks); Water Utilities (well and tank monitoring and meter reading); Public Works (access to GIS data in the field); Development Services (building inspections and field reports); and General Government (network access for sales tax auditors). It is important to note these are applications that Tempe envisions the network will ultimately impact over time.

Subject #TE-5145 confirms that Tempe is already offering some of these applications via the wireless network, but different city agencies are interested in offering more applications remotely in the field. For example, she states, the Police Department is now able to:

> "…access a lot more data out in the field…as far as being able to remotely access …any piece of information you may need, or if you need to get a piece of information back to the city you can do that remotely from your vehicle, and that's helped immensely. [the goal is]…to continue to look at applications that we could put out on some type of PDA, cell phone device or something like that, where we can get applications more readily to the staff development field, our co-inspectors, our public works department and our water department. So we have some pretty good plans for what we'd like to do in the future with using the wireless networks."

Respondent TE-5140 believed there are many different ways to use the technology to respond to local governmental and civic needs. Participant TE-5144, a parks and recreation staff member for the city, agreed and added:

> "Once we get some more of the technology on board, I see our department using the wireless broadband network to cater to our customers for dispatch and to pull something off of a Web file…As far as recreation, impact has probably been a little more indirect…having the wireless broadband network in the entire city allows people to get out with their computers more. I have a feeling we're going to see the trend of more and more laptops in city parks…"

This subject felt that by putting wireless broadband throughout the city helps create new types of information workers. As stated by the subject, these "knowledge generators" enjoy the flexibility of going out to a park with their laptops to check e-mail. She argued that by being outside, people are more attracted to that technological benefit in the city.

Similarly, a local cultural services manager (Subject TE-5143) agreed that the idea of wireless coverage is good and presents an opportunity for Tempe's growing community to stay together and remain in Tempe. He added: "[I believe] people coming in and growing and then moving on after ASU is an issue for Tempe. Having wireless here is a great opportunity to utilize that resource, like a library, because the technology will hold those consumers, so I think it's great."

Conversely, an educator and city liaison between the Tempe school district and city hall, Subject # TE-5142, argued that the services available to ordinary citizens are limited because he thinks it's "more of a PR thing than any real tangible benefit to the majority of [their] citizens." However, although he admitted he does not have a great deal of personal interaction with the network, and no one he works with uses it, he said he has heard many residents talking about it. When the system went online, he heard a number of complaints about people being unable to access it because of dead spots. To him, this is problematic, since it's a paid service.

Aside from understanding how the city responded to the needs and wants of its citizens, it is equally important to observe how Tempe reacted to the availability and/or lack of resources in tackling the digital divide. This theme is explored in the next section.

- **THEME 3: Inability to anticipate future costs/needs and maintenance**

This theme examines how city officials reacted to the availability/lack of financial, human, and intangible resources, including questions about the reasons for not investing in particular computer peripherals. The narrative sheds light on the extent to which the Tempe's wireless project is being used for the creation of digital as well as social inclusion.

Several subjects expressed satisfaction over the project's economics. For instance, Subject# TE-5141 said, "the city has no out-of-pocket capital expenses for this network."

It is important to highlight the city's ongoing expense is limited to electricity charges from pole-top radios. The wireless provider is responsible for all maintenance and upkeep, including relocation of units as needed. Funding for the project comes entirely from the service provider's capital budget, and the provider's revenue source comes from residential and business subscribers. The service agreement between the city and the provider guarantees use of the municipal network for the life of agreement

There remains a strong public sector ethos, which, as Subject # TE-5143 said, can cause problems because in many cases, government officials lack the proper training to tackle the complexities of the digital divide:

> "What we found is not so much the tool that you give the children, but how [they're] using the tool. If every child has wireless Internet, are they using it to access games or comprehension skills based programs? Do I think it has potential to help with literacy? Absolutely. But it has to be used in a highly complex, really smart way. It doesn't just happen because you give them the tool."

The lack of quantifiable information about the network poses a challenge. As Subject # TE-5146 adds:

> "We don't have access to reports that tell us the average user length, the number of users signing up to the network, the Websites they're visiting, etc. We as a city [don't] have access to that. We would have access to how many people logged onto our Website, things like that, but it has nothing to do with whether they came in wired or from the mobile network or how they reached our particular Website."

Another problem is the lack of device transfer mechanisms available to citizens, given the problem of in-home transmitter reach. Although the network covers approximately 90 percent of the city, that number reflects outdoor coverage, not reception inside of homes and buildings. Ninety percent coverage does not mean that residents can sit in their homes, open their laptops and receive an adequate signal. They might be able to see the signal, but be unable to transmit back to it, which is a function of the laptop itself and the signal strength. In order to get this type of indoor coverage, or in-home transmitter reach, it requires an additional device tailored to their equipment that would have a small antenna that would either mount to the outside of a house or sit on the window sill. This would act as a relay from their indoor computer to the access point or nearest node. It appears not only to be complex, but costly. However, everyone indoors could have it, have access to it, and eventually make it work.

As pointed out earlier, digital inclusion programs need dedicated funding to keep them robust and to ensure their longevity. Another key component is to ensure that underserved communities are able to make meaningful use of new technological opportunities. One way this is done is by way of partnerships and strategic alliances with community stakeholders. This idea is explored further in the following theme.

- **THEME 4: Multiple relationships with conflict, coop. and interdependence**

This theme explores the theme of partnerships in Tempe.

Tempe does not have a partnership *per se* with the public school district regarding the municipal Wi-Fi project. In the beginning, this was explored, but it was cost prohibitive for the district to do it. Furthermore, typical school design makes achieving wireless access throughout the building very difficult. Technologically speaking, it does not appear possible to offer the city's wireless signal to the schools, said Subject #TE-5146, a public information coordinator for the district:

> "A lot of our computer labs tend to be toward the middle of the buildings, where you don't have windows. So, the signal would not reach the computers. Again, [I'm] not sure it is of benefit to schools right now due to technical hurdles and filtering issues. I'm not saying a partnership wouldn't be viable as we have a good relationship with the city, but it would take a great deal of work on both sides. We already have a filtering mechanism in place, service providers, etc. For instance, we are governed by CIPA (the Child Internet Protection Act) and if we were to go through a third party providing wireless Internet we would have to incorporate new filtering mechanisms that are already in place."

Curiously, Subject # TE-5146, who participated in this study admitted, "I'm not really sure how the Wi-Fi network works with our school. That's part two of our work plan for next year." There appears to be a lack of communication between different city groups. This city council member said that in the last city council meeting, 33 action items related to the wireless network. Out of those 33 items, 10-12 are in some stage of progress, while the other items are yet to be addressed. One unaddressed issue is the relationship of the Wi-Fi grid to the city's schools. This respondent says the council intends to address this issue the following year, but stresses the fact that the wireless network is a way in which cities can actually be directly involved in helping to support schools in lieu of simply giving them money.

However, the city is exploring the possibility of cutting costs to free up city revenue by having the school district use its network. This appears to be a viable revenue saving idea for the school district. The city does work with the local school district and other stakeholders to see what kinds of things they can do to piggy back on each others' purchasing to cut costs in their systems, but the city views the network as a way of partnering with educators to cut costs, reallocate funds to increase teacher salaries, allow investment in a better curriculum, and also enabling other services for school children, etc.

The partnership with the vendor is one I find both interesting and "safe." From the city's perspective, one of the principle reasons for owning the network equipment is if the vendor decided to leave Tempe for some reason, the infrastructure is still in place for another vendor to resume service. Because of this relationship with the vendor, Subject

#TE-5147 doesn't see this project disappearing anytime soon, although he feels the vendor can exit Tempe at any time. "The fact that we've implemented a lot of advertising [regarding the network] for the city and used to bring in business to it and things like that, I don't see it going away any time in the near future. [This relationship] allows us to maintain the network."

Tempe's relationship with ASU alternates between healthy and strange, depending on the issue. The wireless network is a matter some respondents feel helped bring the university and the city closer together. For instance, one participant specified that students pay lower fees, have free access in certain locations; and are not required to be paid subscribers to use the Internet for certain services.

Other partnerships are beginning to form in the city as well. The city is forming key alliances with businesses and other educational entities to improve efficiency in selling the idea of a universal wireless network in Tempe; the city views itself as a match-maker of sorts.

With over 300 technology-based businesses in Tempe, the city is trying to do certain things to help businesses connect with new hires and interns, through the community college as well as ASU. The availability of wireless network enhances the relationship between the city and these high-tech businesses. It is interesting that wireless coverage and access throughout the city was something the business community wanted and needed, and the city decided to provide it. The next step, according to a spokesperson from mayor's office, it to involve the business community in very specific projects that show that they make a significant difference in citizens' lives, especially students' lives.

The literature argues that digital inclusion programs need powerful champions. Bipartisan political support and industry approbation are a must. This theme examined how Tempe stands regarding local support of its wireless network. The following theme examines the diversity/richness of approaches employed by Tempe in tackling the digital divide.

- **THEME 5: Well-targeted, Mu-Fi strategies require diverse policy mixes**

Aside from partnerships, the literature reveals that digital inclusion programs need diverse approaches to bridging the gap. These approaches should be full programs that may include equipment, software, access, training, and content. It is important to align the scale of work to the scale or scope of the project.

In the case of Tempe, the city is focused on offering wireless access mainly to its student population. Subject #TE-5147 said, "I don't know that it necessarily caters to Tempe college students, but I would say they're probably one of the largest users." The city provides two hours per day of free wireless access to the downtown campus area without requiring a subscription to the service.

As a result of this narrow focus, an elementary school district representative thinks Tempe is not doing all they can to set up training centers to at-risk groups like the elderly. This respondent believes that although the city has done a good job in letting people know about the wireless service's availability, she believes it should be doing more.

Additionally, a city development services employee said that in terms of how the city represents its community to people, the network becomes a selling point. Subject # TE-5141 states:

> "it's like a sales point, it's a point of pride, it's how we continue to differentiate ourselves from the other communities around us in our competitive economy…I work closely with the economic development guys, and they'll tout that in our literature; our politicians use it in our speeches, the mayor uses it in his state of the city speech and we try to project the image that Tempe is a progressive community. The wireless network, being the first city in the area to do it, helps us again solidify our position as a young, hip, you know, smart place to be"

One respondent argues the city is not obligated to offer a wealth of benefits that aim to bridge the gap between the technological haves and have nots. According to a city official (Subject # TE-5140), there are many segments of the rural population where she thinks municipalities need to intervene, get involved, and provide services because they're just not accessible, such as poor technology and infrastructure. She argues that governments in many urban areas need to step in and act as a catalyst for social change. To her, there's a model there for the government to step in and partner and offer "digital divide" services. She asserts that there are other markets that rely on extensive competition for broadband, and the infrastructure is there and is not feasible for the government to get involved on that level. She argues Tempe is somewhat at a crossroads because in terms of providing computers to under serviced areas, or building community centers, she feels the government does have a responsibility to provide and could get involved, but providing the infrastructure is not its responsibility. To her, it doesn't make sense for cities to get involved on that level.

Tempe has computer training available, namely, one major public library that residents can visit. For example, locals can learn different programs based on their age range. One participant, Subject TE-5145, briefly mentioned a senior citizen computer program in the local library "because seniors have a little bit of a different learning style than … young adults and adults. They can learn various software, how to get on the Internet, how to set up an email account. We have really good training."

This theme shows that the multiplicity of approaches to bridging the digital divide is essential in order to increase the rate of users socially included in society. Another key theme is the knowledge base of public elites. I now turn to the following theme in order to further explain this finding.

- **THEME 6: Cities are merely momentum players**

Most respondents categorized the city's IT personnel as "phenomenal," "excellent" and "somewhat knowledgeable" to "very knowledgeable." Most issues that arose in the Wi-Fi project appeared to be resolved quickly and efficiently. One part-time city worker, Subject TE-5145, said:

> "When they will be establishing those partnerships, I can't tell you with any level of accuracy, but I can tell you they are so creative with their ideas about whom to partner with. I was very pleased that that was happening."

Some subjects were advocates for low-income and disenfranchised communities, but they clearly understand their concerns for social justice might not resonate with city leaders. However, one participant mentioned the city manager is a former librarian, and remembers one of the things that he talked about 10 years ago was the net scope of the digital divide. This respondent believes the city manager has a wealth of knowledge and can be a key player in advising other city officials about the network's design, development and deployment strategies.

In sum, this theme reveals the importance of core competencies in tackling the digital divide via municipal wireless systems. The following theme examines another key finding: effective integration policy initiatives.

- **THEME 7: Inability to grasp the policy arena**

Digital divide initiatives not only need sound policies but policies with allocated dollars. This theme exposes how Tempe has attempted to integrate policy programs with their digital divide agenda.

A few years ago, Tempe went after the high-tech market and, as a result (though still arguable), a higher number of people are coming into the city to work than the number of residents who live there. Tempe is viewed as an importer of jobs. "We've really attracted a great pool of techies," said Subject #TE-5145. "We went after that market a while ago. We used to have this thing called Techie Tuesdays where all these high-tech people would get together and explore ideas, etc." Tempe knew how to craft policy in a tightly defined political/cultural structure, in a traditional economy that had little contact with high-tech firms.

Another way for Tempe to create sustainable policy is to use an initial concept analysis of the link between the financial and digital divides in the city. This idea was made explicit by one respondent, Subject # TE-5146:

> "The key to financial status is access to and comfort with education, and information that helps you lift yourself out of your current condition. The digital divide is creating, fostering and supporting the financial divide and is the most problematic in the future, especially for the younger generation. The city thinks they know about it but don't feel it as deeply. They feel is about being cutting-edge and it's about the 'smart place to be' – that's our tagline. It used to be 'the

> best place to live, work and play.' Smart communities are forward thinking by having this kind of amenity in their community."

I believe it would behoove Tempe's elected officials to have some qualitative information about this network in order to understand why people are using it, who is using it, and how accessible it is. Currently, the city does not have any reports of this nature. Tempe recently sent residents a survey with their water bills asking residents if they had a computer, if they had Internet access, if they used the Internet, and other similar questions. Unfortunately, this type of survey doesn't provide an accurate, representation of Internet use in the city.

A local technology advocate, Subject # TE-5149, argues that the integration of policy hasn't been achieved vis-à-vis the Wi-Fi service. He explains that Tempe residents get a certain amount of Internet access for a certain number of minutes for free with their chosen broadband carrier, but if they really want to use it, they have to pay for it. To him, the city is just a telecom carrier. He explains:

> "The city leased its infrastructure on light poles to a third party company to put up their equipment to put up their umbrella. So I don't really see this as a municipal service, it's just like… anything else - we lease property for cell phone towers and we lease conduit and our right of ways to the cable companies. And this is sort of the same thing, from my perception, so I don't really see it integrated or tied to public service."

Following this line of reasoning, a member of Tempe City Council and a policy expert, Subject # TE-5145, understands Tempe needs to begin asking questions and crafting the right policy. He mentions that no one is asking questions like "we put this in, is it really helping all of our citizens, is it only helping people who have the money for a laptop? How is it affecting everybody in the community? Are we getting our money's worth, or is it just something that sounds neat?"

The next theme examines how deployers of Mu-Fi networks, as well as the network's users perceive this project, as well as how it enhances their community identity and participation.

- **THEME 8: Using the digital divide as an excuse to build their systems**

One respondent, Subject # TE-5142, who is responsible for information dissemination at the public school district, emphasized that the network might not necessarily be enhancing QoL, but certainly made people think the city is progressing and ahead of other cities by becoming pioneers. She attributed the city's sensationalist approach to their communications team. She articulated her view as follows:

> "[It's] hard to say it has an impact on the community at large. I know it's definitely being marketed as another great feature of this town. I deal with a lot of the city's marketing and communications people and they've had very interesting and successful campaigns; both publicity in local media and marketing

> that have made the system look positive. They've done a good job by letting people know it's available."

The same participant adds:

> "When you look around the city where I work in Tempe, I see people working all the time using their laptops and I'm right by the university and Tempe is a unique place. Where I live (25 miles north of here), I never see this. Here, you can't go anywhere and not see a laptop open. Usually you see a bus stop with many people sitting waiting for the bus with their laptops open."

In Tempe, it is clear that the wireless network has brought many people a new convenience, which is the ability to remotely access information and services. For people on the go, this is a tangible benefit. For people who want to be in the downtown area away from home and not wired to a particular computer, there is also a potential benefit for them, too. However, this appears to be a dream rather than a reality. Tempe envisions people using this new high-tech infrastructure, but ordinary citizens other than students are still not using this technology.

For example, Tempe's cultural services department has over 100 special events a year in the main city park in its downtown area. One respondent said he knew some promoters of those events who have used the wireless network to accomplish a host of different things. Although he does not know the extent that Tempe's police force or public safety personnel have used or depended on the network, he has heard anecdotal evidence of long term plans for the network. For instance, he has heard of plans for Tempe's building inspectors to use the system in the field via handheld laptops or palm devices to connect to the city system, and have blue prints and other drawing files online. This has not yet happened because he has been unable to obtain capital funds to buy the needed equipment. However, the Water Department is already using the system to read water meters as well as remotely accessing other geographical information system (GIS). It is clear the impact of this network has been felt within the walls of city hall.

Primary users of the network seem to be university students, since ASU is located downtown. However, the coverage area has been expanded to include other segments of the population. Subject # TE-5146 adds:

> "I don't have data to show you that it's made a difference in other neighborhoods outside the downtown area. I don't have any data to share with you that says these people are not using it or how it's affected them. It's my gut to say yes it has made a difference, at the college level specifically. But, I can tell you having a student that's getting ready to graduate with a degree in economics, and another daughter who was an engineering student there a couple years ago….It's been very convenient for my younger daughter in terms of her flexibility and where she can do her work and where she can meet with her groups and I think that flexibility is good."

Another top government official, Subject # TE-5143, mirrored the same sentiment:

> "Currently, I haven't heard anything, I don't know that it has been discussed in meetings that I was involved in, as far as quantifying things that we can look at, by having this network availability and the type of workers we're looking to attract. The network does seem to be working, but giving it a quantifiable number, we do not have. But, we have been able to measure other types of services and look at their fiscal impact on the economy."

Though public officials tout their wireless projects as good endeavors that enhance the image of their cities, respondents tended to think it will take time to collect data before unequivocally being able to say the network is making any sort of discernible impact. Because Tempe is a college town, the city is using the university to its advantage and vice versa. It is no surprise that those impacted by the network tend to be college students. City officials are hopeful and optimistic that the network will eventually impact other sectors of society. Two subjects mentioned a downtown development project where the city put in a lake roughly ten years ago, and a dry river bed. According to them, this project spurred a significant amount of community development; from parks and recreation to economic development, creating a desire for many to be next to this lake. Before the lake, this area held little appeal, yet now people are paying millions of dollars for a 1,200 square feet condo overlooking the lake. To these subjects, they feel the network will stimulate similar growth. City officials are investing in it, thinking it will generate a similar return.

A department of parks and recreation employee viewed the network positively and thought it has the ability to attract people to the parks, and reinforcing what parks are created for in the first place. He even suggested the network helps deter some of the activities we would consider detrimental to society.

In sum, this theme provides a set of personal, even idiosyncratic, perspectives on what the participants in the program thought was important to their groups and communities. Although study participants spent a good deal of their time contradicting their own statements, they managed to present a coherent view of "their" worldview, adding a further example of the way in which Mu-Fi might perhaps serve the community.

7.2 Chapter Summary

Tempe's track record with its wireless network is incomplete. The city has a great deal of work to do before its denizens have universal, adequate access to the network inside their homes. Undoubtedly, based on comments from respondents, Tempe's network infrastructure needs significant upgrades. However, the city's model is the template for a "safe" network; while the city has outsourced the operation of the network, it retains ownership of the infrastructure in the event that the vendor pulls out of the city. Another attractive trait of Tempe's network is the cost to the city, which is limited to the cost of the electricity used by transmitters atop city light poles. Considering Tempe's growing reputation as a technology city, which is on the rise considering over 100 high-tech businesses have locations in the city, having a viable wireless network makes sense on many levels. Yet, it appears the city has not done the necessary research and legwork to find out how many residents are actually using the network. This is perhaps Tempe's biggest shortcoming in building its network – it must do the legwork to find out what the city's usage statistics are and why. Based on subjects' responses, it appears ASU students are the only people using the network in significant numbers.

Considering the other cities examined in this study, Tempe's network seems to have the brightest future. No city has yet mastered its wireless network, but Tempe appears to have many advantages over the next city examined – Portland, Oregon.

CHAPTER 8: PORTLAND, OREGON

8.0 Introduction

This chapter aims to show the findings of Portland's wireless broadband network in relation to its impact on the digital divide. The overt aims of this Wi-Fi project were to increase digital inclusion and promote economic development. The extent to which this goal was fulfilled has been investigated through analyzing a sample of key city stakeholders. Data was obtained from ten interviews of people who were very familiar with the city's Mu-Fi network. The interview guide included both closed and open questions. This section explores the eight themes revealed during the interviews.

8.1 Themes

One way of evaluating whether Portland had fulfilled its goal of impacting the digital divide was to identify key themes that emerged from the interviews. Subjects pointed out that complexity, responsiveness to the community, reaction to resource shortages, patterns of relationship building, diversity/richness of approaches, stakeholders' knowledge base, effective integration of policy, and the perceptions of the project enhancing community identity and participation were relevant themes and contributed to a better understanding of the digital divide and QoL factors. In the following section, these themes are explained in-depth.

- **THEME 1: Unanticipated social, political, and technological complexity**

Portland has a different form of government than many other U.S. cities. The city has a commission form of government, which in political-science terms is the weakest possible mayoral form of government (also known as "the five mayor form of government"). Portland's city council is comprised of five commissioners with various portfolios within their oversight. Each commissioner is basically a chief executive for various departments and bureaus. One of those commissioners happens to be the mayor of Portland. It's a mayor by title; elected city-wide, but all the commissioners also get elected city-wide.

These commissioners sit on the city council, meeting once a week as a legislative body to discuss multiple issues. One respondent's supervisor has been on the council for a number of terms and has overseen different departments, including the Office of Sustainable Development; the Office of Cable and Franchise Management, which encompasses all the telecommunications policies for the city; the Parks Bureau; the Children's Investment Fund, etc. There is no city manager; these units are all divided

within the council offices. This political and administrative structure plays a significant role in why Portland is able to do many of the initiatives that it does.

One subject who served on Portland's telecom steering committee adds that they were basically looking at how they could help bridge the digital divide, given that Portland has one of the highest Internet penetration rates in the country. Portland is a very tech savvy city with many small businesses. The city leads the nation in the per capita number of small businesses. Their regional monopoly is made up of two separate entities: Comcast (formerly AT&T) and Quest. Comcast bought out AT&T, and they're the incumbent cable provider. Quest, the incumbent telephone provider, holds many advantages. A local government representative, Subject # PO-6025, adds:

> "In this information age, we need access to the Internet, to information and we know that those most vulnerable in our communities are the ones [who] aren't getting it the most and are having the lowest rates of Internet penetration. We asked ourselves, how do we encourage competition in a highly regulated industry of telecommunications that has lots of lobbyists and lawyers involved?"

Portland has been sued a number of times by Quest, because the city actually provides its own fiber optic service to themselves. The city is currently conducting a business case study on the feasibility of fiber optics to premises network and, thus far, has found many small businesses need broadband in order to survive. Broadband access, such as T1 connections, are almost always needed for some of the applications that small businesses require. The city feels this type of initiative, which helps small businesses in Portland, can also be positive for ordinary citizens. The city believes it can help foster that same movement to a public-private partnership, like Unwire Portland. They argue small businesses and residents share one point in common. The small business sector is on the margins much more than big businesses, paying over $1200 for a T1 line. This becomes cost prohibitive for them, and they end up using DSL and cable, neither of which is as efficient as a Mu-Fi. This case study analysis is under review by the city council and, if approved, will create an additional public-private partnership, or public network, that would be open access to these businesses.

Similarly, Portland conducted a feasibility study that looked at its existing broadband infrastructure, because it understands that every city is different. In the next couple of months, they're going to update a lot of that information with additional data. Portland officials argue that Portland is the only city in the US that's actually taken a look at this, though they know Seattle and San Francisco are looking at performing capability studies.

Portland has created a public-private partnership project, Unwire Portland, to bring wireless Internet access to the city. The project manager works with the selected vendor, Metro-Fi, to help provide the city with information and guidance about various city policies, from bureaus related to zoning and permitting questions, as well as serving as the official voice for the city. In terms of information the city needs from Metro-Fi, the project manager helps facilitate two-way communication between Metro-Fi and the city, as well as providing a voice for the city to the community, such as answering questions

that residents or businesses may have about the project, as well as serving as a source of information for the media.

The current project manager started his position in June 2006, which was around the time the city and Metro-Fi were negotiating their Mu-Fi contract. Although the contract was still being finalized when he joined, much of the vision and questions regarding the purpose of the network were already well established. He admits they never really finished the visioning aspect; there's a constant cycle of implementation, which leads to new questions of vision.

Portland's Mu-Fi began as an initial "proof-of-concept" network that was about two-and-a-half square miles, covering most of downtown and some other parts of the near east side. The network went live in December 2006, and they operated that concept for about three-and-a-half months. At that time, a couple weeks after I interviewed the project manager (Subject # PO-6020), the city approved the proof-of-concept network and Metro-Fi expanded its coverage area. Subsequently, the city's network went from a proof-of-concept network with about 70 access points to an expanded network with about 200 active access points. Portland now has about 500 access points, but many are still in the process of being turned on.

When I interviewed Subject # PO-6020, there were between 5 to 10 square miles that were on, and within that area, there were pockets of non-coverage due to pole attachment issues, because Metro-Fi is going to hang their access points on municipal street lights, but the lights on the poles belong to a third party. There are three third parties in Portland; Portland General Electric (PGE), Pacific Power (PPO) and Quest. This means these utility poles in any given municipality are someone else's property. In Portland, there are a significant number of light poles where Metro-Fi's access points hang on to many municipal street lights. The city does not have third-party attachment rights, so Metro-Fi has no clear right to attach to third-party poles. The city understands there are many coverage holes, and has received several reports from Metro-Fi showing the gaps in network coverage. The city hopes to have 95 percent coverage of outdoor areas by the middle of this year.

The first goal of the Unwire Portland project was to expand low-cost Internet access to city residents and businesses. The city operationalizes and measures this goal in consultation with Metro Fi based on monthly number of active users and target levels (the city wanted to see numbers equate to roughly 2 percent (or 11,000) of Portland's residents by the end of last year - 4 percent of or 22,500 this year). According to Subject #PO-6020, these indicators would reveal whether they've succeeded.

The second goal is to increase Portland's economic development potential. The city operationalizes and measures that by monetizing the value of the free connectivity provided. Unlike Philadelphia or other cities that have subscription-based models, they argue they can take the free connectivity approach, monetize that, and calculate if Person X had to buy a similar product on the open market, how much would it cost? One target level was by the end of 2007, to provide $5.4 million without the value of the free connectivity provided by the end of 2007, and that is a function of the previous

performance metrics which is 11,250 monthly users, times $40 a month, which is what they find to be the cheapest form of wireless Internet access, times 12 months. They argue that if they take 11,250 users and they all had to buy wireless Internet access on a monthly basis, the cheapest fee is roughly $40. This would be 11,250 times 40 equal to roughly the monthly amount of money or value provided. They multiply that by 12 and it would be an annual base. By the end of 2008, their target number will go up to $10.8 million, which would be 22,500 active users, times $40 a month, times 12 months.

The network is partially deployed, and until very recently, the city turned on phase two, which is still a small part of the city. As I interviewed different subjects, I noticed two things: some folks are happy, although they recognize coverage within their areas is extremely spotty, but have high hopes this problem will be fixed soon; others are unhappy with the service but they don't complain – they simply go to a local coffee shop to access the Net.

Subject #PO-6027 commented on the recent articles published by two major newspapers in the city, the *Portland Tribune* and the *Oregonian*. He says that most press is negative, although he admits he never actually tried to personally use the network for more than five minutes. He complains that he constantly gets "kicked off" because the network is "too slow," "full of ads" and he feels "frustrated."

Similarly, another respondent, Subject # PO-6026, added:

> "I would say there are pockets of no connectivity. I live in an apartment building, and one of the antennas is [at] an intersection, which is only 300 feet from where my apartment is, but it has to go through several walls, etc., so it doesn't reach me in my apartment building even though in a straight line it's only 200-300 feet away."

One respondent from a local community center noted that in 2003, the city conducted a study that involved actually giving people computers and low cost access to the Internet, but those people didn't use the computers for e-government reasons as the city thought they would. A copy of this report was sent to city hall. Subject- PO-6024 argues,

> "What people use technology for sometimes has nothing to do with what governments do, and there's a difference between providing people the tools and providing them content that makes sense to them, or they'd want to even interact with the government. If you ask most people what they want to do on the Internet, they're going to want to do something different than look up a city council meeting. It's interesting what we assume will help. If you really wanted to go with technology that goes with the masses, you'd go with cell phones!"

Interestingly, despite having made the connection previously between deploying a Mu-Fi and closing the digital divide directly, Portland has now chosen not to engage the digital divide directly through a digital inclusion program tied directly to its network efforts. In this way, Portland seeks to address the digital divide indirectly by providing low-cost Internet access, which in turn may address at least one of the following: poverty

reduction, increased social or political involvement, or improved QoL for residents of low-income profiles. A city employee, Subject #PO-6024, said:

> "One of the things here in the city is that we recognize there are several aspects of the digital divide. We understand this project is not designed to solve all of those aspects. This project can solve issues related to the availability of high-speed Internet access, and the monthly cost. It cannot solve the relevance of Internet access. We did not lump all those issues in the Unwire Portland project."

Additionally, another city employee, Subject # PO-6020, stated,

> "We are beginning to realize it's more than access. In 2003-2004, we conducted a study where we gave people computers and a low cost Internet connection and they didn't use those computers to interact with government. It was really interesting to us. Sometimes what people use technology for has nothing to do with what governments do. There is a difference with providing people the tools and with providing content that's relevant to them."

Another city employee, Subject #PO-6025, adds:

> "As a public servant, I think my job is to be a good steward of those public funds. These are tax payer dollars and it's not my birth right to go, try and allocate taxpayer dollars to whatever I feel is an interesting idea. There has to be more than just 'this is interesting' and 'this is good for the time being because it sounds exciting.' It can't be just a fad…I think people should bring those issues to the attention of their elected officials to say 'you're the person who is responsible for taxpayer dollars. They elect you to make appropriations, decisions, are you comfortable with doing this sort of thing?' I'm not an elected person, I'm appointed, and it wouldn't be fair to do those things in a vacuum."

Most of the data reported by Metro-Fi via Portland is demographic information on whom they're reaching. This is self-reported information. This is a concern for some grassroots advocates. For instance, Subject # PO-6022 comments:

> "I think this network is a box that the city of Portland can check off and then forget about. 'We did it. Good. We're done - next thing' versus a piece of infrastructure, a piece of capability, so the city can promote civic engagement, to promote economic development, to promote equality of opportunity, and it's lying shallow in that way, that the city, including [its] leadership, doesn't know what to do with the network."

In sum, the multiple definitions that have been assigned to the digital divide and the multifarious nature of rolling out a wireless network in a large geographic area raised key issues in the Portland case study. Issues related to signal strength, coverage, network access fee, ISP business models, and unique political approaches have re-shaped and

redressed the goal of the project. Some of these topics are not only complex, but also remain one of the greatest Mu-Fi challenges.

The next section takes a look at how Portland is responding to community needs.

- **THEME 2: Variable mismatch between city's intentions and populace's needs**

The power of Mu-Fi to respond to citizen needs by improving QoL and perhaps alleviating digital inequality remains to be seen. A common observation about Portland's wireless network is the prominence it accords to the number of access points installed. More generally, it was argued that if more access points are installed in at-risk neighborhoods, residents might be in a better position to say the network is positively impacting their community.

During an interview with the program manager, he said the network's coverage will continue to expand throughout into 2008. The Portland network has over 550 live outdoor access points in more than 25 neighborhoods. Metro-Fi announced that its city-wide Wi-Fi network in Portland had 11,200 users in May 2007. This represented a 40 percent increase in the users compared to April 2007's delivery. May's utilization also represents an estimated 11.5 percent of the population within the current coverage area, as well as 56 percent of the 19,900 individuals who have registered for the network since its December 2006 inception.

The Portland network's usage tripled in the first three months, culminating with 5,800 users spending over 50,000 hours online in March 2007. A month later, in April, those numbers increased to nearly 8,000 individuals online for over 80,000 hours. May's users spent over 131,000 hours online, averaging 94 minutes per session.

By July 2007, Metro-Fi's Portland network had approximately 16,000 users who spent over 210,000 usage hours during more than 133,000 sessions. This represents a 23 percent increase in monthly users, a 40 percent increase in usage hours, and 38.5 percent increase in sessions when compared with June's statistics.

One can make the logical argument these numbers prove the city is bridging the digital divide. However, interviews reveal several participants outside of city hall did not understand the city's purpose in building the network. These interviewees had significant doubts that Portland's network is narrowing the digital divide. One community advocate, Subject # PO-6026, described reluctance on the part of the city to fund digital divide or digital inclusion efforts:

> "We haven't found the Portland's Metro-Fi solution to be very workable. Despite efforts that I would applaud that I would place the receiver near low-income buildings, there is very little penetration into the building. The way it's set up, [it] is very hard to repeat that signal from Metro-Fi to inside buildings. I have a

> concern, does the free model create a perception that it's there? We're actually worst off than when we started."

Overall, I believe it's a bit difficult to determine at this point in time if Portland's network will respond to the needs of its community because the city hasn't built it out completely; currently the city is in phase two of the build out. However, based upon the first phase, it may be a useful tool for people who are outside of a nearby signal. Right now, given the slow speed of the network, the signal is fairly weak without a booster. Subject #PO-6026 stated: "I think it may be something that has some use somewhere, but I'm not sure that the business model is going to see these folks around in five years."

Another participant, Subject # PO-6021, adds:

> "I know there was quite a lot of buzz and fuzz about it in the beginning, but I don't know now if it's made any difference in the local economy in that people are actually accessing information that they wouldn't otherwise. I know there's some excitement in the community. I also know there's some detractors in the community. I think it's an interesting thing [that] there's a citizen movement that's creating Wi-Fi networks from the ground-up that people can use and it's kind of a grassroots based thing. Why that didn't happen in Portland? I don't know. But I do think there's a desire for it here. Is it going to change things? I think it may change how many, if we're lucky, people who are younger actually perceive the government and something they can interact with. But again, we don't have a really strong government presence."

A city official, Subject # PO-6025, adds:

> "We can always do more as government, we can always find ways to educate people about how to use the Internet if they don't know how to do that I suppose, but I'm still not sure how much of a responsibility that is of government as opposed to other groups in the community."

Furthermore, a technology expert from a community center suggested a particular digital inclusion program proposal for $120,000 in the city budget. The proposal was, in part, a "get connected campaign" that would help people purchase computers at a lower cost and, via a partnership with Intel, digital training through 30 connected "sensors" or places where people could walk in and get help with both high-speed Internet and troubleshooting problems that they may have with their computers. Unfortunately, it was rejected by city council and didn't make the mayor's budget. According to Subject # PO-6023:

> "…just the politics of it is that the mayor believes that it has to come from the community and this definitely came from One Economy [a local non-profit] with a few other people like Intel. So, the mayor didn't support the budget. I find that a little disconcerting because one of the things that the mayor said at this two-day trial front when this started was something completely different. Some reporter asked him, 'What's the most important thing about this project?' and he stopped

> as he was leaving the room, turning to the audience of 60 people and said, 'I believe giving Internet access to low income people, and helping low income people use the Internet to improve their lives is the primary reason for deployment.'"

According to city officials, the current impact of this network is small and growing, but will be significant by mid-2008. By the time it's completed, they expect that a high percentage of the population will have access to this service; right now, a relatively small percentage of the population has access to the service. To city officials, it is directly proportional. The value is directly proportional to the number of people who have access. The city argues the fact that the number of people using it in a day, between 750-1,000 users, is a small but nevertheless significant percentage. To them, it proves the network has significant economic value. The city does not say "saved dollars," because it contends some people merely supplement their Internet access. During my interviews with government officials, they always say "value," not "savings." Interestingly, they state Metro-Fi won't know the real value and highlight is not important for them; they just need people to begin using it. According to the city, the demand curve for Internet access can be flexible so that people can economically support both Metro-Fi and their DSL connection, but it argues Metro-Fi is not concerned about that.

Metro-Fi's business model fits fairly well with helping digital-divide issues related to the costs of connectivity. To some degree, they've also said fairly high income communities are not interested in the free service. In other words, they already have a wireless modem or a wireless router at home that broadcasts throughout their residence, and they have a high-speed cable modem connection. They don't' see any value in using Metro-Fi. Even though they have the money, they're already paying for a better service.

Other local non-profits were not as charitable in their characterization of the digital-divide efforts in Portland. The city recognizes there are several different aspects of the digital divide, including the provider. One representative from Metro-Fi, Subject # PO-6029, said:

> "This project is not designed to solve all of those aspects, only those related to the availability of high-speed Internet access, and the monthly cost of it. It cannot solve issues related to the relevance of Internet access. It's not that the city does not recognize that those issues exist. It does. This project is just not designed to solve it. We did not lump all of these issues in the Unwire Portland project."

The next section examines how Portland is reacting to the availability/lack of resources.

- **THEME 3: Inability to anticipate future costs/needs and maintenance**

Subjects feel that determining what is (or ought to be) potential resources in tackling the digital divide and improving QoL is no easy task. City officials argue that the nascent nature of Mu-Fi is their reason (i.e. excuse) for not investing in human, financial and/or intangible resources.

According to a neighborhood group member, one reason is that the impact of the network is still undetermined. Much of the impact is tied to first solving the issue of accessibility (poor signal strength) and broadband capacity to do what they would like it to do. This member, Subject # PO-6026, adds:

> "As an organization that provides video, [we] are never going to be much a player in a Wi-Fi network until it moves it up to the Wi-Max capacity capabilities."

According to city officials, it is highly doubtful the city will switch from the current wireless platform to a higher standard, since it might not have the capital necessary to build up the network or expand its capacity.

An employee from a local firm, Subject # PO-6028, stated:

> "People think Portland has a lot of invisible resources from which to raise capital and grab new customers while ensuring the success of [its] network. However, this is a myth. Although Portland is very interested in bridging the digital divide, Portland understands this is not done overnight. This takes a long time to accomplish with many, many resources."

In terms of tackling the digital divide head-on, a digital inclusion expert, Subject # PO-6021, stated,

> "From a digital inclusion side, the city has got to a) put up some money of its own to help people get computers. More than 10,000 kids in Portland schools don't have a computer at home. Something has got to be done to get computers into their hands. b) There needs to be a real focus on training and the city needs to show how people will use the Web to access government services. When you are dealing with people [who] are poor, you have to think about literacy issues with low or no literacy. If you look at Portland's Website right now, not only does it not provide any real information to people with little or no literacy, you need a master's degree to navigate the site."

A participant from a local organization who serves as "device transfer mechanism" in the local community discussed some of the ways her organization is attempting to address the digital gap. For instance, she discussed the use of a particular $50 wireless mesh router for use mostly indoors; generally her organization does not deploy any outdoor access. One way her organization sets up in-home broadband reach is by taking a single DSL connection in a utility closet near a building manager's office and essentially spreading that DSL throughout a housing complex. At the time of the interview, they had completed approximately 300 apartments in six complexes using the equipment. Subject #PO-6026 highlights:

> "It's just very, very low cost. The thing we like about it is, besides the cost factor, it's got an excellent backhand for managing it. The backhand is free. We can go and do a whole complex in an afternoon for $200-$300. That's the beauty of the

> product and we started working with that when it was a research project at MIT, working with the grad students there about a year ago."

Clearly, it's not a cookie-cutter solution. There are many expenses and volunteer hours required both to learn how to perform this solution and actually building it. Nevertheless, more and more people are hearing about such programs in Portland and have benefitted from these services, both as trainers/builders and as recipients. Curiously, the city is not formally involved with this group, although it understands that clearly it has the resources to launch a possible joint project with this organization.

However, Portland officials have stated they understand local grassroots organizations are working to address the issue of equipment and peripherals. They are ensuring their community centers have computers with access to their city-wide Wi-Fi network. They count on these centers to provide training, equipment, advertising and information, such as getting the word out and clearing up misinformation. City officials did mention they view their community groups as potential allies and an important resource. One particular group they are considering is a local non-profit that refurbishes, drains and fixes old computers, and then gets them in the hands of low-income residents. Citizens who donate their old computers get a tax-exemption.

One city official, Subject #PO-6025, said:

> "That organization is a good one, but we are also interested in partnering with others like Personal Tel-Co, One Economy, and the media. I'm putting together these people to convince my boss [about] what we need to do, or what we need to do as a city. We need to get the equipment and training and get it to the peoples' hands [who] need it, we need to educate them on why it's important; we need to get out there in these communities. This is a learning process. It's not perfect. It's an experiment that needs work. We want to make it better. It's not like we want to protect what's there now. We just want to make it better."

The above statement is somewhat contradicting. Initially, the same public servant said the city is not sure about investing in a digital inclusion program per se. However, it is clear they are pursuing an agenda that includes closer ties to computer technology centers, non-profits, grassroots groups and other community advocates.

The next theme explores partnerships in Portland.

- **THEME 4: Multiple relationships with conflict, coop. and interdependence**

When Portland announced its Wi-Fi plans, the city received many e-mails from different groups stating they were interested in supporting the program and officially partnering with the city. Fast-forward a few years: it wasn't as easy as they had hoped for the following reasons: (a) they didn't have enough community partners; (b) getting all the players together became an issue; (c) meeting the budget deadlines and process was

problematic; (d) making the project scalable so it became city council dependent was not feasible. However, the city is still trying to seek ways to get local partners involved in its Mu-Fi project.

A representative from a local grassroots organization, Subject #PO-6023, adds:

> "The city helps us where it can in terms of contacts, areas that they've heard may have special needs, but we're completely independent of the city. We don't have any contract with the city or any type of formal partnership with them. We're more of a pure charity in that we go in and we provide the equipment and labor."

On the other hand, another respondent from a different community-based organization, Subject #PO-6027, notes:

> "I personally don't see the city of Portland partnering or making an effort to partner with [omitted], or other organizations like [omitted]."

Interestingly, Subject # PO-6023 mentioned that prior to Metro-Fi's plans in Portland, this organization was working with many local computer technology centers and the local housing authority to provide equipment and the labor to install it. Metro-Fi asked the city to simply provide one or more DSL connections, which at the time of this interview, was typically under $1 per month for each apartment. The respondent said the city was "very excited and enthusiastic, and were "rooting" them for that model. However, once Metro-Fi announced its project, "everything came to a grinding halt." This participant states the city told them they wanted to see how good the coverage was in the city. "In other words, we don't want to pay for anything."

Subject #PO-6026 seems to downplay Portland's commitment to collaborating with organizations to bring Internet access to the masses at cheap prices:

> "Categorically-speaking, I don't see the city pursuing any formal partnerships to ensure the success of the network. It actually refuses to engage in any kind of collaborative process. It's just not a priority."

However, Subject #PO-6028 disagrees, saying:

> "Partnerships are important in alleviating the gap and Portland is taking the necessary steps to partner with local groups like Beehive, One Economy, etc. This said, however, I feel advertising is much more important than building partnerships. Why? Somebody needs to make claims. If Metro-Fi goes out of business, the network goes down with it. Would you leave the keys of this network in the hands of the city? I hope not. The city does not have the core competencies to sustain this project."

Subject # PO-6022 thinks awareness is the biggest issue right now:

> "I think all of the social service organizations are not aware of it or capable of using at this point in time. They're not sure about the impact on many communities. The non-profit community is not fully utilizing this at all right now because they don't know how to use it or where to use it."

I agree with some respondents that serving as "device transfer mechanisms" is not the direct focus of their organization. They understand other community groups are responsible for these components of the digital divide. From a governmental perspective, the city gets its Web portal up and running, and it views that connection with users as a prime opportunity to interact. However, residents have been having trouble accessing the free wireless portion of the network. It appears that if you pay for the service you do get a signal. One respondent, Subject #PO-6027 adds:

> "I have no statistics about this, but I have a lot of people we sell to and we have a thrift store that we support. The owner told me one day, 'Oh, I live right next to one of those antennas…and I just can't get on the wireless network in Portland.' I've heard more than a little frustration with actually being able to use the free Wi-Fi portion of the network."

I believe there are different perspectives within Portland's community about whether the city should be involved in seeking partners to tackle the digital divide. The city has stated that it should and will be more involved in these issues. They think the debate is "healthy" and "thorough." One city representative, Subject # PO-6020, adds:

> "It's not entirely clear what the city's role should be and that there should be some fairly patient, and thorough thinking about what cities do and don't do well, and certainly contracting with a vendor to build a network is one thing."

The following section delves into Portland's diversity and richness of approaches in tackling digital inequality.

- **THEME 5: Well-targeted, Mu-Fi strategies require diverse policy mixes**

A respondent from the city's Office of Management and Finance, Subject #PO-6024, said:

> "Intel is 100 percent behind the Portland project and we want to foster it. Our firm understands that in order for their project to be successful, they need to have clear, crisp and multiple strategies to not only get the project off the ground but to have it be sustainable in the longer term. I am unaware of their strategies, but I would assume they have (or will have) incorporated it in their model."

A respondent from a local community group, Subject #PO-6023, adds:

> "So far, we haven't found the Portland Metro-Fi solution to be very workable, unfortunately."

Despite efforts I applaud, such as the placing of network repeaters near low-income buildings, there still is very little penetration into the building or home. Unfortunately, it's very difficult to repeat the signal from Metro-Fi inside a building because of the one megabit throttling employed on each node. In a large apartment complex, the city admits it won't serve several hundred apartments off of one megabit connection. The city understands it will have to eventually install multiple outdoor connections.

There appears to be a disconnect between what the project was set out to accomplish during the design phase and what the project actually resembles in reality. The project was designed to provide localized information, interactive opportunities for government and citizens coming together. The goal was to employ the tools of technology to more effectively solve problems between government and citizens. During this process, they identified Wi-Fi as a viable option to fulfill this promise. However, shortly after beginning implementation, the city quickly realized its goal was too complex considering its connectivity, mobility, and general infrastructural issues.

One respondent believes the city needs to learn from this experience of this network to turn it into something truly positive for its citizens. The respondent uses the analogy of the e-waste issue, where junk PCs are refurbished, loaded with free open-source software, and given back to the community so that people are provided with access to technology who wouldn't otherwise have access to it. Similarly, Portland needs to quickly learn to leverage this wireless network into something that's usable by all residents.

Clearly, Portland's experience in trying to build, develop and maintain partnerships has been unclear. During the course of the interviews, I asked subjects about how the city is seeking support for its wireless system because my motivation was to understand how key stakeholders were involved in the decision making process. Most participants mentioned the issue of core competencies as a possible reason why Portland has not been truly successful in alleviating the gap by way of wireless access. This theme is examined in the following section.

- **THEME 6: Cities are merely momentum players**

A member from a local firm, Subject # PO-6028, who works in conjunction with the Unwire Portland project noted:

> "Portland has to be careful. The city does not have the core competencies in regards to spectrum policy, management of network, device knowledge, etc., to run this network if Metro-Fi fails or goes out of business."

A local grassroots member noted that the community should be seen as the primary information source; they want to tell people how to build very inexpensive computers. For instance, this particular group's mission is to assess and improve the IT infrastructure, specifically the equipment of their local community and install PCs for

free in marginalized communities. This group started three years ago with very different equipment, and argues that due to lower prices, residents can easily self install and need not be experts. Neither the city nor the Unwire Portland committee have sought their advice. Subject # PO-6023 sums it up thusly:

> "You don't need to know anything other than how to plug in a little box to an outlet and you can create a mesh for your local community, whether that's housing, whether it's apartment, it could be a hotel, it could be anything."

Another organization that has never been called by the Unwire Portland committee claims the city "puts a lip service" in wanting its system to be open and available to lower-income citizens. However, key experts who know how and where the right places to deploy and serve the greatest amount of disenfranchised people, have not been consulted. I don't have the perception that the city thought about this issue extensively ahead of time, because the city asks citizens who can't connect to Metro-Fi's signal at home to purchase a $120 kit that helps amplify the signal. There appears to be a definite disconnect between the reality of some peoples' financial situations and what the city or committee believes is viable for low-income people. Perhaps the lack of adequate expertise is one reason a disconnect exists.

The following theme explores how Portland has integrated public policy in their digital inclusion program.

- **THEME 7: Inability to grasp the policy arena**

Cities like Portland claim they are constantly criticized for being behind the technology curb. Portland contends it can't even imagine how one has an informed debate within a six-month period about how cities have been involved on a municipal or even in a non-profit setting. However, they consider the debate "healthy" as it creates ongoing policy obligations to citizens and eventually leads to a long-term approach to policy.

Subject # PO-6021, who now works for a local online advocacy group, said the network is incomplete without tools to help people put it to work. Still needed, he said,

> "[Are] program and policy initiatives to put computers in the hands of low-income residents, and online resources to help them learn how to use the network to find work and educational opportunities. We're getting a 'C' right now, and to really get an 'A,' I think we have to think of all these other things,"

The lack of local policy hinders Portland's digital inclusion efforts. It is my contention that Portland was interested in the idea of the digital inclusion program; I believe the city simply wasn't interested in paying for it. From a public standpoint, they wanted to give providers affordable solutions that would promote digital inclusion via the development of the system. In the RFP committee, one respondent mentioned that the student committee, not the judging committee, had a robust conversation about whether they should be a free network or a subscriber-based network for communities.

Subject #PO-6022 argued that people value Internet access and will pay for it. However, people desire robust speeds just like everyone else. This participant argues that if the city offers a free network that fails to generate any funding that would allow for digital inclusion programs (for example, training or low cost computers), you will get a low-speed network that is of little or no use to anyone. In sum, my interviews with key officials confirm that Portland does indeed have a free, low-speed, ad-supported network that has with no digital inclusion benefits funded out of the operation of the network.

It is important to note that the city's model is sustainable from a city perspective. Because of the ad-supported network, they feel that if Metro-Fi goes under they retain the assets and they'll just bring in a new provider. It appears a bit naïve and sort of a "fire and forget" model. It seems that if a better project comes up later, they'll deal with it then.

But, there's an operational side to Portland's story. The city can really use this network to do good things, but it fails to use that at all. Some of the policy issues that city representatives failed to mention were civic engagement, promoting small business development, attracting a creative class, participation in city council, etc. From a business model perspective, I think it makes sense for city officials. However, this is catastrophic in terms of digital inclusion.

On May 17, 2006, a local non-profit met with the city council to pass a resolution that proposes digital inclusion is important to the city and with use of this network. The city promised to produce such a report stating all the activities the city is undertaking to promote and improve digital inclusion. The anniversary due date of that report passed in the summer of 2007, and the city still hasn't produced the report it pledged to provide.

Next, I explore how Portland's public officials and citizens believe this network will (or ought to) enhance their community's identity and increase citizen participation.

- **THEME 8: Using the digital divide as an excuse to build their systems**

Several respondents felt that the city had placed less of an emphasis on solving the digital divide issue and more emphasis on the hype surrounding the network. One senior executive from a local economic development agency, Subject # PO-6021, said,

> "It's a fad in government because it's something to check off its list. I think people are fundamentally opportunists. The reality and the problem that I see from rural to inner city communities is that those kids who qualify for free or reduced lunch are those kids who are least likely to have a computer or Internet access at home. Our economy is hemorrhaging manufacturing jobs. Eight out of 10 jobs require technology skills. I don't think the city has failed; I don't think it has tried."

According to most participants, most people are either having trouble accessing the network and/or with the applications needed to get it in their home or apartment building.

It is important to mention that the city is in the phase where they're just getting into the areas where low-income families might live, such as the eastern part of the county and the northern area of the city. Unfortunately, these families don't have the hardware capacity necessary to actually access a Wi-Fi network.

Most respondents feel the Unwired Portland initiative is great for mobility. One participant, Subject # PO-6025, is using it and dropped his Comcast account. He said he's saving $50 a month. He adds, "I guess I know the system works." The city admits there isn't one dollar of public subsidy going into this project and feels it's headed for success. They admit they are not selling it to the residential market, because that's not a benefit. They don't believe this constitutes good sound policy.

Metro-Fi claims the number of subscribers continues to increase, and, according to Subject #PO-6020, the city will eventually "do a little feedback from the community." To city officials, it has given people access that they didn't have before based on the ad model. Unlike EarthLink, which is based on subscriptions, the city believes this model is a key for success. City officials admit they were skeptical about the ad model with the selling of little banners on top of the browser. To them, Portland is not a corporate culture. To city officials, Portland's a very rogue city. Case in point: Portland's unofficial motto is "Keep Portland weird." Most public officials are proud of the project because they think over the course of time it's going to be a "huge hit." To them, according to Subject # PO-6025, "it just totally beats the cost of what you were paying before."

One respondent, Subject # PO-6027, feels otherwise. He notes:

> "That's the problem. I think it's just a big zero in some ways. If I'm a business owner and sitting out in Pioneer Square with my fancy $2,000 laptop, it's sweet. This is great! But, if I'm a low income person paying $20 for high speed internet, this isn't quite as impressive."

The city is unsure about who is taking advantage of the network per se. The registration process doesn't require people to indicate their income level, occupation, or gender. It's completely anonymous to Metro-Fi. However, Metro-Fi used to ask demographic questions during registration. One respondent argues that perhaps it changed because on a marketing scale, it is hard to get people to be honest with you before you have established a relationship with them. So, even if you're offering a free product, people are going to be reluctant up front to be honest about sensitive information.

For city officials, the wireless service is opening new doors for disenfranchised communities and driving the information poor to a new information highway. For citizens, the Wi-Fi cloud has yet to prove it has contributed something position to their communities.

8.2 Chapter Summary

A viable wireless network makes sense for Portland for a number of reasons, and perhaps the biggest one is the city's high number of small businesses. Reliable broadband access is the lifeblood of today's small businesses, and a workable network can be an excellent tool to help them succeed. Many applications that contemporary small businesses use demand reliable, low-cost access to high bandwidth, and both cable and DSL do not meet these requirements. A traditional T1 line costs small businesses over $1,200, which is cost prohibitive, so reliable broadband is essential. Portland has faced a number of stumbling blocks while building its network, most notably the two incumbent companies that are in charge of delivering the city's telephony and cable services – Quest and Comcast. Quest has sued the city a number of times because of disagreements over fiber optic services. However, Portland seems to be overcoming these obstacles, since the network's usage statistics continue to steadily rise. The city also has another advantage over other cities in this study – Internet penetration rates in Portland are already quite high, so residents seem to be quite ambivalent about the city network's spotty service – they merely go to a coffee shop or café that offers wireless service.

Portland has the benefit of some innovative approaches being undertaken by a number of organizations in the city to bridge the digital divide, including the installation of Wi-Fi networks in apartment complexes and several initiatives that are putting low-cost and recycled computers into the hands of people who need and want them. These are very positive developments for Portland, because the city wants a wireless network, but it doesn't appear to want to pay for it, so grassroots efforts in the city by a number of organizations have been an important component toward it's goal of achieving a city-wide wireless network. Other cities can certainly learn from a number of developments in Portland, most notably that there are no cookie-cutter approaches in achieving a truly universal wireless network.

In contrast to Chapters 7 and 8, the following chapter analyzes a less successful attempt in Federal Way, Washington, by the city's municipal wireless broadband leaders. The explanations for limited success illustrated in the case will build upon the findings of this and other chapters. With all five case study findings combined, a comprehensive listing of success in relation to the digital divide will be available with which to draw conclusions on the overall impact and make recommendations to policy decision makers.

The next city in our case study, Federal Way, Washington, has neglected to take advantage of some of these local partnerships, which, to a certain extent, has not allowed the project to succeed.

CHAPTER 9: FEDERAL WAY, WASHINGTON

9.0 Introduction

This chapter aims to show the findings of Federal Way's wireless broadband network in relation to its impact on the digital divide. The overt aims of this Wi-Fi project were to increase digital inclusion and promote economic development. The extent to which this goal was fulfilled has been investigated through analyzing a sample of key city stakeholders. Data was obtained from nine interviewees who were very familiar with the wireless network. The interview guide included both closed and open questions. This section explores the eight themes revealed during the interviews.

9.1 Themes

One way of evaluating whether Federal Way had fulfilled its goal in terms of impacting the so-called digital divide was to identify key themes that emerged from the interviews. Subjects pointed out that complexity, responsiveness to the community, reaction to resource shortages, patterns of relationship building, diversity/richness of approaches, stakeholders' knowledge base, effective integration of policy, and the perceptions of the project enhancing community identity and participation were relevant themes and contributed to a better understanding of the so-called digital divide and QoL factors. In the following section, these themes are explained in-depth.

o THEME 1: Unanticipated social, political, and technological complexity

According to one respondent from the economic development sector, about 10 years ago the city of Tacoma (adjacent to Federal Way) began installing fiber optic cable. The city decided to provide a broadband network, beginning with city center, and then eventually to other areas. The infrastructure would be in place for what in those days was considered state-of-the-art wiring for broadband. At the time, Tacoma became known as *America's Number One Wired City*, a key selling point for the city to attract businesses. The city subsequently conducted an aggressive campaign to attract high-tech firms. According to Subject #FW-8204, "[Tacoma] got a lot of press from the national publications in town."

A few years later, wireless networks became *de rigueur*. Federal Way, after witnessing the success in Tacoma, recognized a viable network's importance as an important attraction for bringing business to the city and for improving QoL of its citizens. Other cities in the US were simultaneously jumping on the wireless bandwagon, including Spokane, Washington, the state's second largest city. Spokane's entire city center was

wireless. Federal Way, a smaller, suburban city, saw that Spokane, like Tacoma, received a great deal of favorable publicity for its technological initiative.

Between Tacoma and Spokane, Federal Way officials started to think about wireless services for its residents and businesses as they realized that other smaller cities were effectively using it to attract business, while also improving QoL for their existing businesses and residents. Federal Way officials also thought it would help its public safety department remotely connect to its system. The city felt that a wireless network was something it could use to attract businesses and residents alike. It is important to note that Federal Way is predominately a business community with many white-collar professionals.

The coverage area is limited in Federal Way; the entire city is still unwired. According to Subject # FW-8205, the city started the project as a pilot in order "to identify an area with the biggest bang for the buck," which is mostly its main commercial districts. As a starting point, the city decided that tourist areas and shops would have access to it. The city also considered installing wireless in a residential area, but has not implemented it.

Perhaps out of fear of failure, the city is not advertising its network as it should. One respondent, Subject #FW-8201, adds: "We need get the word out more, we haven't actually been advertising enough… I think we've done a minimal amount of PR and we need to do more."

The city views the network as an opportunity to create a better downtown core, stimulate more pedestrian traffic and to encourage more people to spend time downtown. This technology is a key attraction in increasing traffic in the city. According Federal Way government participants, this Wi-Fi network keeps the city technologically competitive. It is their contention this network will increase business travel to the area because they see the network as an amenity. In turn, they argue, this enhances their economy and creates jobs. As one participant, Subject # FW-8203, notes, the city sees this as:

> "…a part of the pie of things that you need to do in this community to be on that cutting edge. To make sure you keep attracting as many people as possible."

This said, however, Federal Way also failed to understand the complexity of attempting to engage the digital divide. The next theme also demonstrates how the city has not adequately responded to the needs of its citizens.

- **THEME 2: Variable mismatch between city's intentions and populace's needs**

Federal Way foresees many benefits if the network is successfully implemented, from navigating through different city services and bulletin boards to serving as an ultimate information resource hub for the end-user in the community. However, the city is cognizant of the fact it has not met expectations and has failed to respond well to the needs of its citizens. Subject # FW-8202 says,

> "the potential is still unexposed; it's there, but we haven't maximized on it. I think this is a tool that's available to many folks that most don't even know about yet."

The city wonders about its role vis-à-vis what the community should be, what information should be available in the community, and answers to their questions relative to information resource needs. From the citizens' perspective, they want to know more about the benefits of such a network to them. Some of the respondents who have used the network have been unable to access it from outside or near an access point.

The next theme discusses how Federal Way has reacted to the availability/lack of resources.

- **THEME 3: Inability to anticipate future costs/needs and maintenance**

When I asked subjects to describe how Federal Way plans to use existing and future resources to tackle the digital divide, I was trying to understand if the city had clearly outlined this provision in their digital inclusion program. However, I quickly learned the city did not have a formal digital inclusion agenda.

Subject # FW-8202 suggested that the digital divide problem is a non-issue for Federal Way, but something that third-world and developing countries are dealing with. This government respondent argues that the significant number of Internet cafes or Internet stations one finds in places outside of the US is astounding. However, the number of such public venues in Seattle is minimal, since most people have access to a computer.

In contrast, Subject # FW-8200 argues the city certainly has a full range of income; it's not a wealthy suburb or a poor area. He states there is a wide range of people on housing assistance. To him, the digital divide issue is very real in Federal Way. He struggles with the notion of getting people who are on housing assistance and unemployed and / or working two jobs, on the other side of the divide. He thinks this network might help them "with accessing the cyber world" but understands it seems much more complicated than just the availability of the infrastructure.

Next, I look at patterns of relationship building / potential for partnerships in Federal Way.

- **THEME 4: Multiple relationships with conflict, coop. and interdependence**

During the course of the interviews, I discovered that it appears that Federal Way has neglected to invest in partnerships with key stakeholders. However, it is interesting that a local community college, which is actually located about 15 miles north of the city, decided to open a branch campus in the downtown core. One government official confirmed the wireless network was one of the strategic reasons behind the college's

decision. Federal Way officials argue the community college branch campus would probably not have happened were it not for the wireless network.

Subject # FW-8200 argues the city has not had enough experience with the network to build community relationships. The subject feels this takes time through trial and error; if and when this network has an impact the city intends to then pursue formal alliances with community leaders. In the interim, government officials are not actively pursuing creative ways to make this work for the long haul. To Federal Way officials, "it's too soon to tell."

Despite finding no signs of formal partnerships in Federal Way, I also realized the city had a very narrow and superficial approach to addressing digital inequality.

- **THEME 5: Well-targeted, Mu-Fi strategies require diverse policy mixes**

Federal Way participants talked a great about "fixing the leakage problem" in their city. According to local statistics, 50 percent of the city's residents were going outside Federal Way to do their shopping (food, clothes, etc.). The city is trying to develop a lifestyle center to help create an eco-system to keep people in the city. The city understands the wireless service is an amenity for people, but that it certainly won't drive shoppers. According to Subject # FW-8203, the network is something the city considers "one of those added things."

Another reason Federal Way launched the wireless network is its Police Department. The city mounted cameras that connect to the Wi-Fi coverage grid in the downtown core. This project is tied to Safe City's initiatives adopted by the city from Google. This initiative, which started in Minneapolis, Minnesota, in the back of a Target store, found that crime rates dropped significantly in stores with cameras with high crime rates. The city developed a camera system infrastructure where the Police Department dispatch center monitors approximately 30 cameras. If dispatchers see crime in progress, they'll dispatch a police officer to the area immediately. This Wi-Fi network makes these types of real-time applications possible.

Federal Way is considering setting up a business incubator via the local chamber of commerce. The project would be similar to a graduation program where participants go through two to three years of tailored training. This would help Federal Way create an IT professional pipeline. It also focuses on trying to reduce the failure rate for new businesses. The city is considering developing and building such an incubator in partnership with the local chamber of commerce, in downtown or the outskirts of the city. According to Subject # FW-8206, the Wi-Fi network is an added benefit that encourages firms to locate to the city.

The following theme discusses the knowledge base / core competencies of Federal Way's public elites.

- **THEME 6: Cities are merely momentum players**

The Wi-Fi project team is composed of the IT project manager, the city's economic development director, and all the IT directors. During the project design phase, meetings were held where all the team members' ideas were put on the table for discussion and debate. The team crafted a set of recommendations for the mayor and also reviewed several articles about other cities' networks.

Unfortunately, I felt hamstrung by the availability of data for this theme. Thus, I am unable to paint a richer picture of the core competencies in this city.

Similarly, the next theme shows the lack of data vis-à-vis policy integration in Federal Way.

- **THEME 7: Inability to grasp the policy arena**

Respondents commented on the lack of policy regarding Federal Way's municipal wireless initiative. Washington is one of the states that effectively limits public utility districts' ability to providing wholesale telecom services. Washington municipalities often have greater authority and flexibility.

During the course of the nine interviews I conducted, most respondents did not mention any local statutes or public ordinances that support (or not) the Mu-Fi project in Federal Way.

Next, I discuss how city officials and community groups believe the project will enhance their community's identity and increase citizen participation.

- **THEME 8: Using the digital divide as an excuse to build their systems**

Granting wireless access to the local mall is a huge motivation for Federal Way. In the city's view, this will potentially fix the "leakage problem." However, a staff member from the local mall, Subject # FW-8202, states they don't receive a good signal because of their proximity to the current transmitters and repeaters. "It's not of great benefit to us right now." However, people feel that as the city increases the number of transmitters around the city, the density, quality and strength of the signal will increase.

Most respondents mentioned that very few people use the network because of the spotty service. Though a number of stores offer wireless access and staff personnel have access to broadband at work, they argue the added benefit and perk for using the network will take some time.

A number of subjects mentioned that the city frequently mentions its commitment to improving QoL. The subjects believe this network will improve their lives by improving access to technological resources. However, many mentioned that the city does need to become not only an information resource, but also a training resource. Another concern

was the city's need to find a way to measure the success of the wireless system, in case no one is using it. As Subject # FW-8207 noted: "As a city worker, I admit the city needs to push the envelope and start doing something to get more folks involved with it and utilizing it."

The lack of PR and public involvement in the wireless system has prompted the city to continue to expand its network. Subject # FW-8205 said, "…if [the network] was expanded, it would create a better sense of community."

Most subjects agree there isn't any evidence businesses have or haven't taken advantage of the network. However, most people have heard anecdotal evidence of businesses appreciate having the ability to tell their clients that they can take advantage of the city's wireless infrastructure, although they haven't seen or heard any comments about any particular business that came to town expressly because of Federal Way's wireless network.

9.2 Chapter Summary

the entire city, including residents. Initially, the city considered wiring a residential section of the city, but this never got off the ground. The city's principle motivation for beginning a wireless network was to attract businesses to the city, as well as to attract residents to the downtown area to combat the city's "leakage problem," where statistics show 50 percent of its residents are travelling outside of the city to shop. Another motive for creating a wireless network in the city was to aid the police department, including dispatching officers in a more timely fashion to crime scenes. Despite the fact that Federal Way has a long way to go before the city has a widely available wireless network, there have been several notable successes, most notably an area community college's decision to locate a new branch campus in downtown Federal Way.

Further study is needed to truly determine if the city's wireless efforts have spurred business growth downtown. However, several respondents said that local businesses appreciated that they were able to mention to clients the availability of wireless network services.

CHAPTER 10: CORPUS CHRISTI, TEXAS

10.0 Introduction

This chapter aims to show the findings of Corpus Christi's wireless broadband network in relation to its impact on the digital divide. The overt aims of this Wi-Fi project were to increase digital inclusion and promote economic development. The extent to which this goal was fulfilled has been investigated through analyzing a sample of key city stakeholders. Data was obtained from ten interviewees who were very familiar with the wireless network. The interview guide included both closed and open questions. This section explores the eight themes that were revealed during the interviews.

10.1 Themes

One way of evaluating whether Corpus Christi had fulfilled its goal in terms of impacting the so-called digital divide was to identify key themes that emerged from the interviews. Subjects pointed out that complexity, responsiveness to the community, reaction to resource shortages, patterns of relationship building, diversity/richness of approaches, stakeholders' knowledge base, effective integration of policy, and the perceptions of the project enhancing community identity and participation were relevant themes and contributed to a better understanding of the so-called digital divide and QoL factors. In the following section, these themes are explained in-depth.

- **THEME 1: Unanticipated social, political, and technological complexity**

The Corpus Christi economy would probably be considered by most to be more of an older economy. The city's industry is largely steeped in the petro-chemical sector; most of the area's refineries have been operating for 40-50 years. As Subject CC-7514 sagely notes: "…you make gas kind of the way you've always made gas…" Corpus Christi is described an old lion economy, where the lack of young, fresh entrepreneurs is quite evident. The same respondent said, "I think the city is pushing the limits of our platform in trying to engage folks in the information technology arena."

Getting access to specific data about the network from the city officials was challenging. The city claimed not to have the data, citing the impetus for their network as governmental service efficiency (AMR) – Automatic Meter Reading tools for mobile government workers. It was not for resident use, although the city allowed residents to use the network to access the Internet during the build out. As such, they did not have any authentication process in place to connect to the network. Citizens/households that tried to access the network simply had to accept terms and conditions of network use but they did not track individual usage - there was no need for them to do so at the time. As

they were completing the final portion of their network, they began negotiations with EarthLink so they did not go through this process.

As a direct result, the network now no longer belongs to them. EarthLink owns all the Tropos radios, which contain the data I sought. They now have a process in place for tracking households as they are now charging for usage. However, that data is not the city's. This said, nonetheless, they do have data that captures the number of times the system was accessed during a period of time prior to their agreement with EarthLink. However, it is unknown how many people accessed it; one person/mobile worker may have accessed it numerous times in a day.

City participants were willing to share their data and wished they had better information to give me but their initial platform for building their network was not digital inclusion or community use. Once they realized there were other uses for this network and that they did not have the resources internally to extend use to the public, they sought a commercial partner.

However, the city did have some data that addresses estimated average monthly fees previously paid by users for Internet access, estimated current monthly available savings to the average Corpus Christi family, and estimated current annual potential economic stimulus to the local economy (see charts below for Corpus Christi). These numbers were put together by one of their consultants when they publicly sought out partnerships for the Mu-Fi network.

One participant said that ever since EarthLink purchased the network, all the city's time had been spent in working with its new partner in optimizing and transitioning the network over. This left little to no time to work on further inclusion efforts. The city hopes that since the network is now completely transitioned (as of Aug. 15 2007), that they will now have opportunities to focus on these efforts and begin collecting their data/measuring their outcomes.

The city established a non-profit corporation via city council to manage its network. This corporation is an integral part of the city and its purpose is to develop the network and its applications; to empower the public with the highest possible level of communications technology. Unlike the Philadelphia model, where it was a full fledge non-profit, the Corpus Christi program manager (Subject # CC-7511) stated that she "was working with a couple of other people, and we're starting small…" by looking for foundations, fundraising, etc.

The city's non-profit board is small and composed of members from different sectors of the community; namely, the President and CEO of the local economic development corporation, the mayor, one technology guru, university professors, a vice president from one of their local banking institutions, a vice president from one of our title companies and also the school board president. Like any other committee, they report to a board and take recommendations. One respondent stated, they have a great deal of latitude because of such organizational structure whereas you couldn't do that as a city government in

other cities. They consider their stand-alone structure a huge plus and an advantage for the delivery of technological services.

Like most projects of this magnitude, there were issues to work out. Some of the issues were concerns within the community about why the city had spent taxpayer dollars on a wireless system. Specifically, residents were concerned about how they were going to go forward with the Wi-Fi network: Keep it as a city program, or sell it to a private carrier? Nevertheless, city officials knew they wanted a city-wide, community-based portal. As one respondent stated:

> "We wanted it to free and accessible to the independent school district, for example. We wanted a web link in the portal to find out what your child's grades were, or other type of similar information. We want the city to provide all sorts of public information about city services. Also, there was some interest in seeing if we could start doing some e-business training and perhaps through the city portal, you could access certain local businesses that were willing to be included in the portal…" Subject # CC-7512

The original model adopted by Corpus Christi was for predominantly a government service like e-meter reading. The original intent was really to provide a kind of a government service to the community. From the interviews conducted, bringing in Earth Link changed the dynamic; in lieu of having access to the Mu-Fi network for free (which they enjoyed for over a year), people had to pay a fee to truly access the power of that platform.

After the new model was implemented, some subjects revealed there were pockets of no-coverage. Some also said that the wireless technology was made to be more of an internal network, not an external-outside network. So, the signals are "on" there but sometimes depending on the particular home or the construction materials used by that home, you may be getting a weak signal inside the home. One respondent adds:

> "I think that's going to be true of all wireless networks in the country, that if you're very close to where the access point is, physically speaking, then you might be alright. If you're a little further out, you may need to invest in a little Wi-Fi antenna in order to make sure that the signal is strengthened as you communicate back and forth to the access point closest to you." Subject # CC-7513

One of the public institutions most affected by the lack of indoor broadband penetration is the school system. Corpus Christi is currently pursuing a grant from the National Science Foundation that includes Wi-Fi technology within the schools and classrooms. As one subject explained:

> "…We're going to try to provide laptops to students who are in almost 100 % low income minority schools. These laptops will be Wi-Fi enabled laptops that will allow students to connect to the Internet and allow these students to take these

> laptops home into their particular community. Our goal is to begin to introduce these types of technology in targeted areas so that these people who aren't left-behind….The City is using education as a way to bridge the digital divide." Subject # CC-7516

Corpus Christi tried to make its network seamless. When city officials started with their pilot project, it was a 24 mile square-foot area with their Automated Meter Reader (AMR) project, and it worked extremely well. At the time, in 2003, Intel had created the first ever Wi-Fi integrated mesh network and they decided to expand it to a 147 square-mile area, but with pockets. In turn, Intel concentrated its radios in more populated areas. Considering Corpus Christy's geographical landscape, there are many areas that are not densely populated. The city considered densely populated areas a priority. Corpus Christi has some areas that are very sparsely populated, such as near the city's airport where there are vast fields; quite naturally, coverage in these areas is spotty.

According to the city, it developed a seamless network (and they were clearly going for seamless). The city wanted to complete its network by December 2006, but to meet this goal, city officials realized they needed some partners to come in and help them with this network. During the build-out phase, the city allowed its citizens to use the network for free to see if they can log on and access the Internet. To the city, citizen use and feedback was good information because it could learn from the early problems. However, people began to get the idea that the network was always going to be free of charge, which was not the case, which presented problems for the city when free access was terminated.

The bottom-line is that free is always free and when it is no longer free there's a cost and sometimes that cost can be a barrier to some people. There's not only the access charge, but the larger charge on the front end of just having the equipment to access the platform. However, cost is not an impediment to everyone, either, such as Subject # CC-7510:

> "My hunch would be, the inconvenience of pop-up ads and stuff like that, that if you want something bad enough, you'll suffer through that stuff, if you want it for free. General folks like myself and my wife has a home office, we're not going to tolerate that kind of stuff. We're going to the $19 a month or whatever it is, so we don't have to live in that ad environment. However, it seems like if you want to conquer the digital divide, the free piece is important and the way you get the free piece is having the ads supported."

Several participants expressed the fact that every city's model is different, and there are different things that must be explored in-depth. Most participants felt this is a multi-faceted, iterative process and that the city does have some hurdles to overcome if it want its technology venture to succeed.

It is important to highlight that right before city officials decided to sell the Wi-Fi network to EarthLink, they decided to put everything on hold until they knew how they were going to achieve their goals, how the network will be sold and to whom, and under

what terms and conditions. There were a lot of issues facing the city at that time. This demonstrates the dynamicity and complex political processes in creating many of these government-led networks.

The next section takes a look at how Corpus Christi is responding to community needs.

- **THEME 2: Variable mismatch between city's intentions and populace's needs**

According to one participant who works for a local economic development agency, over 80 % of the agency's businesses are small-owned businesses (Subject # CC-7510). Some of those businesses are working within their homes and may not have an office where people can access the Internet and browse for products. Some of these business find that having a city-wide wireless network is a good feature. For other mid-to-large businesses, they already had Internet access with a traditional broadband provider, and others had wireless Internet access via city hotspots already in existence around the city. According to this participant, the marketing toward all these groups has been minimal to none via the radio or more local face-to-face city meetings. It suggests the city isn't trying to get their attention.

However, another participant from a local university mentioned the city worked hand-in-hand with the university even though there were times when they were at-odds. For example, when the university had suggested a slightly different direction than what they wanted to go (e.g. the anchor-tenancy agreements to ensure the success of the network) they still worked with them to ensure the network plans still moved forward. The city being very interested in helping the citizens, decided they're not trying to do something that is self-serving; they're trying to actually provide support and help to the population. (Subject # CC-7513).

Participants had not heard anyone express any fear about Mu-Fis. One the contrary, one participant from an organization that works with both at-risk groups and affluent residents on a daily basis highlighted users were excited about the possibility of having another option (Subject # CC-7514).

Corpus Christi city officials want to provide more than a splash page, they want to provide content that is relevant to their experience. (Subject # CC-7511). The city expressed interest in developing a digital community portal, where they hope to bring together the groups that exist in their community. Their goal is to have six sub- portals in that main portal; one will be dedicated to education and talks have begun with their independent school district partners, their local university, their local college; other sub-portals will be focused on health; e-commerce, government, community and business content.

The next section examines how Corpus Christi is reacting to the availability/lack of resources.

- **THEME 3: Inability to anticipate future costs/needs and maintenance**

Based on conversations with local community groups and one participant, who takes long-distance classes at a downtown college, it would be a nice feature to offer the service for free to other members of the population who are not in college. According to this subject, he already gets Internet access at work and on-campus when he visits the college. He suggests the city should examine the possibility of giving not only Internet access for free but perhaps partnering with a local organization to provide computers or laptops to at-risk groups. "This type of program, though not as clear-cut as providing Wi-Fi, can be of tremendous value to such groups." (Subject # CC-7519).

The partnership with EarthLink grew out of a need for and lack of resources. Corpus Christi sold their network to a local ISP, EarthLink. When EarthLink's re-structured the network for Corpus Christi they optimized it and many were very excited about what the network would do for their citizens in the community. The city recognized the important of partnering with a local provider to create a seamless, good quality network. Although the city wanted to do it without asking an incumbent to intervene, they felt the partnership allowed them to reach their goals quicker.

> "…it's something that we just didn't have the resources to do, a commercial partner, and IFC can come in and do those types of things. We did extend city funds to pay for a network, we treated it as infrastructure, it was, tried to automated meter reading, so we used our city's utility funds for that, the utility, the capital funds, and so when EarthLink purchased the asset, the purchase price replenished those funds…" Subject # CC-7511

The city understands their role as civil servants and does recognize local governments should always look at best practices, see what other cities-people are doing, borrow somebody else's idea and make it your own rather than re-inventing the wheel. The city understands that for Corpus Christi, this is one of those areas where they're going to have to invent the wheel. They're the first city to actually build their network out as large as it was (Subject # CC-7515).

The next theme explores partnerships in Corpus Christi.

- **THEME 4: Multiple relationships with conflict, coop. and interdependence**

Corpus Christi has consistently focused on the building and maintenance of local partnerships that have taken on the city's Mu-Fi vision (affordable access) as well as its mission (universal service). Moreover, it has made a dedicated effort to host local forums and form local groups into a cohesive network by promoting inter-collaboration programs among different stakeholders and by encouraging the local constituents to serve as information disseminators and marketers of the network. A staff member of the Corpus Christi Chamber of Commerce adds:

> "We help create events that will help businesses meet people, groups, and other businesses that will help them achieve success. We promote the Wi-Fi network through our website, sending out email blasts and we always have our yearly state of the city address where we bring in the mayor and the city council, and they address the city on issues that are going on. In one of those addresses, they mention the wireless project. This year we're having it and they're doing a recap and I'm sure they'll include that in there." Subject # CC-7510

The local public chamber of commerce, with its mission of fostering economic development and helping the business sector prosper, helps the city with promotion through its Web site or by sending e-mails regarding the launch of the city's Wi-Fi system. The chamber also invites the city mayor and city council on a yearly basis to address its members on contemporary business issues, , including information about the city's wireless network.

Aside from their relationship with the local chamber, the city has also has garnered a geographically and occupationally diverse set of partners through its advisory board. Through these partnerships, differing perspectives are brought to the program along with a range of knowledge and skills. One city representative was very proud to say the city has a very good relationship with local school districts, their economic development corporation, their chambers of commerce and other regional entities. City officials consider themselves relationship friendly. For instance, an educator noted:

> "I mean they certainly have a partnership with the university, the community college, partnerships, the small business development center, the county medical health authorities. In fact, they will be building a web portal tied to the local city-wide Wi-Fi portal, that provides health support to the citizens of the area. The portals will be free to anybody. I mean if you've got access to the Wi-Fi within say one of the hot spots, it's free. You can get to these portals without having to pay the $19.95 price" (Subject # CC-7517).

The city did disagree with the local university on one issue. During the city's negotiations with EarthLink, the two sides came up with "free internet zones," and one of those that existed prior to Earth Link arriving was in their local airport. During their negotiations, the city gave away to Earth Link this free zone so that now if one wants to use Internet in their airport, one has to pay a fee for the hour. Though one subject from the local university did say it wasn't a big deal, did express some concern. To her, it's a bit of a hassle when city visitors mentioned how they used to have access to the Internet free zone from the airport, but no longer do. One respondent did say, however, "I've heard more complaints about folks who travel and like to use their computer to access the net. It was free for a while and now you actually have to pay a charge to access the Wi-Fi in there" (MOWER). Though the university disagreed with the city on this clause, the understood the city gave that away and received other free zones. The negotiation had been concluded on that aspect already so they weren't able to modify that (Subject # CC-7513).

The city is also visiting small businesses to get them involved in the Wi-Fi network. One local school teacher sent some of here students in her Senior Capstone class to a small Hispanic-owned business that was an importer of products from Mexico. The students developed and built an e-commerce Web site using open source in order to offer their products across different platforms on the Internet. Though she does say it's not Wi-Fi related, she argues that the Wi-Fi network brings small mom-and-pop shops into the world of Amazon.

The partnership with the local provider is also unique. The city sold their network to EarthLink in March 2006 and they, in turn, pay the city for the backhaul. This is a new type of partnership for the city. This type of commercial partner is one of these "exceptional public private partnerships that Corpus Christi will be managing for the next ten years" (Subject # CC-7511). Though EarthLink owns the asset, the city continues to manage much of the assets. It will be interesting to see how the relationship between Corpus Christi and EarthLink plays out; as with any partnership or relationship, there will be difficulties, both technical and otherwise.

One of the things the city was able to keep during the negotiations process with EarthLink was their digital inclusion concept for their community development programs. Though the city will oversee these programs, they want their assistance in them. An EarthLink representative indicated: "…the city is still trying to grasp what that digital inclusion means,, but we're happy to help them along" (Subject # CC-7511). The city is open to seeking other commercial partners for other services and applications. To Corpus Christi, their partnership with EarthLink addresses the access issue but it's not simply just EarthLink or access. EarthLink is going to be providing a lot of Internet service.

The following section delves into Corpus Christi's diversity/richness of approaches in tackling digital inequality.

- **THEME 5: Well-targeted, Mu-Fi strategies require diverse policy mixes**

A respondent who works for the local Chamber of Commerce, Subject # CC-7516, helps create multiple events that help businesses meet people, community groups, and other businesses, and believes in forming multiple strategies for ensuring the success of local business stated the following:

> "It would be incredible helpful and beneficial to see something of metrics in the future, especially when the city is taking time and dollars to build this network. They've done the groundwork for having the service up and running. The fact that someone like a college student or low income person can use the service is awesome. Not sure if schools have something where they can link up and not have to pay, but having them join as well would be interesting. But, a study that looks at different approaches is needed and important to conduct if they intend the project to last for a long period of time."

A staff member of the Corpus Christi Chamber of Commerce, Subject # CC-7516, adds:

> "I do a lot of work with family outreach centers and also the women's shelter here. We have a very large percentage of single mothers who are unable to go to school and go to work, but if they have the ability all of a sudden because of the Wi-Fi service, if they create any programs were people who meet financial aid requirements can talk online courses. This could be a huge deal. A lot of these single moms are not receiving child support and are barely making ends meet and if you can encourage them to take classes online. That would be life changing."

During their negotiation meeting with EarthLink, they discussed the magnitude of the service, how it was being set up, and what would happen with all the equipment after installing the network, and, among other things, how quickly service can be restored if a hurricane came (similar to *Hurricane Katrina* in Louisiana) (BELCH). The city was very interested in ensuring the success of its network, both pre and post-installation.

Another issue raised during the interviews was unemployment. Today, the city has about 1,500 unfilled jobs (approx. 4.2 % unemployment rate), and the reason they can't fill the job is not as simple as a or b. One respondent feels one of the reasons is that the young people in the community lack the essential, necessary skills to fill these jobs. Most of the jobs available in the city at the time were relatively high paying jobs with a particular profile and background. The city is not looking for office clerks or waiters; it needs industry type personnel who make $40-50,000 a year. The city claims it can't find people to fill these jobs. The city feels its Mu-Fi network will eventually fill that void and improve basic information technology skills with the young people who are now in junior high and high school; when they graduate, the city will have a pool of tech-savvy candidates to fill these technical jobs.

Corpus Christi is unlike other municipalities in the U.S., such as Philadelphia, San Francisco, Chicago, and countless others municipalities that built their Wi-Fi platforms on the digital divide concept. Corpus Christi's network, however, was designed for municipal service. When it began to look at municipal Wi-Fi as a solution to enhance city services, Corpus Christi was looking for ways to automate its meter reading system. This soul-searching process, in turn, led to other applications, such as public safety and code enforcement applications. This experience taught the city the value of wireless access as a user of these applications.

The city also has a pilot program with one local school, where teachers post all their lesson plans electronically on the Web. These teachers go through a teacher development program every week to learn how to communicate via community-tailored software and the city's wireless network to e-mail their lesson plans to students. The students access their homework and all their book materials on the Web. The city hopes to take this pilot and some of their Internet traffic off of the school districts using the wireless network for this particular concept. The overarching goal of this pilot is to determine the feasibility of having the school district use the network. The district has worked with the state in

purchasing laptops for all of its students and teachers. The hope is to expand this program district-wide to all the other schools in future phases.

Additionally, Corpus Christi has another project with senior citizens. Working with a local community center, the city works with these residents so they have the actual applications to help them learn about computers. Though a partnership with a third-party vendor, the city is able to buy and provide the computer equipment and peripherals. This has created a different learning experience for them. As one Subject # CC-7511states:

> "I'm sure they want to jump on that Web 2.0 bandwagon and share pictures and personalize things for themselves. It's such a neat experience to see the first class that started just about a month ago. I'm serious! Each class is very small. That's how we started but we hope to expand if it works. There is a waiting list for probably the next six months…once the word got out…they want to come in, they want to learn and they want to keep progressing…I think it's important for all cities that are embarking on this to actually document and measure it, because it's only going to help them in refining what they're doing and enhancing it and making it better as you move along."

The city wants to work very closely with all these groups and while monitoring all these pilot projects. City officials understand they will find something different in every community, depending on the partnerships that exist. Obviously, city officials want to be successful, but they know it's going to be "trial and error"

The next theme examines public elites' knowledge base in Corpus Christi.

- **THEME 6: Cities are merely momentum players**

The city put together a committee of educators who were involved with the business community and wanted them to seek positive ways of employing this new wireless resource. Many saw this as like "the great awakening" and the "IT factor" that would differentiate them from other cities. They decided to use this opportunity to build awareness in the community and develop marketing strategies to reach out into the community and the small and large businesses, ISP providers, educators, etc. The city had a series of "awareness building sessions" (approx. five sessions), and the objective was to get the community thinking about the Wi-Fi system and how it might apply to them. During these meetings, there were roundtable sessions and people explained the Wi-Fi system and how it was going to work and what the potential was, and asked for input and suggestions from the community, trying to gauge how the city might adapt or adjust its program to be more responsive to the community.

The city was earnestly trying to determine how they can best utilize the system to support the community. During this-eight month process, they held a round table session every six weeks, looking at how they could address the issue of the digital divide. The committee looked at giving out computers, or even selling at a very reduced rate. The city quickly contacted its local "workforce network" and inquired if members could liaise with EarthLink or Dell to provide computers at a very low discount rate. The workforce

team was very excited and receptive. That was how they started engaging the digital divide, seeing a potential to help them address the issue of access. Once these awareness sessions ended, the MIS department for the city took over and began to see how to go about actually implementing the ideas that were discussed.

The city contracted a university professor and chair of a computer science department to move forward its digital inclusion agenda. This subject is also on the Corpus Christi digital community development corporation. One of the technical leaders for the wireless project has a background in legal and human resources, and for the past three years has been the city manager's assistant. The city manager gathered the entire executive staff group and department heads together to begin thinking about many of these other applications that could be available once the wireless service was launched. They call their wireless network their "cloud." They would have "cloud chasing" meetings, where they discussed the digital divide and other issues, following implementation of the Mu-Fi network.

The following theme explores how Corpus Christi has integrated public policy in its digital inclusion program.

- **THEME 7: Inability to grasp the policy arena**

The following interviewee, Subject # CC-7510, from a local economic development agency said:

> "I think it's going to be very hard to attribute the wireless network to people's success (or lack of) in the future. It's now so much the impact today because when you have individuals that have all of a sudden the opportunity to better themselves, it will take years to understand and even difficult to grasp if that knowledge acquired by the availability of the wireless service. This will be challenging as politicians and legislatures think about possible future policy in regards to the wireless services being offered to their local citizens."

There is an interest by public elites to start building all the different building blocks of the system, but it appears a bit vague where the city and EarthLink are in terms of policy.

One subject explained that in the late 1990s Corpus Christi was working under a different model supported by an organization called the Business Alliance (Subject # CC-7512). The model under this alliance was a consolidation into one entity, the functions of the city, the chamber and the economic development organization. According to respondents, that particular model did not work well in Corpus Christi. As a result, in the late 90s, they re-formed several independent chains. One of the things the city discovered was that it had five to seven target industries, like petroleum, petro-chemical industry, aviation, health care, business services, etc. One of the areas that it was considered to be soft on was the industrial clusters in information technology. So, city officials felt they needed to grow their IT presence in the community. Their interest in the Wi-Fi project was a spring board to encourage that industry cluster to grow.

Next, I explore how Corpus Christi's public officials and citizens believe this network will (or ought to) enhance their community's identity and increase citizen participation.

- **THEME 8: Using the digital divide as an excuse to build their systems**

A member of a local economic development agency, Subject # CC-7512, states:

> "Being out in the community as much as our agency is, I hear people talk about the network all the time and they are very proud to have that service and it has been interesting. Interesting because citizens feel not a lot of others cities have. We feel special. I know people are not too happy it's not free anymore. It used to be free but it no longer is free and that makes people mad. Some people feel the city shouldn't be doing this now. Before if someone wanted to pay for Internet services, they can go to a Verizon or an AT&T. But now, if you wanted to use the city's Wi-Fi service you have no choice but to you Verizon. I know there have been instances where people are not happy about it. When I say 'people,' I may regular citizens, like friends, small business owners, low income households, etc. I know the fee is about $20 per month."

Similarly, another respondent, Subject # CC-7510, adds:

> "I have not heard any talk among small business owners regarding the impact of the municipal Wi-Fi network to them. I am not surprised. The reason is quite simple actually. Most of these small business owners have wireless access and we have hot apartments setup in the city (a coffee shop, homes, apt complexes, etc). This said, however, some people did say it was nice to pull up on the side of the road and have access to the Internet. Not sure if they are willing to pay for two different services every month."

Most of the respondents mentioned that residents are very proud to have the wireless service. Business representatives were excited about the option, particularly about people from the outside, having that capability in their community to sit and watch the sailboats go out and have access to their Wi-Fi network. However, regular residents really appreciated the network when it was free and some are unhappy that the network is no longer free. Some people feel like the city should not be charging a fee for this service. As one respondent, Subject # CC-7514, stated: "…if somebody wants to pay they could go to Verizon or AT&T or [whomever], but now if you… wanted to use the city's Wi-Fi service, you have no choice but to use Verizon." Another participant mentioned preventative specialists who do significant business-to-business work on the road who were using the network to get information on the side of the road if somebody asked them a question. Now that the service is no longer free, she doubts they will pay for two different services every month.

One respondent, Subject # CC-7513, highlighted the potential of this network to help bring people out of poverty, stating,

> "…from an economic development point of view, I want that very badly. Although the impact has been minimal, I think that now that EarthLink is on board, things will change. EarthLink has been marketing broadly over the last couple weeks and people are slowly hearing about the wireless network.".

The city hopes its Mu-Fi network will directly result in new job creation. The handful of very small software companies in the community can take advantage of the municipal Wi-Fi network, lining their employees to work on a variety of places, locations, etc, and have connectivity to the global economy. In addition, the city is hopeful that having this 147 square-mile platform will be a springboard for a variety of initiatives. One is hopefully finding a way to encourage entrepreneurs to take advantage of this platform by developing new business models for delivering goods and services from within the community. Secondly, city officials is that they want to leverage this technology. As Subject # CC-7514 asked: "…why wouldn't companies that are developing products from a Wi-Fi platform, have a development center in place that has the nation's largest Wi-Fi platform?"

Similarly, the city wants to measure the impact of its network on other factors. For example, Corpus Christi has a very high drop-out rate in this community, and the wants to be able to measure whether it can leverage the network to make an impact on that dropout rate. The city is interested in exploring how its multiple pilot projects can tie in and also to see if these students can continue on through high school; the city would like to track and monitor the student's progress The city's starting a new performance measurement internally as a balance scorecard to establish metrics to see how they are actually performing, services offered, etc.

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It's not apparent how the city will actually go about evaluating its network or how it intends to measure the "impact" in future phases. Corpus Christi does not have exact numbers at this time.

10.2 Chapter Summary

There are probably few large cities in America who are in need of a wireless network to bring in businesses in the "new economy" more than Corpus Christi, Texas. The city's economy is largely steeped in the "old economy" of the late-19th and 20th centuries – most notably the petro-chemical sector. Shortly after beginning its network, the city decided to sell the network and its components to EarthLink. Examining cities that are implementing wireless networks reveals that every city brings at least one idea that cities wishing to build a wireless network can apply to their efforts. Corpus Christi, shortly after beginning its wireless network efforts, established a non-profit corporation via city council to manage its network. This greatly streamlines the decision-making process by avoiding the byzantine structure and red tape that plagues many cities in getting things done. Like several other cities, the biggest obstacle to improving and increasing access to the Internet is access to low-cost computers for those who need them. Some respondents also expressed skepticism and hostility regarding taxpayer dollars going toward paying for a wireless network. Opinions vary widely about paying for access – several would rather pay for access rather than having to wade through a litany of pop-up ads, while other are all but demand free access, especially since it was initially free during the testing phase. This fact underscores a central issue to any city's implementation of a wireless network – the money has to come from somewhere to finance it. Corpus Christi realizes the value of having a viable wireless network, and two of the biggest benefits are the enhancement of city services and the dissemination of information through a city portal. Like all cities in this study, Corpus Christi still needs to make many decisions about who is going to be responsible for the portal's content, as well as the actual content.

Corpus Christi also is actively working to build successful relationships with its K-12 schools to build them into the network, which creates many valuable benefits, including valuable partnerships that increase the viability of the network, as well as the number of users. However, perhaps the biggest benefit to Corpus Christi's marriage of its Mu-Fi network to schools is, if everything proceeds accordingly to plan, a fresh pool of tech-savvy high school and college graduates, ready to join the city's burgeoning tech workforce.

The next city in the study, Madison, Wisconsin, would do well to examine the many lessons learned by Corpus Christi.

CHAPTER 11: MADISON, WISCONSIN

11.0 Introduction

This chapter aims to show the findings of Madison's Mu-Fi network in relation to its impact on the digital divide. The overt aims of this Wi-Fi project were to increase digital inclusion and promote economic development. The extent to which this goal was fulfilled has been investigated through analyzing a sample of key city stakeholders. Data was obtained from nine interviewees who were intimately familiar with the wireless network. The interview guide included both closed and open questions. This section explores the eight themes revealed during the interviews.

11.1 Themes

One way of evaluating whether Madison had fulfilled its goal in terms of impacting the so-called digital divide was to identify key themes that emerged from the interviews. Subjects pointed out that complexity, responsiveness to the community, reaction to resource shortages, patterns of relationship building, diversity/richness of approaches, stakeholders' knowledge base, effective integration of policy, and the perceptions of the project enhancing community identity and participation were relevant themes and contributed to a better understanding of the so-called digital divide and QoL factors. In the following section, these themes are explained in-depth.

- **THEME 1: Unanticipated social, political, and technological complexity**

The City of Madison, Wisconsin, issued a Request-for-Proposals (RFP) about a year-and-a-half ago, in search of a company to design and deploy a wireless network, at no cost to the city. The mayor expressed a strong desire to see this happen, but was very specific that there would be no up front capital investment from the city, although there may be some city tax revenue put into the project at various stages. During this initial phase, the city preferred an excellent, comprehensive, higher-quality network that functioned well. Madison officials understood that state legislative prohibition[61] was an issue, and according to Subject # MA-9741, "pursuing any type of city-wide coverage was messy; there are many pieces to that puzzle."

[61] Wisconsin imposes burdens on municipal communications providers not imposed on nongovernmental providers. This was an AT&T backed law and prohibits non-subscribers of the cable television services from paying any cable costs. Further, it requires municipalities to conduct a feasibility study and hold a public hearing prior to providing telecom, cable or Internet services. It also prohibits "subsidization" of most cable and telecom services and prescribes minimum prices for telecom services. (2003 Wisconsin Act 278, effective July 1, 2004)

A local community advocate and information technology professional, Subject # MA-9743, noted:

> "Maybe two years ago, the mayor's office made an announcement and seemed to want to get political about being involved in development. It's a bit hard because they seemed to want to get involved from that point forward. Now, they're missing in action, and not wanting to get involved with service issues. There's a city council subcommittee that has to do with telecommunications issues (access TV, etc.), and even those guys have not been getting any response from key decision makers... They're kind of fuzzy on their standards on who does what."

When the city released the RFP to request proposals, they received a couple between fall 2004 and spring 2005. The winning bidder at the time was a partnership between America Online (AOL) and a third-party, a local ISP. Shortly after rolling out Madison's network, both partners pulled the plug. In September 2005, AOL made a nationwide decision to drop out of all of their Wi-Fi projects, including Madison's. After both partners pulled out of Madison's Wi-Fi project, the city was unsure about whether to discontinue the deployment or move ahead.

The city then talked to one of AOL's infrastructure partners at the time, Cell Net, who wanted to remain with the project. Cell Net, a company from Atlanta, Georgia, proceeded to pick up the pieces of the project and move forward. The company built the hardware and promised to work with a local partner (i.e. ResTech) to do the service provision to residents. Under this limited agreement, Cell Net was allowed to mount transmitters on a certain number of their city properties (e.g., light poles and buildings), which it was required to pay the city a certain amount of rent for. This new agreement allowed Cell Net to build a new system for Madison; it was approved by the city and was rolled out beginning in the summer of 2005. This implementation proceeded for about a year-and-a-half. During this period, Cell Net encountered connectivity problems in certain areas of the city. Then, in the spring of 2007, ResTech issued a press release[62] stating that the economic/commercial model wasn't working for them, and closed shop.

The commercial model that Cell Net retailed was for about $40 per user; they were also doing some provision of business hook-ups. This network never fully reached its intended coverage area, perhaps due to other competition that offered free wireless access across the city. Subject # MA- 9744 said:

> "…the problem with providing wireless in a community that's as connected as Madison is, you've already got a lot of free wireless in the coffee shops, the university, and so you're saddled with this kind of doughnut where you have to reach these far edges of the city that aren't getting access to the already available downtown grid. You haven't got the client base and the economic base to make that feasible or to underwrite the cost of maintaining the hardware. So, Madison is a prime example of why you need municipal intervention."

[62] The press release was issued in April 2007 but service was available until 30 June 2007.

Perhaps the commercial model did not work for the above cited reasons. Several subjects mentioned the point that city officials should be able to have a municipally supported and run wireless service. However, the only thing that's precluding it is the state prohibition that was backed by AT&T lobbyists in 2003.

Cell Net spun the project out to a new company called Mad City Broadband (MCB), the current commercial provider. Currently, MCB has the first phase of the network up and running with an estimated 2,000-3,000 customers. The company is continuing to optimize that network and starting to look at possibilities for expansion to other parts of the city.

MCB has no contract with the city, except for the rental of five or six traffic signal light poles, where it installed radio transmitters. The remaining signals are all in contract with the local electric utility company. MCB puts Access Points (APs) on its utility poles. However, its network is not seamless, nor are they advertising as such. A representative from MCB did agree that there are pockets of the city that are not completely wired. Wired areas of Madison include the capital, the section leading to the local university area, most of the community centers, and particular streets where MCB has equipment installed on telephone polls.

Some respondents thought that the lack of full coverage is a huge barrier to the network's success. "The university and the coffee shops are providing more service downtown than Mad City Broadband was or will ever be able to," said Subject # MA-9744. People are having significant connectivity issues, but it appears that one aspect that drove initial negotiations was the airport. The county which runs the regional airport wanted to improve wireless access for not only the Internet but also cell phone reception. Although the representative from MCB did not comment on how the company tracks users, most respondents agreed that a huge portion of MCB's user base is the student population and business travelers who come to Madison.

Two subjects mentioned that Madison is "a different city" (Subjects # MA-9743 and MA-9747) and there certainly are people living below the poverty line who need Internet access. However, these participants argue that local technology advocates cannot afford access and/or particular access tools needed for poverty stricken neighborhoods in Madison. "There's just not a lot of poor people. It's not a big city like Philly or Chicago. It's not a place where there are a lot of poor," said Subject # MA-9747.

I believe that the MCB Project did not have (or has not yet had) an opportunity to address the issue of the digital divide, because of legislative constraints and the nature of the commercial model with its inherent geographical limitations. It would be unfair to the provider to call the project a failure; it is correct, however, to say the provider wasn't even at the point to raise that question.

Similarly, one subject, # MA-9742, said the Wi-Fi network is not the city's top priority, since the mayoral elections just concluded. She adds:

"I do think that one of the city's priorities is to try to maintain a good economic status, and I think that they see the wireless network as a part of that, but not their *top* priority. In my own personal opinion, what's driving the wireless network is more economic concerns than social concerns, although I'm sure that's not the way it's pouched."

The next theme also demonstrates how the city has not adequately responded to the needs of its citizens.

- **THEME 2: Variable mismatch between city's intentions and populace's needs**

A representative from a local grassroots organization, Subject # MA-9743, adds:

> "I would say very little to no impact to the city due to the network at any level. There was an article in one of our local papers that said one of the city's two private vendors [ResTech] dropped out because most of the people who signed up bailed out. Most of the people who used the service like me noted bad service. Some of them came to the realization that if they had DSL at home, they might as well keep it because it works. So, it's not successful. My take on Mad City Broadband is they're defensive about everything. They're getting ready to make a big announcement in a couple of weeks and the reporter who interviewed them (who is a friend of mine) tells me she gets the sense they don't know what it is they are going to announce."

From a library's perspective, one respondent argues that offering access is not enough; cities need to offer hardware to get people truly involved in the deployment process. "Most people who are using the wireless network are people who already have and use computers a lot. I don't think it's breaching that gap," said Subject # MA-9749. As I probed for device transfer mechanisms, most respondents agreed there aren't many, or at least not any they could speak of at the time of the interviews.

The network has been able to fill a particular void in the community; this void is tied to town gown reasons. A representative from MCB, one city official and one community advocate all agree the network is attracting travelers to the area. However, one respondent, Subject # MA-9746, states,

> "It's very easy to attract travelers if you have wireless everywhere. I think by offering a wireless network, but not the equipment to use it, you're really catering to people that already have computers, so you're clearly not trying to bridge the gap."

One subject adds that the reason the city is interested in this town gown approach might be related to losing taxpayers to the suburbs, as the Wi-Fi project is currently a buzzword in Madison. The city is seeing people go to suburbs that don't necessarily have the challenges in the education, homeless problems and social issues that the bigger city of Madison is grappling with. People are leaving to go to suburbs because they think the

quality of life is better, and the property taxes smaller. Categorically speaking, the wireless network keeps people in Madison. Keeping the tax base robust is a grave concern and the wireless network is one strategy to keep people from leaving the city. Subject # MA-9749 adds:

> "By luring them, keeping them, a lot of condominiums are going up in the downtown area. That's one of the reasons why they charged for the wireless networks."

Some participants argue responding to their student population was an effortless task. Many of the apartment dwellers who are students clearly have pre-Wi-Fi access and/or broadband access roaming throughout the downtown area that they work and play and go to school in, which is the university and state street corridor. Downtown residents can also go into any coffee shop and have free Wi-Fi. "They are preaching to the choir," said Subject # MA-9742.

City officials argued that there were many hurdles the city and MCB had to clear (ref. AOL and Res-Tech). The city had to start the network somewhere, and the downtown area is where it chose to begin. City officials knew that they were going to have to work out technical bugs, so they chose a low-risk area to begin.

As I interviewed several subjects, they constantly mentioned that Madison is one of these places that comes up on the best list (i.e. best places to live, best places to raise a family, etc.); to them, it's almost become a standard story. Madison is a city that strives to be the best, and loves to be on these lists. It is my contention that part of that is having high-tech amenities. The university and its spin-off business community is building the bio-tech sector. Interestingly, when Madison announced its Wi-Fi plans, said Subject # MA-9749:

> "They were very interested in having their name attached to it, and endorsing it because Madison was going to be one of the first cities of its size to be wireless. It's that whole allure, the image of being ahead of the curve and the reason they wanted to have that image attached to them is because they want to attract businesses, attract investment, keep success rolling here and clearly the city believes that it's a quality-of-life issue, and it's something they need to market themselves to keep business growing here."

Paradoxically, the city endorses the network and is 100 percent behind this initiative. However, it's hard to say what city officials have done or how they've responded to local consumer needs and wants; they've kept out of it except to say that they want to do it. A city council member, Subject # MA-9743, stated:

> "There is a relatively vibrant local forum at Isthmus (an alternative weekly forum on their *Daily Page* Website. It's www.thedailypage.com and there's a forum link on that page. There's local politics, technical forums, and a couple of other things and I've posted before, 'Is any one else having this experience on the network? Can you post it and give feedback.' I got very minimal response. Not

> sure this is so but perhaps at some level people hold the same assessment that I do and have more expectations that I do so they don't bother to go there. When I asked people on the same forum about their experiences, I got one bite that said, 'Yeah, I got on and I got off.' Then, on the Capital times article and a State journal were people echoed the same sentiment, 'I got on and I got out.' Folks signed up for a month and realized it wasn't worth [it] and got out. A lot of us go to the city and tell them this is not working and they say 'we didn't put any money into this so we don't have any expectations.' Mostly people have seen this as a just a superficial endeavor with empty promises. Maybe someone else down the road might come and do something to make this work."

The next theme discusses how Madison has reacted to the availability/lack of resources.

- **THEME 3: Inability to anticipate future costs/needs and maintenance**

Madison officials consider themselves in support and facilitator roles, trying to do what they can to help the wireless network, but with the realization that their resources are fairly limited, and the core mission of city government is to ensure public safety, plow the streets, pick up the trash, and so forth. The city officials interviewed noted that they don't have a great deal of resources for additional infrastructure developments that the wireless network requires. Thus, they simply try to create an environment and be facilitators for private entities like MCB to come in and address these issues for the community.

Similarly, from the city's side, their approach was, according to Subject # MA-9745:

> "…to seek a product that was self-funded, as the city would work with the providers on erecting infrastructure and so forth. A product that was fundamentally a privately-owned and operated network, as opposed to municipally-owned which has some issues with the state law."

The role of the city is very hands-off. The city is welcoming the service, but is not licensing it. The city is letting MCB put the equipment on various utility polls and rent utility poll usage. The depth of the city's involvement is to say "we want this," but, "We are not part of the operation." City officials were very clear from the outset; it's a for-profit enterprise; the service is not free and it won't be free. The service provider will provide access for a fee; they're a for-profit business. As a result, respondents don't envision the city providing universal access at all; it appears the project was never intended to from the outset.

One respondent feels the quality of MCB's service is poor. He thinks the provider needs to test its equipment and market what it's selling better so people don't expect something that they're not getting. It seems the testing was done at the beginning, but stopped shortly thereafter. Once MCB rolled out the service, it wanted people to pay for it, but it didn't meet users' expectations. It simply did not work. To address this issue, a representative from MCB said the company is exploring the possibility of purchasing a

number of city government accounts through the service (the number is yet to be determined) to help create a little bit more of a city stake and to show more commitment to the project on the part of the city. However, this subject stresses the fact that the city government itself is not involved in the running, operation or ownership of the system. Subject # MA-9740 adds,

> "… in terms of major financial commitment or investment in say infrastructure or operating and subsidy, we're not really looking at anything along those lines at this point."

Next, I look at patterns of relationship building / potential for partnerships in Madison.

- **THEME 4: Multiple relationships with conflict, coop. and interdependence**

In contrast to Corpus Christi, Madison's wireless network is much more limited in scope. While Madison has publicly acknowledged the need of such a project to tackle the digital divide, MCB has not formed any partnerships with local groups, aside from allowing downtown students to access its network at a reduced fee. Although MCB has long-range plans to do so, respondents who deal with the ISP claim that legislative burdens[63], management changes, bad service, limited coverage and poor leadership hinder those potential partnerships. A technology expert for one of Madison's local hospitals, Subject # MA-9743, said:

> "I work for one of the local hospitals as a desktop analysis and IT helpdesk. I install huge amounts of computers for the hospital. I consider myself technologically knowledgeable. The hospital said in a meeting they are picking up the wireless service via Mad City Broadband via the patient network. In the past, we used to provide Ethernet lines to people with laptops in our patient rooms. Now, they are going to provide wireless Internet service to our patients because people are now coming in with laptops with wireless cards, Wi-Fi adapters and might be in the cafeteria, lobby, etc."

The same respondent made the following negative remark:

> "Initially, I decided that if I could get wireless services for $15 a month [via MCB] and cancel my phone land line, which costs about $50 a month, then I would have a cell phone and Mad City's broadband service at home. Many of my friends did the same thing. Since then, it's been quite problematic for all of us because they don't do a very good job of interacting with users. The network is not installed in all of the city, but where the service is supposed to be functional,

[63] Wisconsin imposes burdens on municipal communications providers not imposed on nongovernmental providers. Generally, it prohibits non-subscribers of cable television services from paying any cable costs. Further, it requires municipalities to conduct a feasibility study and to hold a public hearing prior to providing telecom, cable or Internet services. It also prohibits "subsidization" of most cable and telecom services and prescribes minimum prices for telecom services.

> the throughput is bad and the access points drop out. That's one side of the coin. The other side is your non-response to that issue. This creates foes, not friends. I've lived with it because most of the day I'm getting my Internet access via work. I will probably go back to the land line customer mode."

When the mayor first announced his desire to provide wireless coverage for the city, a local community group was formed. It advocated free community-based wireless that would be available to people throughout the city. As the city was hamstrung by the state law, it proposed a model that would be similar to a rural electrical co-operative model of the 1930s. This model would be run by a cooperative, not the city, although the network would be able to partner with the city. However, city officials chose to follow the commercial route, since this group wrote a grant to do two demonstration projects in Madison.

One project is in a low-income housing development, where the city would install wireless to serve the residents of these apartment buildings, plus have a public-use computer terminal for youth to use; the computer would resemble one at a public library.

According to Subject # MA-9744, the second demonstration project is in a co-housing community where there's a series of housing units that are like condominium style homes; people buy into them, but there's also a common building and in this case, it's a nature center and is a community guard. The group offered to provide wireless for the residents and their homes, plus common space (e.g. their learning center facility). The idea was that once these demonstration projects were built, they would serve as a non-commercial model of doing wireless..
The grant proposal that was funded includes both a national umbrella organization called the Funding Exchange, but locally administered through the Wisconsin Community Fund. The City chose not to work with this local advocacy agency. According to one participant from this local community group, Subject # MA-9743, "We're very involved in the notion of making technology accessible to people around the city; the city is interested in the notion of making technology accessible to people."

Another subject from a different grassroots group, Subject # MA-9749, met with representatives from the mayor's office, but felt he was "the voice on the outside shouting in." It is worth noting the subject does not have a personal stake or connection to any of the players in terms of the city-wide network. The participant was simply advocating looking at different models, ways, shapes and forms the city could do wireless. He was interested in figuring out the best model for Madison. He said he's uncertain about what that model is, but is certain Madison knows some of the things that are not a good working model.

The Mayor's spokesperson corroborated Subject # MA-9749, stating that the city's IT staff does talk to different stakeholders on a periodic basis to resolve issues related to the wireless network. The city tries to serve as a liaison to connect citizens with different entities, university personnel and/or county officials in an informal way.

A local librarian explicates there is nothing formal in terms of a partnership with the city. Libraries work with the city because they are one of our Internet service providers, she said, but she also adds that their networks are separate. The libraries have partnered with another local support organization to offer training to the public, the local school district, and to teachers.

Despite finding no signs of formal partnerships in Madison, I also realized the city had a very narrow and superficial approach to addressing digital inequality.

- **THEME 5: Well-targeted, Mu-Fi strategies require diverse policy mixes**

A spokesperson for the city, Subject # MA-9740, stated:

> "The digital divide has not been one of the issues that, to my knowledge, has been discussed."

Most people who access MCB do it as a regular Internet service provider as they would with any other ISP. The "wall garden," or splash page, is free to anyone who accesses the network, but you have to be a subscriber in order to access the Internet. The city plans to add the local metro bus schedule for "wall garden" visitors.

A technology expert, Subject # MA-9748, adds:

> "Most of the coverage area is the isthmus (from the near east side to the near west side) is covered. Interestingly, the student area is covered, so there's a sense that the mayor and city council (who are both are liberal), are providing this for people who are exited about this who respond to the fact this was done for us as a political stunt. When this was touted it was like 'we're going to get this for you.' When in fact, no city funds have been spent to do this, so it's a bit of a charade."

Some respondents feel the city or the provider need to go the extra mile to recruit other potential subscribers. Some participants gave the service a "test drive" and mentioned they had some problems connecting to the service, even in coverage areas. Some feel that because of the areas they chose (e.g. students, professionals, government buildings, etc.) this will be a barrier for the network's ultimate success. These respondents believe that professionals outside of the downtown area need to be connected, too. Most of these professionals are located on the outskirts of the city, which is home to many bio-tech companies and research parks. Since these companies are not located downtown, the city fails to focus on this target audience.

A member of a local community technology center, Subject # MA-9743, responded:

> "This project is one of those things that has enamored people in political office that they can use this as something they are delivering and hope that people will believe will solve their problems because its wireless and it involves computers,

> but people who are touting this stuff don't have plans to deliver the other components or better yet, they don't know the other components exist. It's a highly superficial endeavor. People are using this for town-gown reasons. I can make that argument for municipal electric facilities, but all they need is electricity. We're trying to tout we're a high-tech center so that we can compete with every other city in America, even the world. We are starting to tout ourselves as being the Silicon Valley of this region (whatever value that's supposed to have)."

I think there's a great potential to bridge the digital divide with this project, but it's only the delivery component for the ability to have Internet access for everyone. The city must organize people on the other side of the divide by coming up with other programs, such as hardware, training and programs that deliver Web sites, forums and other online resources. Devices and training are needed to teach people to make it worth their while. This falls outside the scope of what MCB is trying to do in Madison.

An educator from the local school district, Subject # MA-9742, adds:

> "I think there are different levels, the nodal level and 'the-hardware-in-your-home' level, but the latter, [the] most difficult component in the whole structure, is missing in Madison. I don't see it happening here. Madison often has a watered-down version of attempting to do these things, but then again, Madison is a smaller community than other cities with a small budget, etc."

According to anecdotal evidence, the for-profit model adopted by Madison has changed the scope of attempting to address the other components of the digital divide. However, there are other grassroots community members trying to address and redress issues related to the digital divide, namely, www.madisoncommunitywireless.org and www.danenet.org. Such groups are picking up where the city and MCB are not going. As stated by one representative from these organizations, they would rather see the city not endorse a for-profit enterprise and approve a free model, so that there is *no* digital divide.

The following theme discusses the knowledge base / core competencies of Madison's public elites.

- **THEME 6: Cities are merely momentum players**

Madison started researching the issue at about the same time that Dane County, which the city is a part of, was looking to get some type of wireless service brought into its airport. The city, then, decided to collaborate with some technical support from the state, on an RFP that it released in December 2004, looking for potential vendors. Several months later, in the Spring 2005, city officials selected a group led by AOL, and began negotiating terms of the network with this group. Eventually, Mad MCB took over the lead role as ISP. I have had a bit of difficulty in trying to communicate with them to

solicit information about their wireless project. As one grassroots member, Subject # MA-9749, said:

> "I think part of Mad City Broadband's defensiveness is attributed to the person spearheading the project. As far as I know, she doesn't have a technical background. She used to work with a senator from Wisconsin who got hooked in with the liberal establishment. I have to tell you my political bias. I used to be progressive until apparently that became synonymous with liberal and so I'm not really in tune with some of the liberals. One of my critiques with them is that they tend to reward people who have stayed a part of their establishment for a job they're not qualified for. I think Mad City Broadband's program manager falls in that category. I think most of our problems are tied to this issue… Cell Net are the people designing the network and telling someone where to put access points on poles. Mad City is this fuzzy administrative office that, as far as I can tell, has no purpose. It's a political reward of sorts with no technical expertise to run this very social project."

A huge portion of the technical know-how and professional expertise lies outside of MCB. A local community group called Dane.net has partnered with other community establishments to collect data on usage trends and behavior patterns. Most of the members who belong to Dane.net are computer experts, college professors and sociologists.

Unfortunately, I felt hamstrung by the availability of data for this theme. Thus, I am unable to paint a richer picture of the core competencies in this city.

The next theme examines municipal wireless policy integration in Madison.

- **THEME 7: Inability to grasp the policy arena**

According to one interview with a city official, Madison does not feel hamstrung by state legislation, to some degree. From a policy perspective, if the city wanted to own the network, there are some state hurdles that would only require them to seek approval and a waiver from the public service commission, but this could result in the city facing opposition from other telecoms. However, according to Subject # MA-9745, "[the city] never looked at that closely because that wasn't really an option that [the city] ever seriously considered."

It is plausible that one of the reasons the city decided to outsource was due to fear and doubts about the viability of a wireless network in Madison. A representative from the city government stated that assuming their network is successful and achieves what it sets out to do, there are a set of challenges in terms of build out and operability. This respondent, Subject # MA-9747, cited a nearby city, Milwaukee, that within the past month experienced the collapse of their efforts. He adds:

> "This Wi-Fi technology has yet to prove out as something really robust to be an essentially wireless version of high-speed Internet that you know you truly can use anywhere within a fairly wide geographic region."

The lack (or support of) broadband policy to some degree perpetuates the digital divide. It almost perpetuates the depth in a sense as those who can take advantage of it already need to have their own Internet connection. For example, if the city partnered with local neighborhood organizations to loan laptops, and simultaneously wired places by putting many more computers into neighborhood centers, then that would make a difference. The majority of network users appear to be students and travelers. These people already own computer equipment; on the city does not need to focus on them.

A technology expert, Subject # MA-9744, noted:

> You can definitely improve quality of life for Madisonians via wireless technologies (it's a component) and craft the right policies to ensure the success of community wireless projects. In those realms where I do collectively organize with people who attempt to achieve any of those things, we're all doing it via our computers and our networks. For instance, I work a 40-50 hour job and have other responsibilities, including a full-time family. [You] have to be efficient if you're going to do those things. So, computers and networks help in achieving that efficiency. I've been able to achieve these tasks because I have a background in computers and I am working with politicos who all have different backgrounds in computers or another of one kind or have the means to purchase state-of-the-art computers put it on their desk and pull a DSL line to connect to the Internet. Computers and networks make us work more efficiently, but by themselves, especially if you don't have those backgrounds or financial resources, are meaningless and accomplish nothing. I think Madison is only looking at the delivery component, but not the other factors needed for success. I think this project is doomed for failure both from a practical and legal standpoint."

Next, I discuss how city officials and community groups believe the project will enhance their community's identity and increase citizen participation.

- **THEME 8: Using the digital divide as an excuse to build their systems**

For most respondents, it is clear that Madison is a wired and unplugged city. Broadband access is easily available and many businesses offer Internet access as a convenience and creative way to attract customers. However, they wouldn't attribute this Internet cloud to MCB. The city was already wired prior to the arrival of the vendor, since many coffee shops and other retail outlets already offered wireless access. However, recent news reports and editorials reveal that the city was falling behind other municipalities in terms of wireless access. Some of these reports suggested this shortcoming would impact everything from tourism to job creation in Madison. As a result, the city government decided to partner with local ISPs to offer wireless services. The city's municipal options

ranged from reviewing previous bids, the city going at it alone, to initiating a new process to select a replacement vendor. One respondent, Subject # MA-9743, said:

> "I personally investigated the city's wireless status by going down from the Capitol to the UW along State Street. I quickly discovered an open wireless AP from which I searched the Web and found 65 wireless hotspots for the city of Madison, 29 of which were free. I discovered several more unlisted hotspots during my adventure."

The businesses that offered access were crowded with customers who appeared to be students, tourists and everyday people seeking Internet access, at a place where they could buy food and drink. Surprisingly, this respondent discovered numerous open, unsecured wireless connections that broadcast from buildings along my route.

At the far end of State Street, the campus libraries and student union and outdoor terrace were full of people unplugged accessing the Internet. UW-Madison has announced plans to have wireless access for the entire campus by 2008by adding over 2,000 access points for wireless access in 180 dorms, laboratories and administration buildings.

Madison visitors appear to have plenty of wireless access provided by hotels and conference centers.

If economic development and job creation are the most frequently cited reasons for cities like Madison to offer wireless, it is not clear how it enhances community identity or how it actually generates employment. It is important for Madison and its residents to re-evaluate whether such a broad, public-supported venture is necessary. In the interim, the private sector seems to be doing just fine providing Madison with options for wireless access.

A member of a local community technology group, Subject # MA-9744, adds:

> "The mayor here has been under fire for being anti-business during his first term by Progressive Dane, a political party I belong to. [During] his second term, he's semi-labeled himself as being more business friendly because he was challenged in his second election from the right and the left. Now, this Wi-Fi high-tech venture is perceived to be pro business and anything and everything that has electrons spinning around is a good thing for businesses. My apologies for my cynicism. The city definitely wants people to think of this network as something good, tech friendly and thus business friendly. That perception is just that, a perception."

I want to believe the network was not approved simply for town gown reasons. I certainly hope the network reaps certain benefits in the ten square-mile downtown area where it began and well beyond these borders. However, all sources point in the same direction: it's a business attraction. The reason the city decided to invest time in

choosing the vendors was an economic move rather than a social one. This is based on interviews with key respondents and on the places that they've wired.

Most of the people interviewed connect to the Internet at work via a third-party ISP, not the city's wireless network. A local librarian Subject # MA-9742, said, "I haven't used the municipal one because I can use the library one for free." There should be more effort on the city or MCB's part to have more residents use its network.

Interestingly, interviews with city representatives reveal they are interested in Twigg bridging the so-called digital divide. In their eyes, according to Subject # MA-9745, "it could be a modest step in that direction. Under the current model, you could see the entrance of an additional Internet service provider into the market place, hoping to drive down rates overall. It's a fairly modest bet." Madison is looking at the vision itself as kind of a technology leader, especially in the Midwest. Having a robust, city-wide Wi-Fi network would certainly contribute to that, and through competition help to make Internet access more affordable by bringing it more easily to neighborhoods throughout the city.

11.2 Chapter Summary

Madison's initial intention in creating a wireless network was a noble one – to improve city services. When the network was rolled out in a small part of the city, the decision was made to let residents piggy-back on the network by using it for free. However, Madison's efforts have been marred by a myriad of obstacles, including state regulations that place burdens on municipal communications providers not imposed on nongovernmental providers. The legislature requires municipalities to conduct a feasibility study and also to hold a public hearing prior to providing Internet services. It also prohibits "subsidization" of most cable and telecom services and prescribes minimum prices for telecom services.

Furthermore, Madison started with a desire to have a high-quality network, but at no cost to the city; this underscores the challenge of any city in building viable wireless networks – it's easy to want one, but start-up and access costs can quickly curtail or scuttle cities with even the best of intentions. Madison is no different – initially, access to the network was going to be free, but a fee is now required to access the network. When the city realized that it did not have the money or resources to complete a city-wide network, it sought partners, and that is when the real challenges began. Initially, the city partnered with America Online, but the company later pulled out, which suspended implementation of the network, and nearly killed the project altogether. This is one of the great lessons of the Madison model – cities need to be wary of whom they partner with; even the best partnerships can go astray or disintegrate, so contingency plans must be put in place from the very beginning. Another lesson that can be taken from Madison is that cities must compete with entities that already offer free wireless services, such as coffee shops, cafés and other businesses; it's a hard sell to require and expect a high number of subscribers in downtown areas, when citizens can walk to a coffee shop and get all the free Internet access they desire.

Probably the biggest obstacle to a viable network in Madison is city priorities; clearly the city has not made a wireless network a critical priority, as evidenced by its desire to have an effective, successful network without using taxpayer dollars. In fairness, the city is hamstrung by regulations imposed by the state legislature – the state of Wisconsin does not make it easy for a major city to build a city-wide wireless network. As far as bridging the digital divide, several respondents sagely stated that the network only appeals to people who already have computers – the network serves no purpose for people without them. Thus, some believe Madison's network is doing little to bridge the digital divide.

Madison's wireless efforts have not gone for naught, however. The study revealed that the network is helping to keep people in Madison, and this is of major concern to the city's leaders, and it has made it a priority to maintain the city's tax base. Several respondents said that the Madison's wireless network seems to be helping these efforts.

CHAPTER 12: SYNTHESIS ACROSS CASE STUDY CHAPTERS

The five case studies revealed key themes about how participants view their wireless network in relation to improving QoL measures. These respondents pointed out that complexity, responsiveness to the community, reaction to resource shortages, patterns of relationship building, diversity/richness of approaches, stakeholders' knowledge base, effective integration of policy, and the perceptions of the project enhancing community identity and participation were relevant themes and contributed to a better understanding of the digital divide and QoL factors.

Many of the subjects identified potential partnerships and inter-communal relationships as the most important theme influencing the success of the project and possibly enhancing quality of life factors. Multiple truths were found in the qualitative research. According to the interviewees, the reaction to resource shortages (availability of computer technology centers, libraries, training centers, in-home signal reach, etc) had both a positive and a negative impact on QoL. They reported that the few community portals provided them with software and hardware support (i.e. training and education) and encouraged participants to use this newly acquired technological knowledge to move forward with their lives. Still, respondents reported that the lack of resources (technology transfer mechanisms, for instance) were emblematic of the bitter power struggle between the resource haves and have-nots as well.

For a detailed cross-case comparison summary of all five cities see table below:

Emergent Themes	*Cities Studied*				
	Tempe	**Portland**	**Federal Way**	**Corpus Christi**	**Madison**
1) Unanticipated social, political, and technological complexity	Highly understands city's role, project goals, citizen expectations, & next-steps	Vague on city's role project goals, citizen expectations, & next-steps	Vague on city's role, project goals, citizen expectations, & next-steps	Understands city's role, project goals, citizen expectations, & next-steps	Poorly understands city's role, project goals, citizen expectations, & next-steps
2) Variable mismatch between city's intentions and populace's	Responds well to community needs and	Mixed response to community needs and	Odd response to community needs and interests	Responds well to community needs and	Poor justified response to community

needs	interests	interests		interests	needs and interests
3) Inability to anticipate future costs/needs and maintenance	Some action	Some action	Some action	A lot of action	No action
4) Multiple relationships with conflict, coop. and interdependence	Somewhat strong partnerships Strong community relations	On the way to partnerships Mild community relations	No partnerships Weak community relations	Strong partnerships Strong community relations	Not seeking partnerships Weak community relations
5) Well-targeted, Mu-Fi strategies require diverse policy mixes	Few	n/a	Few	Many	n/a
6) Cities are merely momentum players	Strong	Somewhat strong	Unknown	Strong	n/a
7) Inability to grasp the policy arena	Effective	Somewhat effective	Unknown	Effective	Not effective
8) Using the digital divide as an excuse to build their systems	Mixed	Partly negative	Partly positive	Positive	Unknown

Table 4: Cross-case comparison summary of all five cities

The eight major themes aforementioned evolved out of the phenomena of municipal wireless broadband network vis-à-vis the digital divide. Within each theme, this study found attributes that were repeated by multiple participants, which included the following:

1) Unanticipated social, political, and technological complexity
    a. There are degrees of complexity

The degrees of complexity influenced the potential of how tech inspired the municipality actually became.

2) Variable mismatch between city's intentions and populace's needs
    a. Different responses to community
    b. Duration/time in which the city respond varies, based on immediate need

The higher the tech enthusiasm, the lower/slower the responsiveness type.

3) Inability to anticipate future costs/needs and maintenance
    a. Obvious recognition of the availability or shortages in the community

The higher the tech enthusiasm, the more communities complained or completely ignored the resource factor

4) Multiple relationships with conflict, coop. and interdependence
    a. Communities who are committed to addressing the digital divide have more formal community linkages than those who do not

The lower the tech enthusiasm, the higher the number of partnerships

5) Well-targeted, Mu-Fi strategies require diverse policy mixes
    a. Mostly access/connectivity related
    b. Diversity of approaches to bridging the digital divide is evidenced in type of partnerships that are formed, tech enthusiasm and existing community infrastructures

The higher the tech enthusiasm, the fewer approaches adopted by cities to tackle the digital divide

6) Cities are merely momentum players
    a. Know-how is mostly composed of two types of people:
        i. Politicians
        ii. Educators

The higher the tech enthusiasm, the higher the number of unqualified personnel, experts and well-informed decision makers tends to be in the Mu-Fi process

7) Inability to grasp the policy arena
    a. Mostly non-existent

The lower the tech enthusiasm, the more policy, statutes, regulations, and bylaws tend to be adopted at the local level.

8) Using the digital divide as an excuse to build their systems
    a. Mostly positive
    b. Very emotional

The higher the tech enthusiasm, the more obscure the perception

The descriptive quantitative data was corroborated by the interviews. Most interviewees in Corpus Christi said that the city's "digital inclusion concept" was a direct result of the city's large at-risk community. Research has shown a causal link between poverty and education. The findings showed Corpus Christi with the lowest level of educational attainment out of the five cities. Conversely, Madison had the highest and might, which might explain the city's lack of focus on the digital divide, in contrast to Corpus Christi's commitment to conquering the digital divide. Unfortunately, there is not too much else to tell as far as a quantitative analysis is concerned. The problem lies in the fact that one cannot obtain reliable statistics with only five cases. One needs at least 50 cases to get reliable estimates with bivariate techniques such as One-Way, ANOVA. These techniques would be able to demonstrate the strength of the relationship between the cases. This is so because the standard error is huge with such a small sample. Another option is to use the population of each city for the year that the other variables were measured in and calculate rates (mean income per 100,000 or 10,000 people). Using the rates approach would be the only way to compare the means because it standardizes the mean to a fixed population size, while if one compares the raw mean one is not taking into account the size of the state and therefore the means are not comparable.

The descriptive quantitative findings suggest that municipal wireless networks have the potential of increasing QoL factors and revealed each city's process of attempting to engage the digital divide and the byzantine nature of that process. Several NAI were an influential factor on increasing QoL factors. Several participants reported that increased availability of nodes, an expanded coverage zone, and additional training and general education venues, increased the project's success and, perhaps, will eventually increase local QoL factors.

The findings affirm the theoretical model proposed in this research. Technological enthusiasm with Mu-Fi networks is associated with high hopes, tech enthusiasm, and a halo of positivism.

A particular lesson of the findings is that the notion of structuring, building, and connecting communities around the use of ICTs like wireless broadband may be oversimplified by public elites. Public officials are not taking into account the multiplicity, volatility and dynamicity of deployment per se, yet they continue to press on with their technological plans.

In sum, the overarching purpose of these case study chapters was to establish connections across chapters of interpretation. These chapters shared excerpts from participants' stories in a categorical fashion by theme. I included my reflections and reflective interpretations with the participants. To interpret their stories further, I discussed my understanding from a *technological enthusiasm* perspective. In Chapter 13, I will utilize an aggregate model as a visual anchor to organize and interpret their stories both pre- and post-deployment. By employing a qualitative strategy to understand the perceived impact of municipal Wi-Fi on the digital divide, I was not "locked into" one perspective which helped me extend my learning across different cases.

Interestingly, the interviews percolated my ideas, took numerous forms, and shifted my research position. Technological enthusiasm illuminated my thinking. My greatest lesson was this: Under the philosophy of autonomous – substantive – deterministic theories, this study reveals differences, dynamics, contradictions, marginalization and dominant ideologies. Willing or not, municipalities are attempting to engage the digital divide and enhance QoL factors in a world of contradicting and complementary paradigms. This dissertation, *Perceived Impact of Municipal Wireless broadband Networks on the Digital Divide*, provides us with an opportunity to learn how multiple realities coexist in five U.S. cities, and how much public elites can learn about the real impact Mu-Fi is having in their respective communities.

The next chapter will analyze more in-depth these themes and aggregate findings.

CHAPTER 13: ANALYSIS

13.0 Introduction

During this research process an exploration of municipal Mu-Fi networks in their quest for alleviating the digital divide was undertaken. Chapter Five brings this dissertation to closure through taking cognizance of the methodological and theoretical fit to the research findings, and attempts to situate the research findings within the context of the literature collected and the relevant quantitative and qualitative aspects of Mu-Fi projects. This chapter concludes with a reflection on the exploration process that was engaged upon in this thesis.

As indicated in Chapter Five, the aim of this research study was to examine how Mu-Fis affect the digital divide. Specifically, it explores and offers a descriptive account of how municipalities attempt to engage the digital divide process. Owing to the exploratory nature of the study, a qualitative process was engaged. This provided a suitable vehicle for this journey, as it allowed for the investigation into the different facets of technological enthusiasm that were revealed.

Despite the difficulty in disentangling the multiple components involved in a Mu-Fi project and the digital divide, the reported findings reveal some aspects of the digital divide and its relation to Mu-Fi processes. In this chapter, quantitative and qualitative findings are analyzed.

13.1 Qualitative analysis from each case study

- **Tempe**

Interviews revealed that Tempe, with its provision of wireless broadband access, largely failed to meet its goals in terms of lessening the digital divide. Those who were connected to the computer network were predominantly residents who were already employed – groups generally described as traditional Internet users. Respondents indicated that those residents who were connected were also significantly more experienced in the use of Internet than the non-connected. The project failed to extend access to the excluded. As Tempe's municipal Wi-Fi was hardly used by the excluded due to a lack of effective marketing strategy, it can be argued that the effects upon quality of life for the excluded were also minimal.

Despite failing to fulfill its promise, the expectations of Tempe's wireless network remained high. Both government officials and local stakeholders interviewed believed that the high-speed project had the potential to be a powerful weapon in attempts to enhance digital inclusion. The network was also believed to increase access to local information and communication, the basis for the development of community identity and participation.

In contrast to Madison and Federal Way, with their Wi-Fi clouds, Tempe still appears to be more successful in combating the digital divide. Though network coverage is still limited, Tempe's network has tried to include the digitally excluded by adding splash page availability to anyone in the city who has access to a computer and the city's wireless network. This splash page gives citizens free access to tempe.gov, one of the city's contractual stipulations with the vendor. The provision of department applications via the network has facilitated social participation for both city workers and residents.

In addition to increased digital inclusion, the interviews also revealed that the Mu-Fi concept is both healthy and strange in terms of social integration in the area. The wireless network is an issue some respondents feel helped bring the city and the community closer together. Other partnerships are beginning to form in the city as well. The city is forming key alliances with businesses and other educational entities to improve efficiency in selling the idea of a universal wireless network in Tempe; the city views itself as a match-maker of sorts.

According to subjects, a higher QoL or a reduction in digital inequality is not directly attributable to an increase in wireless broadband access. It is argued that the network, as a technological tool, may increase QoL factors. In addition, city officials stressed that the project provides a local attraction, plays a town-gown role, increases the sense of pride and local identity. It lends support to the argument advanced by a number of other substantive-autonomous-deterministic writers that the technology itself determines social change.

- **Portland**

Despite aiming to bridge the digital divide in the community, the Unwire Portland project fails to connect all groups (including marginalized communities) to the wireless cloud. Compared to the general population, only a small fraction of citizens were connecting to the city-wide Wi-Fi grid, and those who were connected were mainly students, knowledge workers and downtown residents who are already experienced in the use of Internet access and computer usage.

Disadvantaged communities, the elderly, the unemployed and the computer-illiterate were largely excluded from the wireless network. The government-led initiative failed to span the digital divide, as those who took up the offer of Wi-Fi access were much more likely to be among the more privileged members of Portland than those who remained on the negative side of the divide.

As the Unwire Portland program has not attained its goals in terms of alleviating digital inequality, it has also been unable to craft a sound digital inclusion policy vis-à-vis the wireless broadband project. Only a small number of people are actually enrolled in the service (about 16,000 users by 2007 out of approximately 500,000 residents) and it's still a mystery whether these 16,000 users are those who were previously unconnected; not all of them turned out to be users. The general lack of demographic information by the government and Metro-Fi means that researchers have little to no information about who is accessing Portland's Mu-Fi network. Beyond the city's splash page, the paucity of content and services poses a series threat to improving the QoL of at-risk groups.

Despite the network connectivity issues and relative lack of use by all groups, to city officials the overall perceptions of Unwire Portland's potential remained extremely positive. In agreement with the view expressed by *technological enthusiasm*, the general belief was that the city-wide broadband grid is an emerging technological phenomenon with the potential to affect socio-economic structures. Expectations of the network's impact was quite high. Not only were city officials and Metro-Fi content with the service, but community groups and residents thought that wireless projects like Unwire Portland were to be common place in most areas in the near future, and the expectations of its impacts on community identity were high.

According to the general expectations held by respondents, Unwire Portland was also seen as having the potential to improving QoL for residents, outlined in this thesis. Although little emphasis was actually made by city officials on different QoL indicators – for instance, working with local employment agencies to decrease unemployment or using the wireless network to decrease crime, participants remained interested in employing Wi-Fi for dealing with local societal issues. This suggests that a strategy that includes QoL indicators in relation to the wireless project was not examined.

- **Federal Way**

There are five main reasons for the difference in success between all the other case studies and Federal Way: 1) timing, 2) project focus, 3) stakeholder support, and 4) the nature of the project.

It can be argued that Federal Way, which started its Wi-Fi program after Tacoma and Spokane, simply began its initiative too late to succeed. Although some cities clearly caught the Philadelphia fever, by no means did all project followers survive. Perhaps residents were less interested to access the Federal Way's wireless network. This made it difficult to attract users as well as sponsors.

The Federal Way wireless broadband initiative failed in its goal of involving the entire community in the design, development and deployment of the Wi-Fi service. The local mall seemed to be the primary motivation and target audience for launching and using the broadband service, to stop the city's "leakage" of residents who go shopping outside the city. According to interview data, the network seems to have been perceived as built exclusively for the mall and not city residents themselves. For the success of a government-led broadband project, it is thus very important that all the residents in the community feel a part of it.

The fact that Federal Way is the smallest case study site with limited community actors and resources is probably another contributing factor to the relative lack of success of its Mu-Fi network. Although the projects in Tempe, Portland, Corpus Christi and Madison provided Wi-Fi access, the most obvious difference between those four efforts and Federal Way is in the public-private agreements: the former group depended on multiple community groups to ensure access, while the latter attempted this complex task alone.

Similarly, as there tends to be a general skepticism among many digitally excluded communities, especially elderly people in Federal Way and immigrant groups, it was not enough to rely on only a selected few to support the city's digital-divide agenda.. The digital-divide process is long, complex and convoluted. Considerable amounts of time and effort are needed with an emphasis on training, support, funding and so on; Federal Way did a very poor job of managing these areas.

Federal Way's Mu-Fi also suffered from the lack of community support by residents. Many community members saw the network as a means of providing the city with a high-tech edge and enhancing government services. Some respondents who were familiar with both the government applications offered via the wireless network and the "mall argument" preferred public access over public safety alone because they feared public safety applications would shift focus to government needs versus community issues. One could conclude that the combination of public access and government applications both play an important role in the creation of digital inclusion in communities that adopt a municipal wireless strategy.

- **Corpus Christi**

Access to the Internet is very important for a city like Corpus Christi, as it facilitates links to the wider society and inclusion in the Information Society. However, the original model adopted by Corpus Christi was for predominantly governmental services such as e-meter reading. By adding a digital divide component to their government service agenda, the city took a crucial step to make online participation by all segments of the population a reality.

Despite the fact that Corpus Christi has not made a huge impact on bridging the digital divide in the community, subjects thought that it had the potential to do so. In agreement with the views expressed by some of its proponents, the city was seen as a vehicle for increasing Internet access through the provision of municipal broadband access. The importance of being included in the new digital global economy was emphasized by most interviewees, who praised the step-by-step strategy employed by the city, the partnerships established with key institutions and the positive feedback received from the community. In accordance with TE, it can be argued that the perceived benefits that wireless broadband seems to afford citizenry, at lease in principle, may be out of fear of being left-behind.

It can also be argued that Corpus Christi had the potential to reach a wider audience and perhaps lessen the gap between the information rich and poor, which supports the utopian views in the literature of this thesis. (See Chapter xx) The interview data indicate a significant difference between what the city intended for the network and what the city is currently offering, with the former being a mere splash page. This difference has not been examined further, but it can be speculated that by providing a splash page, the city can be given the benefit of the doubt due to the service it is providing in an otherwise rather Wi-Fi deprived community, and also because of the high expectations the city had of the network.

The expectations were especially high in relation to the potential impact of Corpus Christi's Mu-Fi on improving QoL and decreasing the digital divide, such as access to online services, but expectations were also high relative to how they will actually go about evaluating their network or how they intend to measure the impact in future phases. However, some residents were worried that the service was no longer free. Respondents argued that free Mu-Fi access is the key to successfully bridging the digital divide in Corpus Christi. Some support was given to the views expressed by a number of dystopian proponents that the Internet may lead to the creation of "mouse potatoes" who neglect to participate in society. Generally, however, the majority of respondents believed that Corpus Christi would increase digital inclusion and enhance the sense of local community and identity.

- **Madison**

Despite the general enthusiasm with which Madison's Mu-Fi project was launched, it was clear that there were many problems with the project. In contrast to Corpus Christi, Portland and Tempe, the Wi-Fi project in Madison failed to meet expectations due to state regulations, managerial issues and its failure to attract and involve the residents. For example, MCB (the ISP) failed to live up to its promise of providing ubiquitous Wi-Fi coverage. There were problems with MCB, few access points were live and available, and the project failed to extend its membership beyond the downtown core. Some respondents thought the latter was the biggest barrier to the project's success.

It is my contention that Madison's wireless initiative that was supported by city officials and built by MCB will cease to exist in its entirely without lasting impact, largely as a result of the experiences gained from the project's lack of service delivery, clear digital inclusion strategy, community support, and technical glitches. Considerable amounts of time, money and resources are needed with an emphasis on service and support; this is something the Madison has neglected to bring to its lackluster Mu-Fi effort.

Madison failed in its goal of involving community members in the design, development and deployment phases of the network. The MCB group and the city liaison who were in charge of the project and made all the decisions, and that is not a recipe for success. Madison's broadband project seemed to have been perceived as belonging to MCB and not the community. For the success of a city-wide broadband initiative, it is therefore critical that the residents in the city feel a part of it.

Despite the fact that Madison failed to "include the excluded," reaching "everyone" in the area, residents thought that it had the potential to do so. In agreement with the views expressed by the utopian voices in the literature, it was believed that Madison's Wi-Fi technology would usher in an era of increased QoL for all. In accordance with TE, the potential positives/benefits/advantages for Madison to employ technological enthusiasm is that the project had the potential to bridge the digital divide, regardless of the technology or business model employed.

In conclusion, the success of the Madison wireless project lies in improving service delivery, crafting clear and sound digital inclusion policies, aligning the community's goals with the original Wi-Fi mission, and integrating local stakeholders in the Mu-Fi plan. Hence, these shortcomings account for Madison's relative lack of success in bridging the digital divide and increasing QoL when compared to Tempe, Portland and Corpus Christi.

13.2 Qualitative analysis from the cross-case comparison across all themes

Below are the lessons learned from the cross-case comparison across all themes. The qualitative research findings are analyzed here in terms of the theoretical framework employed for this research study.

Because the aggregate model is linear and the effect explored via interviews is muddled and complex, data interpretation was more difficult than anticipated. I read through each transcript several times, attempting to cluster the respondents' meanings without filtering their voices. Eventually, I was able to select excerpts from their stories, loosely organized around elements of the theoretical model. However, as I began writing, I reinterpreted many of the quotes and recognized that they could be discussed in the context of two or more constructs. At times, I have pointed out how their excerpts illuminate multiple dimensions of the themes revealed. In other cases, I did not draw attention to the interconnections. This is not an oversight on my part, but simply a decision I had to make in order to achieve the best possible writing clarity.

As previously discussed in chapter three, there are various aspects of autonomous-independent-deterministic theories that all chapters share:

a) The benefits of technology are seen as naturally self-evident and universally bona fide;
b) Technologies are framed in the upbeat "we will all benefit from this" discourse;
c) Technologies are seen as mythic, all-powerful agents of change and social progress;
d) All ignore the political, social, and cultural context that accompanies the design, development and deployment of technologies

In chapter three, the study reported that TE had been the term adopted for this study. By choosing this terminology, this thesis aims to illustrate the faith, hope, and optimism public elites have in the power of Mu-Fi networks to promote economic development and digital inclusion. Specifically, the goal is to learn from communities' successes in their quest for alleviating the digital divide. The purpose is to (a) interpret the stories using the theoretical framework of *technological enthusiasm* and (b) shed light on the rose-tinted view of technology often adopted by cities based upon what I have learned from these interviews.

During the interviews, unlike the linear distinction of the aggregate model, the data showed the dynamic and nonlinear nature of several network indicators and QoL outcomes. The subjects' stories tended to be circular, rather than sequential. For example, when talking about how the network in Portland will respond to the needs of the community, some participants mentioned that future phases will resolve those first phase needs; others like Corpus Christi talked about addressing the needs during the design stage of the network, before starting the first phase. At the time of the interviews, this did

not occur to me, as I was absorbed in their experiences and constructions. It was not until the research process initiated the secondary level of data interpretation that I began to understand the importance of viewing them holistically.

During the writing of this thesis, I attempted to capture Mu-Fi's growth and development. The goal was to accurately reflect the ebb and flow of its Mu-Fi's goals, motivations, perceptions, and values. But when the study attempted to follow the circular patterns of their stories, I found that the writing lacked clarity. The writing aim was to share respondents' stories without affecting their *voices*. There was an obligation to the participants to reach a broader audience with their stories. Therefore, the thesis employed the theoretical model as a tool to organize the flow of this analysis and provide a visual anchor to facilitate understanding. It is hoped that the reader will still be able to hear the participants' voices and appreciate "their story" as they shared them with me.

13.2.1 Complexity (unanticipated social, political, and technological complexity)

Excerpt 1 (Tempe): "I think the city understands they [sic] need to work out some kinks and they certainly are not resistant to it." Subject # TE-5145
Excerpt 2 (Portland): "Our goal is to expand low-cost internet access to city residents and businesses. We operationalize and measure this goal in consultation with Metro Fi, which is based on the monthly number of active users and target levels." Subject # PO-6020
Excerpt 3 (Federal Way): "…a part of the pie of things that you need to do in this community to be on that cutting edge. To make sure you keep attracting as many people as possible." (Subject # FW-8203)
Excerpt 4 (Corpus Christi): "We wanted it to free and accessible to the independent school district…We wanted a Web link in the portal …We want the city to provide all sorts of public information about city services … there was some interest in seeing if we could start doing some e-business training and perhaps through the city portal, you could access certain local businesses that were willing to be included in the portal…" Subject # CC-7512
Excerpt 5 (Madison): "I do think that one of the city's priorities is to try to maintain a good economic status, and I think that they see the wireless network as a part of that but not their top priority. In my own personal opinion, what's driving the wireless network is more economic concerns than social concerns, although I'm sure that's not the way it's pouched"

Table 5: Complexity (excerpts 1-5)

The personal histories, journeys and trajectories of these five cities are rich in detail, showing how both system and social complexities significantly shaped their Mu-Fi constructions and delivery. For most cities, participants shared how past political experiences, technological challenges (i.e. network coverage dead-zones), geographical barriers (i.e. indoor signal penetration), and numerous ISP-related issues influenced their complexity. To address this complexity, several of the participants mentioned the urgent

need for cities to adopt a more integrated framework for understanding and addressing both the technology and their communities in relation to QoL enhancement. Portland recognized the complexity of this process and asserted their project was not designed to solve all issues of the digital divide, just those related to the availability-cost of high-speed Internet access. This group of excerpts revealed similar themes of self-reliance, goals, motivation, and determination. This theme re-emerged during their "reaction to availability/lack of resources" stories. Corpus Christi's example explains that every city's model is different, and that there are different things that must be explored in-depth. Tempe participants feel this is a multi-faceted, iterative process and that the city does have some hurdles to overcome if they want to succeed.

Included in the participants' stories were observations and constructions about their experiences with this complex network, which I included in the group of excerpts. From these quotes, one begins to see how cities view these networks as powerful agents-of-change. It is particularly interesting to see how they understood the potential benefits of wireless services in their city. Most public elites and incumbents viewed their complex network (a) positively, (b) with strong expectations of creating a very bright future for their citizens, and (c) with open-ended outcomes.

However, some of the grassroots members interviewed in Tempe and Madison disagreed. They re-examined the goal of "broadband for all" the city had set for itself, and asserted the city's optimistic view needs to be tempered in the light of evidence demonstrating the benefits of having the network outweigh those of not having one. Portland public officials acknowledged that governments tend to also be guilty of overlooking, or at least minimizing, the shortcomings in their community. While municipalities seem to be redefining their measurement/performance metrics, *all* of them indicated it is still too soon to predict how the role of wireless broadband networks will evolve regarding digital inequality. What matters most to them is the uncritical acceptance of the panacea wireless broadband can bring to their respective communities and how it might make a difference in improving QoL factors. TE helps us understand the context of these values while appreciating their differing reality. There is a popular view in government that technology determines social change. The difficulty with this belief is that these claims are difficult to substantiate empirically.

Additionally, the findings reveal how cities' unique political histories influence the valuation, design and ultimate use of their wireless network environment. Based on their past experiences, these cities developed philosophies and filters that they employ to shape, structure and setup Mu-Fi in their community. In some cases, legislative restrictions prompted government officials to re-think their strategy (see Madison case study). For others, their unique form of government (see Portland case study) created a unique vantage point for maintaining their highest Internet penetration rate. For most subjects, it is clear that past events have shaped their perceptions of their current roles. From the stories of these participants, we are beginning to learn how multiple levels of complexity– political and historical – can serve as a filter or layer through which these cities perceive, navigate, or negotiate their TE.

13.2.2 Responsiveness to the community (variable mismatch between city's intentions and populace's needs)

Excerpt 1 (Tempe): "[The goal is]…to continue to look at applications that we could put out on some type of PDA, cell phone device or something like that, where we can get applications more readily to the staff development field, our co-inspectors, our public works department and our water department. So we have some pretty good plans for what we'd like to do in the future with using the wireless networks." Subject # TE-5145
Excerpt 2 (Portland): "This project is not designed to solve all of those aspects, only those related to the availability of high-speed Internet access, and the monthly cost of it. It cannot solve issues related to the relevance of Internet access…it's not that the city does not recognize that those issues exist; it does. This project is just not designed to solve it. We did not lump all of these issues in the Unwire Portland project…" Subject # PO-6029
Excerpt 3 (Federal Way): "…the potential is still unexposed; it's there, but we haven't maximized on it. I think this is a tool that's available to many folks that most don't even know about yet." (Subject # FW-8202)
Excerpt 4 (Corpus Christi): "We as a city are very interested in helping the citizens, and not do something that is self-serving; we're really trying to actually provide support and help to the population." (Subject # CC-7513)
Excerpt 5 (Madison): "…it's very easy to attract travelers if you have wireless everywhere. I think by offering a wireless network, but not the equipment to use it, you're really catering to people that already have computers, so you're clearly not trying to bridge the gap." Subject # MA-9746

Table 6: Responsiveness to the Community (excerpts 1-5)

As described in the prior theme, cities' prior experiences directly influence their perceptions, values, norms, and beliefs. The narrative in this section helps us better understand their unique and diverse orientations. This theme reveals how subjects discuss applications, ubiquitous computing opportunities, context-specific tools, content for businesses, and other services that they either are offering or hope to deliver in the near future. Most of these services are tied directly to their past experiences. For instance, Corpus Christi claimed governmental service efficiency via Automated Meter Reading (AMR) technologies was the impetus for the creation of their network. From a TE perspective, it appears that governments have latched onto wireless broadband as a "good thing" rather than critically exploring the claim they represent (or may represent) a means of affording a number of development services.

Overall, I believe this cluster of meanings suggests that Mu-Fi value orientations emanate from their local context. The theme is also revealing in this sense: many of the participants refer to the benefits of having the network in their community in the future tense (i.e. "the network will…" and "the people will benefit from ….") rather than talking about what the network can do in the present tense (i.e. "the network has already done…" or "the people are currently benefiting from…"). For Tempe, Portland, and Federal Way, their respective governments claim their networks will improve access to information and

result in greater social justice. For Corpus Christi and Madison, most respondents assume that once barriers to access are overcome; everyone will embrace the technology wholeheartedly. From all of these we can infer that technology is a causal agent of social change. Together these stories help us challenge the assumption that technologies like Mu-Fi networks shape values and strengthen-increase social capital in a sense. From a TE standpoint, these "utopian visions" have overwhelmingly positive effects on digital-divide reduction and appear to be driven by a determinism perspective on social innovation and development. Overall, the participants' observations offer us insight as to how cities are responding (or expect to respond) to community needs.

The benefit of municipal wireless broadband as a precursor for ubiquitous access and universal service is seen by public elites as intuitively self-evident and universally valid. At numerous points in the interviews, the participants referred to news feeds, stories from the media and articles from popular press about the myriad of benefits Mu-Fi offers, revealing the tendencies and tensions about the debate. For example, in Tempe, one participant described the city's marketing attempt as "very interesting and successful campaigns" in that it made the wireless system look appealing and positive. On the other hand, another participant in Portland described how most publicity is negative press about the network. This is further evidence that governments need to clarify and delineate what Mu-Fi endeavors are aiming to do. If cities do not carefully think through these issues there is a risk that municipal wireless systems will fail and perhaps waste valuable resources.

Of the five case-study cities, Federal Way is the city that has the most work to do in understanding and articulating exactly what a Mu-Fi network can do for its users. In this particular case, the city appeared to have started with the technology rather than with an integral design, development and deployment strategy. TE posits that policy initiatives start from the assumption that access to the technology is necessarily desirable and hence access per se is the policy change to be met in order to achieve the socio-economic potential of ICTs like wireless broadband. When deploying Mu-Fi, having a crystal-clear strategy from the very beginning is essential to a network's success.

13.2.3 Reaction to availability / lack of resources (inability to anticipate future costs/needs and maintenance)

Excerpt 1 (Tempe): "We don't have access to reports that tell us the average user length, the number of users signing up to the network, the Web sites they're visiting, etc. We as a city we wouldn't have access to that. We would have access to how many people logged onto our Web site…things like that, but it has nothing to do with whether they came in wired or from the mobile network or how they reached our particular Web site." Subject # TE-5146
Excerpt 2 (Portland): "People think Portland has a lot of invisible resources from which to raise capital and grab new customers all while ensuring the success of their network. However, this is a myth. Although Portland is very interested in bridging the digital divide, Portland understand this is not done overnight. This takes a long time to

accomplish with many, many resources." Subject # PO-6028
Excerpt 3 (Federal Way): "…the digital divide problem is not a problem for Federal Way as this is something third-world and developing countries deal with, not us…" Subject # FW-8202
Excerpt 4 (Corpus Christi): "…it's something that we just didn't have the resources to do, a commercial partner, and IFC can come in and do those types of things. We did extend city funds to pay for a network, we treated it as infrastructure, it was, tried to automated meter reading, so we used our city's utility funds for that, the utility, the capital funds, and so when EarthLink purchased the asset, the purchase price replenished those funds…" Subject # CC-7511
Excerpt 5 (Madison): "… in terms of major financial commitment or investment in say infrastructure or operating and subsidy, we're not really looking at anything along those lines at this point." Subject # MA-9740

Table 7: Reaction to Availability / Lack of Resources (excerpts 1-5)

This theme is grounded in the voluminous body of literature on substantive – autonomous – deterministic theories. Within the scope of this study, it would be an impossible task to try to reinterpret the participants' stories through each of those theories. (That was never my intent, but I recognize that such theories hold potential for future study.) Instead, in this section, this research study discusses TE, in a very broad sense, referring to what the subjects indicated in order to help illustrate my interpretations.

The most essential characteristic of the utopian argument is the elimination of scarcity. Although respondents did not attach their comments to specific examples, they revealed that public-private partnerships grew out of need and lack of resources (see Madison and Corpus Christi case studies). Others like Tempe are beginning to understand they lack the right training mechanisms in place to tackle the capability component of the digital divide. For Portland, the experience is completely different; they are "highly doubtful the city will switch from the current wireless platform to a higher standard as they might not have the capital necessary to build up the network or expand its capacity" (Subject # PO-6026). It is unclear whether they acquired this experience, through trial and error, critical examination, or from the advice of others. Yet, at the time of the interviews, all seemed confident they knew how to make use of resources. To them, this network will help them eliminate some social ill. However, as TE shows, technologies like Wi-Fi have been idolized and framed as a force that can fix the social fabric of life by eliminating scarcity, like unemployment, poverty, poor QoL, and so forth.

Perhaps not apparent in these quotes, yet clear to me during the interviews, was the sub-theme of *open-endedness*. Most subjects attributed the lack or availability of resources in an open-ended manner. To many of them, government-led broadband networks have the potential to remedy social inequalities if more resources are invested in the municipal project. The resulting impression was that they faithfully believed that if more access points are installed and the quality of the signal is strengthened, their digital inclusion effort will succeed. In Tempe, one participant described how the additional indoor coverage devices could help the city meet its digital-divide objectives. As a result, he said he understands why the lack of investment in indoor signal reach for residents has

taken a toll on the Wi-Fi project. However, he was quick to point out that this was just one component in tackling the digital divide. Later in the interview, he placed more emphasis on learning about the other components that make up the digital divide. For me, contradictions in his story help to elucidate the TE claim that technologies crafted with open-ended outcomes have no reason to emerge as the ultimate antidote of societal maladies, any more than other major socio-technical changes have had such effects in our past.

13.2.4 Patterns of relationship building / potential for partnerships (multiple relationships with conflict, coop. and interdependence)

Excerpt 1 (Tempe): "…the fact that we've implemented a lot of advertising for the city and used to bring in business to it and things like that so I don't see it going away any time in the near future. [This relationship] allows us to maintain the network." Subject # TE-5147.
Excerpt 2 (Portland): "The city helps us where it can in terms of contacts, areas that they've heard may have special needs, but we're completely independent of the city. We don't have any contract with the city or any type of formal partnership with them. We're more of a pure charity in that we go in and we provide the equipment and labor." Subject # PO-6023
*Excerpt 3 (Federal Way):"*We haven't had enough experience with the network to focus on seeking partners or support for the network … this takes time…..if and when this network has an impact we will pursue formal alliances…honestly, it's too soon to tell." Subject # FW-8200
Excerpt 4 (Corpus Christi): "I mean [the city] certainly [has] a partnership with the university, the community college, partnerships, the small business development center, the county medical health authorities…" (Subject # CC-7517).
Excerpt 5 (Madison): "The city talks to different stakeholders on a periodic basis to resolve issues related to the wireless network….The city tries to serve as liaison to connect them with different entities, university personnel and/or county officials in an informal way." Subject # MA-9740

Table 8: Patterns of Relationship Building / Potential for Partnerships (excerpts 1-5)

The original questions about the *relationship-building and partnerships* were prompted by the literature relative to the role of multi-stakeholder partnerships, primarily among key actors, in successfully addressing the digital divide. I had a difficult time coping with how cities were attempting to build their networks without strategically aligning with key community organizations. My challenge was fueled by the lack of documentation from diverse sources (governmental press releases, public speeches, Web portals, RFPs, etc.) about their local partnerships-alliances. It also appeared that the small body of literature on Mu-Fi was primarily (if not exclusively) based upon the different business models employed by cities and their relationships with local incumbents. Obviously, the literature nurtured some bias in my thinking, but it also helped me to frame my research question.

The subjects who participated in this study offered considerable detail about cities' partnerships with community stakeholders. Their stories revealed different types of partnerships in a Mu-Fi setting, including:

(a) *Active partnerships:* Those organizations that are involved in the daily activities of the network and may contribute capital to the project. Tempe and Corpus Christi are great examples of cities that have active partners; namely, their school districts, local universities, small businesses, computer technology centers, and other non-profit organizations.
(b) *Sleeping partnerships:* Those partners who do not "participate" in the day-to-day activities of the project per se but are still involved with the successful rollout of project in some way. These partnerships are not recognized as "official partners" by public elites. Portland is an example of these type of partnerships with local grassroots serving as device transfer gateways for local residents. Portland does not recognize these organizations as partners yet they acknowledge the success of their network depends on their support.
(c) *Nominal partnerships:* Those partners "only" allow the project to use their "name" as a partner but do not have a real interest in the project. Madison is a prime example, with the city serving as the nominal partner that does not take part in the daily activities of the network. Federal Way is also an example, considering that the local mall uses the Wi-Fi network to attract visitors; the city, in turn, uses the "mall label" as an excuse to build the wireless system.

These partnerships (and labels) help to demonstrate how municipalities' realities can differ vastly from what they look like on the ground. Most public officials interviewed felt that partnerships were a necessary component in the successful implementation of their networks. This thesis posits that while some participants do recognize some design-reality gaps, they need to challenge their old assumptions and accept that some Mu-Fi systems do not ascribe to what they were set out to do. Interestingly, the interviews revealed that partnerships are key and a necessary step in attempting to tackle to the multifarious digital divide, but an insufficient component if used single-handedly.

The expectation that technologies like Mu-Fis will improve QoL measures and promote digital inclusion efforts have propelled public elites to form partnerships "loosely" and "poorly crafted" with the hope of leapfrogging into the new information economy. It can be argued that this is done out of fear of being left behind or outperformed by other cities. This phenomenon has been promulgated by the perceived benefits that Wi-Fi seems to afford citizenry, at lease in principle. It may well be an illusion to believe that cities can catch up to other cities that are subject to different dynamicity and complexity (different rates of technological adoption and resource allocation, for instance).

13.2.5 Diversity/Richness of Approaches (well-targeted, Mu-Fi strategies require diverse policy mixes)

Excerpt 1 (Tempe): "It's like a sales point, it's a point of pride, it's how we continue to

differentiate ourselves from the other communities around us in our competitive economy… they'll tout that in our literature; our politicians use it in our speeches, the mayor uses it in his state of the city speech …The wireless network, being the first city in the area to do it, helps us again solidify our position as a young, hip, smart place to be…" Subject # TE-5141
Excerpt 2 (Portland): "…we want to foster it. Our firm understands that in order for Portland's project to be successful, they need to have clear, crisp and multiple strategies to not only get the project off the ground but to have it be sustainable in the longer term. I am unaware of their strategies but I would assume they have (or will have) incorporated it in their model." Subject# PO-6024
Excerpt 3 (Federal Way): "The city is looking at setting up a business incubator via their local chamber of commerce. The project would be similar to a graduation program where participants go through two to three years of tailored training. This helps the city create an IT professional pipeline. It also focuses on trying to reduce the failure rate for new businesses. They are thinking of developing and building such [an] incubator in partnership with the local chamber of commerce whether it's downtown or the outskirts of the city. The Wi-Fi network is an added benefit that encourages firms to locate to the city." Subject # FW-8206
Excerpt 4 (Corpus Christi): "I think it's important for all cities that are embarking on this to actually document and measure how they are addressing the many components of the digital divide via this network….It's only going to help them in refining what they're doing and enhancing it and making it better as you move along." Subject # CC-7511
Excerpt 5 (Madison): "This project is one of those things that has enamored people in political office that they can use this as something they are delivering and hope that people will achieve a certain level of lisp because its wireless and it involves computers, but people who are touting this stuff don't have plans to deliver the other components or better yet, they don't know the other components exist. It's a highly superficial endeavor." Subject # MA-9743

Table 9: Diversity / Richness of Approaches (excerpts 1-5)

The literature discusses the importance of reinforcing the diversity / richness of approaches in technology diffusion, adoption, and training in relation to solving the so-called digital divide. However, most participants revealed that the nature of cities' strategies in addressing the digital divide is less involved than one might imagine. This is especially true for Federal Way, whose leaders had a strong desire for the network to succeed, yet city leaders mostly interested in addressing the "leakage problem" (diminishing the number of residents who left the city for recreational purposes by offering wireless in the local mall).

For Madison, the story is somewhat similar, in that MCB defined "bridging the divide" in terms of low-cost access to their downtown core. Yet Madison's policymakers seem more ambivalent than Federal Way's because the city is a nominal partner and refuses to engage the digital divide directly. From a legislative perspective, (as corroborated by the interviews), it is likely that Madison's refusal to engage the digital divide and offer multiple solutions was prompted by the state's telecom restrictions and/or the business

model adopted. In contrast, Portland who also refuses to face the multifarious digital divide head-on, does not have any legislative state barriers and has, at the time of the interview, abandoned its plans to address it via its Mu-Fi network. The analysis revealed that these cities started to engage the digital divide, but did not critically examine the multiple ways it could tackle this social ill, *despite* a lack of legislative support in some cases, what was interpreted as cities' passive-aggressive attempt to be seen as self-generating and autonomous.

Interestingly, it was also observed that a design-reality gap exists with what the network was designed to do and what it actually does. For Portland, the project was designed to provide localized information, interactive opportunities for government and citizens, and specific neighborhood content. The goal was to employ the tools of technology effectively troubleshoot problems between governments and citizens. During this process, they identified Wi-Fi as a viable option to fulfill this promise. However, shortly after starting the implementation, the city quickly realized their goal became too complex with its connectivity, mobility, and general infrastructural issues. From a TE standpoint, governments seemed to have been "blinded"' by the novelty of Wi-Fi; the qualitative evidence suggests this project does not live up to the proclaimed ideal of progress. To conceptualize technological change outside of any socio-political, socio-historical, socio-economic context causes the technology, in this case access to wireless broadband, as an autonomous agent that has a direct effect on other societal processes.

13.2.6 Knowledge Base / Core Competencies (cities are merely momentum players)

Excerpt 1 (Tempe): "When they will be establishing those partnerships, I can't tell you with any level of accuracy, but I can tell you they are so creative with their ideas about who to partner, I was very pleased that was happening." Subject TE-5145
Excerpt 2 (Portland): "…you don't need to know anything other than how to plug in a little box to an outlet and you can create a mesh for your local community, whether that's housing, whether it's [an] apartment, it could be a hotel, it could be anything." Subject # PO-6023
Excerpt 3 (Federal Way): "We want our system to be open to everyone and we welcome any and all ideas about how to successfully operate this network." Subject # FW-8200
Excerpt 4 (Corpus Christi): "We've had a series of awareness-building sessions between different city departments and local non-profits to get the community thinking about the Wi-Fi system and how it might apply to them." Subject # CC-7510
Excerpt 5 (Madison): "I think part of Mad City Broadband's defensiveness is attributed to the person spearheading the project. As far as I know, she doesn't have a technical background. She used to work with a senator from Wisconsin who got hooked in with the liberal establishment." Subject # MA-9749

Table 10: Knowledge base / Core competencies (excerpts 1-5)

Another dimension of the Mu-Fi experience is the nature of expertise or know-how possessed by public elites in attempting to engage the digital divide via broadband

technologies. Participants tended to label the city's core competencies as "good" or "bad" based on their satisfaction with the network, digital-divide approaches, level of support, and understanding of their local needs. In fact, one respondent noted that Portland "has to be careful" as the city "does not have the core competencies in regards to spectrum policy, network management, device knowledge, etc., to run this network." This same participant noted that the city refuses to engage their local community groups directly on the issue. This interpretation is highly consistent with TE about the one-sided discourse of the government-citizen relationship. This tendency toward monologue rather than dialogue is deeply rooted in the imbalanced power notions that still describe the social construction of knowledge. During the interviews, only Corpus Christi participants talked about the city putting together a committee of educators who were involved with the city and wanted them to seek positive ways of employing this new wireless resource.

Moreover, some subjects discussed how their city fails to connect with them to elicit knowledge about the network. Specifically, most of the participants wanted their municipality to have qualified candidates overseeing the project and more interaction with local constituents. Many - too many -of these participants revealed that their public officials "did not utilize local human capital," or that they felt like "the voice on the outside shouting in." Others, meanwhile, characterized their city's strategy as "phenomenal," "excellent" and "very knowledgeable. By and large, what emerges from these discussions is an optimistic view of the benefits to be harnessed from Mu-Fi networks for ameliorating the digital divide. According to TE, this is surprising given the nascent nature of Mu-Fis and the dearth of scientific evidence to date demonstrating their impacts and influence.

Similarly, the findings suggest that the knowledge produced by public elites remains defined, contextualized and framed by government. This approach is based on a predetermined topology of knowledge that is produced by and for existing power structures, through public elites, with the facade that is universally applicable. In essence, all it does is promote its own cause, while simultaneously detracting from more formidable problems that clearly are more important in society.

13.2.7 Integration of Policy Initiatives (inability to grasp the policy arena)

Excerpt 1 (Tempe): "…the city leased its infrastructure or light poles to a third-party company to put up [its] equipment. So I don't really see this as a municipal service, it's just like… anything else, we lease property for cell phone towers and we lease conduit and our right[s] of way to the cable companies. And this is sort of the same thing, from my perception, so I don't really see it integrated or tied to public service." Subject # TE-5149
Excerpt 2 (Portland): "We need a program and policy initiatives to put computers in the hands of low-income residents, and online resources to help them learn how to use the network to find work and educational opportunities. We're getting a "C" right now, and to really get an "A," I think we have to think of all these other things," Subject # PO-

6021
Excerpt 3 (Federal Way): Respondents commented on the lack of policy regarding the Mu-Fi initiative in Federal Way. Washington is one of the states that effectively limits public utility districts to providing wholesale telecom services. Washington municipalities often have greater authority and flexibility.
Excerpt 4 (Corpus Christi): "I think it's going to be very hard to attribute the wireless network to people's success (or lack of) in the future. It's [not] so much the impact today because when you have individuals that have all of a sudden the opportunity to better themselves, it will take years to understand and even difficult to grasp if that knowledge acquired by the availability of the wireless service. This will be challenging as politicians and legislatures think about possible future policy in regards to the wireless services being offered to their local citizens." Subject # CC-7510
Excerpt 5 (Madison): "This Wi-Fi technology has yet to prove out as something really robust to be an essentially wireless version of high-speed Internet that you know you truly can use anywhere within a fairly wide geographic region… city council is waiting to see if this is viable before they issue decrees and so forth…" Subject # MA-9747

Table 11: Integration of policy initiatives (excerpts 1-5)

Although policy outcomes are represented differently by each city due to state-level telecom legislation and statutes, this study wanted to illustrate how participants made connections between their local network to their policy outcomes (if any) and goals. Portland has a strong commitment to making sure the network is successful in its community, but recognizes that without government policy, the project will not achieve its desired objectives. Importantly, some participants mentioned that the city already has in-committee a digital inclusion proposal as a formal, documented prerequisite to ensuring the success of the network in relation to its digital inclusion objectives; however, the city *perceives* that this network is not focused on the digital divide per se because it has not yet measured or evaluated its local impact. They did not say, and the analysis cannot infer, whether their comments arise from observation or if they faced rejection or avoidance personally and directly by city council. From a TE perspective, a poorly conceived Mu-Fi initiative will give rise to a policy rationale suffering from short-sightedness.

Most interviews talked more broadly about the creation of policy post-benefits. Cities are highly driven to obtain benefits in order to achieve their wireless broadband goals. There is also some indication that Wi-Fi is a new technology, it is somewhat of a barrier, *but not a deterrent.* Unfortunately, the study argues both scenarios are poorly crafted by both government officials and local incumbents (in the case of public-private partnerships). This issue of "playing down" the policy implications and oversimplifying a complex reality might result in wasted resources and false expectations. However, I wish to conclude this sub section on a positive note by reiterating that cities, in some way, understand that integration of policy mechanisms are crucial to the success of their technological initiatives.

13.2.8 Community Identity and Participation (using the digital divide as an excuse to build their systems)

Excerpt 1 (Tempe): "When you look around the city where I work in Tempe, I see people working all the time using their laptops and I'm right by the university. Tempe is a unique place. Where I live (25 miles north of here), I never see this. Here, you can't go anywhere and not see a laptop open. Usually you see a bus stop with many people sitting waiting for the bus with their laptops open." Subject # TE-5142
Excerpt 2 (Portland): "That's the problem. I think it's just a big zero in some ways. If I'm a business owner and sitting out in Pioneer Square with my fancy $2,000 laptop, it's sweet. This is great! But, if I'm a low income person paying $20 for high-speed Internet, this isn't quite as impressive." Subject # PO-6027
Excerpt 3 (Federal Way): "…if it was expanded it would create a better sense of community." Subject # FW-8205
Excerpt 4 (Corpus Christi): "Being out in the community … I hear people talk about the network all the time and they are very proud to have that service and it has been interesting…" Subject # CC-7512
Excerpt 5 (Madison): "I personally investigated the city's wireless status by going down from the Capitol to the UW along State Street. I quickly discovered an open wireless AP from which I searched the Web and found 65 wireless hotspots for the city of Madison, of which 29 were free. I discovered several more unlisted hotspots during my adventure." Subject # MA-9743

Table 12: Perceptions of project in enhancing community identity and participation (excerpts 1-5)

Throughout the interviews, another re-emergent theme was *perception of project enhancing community identity and participation*. This thesis employs the term, perception, because it more closely reflects the subjects' perspectives on Mu-Fi regarding its purported benefits. Their multiple realities teach us that the benefits derived from Mu-Fi are not intuitively self-evident and/or universally valid. Using the digital divide as an excuse to build their systems is a disservice to local communities who must analyze the context of their consequences, and make difficult decisions about whether to invest, pursue and/or collaborate with local governments to achieve their goals.

To this point, the study presents participants' stories loosely organized around the themes uncovered in this study. The thesis tried to convey the cyclic nature of the participants' constructions. The purpose of this last section is to provide a description of what they told me about the project enhancing civic participation. Tempe subjects were so enthusiastic when talking to me, they had difficulty articulating exactly how the network enhanced their community, but emphasized the network makes Tempe "a smart place to be." Portland participants had similar sentiments, describing the city's Mu-Fi project as "in tune with their motto" by "keeping Portland weird." Most public officials were proud of their Mu-Fi projects because they believe over the course of time it's going to be a "huge hit." To them, "it just totally beats the cost of what you were paying before." Corpus Christi respondents said the city has tried to better understand the value and real motivation for having the network by changing from a public safety to a digital inclusion

approach. Both Corpus Christi and Federal Way believe that expanding their coverage zones will create a better sense of community. Madison reflected on initial fears of having a private carrier design a digital inclusion plan based on an ad-supported model, which led some participants to vehemently criticize the project. One of the ideologies in TE is that it takes time to comprehend the potential benefits of municipal wireless broadband. Even when such projects are successful (i.e. measurable benefits), there remains the problem of ascertaining what value residents attach to services rendered.

13.3 Analysis from both qualitative and basic quantitative data for each case study

- **Tempe**

All Tempe interviewees (n = 49) indicated the city actively tried to pursue partnerships with the school districts and some local non-profits, providing many authentic opportunities for the entire network to be of use to the entire community. Both city officials and community leaders provided rich examples of how Tempe sought residents' opinions and used a variety of supportive structures through which all citizens could become involved in discussing and making decisions about the Mu-Fi system. Interviewees made several references to Tempe's "commitment to [its] citizens," which allowed users to be involved in some stages of the design and deployment of their network. Furthermore, the interviewees overwhelmingly asserted that Tempe certainly has many challenges ahead as they try to successfully find solutions to their social ills.

The qualitative data suggest one possible explanation for the increase in Internet access. The answer may be found in respondents' perceptions that the network would help bridge the digital divide. Case in point: most participants indicated they personally used the city's wireless infrastructure. These seven interviewees expressed some "excitement" through their assertions that the city, having considered residents' input, would succeed in tackling digital inequality in Tempe.

Nevertheless, several subjects acknowledged that Tempe had made its win-win strategy visible and explicit from the outset by deliberately seeking supporters and having project staff develop solutions to solve government and community problems. Some of these included: (a) providing ubiquitous wireless broadband coverage over all of Tempe's 40 square-mile area; (b) providing an alternative to DSL and cable modem for residents of Tempe; (c) offering free Wi-Fi service in Tempe's downtown retail corridor for visitors; (d) promoting usage of the Tempe's Web site and e-government applications by offering free "anywhere" access to Tempe.gov; (e) promoting usage of online services by offering free "anywhere" access to ASU.edu; (f) building a border-to-border wireless municipal network that would provide total mobility for Tempe municipal employees; (g) enhancing the ability for public safety employees to protect and serve through the use of broadband wireless technology; and (h) promoting economic development in Tempe by making Tempe a smart place to be, and the best place to live, work and play. This leads to a second possible explanation for the increase in the network's membership base

following implementation. By year two, Tempe may have become "saturated" with the utopianist vision of Mu-Fi. This impression emerges from what seven subjects described as too much hype and excitement turning into a "too good to be true," notion explained by the lack of increase in some 2007 NAI (i.e. number of new device transfer mechanism and training venues).

- **Portland**

The quantitative data between 2006 and 2007 for NAI showed no difference in the means for device transfer mechanisms and general training venues, producing a mean difference between years one and two as zero. Portland subjects most often used phrases in the vein of "Portland is not investing in new training opportunities for their residents to learn IT skills" and "to Portland, the digital divide is mostly an access issue" to describe the vision for the city's Mu-Fi. Similarly, other respondents frequently used the expression "the business model is not the best" when they talked about the potential impact of their network on QoL issues.

Themes that emerged from the qualitative data showed subjects perceived Unwire Portland, "for the most part," a limited success in addressing fundamental issues to the digital divide. In qualifying what was meant by "for the most part," a local non-profit interviewee indicated that from a digital inclusion perspective, "the city has got to put up some money of its own to help people get computers…" Put differently, some community members had expectations of what the vision was for the project, and therefore what the city needs to do to make that vision a reality. This sentiment was expressed by all non-city officials in Portland in what one educator described as "not always agreeing on strategies for how Portland might reach the disparaged." Furthermore, both groups of respondents (city officials or not) attributed, at least in part, a lack of consensual agreement in how to reach the desired end-result for UnWire Portland: alleviating the digital divide and enhancing quality of life.

- **Federal Way**

Similar to Tempe and Portland, Federal Way also showed a mean increase in their NAI, namely, the number of users now using Mu-Fi as an Internet access vehicle. The qualitative data overwhelmingly validated this finding. Respondents from both city hall and the local chamber of commerce indicated "the leakage problem" could be reduced by integrating wireless broadband in their community. When asked about Federal Way's narrow focus on the mall, an interviewee said the city did this "on purpose" and further described the city as "doing what others cities would do if they had similar issues." Subjects often spoke about their city as having too strong a focus on day-to-day city services (i.e. the police department) vis-à-vis the network. Both quantitative and qualitative findings showed that study participants had a strong, somewhat collective

commitment to enhancing QoL, though not necessarily directly reducing the socio-digital gap. According to most participants, this was a non-issue in Federal Way.

- **Corpus Christi**

Similarly, in the Corpus Christi case study, there was a mean increase in the number of Mu-Fi users. Like all other case studies, Corpus Christi also showed no difference in the mean for training venues and device transfer mechanism from years one and two.

Qualitative validation of these quantitative findings is evident in subjects' stories, which also provide a more informative picture of how Corpus Christi's digital inclusion agenda was being achieved. All respondents (n = 10) confirmed that residents saw the value of having a viable wireless network, and two of the biggest benefits were the enhancement of city services and the dissemination of information through a city Web portal. Similarly, all interviewees asserted the city continue to seek alleviating the digital divide and enhancing QoL for all residents.

- **Madison**

Despite the lower broadband fee and an increasing membership base of Mu-Fi users, interview participants suggested that, for the most part, the city and MCB were struggling with successfully implementing the network, and, thus, bridging the digital divide. In particular, community respondents indicated they wanted better service, and more direct participation in the deployment of the city-wide system. Furthermore, all subjects implied the digital divide promise largely "remained a dream and not a reality," citing a variety of reasons why; the most common being the state municipal broadband restriction, the business model adopted, poor management, bad service, and a weak marketing strategy. Finally, participants suggested Mu-Fi administrators should better promote and deliver their digital inclusion promise, holding the city accountable.

In sum, both quantitative and qualitative data suggest the importance of using multiple indicators to measure the impact of network aggregate indicators on local QoL and thus, the digital divide. Both datasets reveal that municipal broadband networks, in the five cases examined have not alleviated the so-called digital divide.

13.4 Analysis from both qualitative and basic quantitative data across all case studies

It has been possible to identify the different values for QoL factors, their network aggregate indicators, as well as their pre-post test comparison for each of the respective cities in this study (see tables in section 13.1). This was accomplished by comparing and contrasting the variations between year one (2006) and year two (2007). As a consequence, as many as two dozen quantitative and qualitative indicators were identified in successfully measuring the impact of Mu-Fi networks on the digital divide, a total that rarely appears on Mu-Fi literature during discussions about digital inequality (DiMaggio, Celeste et al., 2004; Gillett, S. E., Lehr et al., 2004; Mossberger, Tolbert et al., 2003). This suggests that perhaps, 1) cities embracing Mu-Fi strategies should consider incorporating a qualitative (or mixed) method assessment program to safeguard against project failure; and 2) academics and researchers should include similar data collection frameworks and methodologies that require both statistical and interpretative data in relation to Mu-Fi and the digital divide.

This said, all the values varied significantly between the cities, with each variable depending on other variables for explanation. In the case of Tempe, who had the highest number of broadband subscribers, is perhaps explained by the fact that the city's average resident had received a high school diploma and had taken some college courses or attained an Associate's degree. Portland, on the other hand, had the highest number of training and general education venues as well as the highest percent of the population with Internet access post installation of Mu-Fi. Perhaps this can be explained by the fact that Portland had the lowest median earnings reported in 2006 and had the highest poverty and unemployment rates than the other municipalities studied. As examined in Section 13.2, Portland should place greater emphasis in working with local employment agencies to decrease unemployment or using Wi-Fi to decrease poverty. It is clear that a quantitative and qualitative strategy that includes QoL indicators in relation to the wireless project and the digital divide was not examined by Portland.

Despite the variations in the data across indicators, it is clear from the table depicted above that all the cities have some similarities. This is evident though the similarities displayed in their approach to tackle the digital divide. For instance, Tempe and Portland both had high school drop-out rates inordinately high and thus were particularly interested in strengthening their relationships with their local school district via their Wi-Fi networks. Divorce, telephone service availability and violent crime rates were lowest in Madison. This perhaps helps us understand why the city and MCB failed to impact the convoluted digital divide as they had hoped. It can be argued that they did not experience the same issues that bigger, more complex city structures like Tempe, Portland and Corpus Christi face. As a result, it seems that those cities that fit the profile of a large, urban metropolis, like Tempe, Portland and Corpus Christi, are better positioned to address digital divide issues than small, rural towns with higher QoL factors. Therefore, the lower the QoL in a given municipality, the higher the probability of impacting the digital divide, because for it to be any different, there would have to be other issues

greater than QoL that move public elites in alleviating digital inequality. This is most certainly not the case despite what was previously thought (Lehr, W., Osorio et al., 2004).

Moreover, despite the increase in the percentage of population with Internet access and the higher number of subscribed users/households and nodes/access points via Mu-Fi, it has not been possible to ascertain if the network has made an impact on the other components that make up the digital divide. Though certainly more residents have gained access to the Internet via their government broadband system at a reduced fee, the number of device transfer mechanisms and training venues remains unaffected. As a result, it is simply not possible at this time to determine if Mu-Fi has had a direct or indirect effect on these components that alleviate digital inequality. Therefore, the exact impact of these Wi-Fi networks for the cities examined remains unknown and it remains impossible to correlate their relationship with a pre-post test of this nature.

In spite of these difficulties in successfully measuring the quantitative impact of Mu-Fi on the digital divide, due to the nature of this study and the trajectories of socio-technical artifacts, it has been possible to establish a qualitative method of inquiry. This method identifies via TE the multiple realities and frustrations in tackling the digital divide. By mostly employing an interpretative, grounded theory approach, it has been possible to identify, understand and interpret to varying degrees aspects of how cities attempt to engage the digital divide that once were solely determined by quantifiable data; namely, connectivity.

13.5 Conclusion: Big take aways from entire analysis

The Mu-Fi system is a complex process that includes a myriad of activities and processes that are geared toward creating an enabling environment for potentially bridging digital inequality and encouraging a society that fosters a high QoL. Using both quantitative and qualitative indicators, the date reveals that an important element of the Mu-Fi process is to ensure that public elites move away from TE and toward a more measurable assessment of their technological endeavors. This is made possible thorough the collection of ground data that plays a pivotal role in determining if the network has had an impact on local community life.

In the quantitative section, the data was corroborated by the interviews. Most interviewees in Corpus Christi said that the city's "digital inclusion concept" was a direct result of the city's large at-risk community. Research has shown a causal link between poverty and education. The findings showed Corpus Christi with the lowest level of educational attainment out of the five cities. Conversely, Madison had the highest, which might explain why that city is not focusing the way Corpus Christi is on the digital divide. The 2006 cross-sectional data analysis is descriptive and provides useful information that supports the qualitative findings of the study. It sets the stage for the study. It allows the reader to see how the situation looks like on the ground. Case in point: predictably, the 2006 sample data shows that urban, more populated cities have been more successful in implementing Mu-Fis than those that are smaller and rural-like.

Of course, there are exceptions. The problem lies in the fact that one cannot obtain reliable statistics with only five cases.

Due to the quantitative design of this study, the quantitative analysis is very limited. One needs at least 50 cases to get reliable estimates with bivariate techniques such as One-Way and ANOVA. These techniques would be able to tell us the strength of the relationship between the cases. This is so because the standard error is huge with such a small sample. Another option is to use the population of each city for the year that the other variables were measured in and calculate rates (mean income per 100,000 or 10,000 people). I used the latter. Using the rates approach would be the only way to compare the means as it standardizes the mean to a fixed population size, while if one compares the raw mean one is not taking into account the size of the state/city and therefore the means are not comparable.

Once I have gathered the remaining 2007 QoL data from the U.S. Census Bureau and the FBI Crime Reports, I will conduct a similar descriptive analysis using the aggregate model I have designed for the study. In April 2007, the goal will be ascertain if any (or all) network aggregate indicators affected QoL aggregate indicators. In other words, the study aims to examine, for example, if having more access to Wi-Fi reduces crime, increases median earnings, increases school enrollment, etc. Though these are certainly interesting questions and can become full journal articles in the future, this is not the main research question of the study. The main research question is to determine if Mu-Fi has an impact on the digital divide. As stated during the defense, the goal was to use qualitative data to support (disprove) if Mu-Fi impacts the digital divide. The quantitative findings are used to support the qualitative findings, not vice versa. Given the nature of the study, I don't expect my findings to be altered in any (major) way once the quantitative 2007 QoL factors are plugged into aggregate model.

In the qualitative portion of the study, the thesis posits that one of the ideologies underpinning the design, development and rollout of municipal wireless broadband is TE. Like many other governments, public elites in the US believe that introducing technological solutions dramatically influence the social fabric of their communities. To Mu-Fi leaders, the diffusion, adoption and usage of wireless broadband by citizens will open doors to additional opportunities; namely, create jobs, reduce crime, promote a sense of community and help the information deprived. Yet city-wide wireless broadband networks are not a natural process, although they have been touted as such by the mass media and popular press. By accepting it as a natural process, we accept it without question and legitimize the technological artifact. Such belief is mythic and highly deterministic, and has been intrinsically woven into the fabric of Mu-Fi culture.

Overall, I interpreted the subject's stories as reflecting both the current and future status of the project. I discovered eight themes during the course of the interviews: complexity, responsiveness to the community, reaction to availability or lack of resources, patterns of relationship building / potential partnerships, diversity / richness of approaches, knowledge base, integration of policy initiatives, and perceptions of enhancing sense of community and participation. These themes achieved three

objectives. First, they revealed the cryptic issues five U.S. cities are experiencing to date. Second, the themes exposed different components of the research question, leading to additional learning, meaning making, and perhaps future research questions. I will discuss this further in the next section as I attempt to address the main research question of this study.

Both qualitative and quantitative findings suggest that Mu-Fis have the potential of increasing QoL factors and possibly bridging the digital divide. However, given their current architecture, Mu-Fis over promise and under deliver. The study revealed each city's process of attempting to engage the digital divide and the Byzantine nature of that process. Several NAI could be an influential factor in increasing QoL factors. For instance, several participants reported that increased availability of nodes, expanded coverage zones, and additional training and general education venues might increase the project's rate of success in relation to higher QoL standards.

The following provides summary information about the most prominent issues encountered by the five case study sites:

- **Lack of additional technology infrastructure.** A significant barrier for some of the cities was the time, cost, and effort required to develop the infrastructures to support their technological efforts. Many of the stakeholders that were interviewed indicated that their communities' existing telecom infrastructures were either nonexistent or incompatible. These problems, which were sometimes discovered after the Mu-Fi had been initiated, commonly resulted in excessive fees and extensive delays. In the case of Corpus Christi and Portland, the project was delayed numerous times.

- **Keeping pace with evolving technologies.** Some municipal projects reported that concerns about unanticipated technological advances (and the ensuing obsolescence of old PCs) made it difficult to develop long-term budgets for their wireless project.

- **Keeping pace with end users' evolving needs.** One project manager indicated that several city officials had underestimated the number of residents who would use computers and require Internet access. In addition, as the project evolved, end users were making more advanced use of the Internet (e.g., using computers to setup personalized profiles with pictures —which require greater bandwidth capacity to facilitate downloading) than had originally been envisioned at the outset of the project.

- **Underutilization of project technology.** Some cities indicated that Wi-Fi access was not fully utilized by end users. This problem was especially prevalent among areas with low-income residents. Several factors contributed to the underutilization of the service —e.g., not assessing residents' interest in making frequent use of the Internet, a lack of promotion to inform potential beneficiaries of Internet access / capabilities.

- **Underestimating the time required to implement the Mu-Fi.** Almost all of the case study projects indicated that they underestimated the amount of time implementation tasks would require, particularly with regard to technology. Projects that involved the installation of equipment were especially vulnerable to delays in their proposed schedule. This is because such projects were often required to rely on external entities to provide equipment or carry out other technical functions.

- **Lack of socio-technical expertise among project staff.** In addition to encountering difficulties in retaining knowledgeable and skilled staff, several projects experienced recruitment difficulties with the range of skills needed to lead or implement their Mu-Fi efforts. For example, several cities reported that after they had launched the Mu-Fi, they lacked reliable access to staff capable of resolving unexpected problems such as handling public-private partnerships.

- **Lack of a comprehensive training agenda.** The case studies uncovered evidence that several of the cities failed to set aside sufficient time and resources for training. Residents expressed concern that although they might learn some important introductory skills, they might not learn how to fully integrate those skills into their daily work routine and truly improve their QoL.

- **Lack of a comprehensive marketing strategy.** A few of the case study sites did not anticipate the amount of marketing that would be needed to ensure the success of the network. For example, Tempe opened a series of training centers tied to the Wi-Fi network with little or no fanfare. In retrospect, one interviewee mentioned that they should have campaigned more vigorously to promote the program prior to and immediately following their opening.

CHAPTER 14: DISCUSSION AND IMPLICATIONS

14.0 Introduction

Through the comparative analysis of five city case studies, this study aims to answer the overarching research question:

Does a municipal wireless broadband network have a perceived measurable impact on the digital divide?

This research question is answered through the qualitative detailed analysis of the data collected in Chapter 5. The section below addresses the main research question of this study. The digital divide argument is also reassessed. Then, a discussion on measuring impact is presented as well as what information systems researchers have been writing for years in relation to failure theory. The next last few sections highlight the theoretical and practical implications and contributions of this study. The chapter ends by addressing the main research question.

This research is critical if public policy is to make significant progress toward the integration of broadband into the social fabric of American life. Since the Telecommunications Act of 1996 was passed, public officials, policy makers, private carriers and researchers have struggled to incorporate the universal service ideas of telephony into the information society via broadband Internet. Research such as this holds the best hope for finding ways to promote successful broadband integration and civic participation.

14.1 Bridging the divide: Universal Service as a social contract

Existing research exploring the digital divide has tended to take a socio-economic focus. These studies have suggested that the primary factors contributing to the digital divide are income, employment, education, gender, age, ethnicity and disabilities. This research study adopted such focus in designing its multiple QoL indicators. Individuals who can be identified through these factors are more likely to represent the "have-nots" in the digital divide. Whilst these studies are useful in illustrating trends and suggesting possible relationships; and in placing the digital-divide issue into the public spotlight and onto the government agenda, they are nonetheless limited by their narrow focus. A "socio-economic only" perspective does not provide a full portrait of the digital inequality in community. Several researchers have talked *ad nauseum* about the plurality of the digital divide (Kvasny, 2002; Kvasny & Truex, 2000; Van Dijk, 2001; DiMaggio & Hargittai, 2002; Hoffman, D. & Novak, 1998; Norris, 2001; Selwyn, Gorard et al.,

2001; Hoffman, D. L. & Novak, 2000; Servon, 2002; Freire, 2000; Tapscott, 1998; Bagasao et al., 1999; Babb, 1998; Schement & Forbes, 1999).

The current study seeks to build upon the existing body of knowledge of these researchers. The study employs a theoretical model of technological enthusiasm for Mu-Fi that considers participants' notion of the digital divide and its relation to Mu-Fi in five U.S. cities. The research is based on the premise that by combining a grounded theory and theory extension approach to this qualitative-interpretive-critical study, a richer, more detailed and accurate picture of municipal broadband can be established.

Interestingly, the results of the research reveal that when considered together, it is a positive, idealistic, mythic and perceived impact – not actual quantifiable impacts - that are the primary drivers of Mu-Fi use by local governments. As such, technological enthusiasm as a theoretical framework of municipal broadband vis-à-vis the digital divide provides the most accurate perspective for understanding its impact in their communities. A graphical representation of this framework is provided in Chapter 3.

The data reveal that the digital divide is far more complex and evolved than has been imagined. It also supports the argument that the phrase "digital divide" is a misleading oversimplification. Digital inequality in community is more than just a "have" and "have-not" dichotomy of physical access to technology. It is a political rhetorical device lacking a policy focus. It appears that the key elements that first must be addressed in bridging the division between the "haves" and the "have-nots" are QoL factors such as income differences, unemployment, poverty, educational levels, etc. Indeed, the study proposes that the Mu-Fi debate is increasingly less about the digital divide per se and more about a technology craze that has enamored government officials.

The research is significant because it is the first time that a study exploring the digital divide vis-à-vis Mu-Fi has used qualitative indicators in the research design; used subjects of the selected Mu-Fi cities during the data collection process; and was conducted during a period when many cities are abandoning their projects. The outcomes of this research influence our understanding of the impact of these systems in a number of ways. First, it establishes a way of thinking about and understanding digital inequality in community that goes beyond just simple access to connection to technology. Second, the findings provide evidence that the characteristics or make up of the digital divide is more complex than the current dichotomous understanding touted by public elites. Some city officials assert that by not investing in Mu-Fi initiatives, the more likely they will widen the gap between the haves and have nots. To them, current market failures are their chief motivator. However, the study revealed that municipal intervention is not bridging the digital divide. Thus, this would suggest something else might be influencing public elites to engage ICT in their local communities. The study illustrates that this something else is technological enthusiasm. As such, the current research has brought to light elements of the digital divide which have not being considered in contemporary discourse about the phenomenon.

As a result, this research illustrates that organizations like municipalities that aim to support ICTs like wireless broadband need to incorporate a universal service strategy into their program. Programs to bridging the digital divide should include the four core components of universal service noted by Jorge Reina Schement: connectivity (from simple to multiplexed access to the network); capability[64] (digital literacy becomes a basic skill and an information right); content (integral to access); and context (influences applications). Put differently, city governments need to go beyond affording low-cost access so the chances of citizens' use of the Internet are maximized. It is my contention that charging for Internet access works against this strategy. Opportunities should be made available for people in communities who do not normally have access, for whatever reason, to be given access; for example, mobile Internet services to disparaged communities. This should be more than just a "hit and run" access; as these do not allow the opportunity to steadily build on the skills being acquired. The use of these four components of universal service may require that city and community staff members get involved in designing, delivering and supporting the sustainability of the Wi-Fi network. It will inevitably require support from policy makers at the most senior levels; and it will need greater financial assistance.

14.2 Perceptions of measurable impact

Having discussed the complex nature of the digital divide, next the discussion turns to the insights generated about impact through the use of the technological enthusiasm framework.

This dissertation has explored the impact of Mu-Fi networks on the digital divide. Mu-Fis have been found to play no significant role in the process of impacting the digital divide. Specifically, this study provides evidence that network aggregate indicators to increasing QoL factors for five U.S. municipal wireless broadband communities is weak. As previous studies have indicated, when considering the use of ICTs for local development, it is essential to have a clear development strategy at the outset; it is imperative to have an unequivocal understanding of digital divide-alleviation targets that are specific to the context before the form of use of ICTs is defined (Katz & Aspden, 1997; Katz & Rice, 2002; Oden, 2004; Oden & Strover, 2002; Tufekcioglu, 2003; Hoffman, D. & Thomas, 1999; Strover, Chapman et al., 2004; Strover & Straubhaar, 2000). Ironically, as stated in the previous section, even with such an elaborate agenda, engaging the digital divide is still a most complex encounter (DiMaggio & Hargittai, 2002; Gordo, 2000; Lazarus et al., 2000).

The theme of partnerships as a form of relationship building to ensure the success of the network was found to contribute to possibly decreasing the digital gap. Although it has been argued that engaging the digital divide is not an easy task (ibid.), other studies have revealed the importance of partnerships in both social capital studies (Granovetter, 1973; Putnam, R D, 1995; Putnam, Robert D., 2000) and community informatics studies

[64] We need institutional changes to give homes access and one institutional remedy dates back to the 1840s - public libraries. Libraries and schools can be seen as universal service provider.

(Eglash, 2001b; Gurstein, M.. 2000; Gurstein, M., 2003; Loader & Keeble, 2002; O'Neil, 2002) of the digital divide reduction process. Themes that have not been examined in previous Mu-Fi studies, such as availability of resources and the integration of policy initiatives, are expected to play a significant role as well.

Although it was believed that this study would produce slightly different results the insignificant impact on local QoL was not expected. A future task of this study is to develop separate models for both datasets in order to further examine the effect of Mu-Fis on QoL indicators.

Interestingly, previous studies have found that investing in Mu-Fi efforts in fact does impact cities' economies (Lehr & Osorio, 2005; Lehr, Osorio, et al, 2004). Conversely, this paper does not affirm the contribution of socio-demographic characteristics like QoL factors on the digital divide, despite the mediation of wireless broadband solutions. However, the results in both studies exhibited similar patterns. Mu-Fi projects have the potential of significantly impacting a community by promoting digital inclusion.

It is not surprising that the cities surveyed in this study were euphoric in their approach to tackling the digital divide via Wi-Fi technology. The desire by local governments to bridge the gap between the rich and poor has led to a significant number of municipal broadband efforts to exploit Wi-Fi for digital divide reduction. The successful experience of other efforts (particularly the Asia-Pacific Corridor, for instance) has lent support to an "ICT-led" development thesis implying that U.S. cities can adopt "leapfrogging" strategies. Using this approach, wireless broadband represents a "window of opportunity" for U.S. cities to move from a "sub par" or "limited" condition to widespread adoption of sophisticated technologies. Even if the same economic organizations were to be duplicated, they are likely to have very different consequences in different contexts.

14.3 Failing to recognize past technological busts

Having discussed the tumultuous sphere of the digital divide, this section discusses how the findings relate to prior research on failure theory in the IS research field.

The history of technological advance has been marked by incredible inventions and ideas of great aspirations but that soon were left unfinished or abandoned halfway through. Some of them were ahead of their time, while others were too costly and unattainable for the great public. in other opportunities marketing failed and, of course, many of them were simply bad ideas or poorly applied good ideas. Examples of these "great" ideas include: Betamax VCRs, the Apple Newton, E-Books, Virtual Boy, Iridium, Microsoft Bob, Teletrébol, and countless others.

Some practitioners and researchers argue that technology is a tool that serves humanity in achieving its common objectives (Kling, R. & Lamb, 2000; Kling, Rob, McKim et al., 2002; Negroponte, 1995). To them, technology is created by humans; it eventually

matures from the human world and leads an existence of its own. The resulting view is that a technological tool is tailored toward a certain task, which can successfully be used to address the task and solve the problem. Management of the system thus has to ensure that the right tool for the task at hand is present. Once this has been achieved, the rest is a matter of detail and skilled application. According to failure theory, IS failures can occur during development or during system use and may be viewed differently by various stakeholder groups. The story of Mu-Fi networks fits this description. How else could one explain the fact that local governments believed that it could go ahead with the new technology to bridge the so-called digital divide?

Other academicians assert that a more bottom-up approach is more suitable for the successful implementation of city-wide Wi-Fi projects (Gurstein, M., 2003; Orlikowski & Robey, 1991). To them, the bottom-up model assumes that technology is not determined by governments or telecom providers, but is negotiated by all stakeholders in the community. One example of the bottom-up alternative could be the community-grassroots groups that are currently deploying wireless solutions in various cities (CUWIN in Urbana-Champaign, Illinois; and Ile-Sans-Fil in Montreal, Canada are two examples). One can argue that the bottom-up framework would put citizen information rights first, accepting the higher costs, if necessary. A bottom-up advocate would argue that Mu-Fi initiatives should be adjusted to the public requirements (i.e. content and context), not the other way around.

In this study, the thesis has put forward the theory that the "bottom-up" model is of great importance for successfully tackling the digital divide. It used the example of American cities' attempts to institute wireless broadband showing that management of this technology and their limited success can be explained by hearing the stories of local stakeholders. It argued that technological enthusiasm, as the main motivator of public elites, is not contributing in closing the digital divide, because Mu-Fis neglect people. From this standpoint, technological enthusiasm tends to overemphasize the benefits of wireless services. Furthermore, it proposed that a bottom-up approach as a more viable alternative, which puts the Wi-Fi into the social context.

Nevertheless, ignoring societal dynamics and complexities, coupled with the fact that it has never been used successfully on a national scale, governments press on with their "muni broadband" agendas. The lack of measurable impact on the digital divide by Mu-Fi networks could be overcome (or ignored) on the basis of a more grassroots approach. Had governments been interested in a bottom-up approach, then the entire initiative would have developed in a different light. This bottom-up, or constructivist[65] (Bijker, 1995; Kling, R. & Lamb, 2000; Kling, Rob, McKim et al., 2002; Lamb, Sawyer et al., 2000; MacKenzie, 1990) approach does not believe in the independent existence of

[65] The Social Construction of Technology (SCOT) is not only a theory, but also a methodology; it formalizes the steps and principles to follow when one wants to analyze the causes of technological failures or successes.

technology, but sees it in a social context, where technology is being constantly constructed and reconstructed through it's use and interaction.

Interestingly, the recent growth of municipal broadband efforts follow an unequivocal pattern often described as "technological adoption and diffusion," marked by multiple decisions, and often characterized by a large degree of complexity [Rogers]. It can be argued that this pattern might be one of the major drivers toward local and national economic convergence. Similarly, because technological adoption and diffusion is nonlinear and path dependent, the compounding effect of experience and technological learning, may cause technologies like wireless broadband with minor initial successes (or political support) to become favored in the end, even if they are not ideal in the beginning. Rogers explained that the characteristics of this innovation pattern matter. Innovations are adopted at faster rates when they are observable, simply, have a clear relative advantage against incumbent technologies, and are compatible with existing knowledge [Rogers]. Most government-led broadband projects possess these characteristics. This said, however, there are important differences in the degree of Mu-Fi diffusion or adoption across municipalities. The literature review summarizes research that addresses this issue. In sum, the experiences in adoption and diffusion of a new technology like Mu-Fi would be a valuable lesson for other cities in the country as they look for solutions to address their social problems.

Although public elites might not be aware of this discourse, they cannot escape the fact that technological busts happen on a regular basis. The case of municipal broadband for the five cities in this study is a typical example of it. However, it gives us a different perspective and it may allow public elites to avoid some of the mistakes that are frequently made. At the very least, it can be understood as a motivation to reflect upon and question the philosophical assumptions one holds and thereby perhaps improving the way one deals with technology.

14.4 Theoretical implications

This section makes explicit some of the theoretical implications of the data discussed and the analyses proposed. This will help situate the main findings of this part in a broader theoretical framework.

The present study has several theoretical implications. First, the structural approach of the digital divide is not enough to explain and solve the social ills of municipal residents. The present study examined the perceived impact of municipal wireless networks on the digital divide. Even though the effect of NAI on QoLAI in all five communities is generally weak, this only partially explains the limited success of these initiatives in most Mu-Fi settings. Each city will define success differently. Particularly, some public elites will point to the success of their project in their downtown core. To Mu-Fi decision makers, this is clearly a sign that the project is promoting digital inclusion. Thus, the present study suggests that differing definitions of the digital divide may be explained by

understanding how city leaders construct differently the operational and symbolic roles of wireless broadband.

Second, the study provides theoretical implications for studies of the Internet and government-led ICT deployments. The relationships of Internet use to government interventions in hopes of alleviating the digital divide can be examined with diverse approaches, as many as definitions of the digital divide (see literature review chapter), and as many as elements of government market interventions (see context chapter). The contribution of technological enthusiasm to the Mu-Fi literature focused on the association of the digital divide with the delivery of government-led wireless broadband initiatives, and found that Mu-Fi's over promise, over simplify and under deliver. Given that the digital divide is a multi-dimensional social phenomenon, the findings suggest that current Mu-Fi design does not have the potential of ultimately alleviating the gap.

Third, this study offers a more nuanced view regarding the existence of the different types of success attributed to Mu-Fi. In light of the findings, it appears that we get only part of the story from the commonly held assumption that success is true for cities that simply deliver and build wireless nodes throughout their municipal jurisdictions. Sometimes, it is equally (if not more) important to involve local community stakeholders in the decision-making process from the outset. Thus, researchers studying the implications of government-led broadband systems on digital inclusion should be particularly careful when they only invoke the technological challenges as part of their arguments.

14.5 Theoretical contributions

Both theory and empirical findings contribute to our understanding of the interplay between municipal broadband dynamics and digital divide complexity. This study also contributes to our understanding of the research question of how organizations like city governments in five American cities have designed, implemented, and adopted Mu-Fi networks.

The findings of the case studies suggest that complexity, responsiveness to the community, reaction to resource shortages, patterns of relationship building, diversity/richness of approaches, stakeholders' knowledge base, effective integration of policy, and the perceptions of the project enhancing community identity and participation were relevant themes and contributed to a better understanding of the digital divide. Hence, the likelihood that a successful Mu-Fi initiative will be successfully designed, implemented and adopted increases when these themes are carefully considered, leading to a better understanding of the digital divide.

The application of technological enthusiasm helps to analyze the findings of the case studies. The following "nuggets of knowledge" where extracted from these case studies:

- Technological enthusiasm helps us understand the context of cities' values and their differing reality "on the ground." There is a distinctive view in government that technology determines social change. The difficulty with this scenario is that these claims are difficult to substantiate empirically.
- Technological enthusiasm posits that policy initiatives start from the assumption that access to the technology is necessarily desirable and hence access *per se* is the policy change to be met in order to achieve the socio-economic potential of ICTs like wireless broadband. When employing Mu-Fi, it is clear to have a crystal clear strategy at the outset.
- The theoretical framework employed shows technologies like Wi-Fi have been idolized and framed as a force that can fix the social fabric of life by eliminating scarcity, like unemployment, poverty, poor quality QoL, amongst others
- From the stories of these participants, we learn how multiple levels of complexity – political, system, historical – can serve as a filter or layer through which these cities perceive, navigate, or negotiate their TE.
- It appears that governments have latched on to Wi-Fi as a "good thing" rather than critically exploring the claim they represent (or may represent.
- Governments need to clarify and delineate what Mu-Fi endeavors are aiming to do. If cities do not carefully think through these issues, there is a risk that Mu-Fi systems will fail, thereby wasting valuable resources.
- The framework used in this study claims that technologies crafted with open-ended outcomes have no reason to emerge as the ultimate antidote of social maladies, any more than other major socio-technical changes have had such effects in our past.
- The theoretical framework employed reveals that a poorly informed Mu-Fi initiative will give rise to a policy rationale suffering from short-sightedness.
- One of the ideologies in TE is that it takes time to comprehend the potential benefits of Mu-Fi networks. Even when such projects are successful (i.e. measurable benefits), there remains the problem of ascertaining what value residents attach to services rendered.

The above points suggest that it would be worthwhile to further examine how public elites, incumbents, and local community groups engage their citizens in attempting to alleviate the digital divide.

Although some research studies have been conducted on how cities as organizations design, develop and use telecom services (Jacobson, 1977; Thomas, 2004), very little has been done on the role municipalities play as Wi-Fi service providers (Gillett, 2006). The work developed by Jacobson passionately asserts that only local, municipally controlled cable can foster participatory democracy. The work done by Thomas four years ago delves into government entry into the telecom business and explores if the benefits are commensurate with the costs. Gillett discusses the issue of how to ensure municipal oversight does not get subverted to create superficial limits on future wireless competition all while deploying broadband wireless. Although there are studies on the design, development and use of ICTs, none of these have Mu-Fi networks as their main

focus, specifically the interplay between municipal broadband dynamics and the complexity of the digital divide.

14.6 Practical implications

This study also has several practical implications for a variety of users (local governments, policy makers, technologists, incumbents, and so on). As discussed in the literature review, the digital divide is an evolving concept (DiMaggio, Celeste et al., 2004; Kvasny, Forthcoming; Schement, J. R. & Curtis, 1997). Knowing this, public elites have framed their Mu-Fis as a tool that can improve the social fabric of their communities. Thus, the issues of good digital divide policies and a progressive process for evolving policy are therefore of utmost importance. It is important to go beyond the hype and political correctness and tackle the issue head-on. This process should: i) build awareness and understanding of the potential impact of ICT for development; ii) take ownership of the policy reform process at the local level; iii) have political determination; iv) include multi-stakeholder collaboration; v) seek active participation of at-risk groups; and vi) be flexible to adapt to local needs and wants. The importance of the evolving policy process is precisely that, inter alia, flexible policies that promote digital inclusion in the new information economy. Unfortunately, there can be a dangerous tendency by public official to over-simplify and polarize issues in the short-term. This is due, in part, to politicians' short-term tenure in office. This can be problematic as most science and technology programs require a long-term and systematic approach (Bijker, W., Hughes et al., 1987; Rogers, 1995). Government policy rhetoric anchored in the value of wireless broadband needs to be met with significant funding, resources and community support. As this research shows, there are dangers that a superficial investment will lead to surface change that does little to improve the reality of Mu-Fi communities. Below are just a few public policy questions worth considering:

- If municipal broadband is not the solution, what is?
- If access is not enough, what exactly, coupled with universal service, is?
- If universal broadband has had measured positive effects on the economy, why have there not been equally positive effects on the digital divide?
- What are the acceptable limits to government intervention to facilitate broadband change activities in the US?
- How can we afford universal access to sustain our global competitiveness in the 21st century?
- What are the future scenarios of broadband access?

This study does not reveal a panacea as to how policy-makers could help ensure Mu-Fi success. However, it points to the importance of factors that are often overlooked in municipal broadband policy, namely the general understanding of the multifaceted nature of digital divide programs. As previously mentioned, the relationship between the digital divide and Mu-Fis is an aspect requiring further study. One factor that may reduce the digital divide is improving local quality of life for residents. The study suggests that when we view quality of life in terms of broader social indicators, namely, socio-

economic indicators (Diener & Eunkook, 1997; Hsieh & Liu, 1983; Ziegler & Britton, 1981) and incorporate them into a measurement matrix, we may improve the predicting capacity of the levels of impact of such projects. Moreover, for Mu-Fi prononents who view these systems as a gateway leading to a more equitable society, the stark reality in 2008 is that more and more cities are not taking the high road of successfully tackling the digital divide. Beyond a splash page and loosely-formed partnerships, there were no substantial elements that allowed for a digital reduction strategy for these five cities. This raises a broad range of issues which should constitute the platform for future municipal deployments:

- If local governments are not the right leaders of telecommunications change, who is?
- What will the future of communities be in the information society?
- What role will libraries, governments and network connectedness play in promoting democracy and ICT?
- If access alone does not diminish the social problems engendered by technological inequality, what forms might social interventions take that would diminish the problem of information inequality?
- Should municipal governments continue to bring about lower-cost broadband services by leveraging government's regulatory influence or financial resources?
- How can governments build a strong policy framework that will stimulate ICT innovation, and promote investment in businesses (without favoring specific technologies)?

These are just some of the questions that can be explored in future research.

Furthermore, this research posits that cities will continue to face growing opposition from the telecom providers as they launch efforts to speed up broadband deployment. But, as this research has shown, designing and deploying Wi-Fi is a risky endeavor, and not all Mu-Fis are fulfilling their promise of bridging the digital divide. The latest efforts have triggered intense opposition from incumbents. Cable and telecom companies have successfully lobbied fifteen state legislatures[66] to pass laws prohibiting municipalities from entering the broadband market. Cities are also being abandoned and somewhat betrayed by their telecom partners. In 2008, EarthLink confirmed it was pulling the plug on its wireless partnership with several U.S. cities, including Corpus Christi. This raises some serious questions:

- Should private WISPs be concerned about the growing digital divide?
- Should private telecommunications companies be the sole purveyors of broadband in the new information society?
- How should regulators approach the competitive nature of the telecom industries in the new global economy?

[66] As of December 2007

Lastly, the implications of this research to technologists are also worth mentioning. As discussed in the literature review, the internet plays a crucial role in every aspect our lives (education, business, communication, etc.). Expanding access to critical technology that enables Internet access is paramount in today's digital global economy. This expansion should not only include access to the hardware but also lifelong skills training. This study explores the notion of a possible shift from a political economy in which the key actors that control technology are public elites and incumbents to a participatory economy that promotes democracy and access to knowledge. The thesis reveals the role of technologists --within and outside the community. Some questions to be considered include:

- What is the role of technologists in pushing the limits on access within communities?
- How should technologists interact with regulators, pliticians, other community leaders, and other stakeholders?
- Should there be a shift from Mu-Fi to creative communities changing technologists' work?

In sum, this study has showed that some U.S. cities are wasting money, valuable time and effort. The gap between the digital haves and have-nots continues and grows. Community groups, partners and the public grow disillusioned and distrust of public officials and government grows. The belief that technology solves social problems continues uncontested, to fail again and again.

14.7 Practical contributions

One of the practical contributions of this research is the detailed insight provided by the five case studies, which reveal that Mu-Fi projects should be more directly linked to universal service policies (specially in the areas of content, context and capability). This implies that for effective measurable impacts to be obtained, emphasis should be placed on the importance of understanding the four components of universal service (beyond connectivity). This will help increase the successful integration of Wi-Fi in their respective communities, and hopefully, bridge the digital divide.

Second, the case studies also reveal that governments (and community groups, too) seemed to have been blinded by the novelty of Wi-Fi, though the qualitative evidence suggests these projects fail to live up to the proclaimed ideal of progress. To conceptualize technological change outside of any socio-political, socio-historical, socio-economic context causes the technology, in this case access to Wi-Fi, as an autonomous agent that has a direct effect on other societal processes. Both governments and citizens need to move away from this "tech obsession" in order to potentially bridge the digital divide.

Another practical contribution is the framework for analyzing how cities attempt to engage the digital divide. Using analytical induction, theory development, and a

qualitative-interpretive-critical epistemology, this study reveals how substantive – autonomous – deterministic theories provide the main analytical tool (i.e. technological enthusiasm) to gain an understanding of the interplay between municipal broadband dynamics and digital-divide complexity. Thus, the contribution of this research is to understand, based on theoretical assumptions, how government-led Wi-Fi initiatives attempt to engage the digital divide, and also how it has a perceived measurable impact on it. To this end, the model adopted can be used as a practical tool.

14.8 The whole picture: Addressing the research question

From a qualitative perspective, the availability of a Mu-Fi network did not make a discernable difference in terms of bridging the digital divide in five U.S. cities. However, data from the interviews demonstrate that participants experienced a great deal of understanding of the digital divide when speaking about how governments should attempt to tackle the issue at the community level. This understanding was facilitated by questions that probed further on partnerships, lack of/availability of resources, richness of approaches, and so on. Participants produced not only a greater number, but also more complex connotations about how cities should really get involved in alleviating this social ill. The only exception was Federal Way, which was mostly prompted by the local mall to build its network, despite the system's initial goal of bridging the digital divide.

Consistent with DiMaggio, Hargittai and Kvasny's (DiMaggio & Hargittai, 2002; Gordo, 2000; Lazarus et al., 2000; Mossberger et al., 2003; Oden & Strover, 2002; Servon, 2002; Van Dijk, 2001; Warschauer, 2002, 2003) studies, and contrary to Compaine's (Compaine, 2000, 2001) study, alleviation of the digital divide facilitated by the intervention of Mu-Fi programs for five U.S. cities did not have a measurable impact. This study suggests that advances in municipal broadband reform such as key partnerships, diversity of approaches, human and financial resources and the integration of policy, improve the success rate of such deployments.

As previously mentioned, the relationship between the digital divide and Mu-Fis is an aspect requiring further study. One factor that may reduce the digital divide is improving local QoA for residents. The study suggests that when we view QoA in terms of broader social indicators, namely, socio-economic indicators (Ziegler & Britton, 1981; Diener & Eunkook, 1997; Hsieh & Liu, 1983) and incorporate them into a measurement matrix, we may improve the predicting capacity of the levels of impact of such projects. In the case of this study, the model proposed by the author does not show any impact on the digital divide beyond those stated above.

The answer to this thesis' research question, "does a municipal wireless broadband network have a perceived measurable impact on the digital divide?" is found in the findings chapter (Chapter 13). The reality differs a lot from the material found on the topic online, government press releases, and news sources. This research study is a good example of how it can look like in practice.

14.9 Chapter summary

In sum, this study suggests that government-led wireless networks might have a measurable impact on the so-called digital divide when public elites adopt a universal service approach, and a better understanding of their philosophical views is examined. While universal service is a good policy approach for predicting the success rate of municipal Wi-Fi systems, the theoretical framework adopted in this research is better at explaining how and why cities attempt to engage public rhetoric in the form of the digital divide. The findings hold when analyzing the five U.S. cities examined with both theoretical and practical contributions.

This said, however, it is important to consider, or even anticipate, the potential unintended consequences of these government interventions. Mu-Fis' ability to facilitate and coordinate the interconnection of people, organizations, and communities might trigger cultural homogenization and a weakening of social contact within the city. Second, municipal broadband's ability to accelerate and automate the pace of day-to-day life might leave disconnected groups further behind. Third, the city might cherry pick the state's largest consumer base of advanced communications services, providing a deterrent for the telecom industry to invest in its telecom infrastructure. Fourth, local context also needs to be considered over public provision of broadband. Digital divide "solutions" which work for one city may not necessarily apply for another. Fifth, the "shot clock" approach taken by some state legislatures could force a variety of unintended consequences as local governments might rush to decide among the technical options before fully examining all strategies. And lastly, there's the idea that the digital divide requires government intervention, and intervention will invariably and inevitably lead to unintended consequences. This argument leads to a larger debate over whether government can ever act in useful ways, which is quite difficult to summarize. However, in response, some supporters of Mu-Fi have argued that FCC action alone is necessary and sufficient. Others posit that legislation will simply duplicate principles already long in place for many communications systems.

Let us turn to the conclusions and suggestions for future research of these findings.

CHAPTER 15: CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

15.0 Conclusions

This study was designed to explore the relationship between municipal wireless broadband and its impact on the digital divide over a one-year period. An overview of the literature revealed that there was an agreement in both popular press and among scholars, that the digital divide has widened over the last decade. The literature also revealed the existence of very few studies linking government-led telecom services like wireless broadband with the digital divide or with QoL measures.

The exploration was carried out by the author using a qualitative methods approach, which included network aggregate indicators (NAI) considered to have a perceived impact on aggregate QoL indicators suggested by theory and practice. The aggregate model included a definition of the digital divide that linked NAI via the Mu-Fi to QoLAI for five U.S. cities. Several themes were revealed during data analysis, namely, complexity, perceptions of project enhancing community identity and participation, integration of public policy, and five others. The theoretical lens and technological enthusiasm helps us understand that Mu-Fi networks have yet to produce a perceived measurable impact on the digital divide, as evidenced by the qualitative findings. Despite the abundance of predictions of the impact of the "muni wireless" revolution on society that range from positive to negative, from essentialist to constructivist, we are still unsure whether information and communication technologies like Wi-Fi in the hands of public elites will follow patterns of diffusion, adoption and usage to possibly narrowing the digital gap. Indeed, telecom services like Wi-Fi have grown in popularity in the last decade, but the gap in access to ICTs between the information poor and information savvy has not diminished. This is interesting when one considers the euphoria that followed the introduction of TVs and radios in the 1970s. Radio receivers and TVs also grew exponentially in popularity but the gap in access to these media between developed (post industrial) and developing countries did not decrease. On the other hand, because the use of TVs and radio increased much more sharply and aggressively in developed countries in the 1970s, the inequalities of access today between developed and developing countries are actually slightly higher than they were three decades ago (Norris in press).

The research strategy and methodology carried out to analyze the impact on local QoL factors included a pre-post test, multiple case-study approach. This strategy used a qualitative methods of data collection. The qualitative methods included 49 semi-formal, structured interviews. This produced an aggregate model which explained the relationship between NAI on QoLAI and, thus, the impact of Mu-Fi on the digital divide. A major conclusion from the study is that the pre-post impact of Mu-Fis on the digital

divide lies in its ability to explain what engaging the tumultuous sphere of the digital divide entails. The belief in the existence of a strong and positive association between progress in ICT development and bridging the digital divide, suggests that this association will continue to hold for the future, implying the need for future studies of this kind.

15.1 Anomalies and new questions brought to light

This study itself brings to light anomalies and questions that are of interest. This section will enumerate and discuss seven such questions:

1. First is the question of whether cities are going to incorporate universal service components to their municipal Wi-Fi agenda. Would they deploy differently? What would they deploy? It would be productive to examine the data for any indications of whether city officials are thinking about other components beyond access, and to collect new data answering questions regarding these respondents' perspectives. This is interesting because wireless broadband is still an enamored concept, and indeed cities will inevitably continue to make decisions regarding investing in their future.

2. By and large public elites turned their Wi-Fi access to students and professional business workers in their downtown corridor. Statistically speaking, these groups are more likely to be Internet users and by extrapolation, excellent sources of assistance. But public elites were slow to turn to disenfranchised communities. Are the IT skills of marginalized groups being ignored by muni Wi-Fi initiatives? What are the barriers and how can they truly be overcome?

3. The QoL variables collected over the course of one year as an indicator of the digital divide are difficult to measure with enough specificity to be conclusive. QoL is a very subjective and shifting phenomenon, just the like the digital divide. More detailed questions could pinpoint this more effectively.

4. Improving QoL and bridging the digital divide are both ideas that some research equates and other research does not. These concepts need further clarification.

5. Specific grassroots groups were clearly identified, but what are other groups doing with their citywide wireless network, what is their purpose in using broadband? The study focused on groups the city identified as allies (or potential allies), not on groups that act as possible competitors (or potential foes). A more complete picture of municipalities attempting to engage the digital divide would include such analysis.

6. In table (in Chapter 5) there are some subjects which do not fit the pattern, namely, Table 1 (in Page 72). A larger N would make it possible to turn up the

microscope and examine these participants in the table. What are the dynamics there?

7. In general, the quantitative findings were backgrounded in this study. Foregrounding these data to see their influence (if any) on improving quality of life factors would present a more complete picture of these cities.

15.2 Directions for future research

Stepping back and taking a holistic view, the research that this analysis has reported and contextualized in the literature provides valuable guidelines for future research. In one general sense, this research is couched in four disciplinary fields: telecom policy, social sciences, social informatics and science and technology research. As a multidisciplinary field, it is only emerging as a major research area and has just begun to appear in scholarly press. The guidelines and principles for future research can be summarized as follows:

1. *Examine further this research space.* The study of the impact of municipal Wi-Fi on the digital divide provides an opportunity for investigating the nature of the integration between project design and reality. Despite the considerable amount of theorizing that has accompanied the development of the digital divide, and the significant number of news articles written about Mu-Fi, this remains an area in which the extent of empirical research is remarkably slim. Most studies of the impact of Mu-Fi have focused on its economic impact, far removed from the anecdotal and empirical evidence of a lessening divide. There remains a tendency for commentators to adopt technological enthusiasm perspectives, rather than conducting field studies. More generally, it is important to evaluate the effects of government-led broadband systems on the local community.

2. *Explore the purported benefits of Mu-Fi in other contexts.* Future research should seek to further explore the benefits of government-led broadband deployments through attempts to alleviate and eliminate the so-called “digital divide” within other types of cities. Specifically, it would be fruitful to explore whether or not municipal broadband networks operating within different city dynamics (e.g., business models, project design, network goals, etc.) positively predict universal service factors for the city and broader community.

3. *Do individual indicator analyses.* It would also be noteworthy to explore additional individual level consequences, including positive outcomes such as those described above (number of jobs added due to wireless broadband availability, usage rates of at-risk groups, etc.) as well as potentially adverse outcomes (health risks of mobile data devices for instance). Interestingly, while public elites think citywide broadband Internet clouds may achieve significant improvements for their communities as a result of their role as information conduits, carrying out this role and responsibilities can be a challenging and

complex task. As such, future research may seek to explore the potential for government-led wireless networks to report higher levels of ambiguity and dynamicity.

4. *Examine Mu-Fi antecedents.* In addition to benefits, further specification regarding the antecedents of Mu-Fi is needed. While this dissertation begins to highlight several catalysts of Mu-Fi behavior, there are numerous avenues for future research to build upon this work. First, additional predictors should be theorized and explored. Specifically, perceived market failures (Couper, Hejkal et al., 2003) and demand for and use of IT technology in general (U.S. Department of Commerce, 2002; Wales, Sacks et al., 2003) may be fruitful variables to study further.

5. *Define context and success metrics*. The research conducted gives a glimpse into the future, but the relative lack of success of the project means that it is difficult to generalize from it. Despite the problems, however, the case studies suggest that municipal wireless projects should be more firmly contextualized in their communities with multiple win-win partnerships and clearly defined universal service components can help meet many of the needs of residents of marginalized areas and possibly alleviate the digital gap. More research on this criteria for longer-lasting success needs to be conducted.

6. *Go beyond the five case studies.* Furthermore, as expounded in the dissertation, this study attempts to illustrate the impact of Mu-Fi on the digital divide. Specifically, it tries to understand the ways cities attempt to engage the process of the digital divide in five U.S. communities and its interplay with QoL factors. However, the fact that the case studies represent specific Mu-Fi-related initiatives with their context may make the lessons learnt not entirely transferable to other developing cities, organizations and communities. Thus, it would be interesting to expand the study of the impact of Mu-Fi first to these cities and secondly, to other cities and community contexts in order to further emphasize cross-organizational influences. For example, a study might focus on the implementation of municipal broadband and best practices in their quest to bridging the digital divide to determine what contributions they make to the specific cities, and more broadly, to the economic development effort in these municipalities. Another example could be a study of the implementation of Mu-Fi initiatives in other countries to examine to what extent these projects are taking place and what contributions are being made to those cities' economies. This would not only create a cross-country comparison but also help to expand our knowledge on the dynamics of the process of design, development, implementation and use of wireless broadband for development.

7. *Design longitudinal studies.* One of the limitations of this current analysis is that the data was collected over a one year period. Future research might carefully create trend data that can be examined over time, so that in addition to the

anecdotal evidence of participants, one would be able to collect objective evidence of historical change as well.

8. *Maintain inter-disciplinarity.* As this research is couched in an inter-disciplinary field, it can usefully be studied in a multidisciplinary way. The research that forms the basis of the present analysis is a good example, being work drawing from the fields of sociology, telecommunications policy, social informatics, geography, and so on.

9. *Obtain and construct datasets.* In a general sense, future research could result in datasets that could be archived to provide the basis for future secondary analysis, either for the purpose of replication or synthesis.

10. *Follow-up on particular findings.* A number of findings that emerged during the course of the present study could not be followed up within the confines of the research design. Among these are the differences in the meaning of impact between city respondents; the extent to which different dimensions of digital divide arguments hang together; differences in usage patterns between different cities; the relationship between public elites and grassroots groups; the "natural history" of municipal intervention into the telecom market. Again, all of these are suitable topics for future study.

To conclude that further research is needed in order to understand the nature of government-led broadband systems vis-à-vis the digital divide is an understatement. During the last three years, a growing number of researchers and scholars have clustered around the study of the digital divide and the Mu-Fi network. This will surely benefit the understanding of this research space which in particular is especially important for those living and working in the new digital global economy.

Whether or not these Wi-Fi portals will serve as a medium that will push us further into the new digital global economy discussed by countless authors remains a murky issue (Borja & Castells, 1997; Burgelman, 2001; Feenberg, 1999; Grigorovico, Schement et al., 2006). In some ways, these Mu-Fi systems fit well in that they do provide basic access to experienced users. Conversely, it does not serve as a medium that allows universal service for all, especially at-risk communities. Just like other telecommunication services, Internet access cannot be made available only to a certain geographical area of a city if its decision makers truly intend to address the digital divide head-on. It requires that the wireless cloud be made available everywhere and it requires that end-users (experienced or novice) have adequate training, resources, tools, services, and so on, to access and navigate the network.

In 2008, we are beginning to see a fading out effect as more and more free-based Mu-Fi models are going belly-up. Increasingly, local governments are making adjustments and continue to tweak their Mu-Fi systems. It is unlikely that government involvement in

wireless broadband will change substantially other than offering less public, digital inclusion programs and focusing more on internal government services.

As of today, the five Mu-Fis examined in this study do not show any perceived impact on the digital divide beyond those stated above. The reality differs substantially from the material found on the topic online, government press releases, and news sources. This research study is a good example of how it can appear in practice.

APPENDIX A:
Informed Consent Form for Social Science Research

Title of Research: The Impact of Municipal Wireless Broadband Networks on the Digital Divide: A Tale of 10 Cities

Principal Investigator:	**Faculty Advisor:**
Julio Angel Ortiz, Doctoral Candidate Alfred P. Sloan Fellow 307G IST Building, University Park, PA 16802 C: 347-239-3705; E: jortiz@ist.psu.edu	Dr. Andrea Hoplight Tapia, Assistant Professor Information Sciences & Technology 329G IST Building, University Park, PA 16802 T: 814-865-1524; E: atapia@ist.psu.edu

1. **Purpose of Research Study:** This research study is being conducted to fill part of the requirements for a Ph.D. dissertation in the College of Information Sciences and Technology at the Pennsylvania State University. You are invited to participate in a research study, entitled "The Perceived Impact of Municipal Wireless Broadband Networks on the Digital Divide: A Tale of 10 Cities". Its purpose is to examine the perceived impact of municipal wireless broadband systems on the digital divide. Specifically, this project investigates how qualitative quality of life and universal service measures mediate digital divide objectives. It is intended that this study will provide the groundwork for showing if these cities have achieved their digital divide objectives.

2. **Procedures:** These research methods will allow you to share their stories and experiences

3. through individual discussions. The findings will be used to gain insight into how we measure the digital divide by way of municipal wireless broadband networks. In addition, this study attempts to better understand the institutional barriers that are perceived as having to overcome in order to bridge the gap. The participants will consist of key governmental and non-government constituents who have a stake in the design, deployment, and use of municipal wireless broadband networks (both directly and indirectly). The individual interviews will range from 30 minutes to 1 hour. You can choose not to answer certain questions at any time during the course of the interview.

4. **Confidentiality:** The researcher will not release any information that can identify you. All information will be kept strictly confidential. As a way of securing confidentiality, the information that you provide will be assigned a code. A tape recorder will be used to record the individual interviews, and the audiotapes will be transcribed verbatim. Please note that sensitive information may arise during the interview discussions. Only the Principal Investigator will have access to the recordings. The recordings will be kept in a personal filing cabinet at the College of Information Sciences and Technology, 307G IST Building, University Park, PA 16802. The recordings will be destroyed three years after the close of the

study. Your confidentiality will be kept to the degree permitted by the technology used. No guarantees can be made regarding the interception of data via email by any third parties."

5. **Right to Ask Questions:** Please contact Julio Ortiz at 347-239-3705 with questions or concerns about this study.

6. **Freedom to withdraw:** Your decision to be in this research is voluntary. You are free to remove yourself from the study at any time.

You must be 18 years of age older. If you agree to take part in this study, please sign your name and provide the date below. Please print a copy of this consent form for your records.

_____

Participant's Signature Date

_____

Printed Name

_____

Address

_____

Phone Number

_____

Email

APPENDIX B:
Interview Guide

B A C K G R O U N D I N F O R M A T I O N

Name:
Address:
Telephone:
Email:
Occupation Title:
Job Functions:
Organization represented:

Q U A L I T Y O F L I F E Q U E S T I O N S

- **Education**
  - How does your organization perceive the effect of Mu-Fi on education and schools in your community?
  - How has the perception of literacy after the implementation of the network changed over time? Has it increased? Decreased? Stayed the same?
- **Economy**
  - Have new jobs been added due to broadband? How so? What types of jobs and in what industry? Who is being hired?
  - Who is using the network to find jobs? What is the general background of the user (age group, gender/race/ethnicity, financial status, etc.)?
  - Who is using the network to find housing? What is the general background of the user (age group, gender/race/ethnicity, financial status, etc.)?
- **Public safety**
  - Has crime increased/decreased/stayed the same post implementation? What types of crimes, if any?
  - What is the perception of your locals on general public safety? Do they tend to feel more secure with an invisible network embedded on their city and neighborhood?
  - Do people perceive an improvement of emergency first responders (fire, e911, etc)?
- **Social**
  - Are citizens generally more satisfied with their community?
  - How has this network altered the locals' 'sense of community'?
  - Do people perceive an improvement on local government services (health insurance coverage, access to healthcare, etc.)?

U N I V E R S A L S E R V I C E Q U E S T I O N S

Universal Access

- **Connectivity**
  - How has the perception of broadband quality and price changed over time? Is it a seamless network? Are there 'pockets of no-connectivity' in your city? Where are these pockets located?
  - How has the perception of geographical barriers to getting online changed over time? Where are these geographically located?
  - How are device transfer mechanisms used by users in your city?
- **Content**
  - How is the available tailored content used by users?
  - How has your perception of users as content consumers and content producers changed over time? Do you think more users are getting online to create/consume content?
  - How are users consuming and producing content on the Internet?
  - How are local groups helping users create/consume content?
- **Capability**
  - How are training and general education venues available to users?
  - How has the perception of influence/impact of training on users changed over time?
- **Context**
  - How has the perception of place-based interactions changed over time?
  - How has the perception of perception of context-based, multimedia applications changed over time?
  - How has the perception of perception of context-awareness tools used changed over time?

Do your have any other comments, which will help me to know more about the impact of Mu-Fi in your city?

APPENDIX C:
Letter-email sent to potential interview candidates

DATE

Dear Sir/Madam,

My name is Julio Angel Ortiz, a doctoral student in the College of Information Sciences and Technology at Penn State University. You are invited to participate in a research study, entitled "The Impact of Municipal Wireless Broadband Networks on the Digital Divide: A Tale of 10 Cities". Your participation will help me complete the final requirements for my doctoral degree.

The purpose of this dissertation will be to examine the real impact of Mu-Fi systems on the digital divide, and thus contribute scientifically to the discourse. Specifically, I am interested in investigating how quality of life and universal service measures mediate digital divide objectives. The main research question driving this study is: *Does a municipal wireless broadband network have a perceived measurable impact on the digital divide?*. The findings will be used to gain insight into how we measure the digital divide by way of municipal wireless broadband networks. In addition, this study attempts to better understand the institutional barriers that are perceived as having to overcome in order to bridge the gap. More importantly, I am hoping that this study will provide the groundwork for showing if these cities have failed or succeeded in achieving their digital divide objectives.

I will not release any information that can identify you. All information will be kept strictly confidential.

If you are interested in participating in this valuable study, please reply to this email or give me a call at (347) 239-3705 regarding this matter. Please let me know whether you plan to participate in this study no later than May 31, 2007. Additional information will be forwarded should you decide to participate. Thank you in advance for your help.

Sincerely,

Julio Angel Ortiz
Doctoral Candidate
Alfred P. Sloan Fellow
The Center for the Information Society
The College of Information Sciences and Technology
Penn State University
307G IST Building
University Park, PA 16802
C: 347-239-3705
E: jortiz@ist.psu.edu

APPENDIX D:
Follow-up phone call to potential interview candidates

DATE

Hello, _____, this is Julio Angel Ortiz. I am calling to follow-up
(Participant's Name)
on my note dated _____ regarding your participation in the interview. Your participation would be invaluable to my research, and I was just wondering if you would like to share any information related to the project.

(Wait for response).

(Share project overview if asked)

Record Response(s):
_____
_____
_____
_____
_____
_____
_____
_____

_____, your input has been very helpful. Would you
(Participant's Name)
like to receive a summary of my findings after I complete my research? _____ (Yes) or _____ (No). If yes, would you like for me to send it by email or U.S. mail?

Again, thanks for participating and take care!

References

Alfsen, K. H., & Saebo, H. V. (1993). Environmental quality indicators: background, principles and examples from Norway. *Environmental and Resource Economics, 3*, 415-435.

Allen, S. (1985). *Cable Television: Municipal Use of government access, 1972-1982*: University of Maryland.

Alvares, R., & Calas, M. (1996). The global data highway: for whom a freeway? For whom a toll road? In E. Roche & M. Blaine (Eds.), *Information Technology, Development and Policy: Theoretical Perspectives and Practical Challenges* (pp. 27-44). Aldershot, UK: Ashgate.

Alvarion. (2004a). *Introducing Wi-Max: The next broadband wireless revolution.* Retrieved June 13th, 2005, 2005, from http://www.alvarion.com/RunTime/Materials/pdffiles/Wimax_wp.pdf

American Library Association. (2003). Introduction to Information Literacy. Accessed on January 8, 2007 from http://www.ala.org/ala/acrl/acrlissues/acrlinfolit/infolitoverview/introtoinfolit/introinfolit.htm.

American Public Power Association. (2005). *Powering the 21st Century through Community Broadband Services*. Washington, DC: APPA, Inc.

Anderson, D., & Schement, J. R. (1995). Information Infrastructrure and Development in the USA: the Role of Government1. *Oxford University Press*.

Annells, M. P. (1996). Grounded Theory Method: Philosophical Perspectives, Paradigm of Inquiry, and Postmodenism. *Qualitative Health Research, 6*(3), 379-393.

Ariew, R. (1976). *Ockham's Razor: A Historical and Philosophical Analysis of Ockham's Principle of Parsimony*. Champaign-Urbana: University of Illinois.

Baard, M. (2005). *Where to go to eavesdrop on wireless networks*, March 23, 2005

Babb, S. F. (1998). *The Internet as a Tool for Creating Economic Opportunity for Individuals and Families. Unpublished Dissertation.*, University of California at Los Angeles, Los Angeles, CA.

Bach, R., L.,, & Smith, J. (1977). Community Satisfaction, Expectations of Moving, and Migration. *Demography, 14*(2), 147-167.

Bagasao, P., Macias, E., Jones, S., & Pachon, H. (1999). *Challenges to Bridging the Digital Divide: Building Better on Ramps to the Information Highway*. Claremont, CA: Tomás Rivera Policy Institute.

Bailey, E. E., & Panzar, J. C. (1981). The Contestability of Airline Markets during the Transition to Deregulation. *Law and Contemporary Problems, 44*(1), 125-145.

Bar, F., & Galperin, H. (2004). Building the wireless internet infrastructure: From cordless Ethernet archipelagos to wireless grids. *Communication & Strategies, 54*(2), 45-68.

Bar, F., & Park, N. (2006). Municipal Wi-Fi Networks: The Goals, Practices, and Policy Implications of the U.S. Case. *Communication & Strategies, 61*(1), 107-125.

Barranca, M. (2004). *Unlicensed Wireless Broadband Profiles: Community, Municipal and Commercial Success Stories*.Unpublished manuscript, Washington, DC.

Battiti, R., Conti, M., & Gregori, E. (2003). *Price-based congestion-control in Wi-Fi hot spots.* Paper presented at the Proceedings of WiOpt'03, Sophia-Antipolis, France.

Beckman, A. W. (1995). Empowered Enterprise: The Transformation of Pacific Bell". Pacific Bell Internal Web,.

Benton Foundation. (1998). *Losing Ground Bit by Bit: Low-Income Communicties in the Information Age*: Benton Foundation and National Urban League,.

Berghman, J. (1995). Social exclusion in Europe: policy context and analytical framework. In G. Room (Ed.), *Beyond the Threshold: the measurement and analysis of social exclusion*. Bristol, UK: The Policy Press.

Bhatnagar, S., & Bjorn-Andersen, N. (1990). *Information Technology in Developing Countries*. Amsterdam: North-Holland.

Bhatnagar, S., & Odegra, M. (1992). *Social Implications of Computers in Developing Countries*. New Delhi: McGraw-Hill.

Bijker, W., Hughes, T. P., & Pinch, T. (1987). *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge: The MIT Press.

Bijker, W., & Law, J. (Eds.). (1992). *Shaping Technology/Building Society: Studies in Sociotechnical Change*. Cambridge, Mass: MIT Press.

Bijker, W. E. (1993). Do not despair: There is life after constructivism. *Science, Technology, & Human Values, 18*, 113-138.

Bijker, W. E. (1995). Sociohistorical technology studies. In S. Jasanoff, G. E. Markle, J. S. Petersen & T. Pinch (Eds.), *Handbook of Science and Technology* (pp. 229-256). Thousand Oaks, CA: Sage.

Bleha, T. (2005). Down to the Wire. *Foreign Affairs, May/June 2005*.

Borja, J., & Castells, a. M. (1997). *Local and Global: Management of Cities in the Information Age*. London: Earthscan Publications Ltd.

Bovens, M. (2002). Information Rights: Citizenship in the Information Society. *The Journal of Political Philosophy, 10*(3), 317-341.

Bowers, C. A. (1988). *The Cultural dimensions of educational computing: Understanding the non-neutrality of technology*. New York: Teachers College Press.

Brown, M. M., Brudney, J. L., & O'Toole, L. J. (1998). Implementing Information Technology in Government: An Empirical Assessment of the Role of Local Partnerships. *Journal of Public Administration Research and Theory*, 1998.

Bucy, E. (2000). Social Access to the Internet. *5*, 50-61.

Burgelman, J. C. (2001). *How social dynamics influence information society technology: Lessons for innovation policy.* Paper presented at the OECD: Social Science and Innovation, Paris.

Callens, I., & Tyteca, D. (1999). Towards indicators of sustainable development for firms. *Ecological Economics, 28*(1), 41-53.

Calvagna, A., Morabito, G., & La Corte, A. (2003). *WiFi Bridge: wireless mobility framework supporting session continuity.* Paper presented at the First IEEE International Conference on Pervasive Computing and Communications (PerCom'03), Catania, Italy.

Castells, M. (1989). *The Informational City: Information Technology, Economic Restructuring, and the Urban-Regional Process*. Oxford: Blackwell Publishing.
Castells, M. (1996). *The Rise of the Network Society*. MAssachusetts: Blackwell Publishers.
Castells, M. (2001). *Internet Galaxy: Reflections on the Internet, Business and Society*. New York, NY: Oxford University Press.
Chamberlain, K. (1985). Value Dimensions, Cultural Differences, and the Prediction of Perceived Quality of Life. *Social Indicators Research, 17*, 345-401.
Charmaz, K. (2006). *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. Thousand Oaks, CA: Sage Publications.
Chowdhury, N. (2000). *Information and Communication Technologies and IFPRI's Mandate*. Washington, DC: International Policy Research Institute.
Clark, C., & Gorski, P. (2002). Multicultural education and the digital divide: Focus on gender. *Multicultural Perspectives, 4*(1), 30-40.
Clark, D., & Gillett, S. (2002). *Local Government Stimulation of Broadband: Effectiveness, E-Government and Economic Development.*Unpublished manuscript, Boston.
Compaine, B. (2000). *Re-Examining the Digital Divide.* Paper presented at the The 28th Telecommunications Policy Research Conference (TPRC), September 23-25,, Alexandria, VA.
Compaine, B. (2001). Declare the War Won. In B. Compaigne (Ed.), *The Digital Divide: Facing a Crisis or Creating a Myth?* (pp. 315-336). Cambridge, MA: MIT Press Sourcebooks.
Cooper, M. (2004). Cable Report. *Accessed on May 15, 2005, from http://www.consumerfed.org/021304_cablereportrelease.html*.
Couper, E. A., Hejkal, J. P., & Wolman, A. L. (2003). Boom and Bust in Telecommunications. *Federal Reserve Bank of Richmond Econonic Quarterly, 89*(4), Fall 2003.
Crandall, R. (2003). Broadband Communications. In M. M. Cave, Sumit & Vogelsang, Ingo (Ed.), *The Handbook of Telecommunications Economics* (Vol. II). North Holland: The Brookings Intitution.
Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage.
Crew, M. A., & Kleindorfer, P. R. (1996). Incentive regulation in the United Kingdom and the United States: Some lessons. *Journal of Regulatory Economics, 9*(3), 211-225.
Dalbohm, B., & Mathiassen, L. (1996). Power in systems design. In R. Kling (Ed.), *Computerization and Controversy* (pp. 903-906). San Diego: Academic Press.
Darnton, R. (2000). An early information society: News and the media in eighteenth-century Paris. *The American Historical Review, 105*(1), 18 January 2002.
Deephouse, D. (1996). Does Isomorphism Legitimate? *The Academy of Management Journal, 39*(4), 1024-1039.
Derthick, M., & Quirk, P. J. (1985). *The Politics of Deregulation*. Washington DC: The Brookings Institute.
Diener, E., & Eunkook, S. (1997). Measuring Quality of Life: Economic, Social and subjective Indicators. *Social Indicators Research, 40*, 189–216.

DiMaggio, P., Celeste, C., & Shafer, S. (2004). Digital Inequality: From Unequal Access to Differentiated Use. In K. Neckerman (Ed.), *Social Inequality*. New York, NY: Russel SAGE Foundation.

DiMaggio, P., & Hargittai, E. (2002). *From the Digital Divide to Digital Inequality.* Paper presented at the Annual Meeting of the American Sociological Association, Chicago, IL.

DiMaggio, P., Hargittai, E., Neuman, W., & Robinson, J. (2001). Social Implications of the Internet. *Annual Review of Sociology, 27*, 307-336.

Dutton, W., & Peltu, M. (1996). *Information and Communication Technologies - Visions and Realities*. Oxford: Oxford Press.

Dutton, W., Peltu, M., & Brice, M. (1999). *Society on the Line: Information Politics in the Digital Age*. Oxford: Oxford University Press.

Eglash, R., . . (2001b). *Community informatics: A two-way bridge approach*. Retrieved from http://www.rpi.edu/~eglash/eglash.dir/ci.htm: Accessed on June 11, 2007.

Eisenach, J. A. (2001). Does Government Belong in the Telecom Business? *Progress on Point, 8*(1), January 2001.

FCC. (1993). *History of Wire and Broadcast Communication*. Accessed on November 13, 2006 from http://www.fcc.gov/cgb/evol.html.

FCC. (2005). *Strategic Broadband Goals*, January 24, 2005

Feenberg, A. (1999). *Questioning Technology*. London: Routledge.

Filson, G., & McCoy, M. (1993). Farmers' Quality of Life: Sorting Out the Difference by Class. *The Rural Sociologist, 13*(1), 15-37.

Firth, L., & Mellor, D. (2005). Broadband: benefits and problems. *Telecommunications Policy, 29*(2005), 223-236.

Foster, C. D. (1992). *Privatization, Public Ownership and the Regulation of Natural Monopoly.* Blackwell: Oxford.

Freeman, R. B. (2002). The Labour Market in the New Information Economy. *Oxford Review of Economic Policy, 18*, 288-305.

Freire, P. (2000). *Pedagogy of the Oppressed (30th Anniversary Edition).* New York, NY: Continuum International Publishing Group.

Garvey, J. (2002). *Municipal Broadband Networks*.Unpublished manuscript.

Gendron, B. (1977). *Technology and the Human Condition*. New York: St. Martin Press.

Gillett, S., & Lehr, W. (1999). *Availability of Broadband Internet Access: Empirical Evidence.* Paper presented at the 27th Annual Telecommunications Policy Research Conference, Alexandria, VA.

Gillett, S. E. (2006). Municipal Wireless Broadband: Hype or Harbinger? *Southern California Law Review, 79*, 561-594.

Gillett, S. E., Lehr, W. H., & Osorio, C. (2004). Local Government Broadband Initiatives. *Telecommunications Policy, 28*, 537-558.

Gillett, S. e. a. (2003). *Local Government Broadband Initiatives*.Unpublished manuscript, Boston, MA.

Glaser, & Strauss. (1967). *The DIscovery of Grounded Theory*. New York.

Glaser, B. (1978). *Theoretical Sensitivity*. Mill Valley: Sociology Press.

Goggin, M. L., Bowman, A. O. M., Lester, J. P., & O'Toole, L. J. (1990). *Implementation Theory and Practice*. New York: HarperCollins.

Gordo, B. (2000). The Digital Divide and the Persistence of Urban Poverty. *Planners Network, 141*(1), 7-8.
Goss, E., & Phillips, J. (2002). How Information Technology Affects Wages: Evidence Using Internet Usage as a Proxy for IT Skills. *Journal of Labor Research, 23*, 463-474.
Graham, S. (2002). Bridging Urban Digital Divides? Urban Polarisation and Information and Communications Technologies (ICTs). *Urban Studies, 39*(1), 33-56.
Graham, T., & Ure, J. (2005). IP Telephony and Voice over Broadband. *The journal of policy, regulation and strategy for telecommunications, 7*(4), 8-20.
Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology, 78*(6), 1360–1380.
Grigorovico, D., Schement, J. R., & Taylor, R. D. (2006). *Weighing the intangible: towards a framework for Information Society indices*. University Park, Pa: Smeal College of Business - eBusiness Research Center.
Gurstein, M. (2000). *Community informatics: enabling communities with information and communications technologies*. Hershey, PA: Idea Group Publishers.
Gurstein, M. (2003). Effective use: a community informatics strategy beyond the digital divide. *First Monday, 8*(12).
Gustavson, K., & Longeran, S. (1999). Selection and modelling of sustainable development indicators: a case study of the Fraser River Basin, British Columbia. *Ecological Economics, 28*(1), 117-132.
Hargittai, E. (2002). Second-Level Digital Divide: Differences in People's Online Skills. *First Monday, 7*(4), http://www.firstmonday.dk/issues/issue7_4/hargittai.
Heeks, R. (2002b). Information systems and developing countries: failure, success, and local improvisations. *The Information Society, 18*, 101-112.
Heeks, R., & Davies, A. (1999). Different approaches to information age reform. In R. Heeks (Ed.), *Reinventing Government in the information age: International practive in IT-Enabled Public Sector Reform*. London: Routledge.
Henry, P., & Luo, H. (2002). WiFi: What's Next? *IEEE Communications Magazine, December 2002*.
Heycox, J. (1999). *Integrating data for sustainable development: introducing the distribution of resources framework*. London: John Wiley & Sons.
Hirschheim, R., & Klein, H. K. (2003). CMSis in the IS Field? A Critical Reflection on the State of the Discipline. *Journal of the Association for Information Systems, 4*(5), 237-293.
Hoffman, D., & Novak, T. (1998). Bridging the Racial Gap on the Internet. *Science, 280*(5362), 390-391.
Hoffman, D., & Thomas, P. (1999). *Examining the Relationship of Race to Internet Access and Usage Over Time*. Nashville, TN: Vanderbilt University Press.
Hoffman, D. L., & Novak, T. P. (2000). The growing digital divide: Implications for an open research agenda. In E. Brynjolfsson & B. Kahin (Eds.), *Understanding the digital economy*. Cambridge, MA: MIT Press.
Hsieh, C.-T., & Liu, B.-C. (1983). The Pursuance of Better Quality of Life: In the Long Run, Better Quality of Social Life Is the Most Important Factor in Migration. *American Journal of Economics and Sociology, 42*(4), 431-440.

Hudson, H. (2004). Universal access: what have we learned from the E-rate? *Telecommunications Policy*, Elsevier Science.

Hughes, T. P. (1989). *American Genesis: A Century of Invention and Technological Enthusiasm 1870-1970*. New York: Viking Penguin.

Hughey, J. B., & Bardo, J. W. (1987). Social Psychological Dimensions of Community Satisfaction and Quality of Life: Some Obtained Relations. *Psychological Reports, 61*, 239-246.

Inayatullah, S., & Milojevic, I. (1999). Exclusion and communication in the information era: from silences to global conversation. In W. Harcourt (Ed.), *Women @ Internet: Creating New Cultures in Cyberspace* (pp. 76-87). London: Zed.

Jacobson, R. E. (1977). *Municipal Controls of Cable Communications*. New York: Praeger.

Katz, J., & Aspden, P. (1997). Motivations for and Barriers to Internet Usage: Results from a National Public Opinion Survey. *Internet Research, 7*(3), 170-188.

Katz, J., & Rice, R. (2002). *Social consequences of internet use: access, involvement, and interaction*. Cambridge, MA: MIT Press.

Kennard, W. (2001). Equality in the Information Age. In B. Compaine (Ed.), *The Digital Divide: Facing a Crisis or Creating a Myth*. Cambridge, MA: The MIT Press.

Keynes, J. (1972). Economic prospects for our grandchildren" in Essays in Persuasion: the collected writings of John Maynard Keynes. In (Vol. ix). London: Macmillan.

Kling, R., & Lamb, R. (2000). IT and Organizational Change in Digital Economies: A Sociotechnical Approach. In E. Brynjolfsson & B. Kahin (Eds.), *Understanding the Digital Economy* (pp. 295-324). Cambridge, MA: The MIT Press.

Kling, R., McKim, G., & King, A. (2002). A bit more to it: Scholarly Communication Forums as Socio-Techical Interaction Networks. *Journal of the American Society for Information Science and Technology, 54*(1), 47-67.

Kuhn, T. S. (Ed.). (1996). *The structure of scientific revolutions*. Chicago and London: The University of Chicago Press.

Kumar, K. (2005). *From Post-Industrial to Post-Modern Society: New Theories of the Contemporary World*. Oxford: Blackwell Publishers.

Kumar, K., & Bjorn-Anderson, N. (1990). A cross-cultural comparison of IS designer values. *Communications of the ACM, 33*(5), 528-538.

Kvasny, L. (2002). *Problematizing the Digital Divide: Cultural and Social Reproduction in a Community Technology Initiative. Unpublished Dissertation.* Georgia State University, Atlanta, GA.

Kvasny, L. (Forthcoming). *A Conceptual Framework for Studying Digital Inequality.* Paper presented at the Proceedings of the Americas Conference on Information Systems, Dallas, TX.

Kvasny, L., & Truex, D. (2000). Defining Away the Digital Divide: A content analysis of institutional influences on popular representations of technology.

Kvasny L., & Trauth, E. (Forthcoming). The Digital Divide at Work and at Home: Discourses about Power and Underrepresented Groups in the Information Society. In E. Whitley, E. Wynn & J. DeGross (Eds.), *Global and Organizational Discourse About Information Technology*. New York, NY: Kluwer Academic Publishers.

Latour, B. (Ed.). (1992). *Where are the Missing Masses? The Sociology of a Few Mundane Artifacts* (Vol. 225-258). Cambridge, MA: MIT Press.
Lazarus, W., Lipper, L., & Mora, F. (2000). *Online Content for Low-Income and Underserved Americans: The Digital Divide's New Frontier*. Washington, DC: The Children's Partnership.
Lehr, W., & McKnight, L. (2003). Wireless internet access: 3G vs. WiFi? *Telecommunications Policy, 27*(5-6), 351-370.
Lehr, W., & Osorio, C. (2005). *From 1999 to 2002, American communities with broadband access did significantly better than those*, December 2005
Lehr, W., Osorio, C., Gillett, S., & Sirbu, M. (2004). *Measuring Broadband's Economic Impact. Working Paper*.Unpublished manuscript, Boston, MA.
Lehr, W., & Sirbu, M. (2004). *Municipal Wireless Broadband: Policy and Business Implications of Emerging Access Technologies*.Unpublished manuscript, Pittsburgh, PA.
Lenoir, R. (1974). *Les Exclus: Un Francais Sur Dix*. Paris, France: Seuil.
Lentz, B., Straubhaar, J., LaPastina, A., Main S., & Taylor J. (2000). *Structuring Access: The Role of Public Access Centers in the "Digital Divide."* Paper presented at the Paper presented at the Annual Meeting of the International Communication Association, Acapulco, Mexico.
Lewis, S., & Lyon, L. (1986). The Quality of Community and the Quality of Life. *Sociological Spectrum, 6*, 397-410.
Liff, S., & Steward, F. (2001). Communities and e-Community Gateways: Networking for Social Inclusion. In L. Keeble & B. Loader (Eds.), *Community Informatics: Shaping Computer- Mediated Social Relations* (pp. 324-341).
Loader, B. (1998). *Cyberspace Divide: Equality, Agency and Policy in the Information Society*. London: Routledge.
Loader, B., & Keeble, L. (2002). *Community informatics : shaping computer-mediated social relations*. New York: Routledge.
Lyon, D. (1988). *The Information Society*. Cambridge: Polity Press.
MacKenzie. (1990). Economic and Sociological Explanation of Technical Change. *Micro Economic or Micro Sociology?*, September 1990.
MacKenzie, D., & Wajcman, J. (1985). *The Social Shaping of Technology*. Milton Keynes: OpenUniversity Press.
Mansell, R. (1999). Information and communication technologies for development assessing the potential and the risks. *Telecommunications Policy, 23*, 35-50.
Mansell, R. (2001). Digital opportunities and the missing link for developing countries. *Oxford Review of Economic Policy, 17*, 282-295.
Mansell, R. (2002). *Inside the Communication Revolution: Evolving Patterns of Social and Technical Interaction*. Oxford: Oxford University Press.
Mansell, R., Samarajiva, R., & Mahan, A. (Eds.). (2002). *Networking Knowledge for Information Societies: Institutions & Intervention*. Delft: Delft University Press.
Mansell, R., & Steinmueller, W. (2002). *Mobilizing the Information Society: Strategies for Growth and Opportunity*. Oxford: Oxford University Press.
Mansell, R., & Wehn, U. (1998). *Knowledge Societies: Information Technology for Sustainable Development*. Oxford: Oxford University Press.

Maraganore, N., & Morrisette, S. (1998). The Online Gender Gap is Closing. *Data Insights, 1*(18), December 2.
Markus, M., & Bjorn-Andersen, N. (1987). Power over users: it's exercise by system professionals. *Communications of the ACM, 30*(6), 498-504.
McLaren, L. (2002). Information and communication technologies in rural Canada. *Rural and Small Town Canada Analysis Bulletin, 3*(5).
Meadows, D. (1998). *Indicators and information for sustainable development. USA*: The Sustainability Institute.
Meinrath, S. (2001). *Wirelessing the World: Socio-Historical and Technological Factors Affecting the Battle over (Community) Wireless Networks.*: Institute of Communications Research - University of Illinois, Urbana-Champaign, The Champaign-Urbana Community Wireless Network (CUWiN).
Meinrath, S. (2004). *Social Benefits of Community Wireless Networks*. Retrieved March 3, 2005, 2004
Merriam, S. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass Publishers.
Mey, G., & Mruck, K. (2007). Grounded Theory Reader. In B. Glaser, A. Strauss, J. Corbin, U. Kelle, J. Strübing, G. Mey & K. Mruck (Eds.), *Reihe: HSR Supplement*. Seiten.
Miller, M. K., Voth, D. E., & Chapman, D. D. (1984). Estimating the Effects of Community Resource Development Efforts on County Quality of Life. *Rural Sociology, 49*(1), 37-66.
Morse, J. M., & Field, P. A. (1995). *Qualitative research methods for health professionals*. Thousand Oaks, CA: Sage Publications.
Mossberger, K., Tolbert, C. J., & Stansbury, M. (2003). *Virtual Inequality: Beyond the Digital Divide*. Washington DC: Georgetown University Press.
Mueller, M. L. (1993). Universal Service in Telephone History: A Reconstruction. *Telecommunications Policy, 12*(July), 352-369.
Negroponte, N. (1995). *Being Digital*. New York, NY: Knopf Publishers.
New Millennium Research Council. (2005). *Not In The Public Interest - The Myth of Municipal Wi-Fi*. Washington, D.C.
Nielsen/NetRatings Enumeration Study. (2004). *Three Out of Four Americans Have Access to the Internet*.
Norris, P. (2001). *Digital Divide? Civic Engagement, Information Poverty and the Internet in Democratic Societies*. New York: Cambridge Univ. Press.
NTIA. (1999). *Falling Through the Net III: Defining the Digital Divide*. Washington, DC: U.S. Department of Commerce.
NTIA. (2000). *Falling Through the Net IV: Toward Digital Inclusion*. Washington, DC: U.S. Department of Commerce.
Nye, D. E. (1990). *1880-1940: Electrifying America: Social Meanings of A New Technology*. Cambridge: MIT Press.
Oden, M. (2004). *Beyond the Digital Access Divide, Developing Meaningful Measures of Information and Communications Technology Gaps*. Austin, Texas: The University of Texas at Austin Press.

Oden, M., & Strover, S. (2002). *Links to the Future: Information and Telecommunications Technology and Economic Development in the Appalachian Region*. Washington, DC: Applachian Regional Commission.

OECD. (2001). *The development of broadband access in OECD countries*. Paris, France: OECD.

O'Neil, D. (2002). Assessing Community Informatics: A Review of Methodological Approaches for Evaluating Community Networks and Community Technology Centers. *Internet Research: Electronic Networking Applications and Policy, 12*(1), 76-102.

Oppong, J. R., Ironside, R. G., & Kennedy, L. W. (1988). Perceived Quality of Life in a Centre-Periphery Framework. *Social Indicators Research, 20*, 605-620.

Orlikowski, W. J., & Robey, D. (1991). Information Technology and the Structuring of Organizations. *Information Systems Research, 2*(1991), 143-169.

Ortiz, J. A., & Tapia, A. H. (2006). On democracy, public participation, and ethics, Municipal Wireless Networks: toward justice for all? *Sociological Focus Journal,* In Press.

Ortiz, J. A., & Tapia, A. H. (*forthcoming*). Bandwithing Together: The public policy process generating municipal wireless broadband networks.

Ortiz, J. A., Ulrich, W., & Tapia, A. H. (*forthcoming*). The Public Participation Process of Municipal Wireless Networks (MWN) in the U.S. *Operations Research Journal*.

Payne, M. (2005). The Digital Divide and its Discontents. *Currents in Electronic Literacy, Fall 2005*(9), http://www.cwrl.utexas.edu/currents/fall05/payne.html.

Pew Internet and American Life Project. (2000). *Tracking Online Life: How Women Use the Internet to Cultivate Relationships with Family and Friends*. Accessed May 12, 2000 from http://www.pewinternet.org/PPF/r/11/report_display.asp.

Pinch, T., & Bijker, W. (1987). The Social Construction of Facts and Artifacts. In W. Bijker, T. Hughes & T. Pinch (Eds.), *The Social Construction of Technological Systems* (Vol. 17-50).

Pinkett, R. (2000). *Bridging the Digital Divide: Sociocultural Constructionism and an Asset-Based Approach to Community Technology and Community Building.* Paper presented at the 81st Annual Meeting of the American Educational Research Association (AERA), New Orleans, LA.

Precursor Group. (2001). *How broadband deployment skews economic/business growth*. February 2001.

Preston, P., & Flynn, R. (2000). Rethinking Universal Service: Citizenship, Consumption Norms and the Telephone. *The Information Society, 16*(2), 91-98.

Putnam, R. D. (1995). Bowling alone: America's declining social capital. *Journal of Democracy, 6*.

Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. New York: Simon & Schuster.

Rao, B. a. P. (2003). Wireless broadband drivers and their social implication. *Technology in Society, 25*(4), 477-489.

Rizzuto, R. J., & Wirh, M. O. (1998). *Costs, Benefits, and Long-Term Sustainability of Municipal Cable Television Overbuilds*: Tele-Communications Inc.

Robinson, J. P., Kestnbaum, M., Neustadtl, A., & Alvarez, A. (2000). Mass Media Use and Social Life among Internet Users. *Social Science Computer Review, 18*, 490-501.
Robrecht, L. C. (1995). Grounded Theory: Evolving Methods. *Qualitative Health Research, 5*, 169.
Rogers, E. M. (1995). *Diffusion of Innovations*. New York: Free Press.
Sandelowski, M. (1994). The use of quotes in qualitative research. *Research in Nursing and Health, 17*(6), 479-483.
Sanderson, I. (2000). *Access to Services. In Policy Responses to Social Exclusion*. Philadelphia: Open University Press.
Sawhney, H., & Jayakar, K. (2005). *Universal Access: Precedents, prevarications and progress.* Paper presented at the Telecommunications Policy Research Conference (TPRC), Alexandria, VA.
Sawyer, S., & Tapia, A. (2005). The Sociotechnical Nature of Mobile Computing Work: Evidence From A Study of Policing in the United States. *International Journal of Technology and Human Interaction, 1*(3), 1-14.
Sawyer, S., Tapia, A., Pesheck, L., & Davenport, J. (2004). Observations on Mobility and the First Responder. *Communications of the ACM, 47*(2), 62-65.
Schement, J. (1999). Of Gaps by Which Democracy We Measure. *Information Impacts Magazine, December 1999*, www.cisp.org/imp/december_99/1299schement.html.
Schement, J., & Forbes, S. (1999). *Approaching the Net: Toward Global Principles of Universal Service.* Paper presented at the Pacific Telecommunications Conference, Honolulu, Hawaii.
Schement, J., Horrigan, J., Lacayo, A., & Ortiz, J. (Forthcoming). Regaining the Lead: Universal Service for a Globally Competitive America: Making Universal Service Universal.
Schement, J. R., & Curtis, T. (1997). *Tendencies and Tensions of the Information Age: The Production and Consumption of Information in the United States*. New Brunswick, NJ: Transaction Publications.
Schiesel, S. (2005). Growth of Wireless Internet Thieves. *The New York Times*, p. http://www.nytimes.com/2005/2003/2019/technology/2019wifi.html.
Schiller, H. (1996). *Information Inequality: The Deepening Social Crisis in America*. New York, NY: Routledge.
Segal, H. P. (1985). *Technological utopianism in American culture*. Chicago: University of Chicago Press.
Selwyn, N. (2003). *Defining the 'Digital Divide': Developing Theoretical Understanding of Inequalities in the Information Age*. Cardiff, UK: Cardiff University - School of Social Sciences.
Selwyn, N., Gorard, S., & Williams, S. (2001). Digital Divide or Digital Opportunity? The Role of Technology in Overcoming Social Exclusion in U.S. Education. *Educational Policy, 15*(2), 258-277.
Servon, L. (2002). *Bridging the Digital Divide: Technology, Community and Public Policy*. Oxford, UK: Blackwell.
Shah, D. V., McLeod, J. M., & Yoon, S.-H. (2001). Communication, Context and Community: An Exploration of Print. *Broadcast and Internet Influences. Communication Research, 28*(4), 464-506.

Sober, E. (1975). *Simplicity*. Oxford: Oxford University Press.
Stone, M., Maitland, C., & Tapia, A. (2005). Making IT Work for Municipalities: Building Municipal Wireless Networks. *Accepted for publication in a Special issue of Government Information Quaterly.*
Strauss, A., & Corbin, J. M. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Geiler: Sage Publications.
Strauss, A. L. (1978). A social worlds perspective. *Studies in Symbolic Interaction, 1*, 119-128.
Strauss, A. L. (1982). Social worls and legitimation processes. *Studies in Symbolic Interaction, 4*, 171-190.
Strover, S., Chapman, G., & Waters, J. (2004). Beyond community network and CTCs: access, development and public policy. *Telecommunications Policy, 28*, 465-485.
Strover, S., & Straubhaar, J. (2000). *E-Government Services and Computer and Internet User in Texas*. Austin, TX: The University of Texas at Austin: The Telecommunications and Information Policy Institute.
Sussman, G. (1997). *Communication, Technology and Politics in the Information Age*. Thousand Oaks, California: Sage.
Tapia, A., & Ortiz, J. (2006). *Municipal Responses to State-Level Broadband Internet Policy.* Paper presented at the The 34th Research Conference on Communication, Information and Internet Policy Telecommunications Policy Research Conference (TPRC), Alexandria, VA.
Tapia, A., Stone, M., & Maitland, C. (2005). *Public-Private Partnerships and the Role of State and Federal Legislation in Wireless Municipal Networks.* Paper presented at the The 33rd Research Conference on Communication, Information and Internet Policy, Washington, DC.
Tapscott, D. (1998). *Growing Up Digital: The Rise of the Net Generation*. New York, NY: McGraw-Hill.
Telecomm Act of 1996. (2006). *Accessed on March 26, 2006 from* *http://www.fcc.gov/telecom.html*
Thierer, A. (2000). How free Computers are Filling the Digital Divide. *Heritage Foundation Backgrounder*(1361), 1-21.
Thomas, M. L. (2004). *Government Entry Into the Telecom Business: Are the Benefits Commensurate With the Costs?*
Thompson, K. (2005). Axiomatic theories of intentional systems: Methodology of theory construction. *Scientific Inquiry Journal, 7*(1), 13-24.
Thorburn, W. M. (1918). The Myth of Occam's Razor. *Mind, 27*(107), 345-353.
Tropos Networks. (2004). *Metro-scale Wi-Fi as city service chaska.net, Chaska, Minnesota: A Tropos Network Case Study*. Accessed on June 3, 2006 from: http://www.tropos.com/pdf/chaska_casestudy.pd.
Tufekcioglu, Z. (2003). *In Search of Lost Jobs: The Rethoric and Practice of Computer Skills Training.* University of Texas, Austin, Texas.
Turner, S. D. (2005). *Broadband Reality Check.* Accessed on June 1, 2006 from http://www.freepress.net/docs/broadband_report.pdf.
U.S. Census Bureau. (2003). Current Population Survey Supplements. *October 2003*.
U.S. Department of Commerce. (2000). *Falling Through the Net: Toward Digital Inclusion*: National Telecommunications and Information Administration.

U.S. Department of Commerce. (2002). *Understanding Broadband Demand*: Office of Technology Policy.
Uslaner, E. M. (2000). *Trust, Civic Engagement and the internet*. Workshop on Electronic Democracy: Mobilization, Organization and Participation via New ICTs: University of Grenoble, France.
van den Bergh, J. (1996). *Ecological economics and sustainable development. Cheltenham*: Edward Elgar Publishing Limited.
Van Dijk, J. (2001). *Divides in Succesion: Posession, Skills and Use of the New Media for Participation.* Paper presented at the The Digital Divide Conference, Austin, Texas.
Van Dijk, J., & Hacker, K. (2003). *The Digital Divide as a Complex and Dynamic Phenomenon.* Paper presented at the Proceedings of the International Communication Association, Acapulco, Mexico.
Voth, H.-J. (2003). Living Standards during the Industrial Revolution: An Economist's Guide. *The American Economic Review, 93*(2), 221-226.
Wales, C., Sacks, G., & Firth, L. (2003). *Killer applications versus killer attributes in broadband demand.* Paper presented at the PTC Conference, Hawaii.
Warschauer, M. (2002). Reconceptualizing the Digital Divide. *First Monday, 7*(7), http://www.firstmonday.dk/issues/issue7_7/warschauer.
Warschauer, M. (2003). *Technology and Social Inclusion: Rethinking the Digital Divide*. Cambridge, MA: MIT Press.
Webster, F. (1995). *Theories of the Information Society*. London: Routledge.
Weiss, A. (2005). The Battle for Broadband. *NW, June*(2005), 17-22.
Westen, T. (Fall 2000). E-Democracy: Ready or Not, Here It Comes. *National Civic Review, 89*(3).
Wiggins, R. (2005, May 2, 2005). Understanding the Opportunities and Challenges of Mobile Municipal Networking. *Yankee Group Research,* 1-4.
Williams, R., & Edge, D. (1996). The social shaping of technology. *Research Policy, 25*, 865-899.
Williamson, C. (2004). Protocols and Performance. In M. Calzarossa & E. Galenbe (Eds.), *Wireless Internet*: Springer-Verlag Berlin Heidelberg.
Wolfe, M. (1996). *Elusive Development*. London: Zed.
Wood, B. D., & Anderson, J. E. (1993). The Politics of US Antitrust Regulation. *Americal Journal of Political Science, 37*(1), 1-39.
Wright, J. L. (1992). *Possible Dreams: Enthusiasm for Technology in America*. Dearborn, Michigan: Henry Ford Museum and Greenfield Village.
Xavier, P. (2003). Should Broadband be part of Universal Service Obligations? *Info, 5*(1), 8-25.
Yin, R. (1984). *Case Study Research: Design and methods*. London: Sage.
Yin, R. K. (2003). *Case Study Research: Design and Methods*. Thousand Oaks, CA: Sage.
Ziegler, J. A., & Britton, C. R. (1981). A Comparative Analysis of Socioeconomic Variations in Measuring the Quality of Life. *Social Science Quarterly, 62*(2), 303-312.

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REFERRED JOURNAL PUBLICATIONS

Ortiz, J. A. and Tapia, A. (2008), "Keeping Promises: Do Municipal Wireless Initiatives Fulfill Their Promises to Narrow the Digital Divide**?**" *The Journal of Community Informatics: Special Issue on Wireless Networking for Communities, Citizens and the Public Interest.* Volume 4, Number 1.

Ortiz, J. A. and Tapia, A. (2007). "On democracy, public participation, and ethics, Municipal Wireless Networks: toward justice for all?" *Sociological Focus Journal*. In Press.

REFEREED CONFERENCE PROCEEDINGS

Ortiz, Julio Angel & Tapia, Andrea H (2007). "Bandwidthing Together: The Public Policy Process generating municipal wireless broadband networks." *IFIP Working Group 8.2 Conference on IT and Change in the Service Economy*. Toronto, Canada, August 2008.

Tapia, A. and Ortiz, J. A. (2007) "Policy and Plan Convergence for Municipal Broadband Networks," *Telecommunication Policy Research Conference Proceedings*, Washington, D.C., September, 2007.

Tapia, A. and Ortiz, J. A. (2006), Municipal Responses to State-Level Broadband Internet Policy," *Telecommunication Policy Research Conference Proceedings*, Washington, D.C., September 30-October 2, 2006.

Tapia, A. and Ortiz, J. A. (2006), "Bandwidthing Together: Municipal Wireless Broadband Networks," *American Sociological Association Annual Meeting*. Montreal, Quebec, Canada. August 2006.

Ortiz, J. A. and Tapia, A. (2006), "Deploying for Deliverance: The Digital Divide Discourse in Municipal Wireless Networks," *Americas Conference on Information Systems* (AMCIS), Acapulco, Mexico, August 2006

Tapia, Andrea H., Ortiz, Julio Angel, & Maldonado, Edgar (2006). "Making Good on Municipal Promises: Can Municipal Wireless Broadband Networks Reduce Information Inequality?" *Emerging Trends and Challenges in Information Technology Management Proceedings of the Information Resource Management Association Conference* (IRMA 2006). Idea Group Publishing. May, 2006. Washington DC.

Ortiz, Julio Angel, Tapia, Andrea H., & Maldonado, Edgar (2006). "Recruiting Diverse, High-Skilled IT Employees through Existing Virtual Social Networks." *The Special Interest Group of the Association for Computing Machinery on Management Information Systems (SIGMIS-CPR 2005).* ACM Press. April, 2006. Los Angeles, CA.