Producer Network Effects for Rural Economic Development:
An Investigation into the Economic Development Potential of Information Production as a Firm-Level Effect of Broadband Telecommunications in Rural Areas

Stephen Seth Peery

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Dr. Heike Mayer, Chair
Mr. Erv Blythe
Dr. Max Stephenson

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(ABSTRACT)

Broadband telecommunications infrastructure is considered to be an economic development necessity by a significant number of policymakers and economic development professionals, particularly in rural areas. Across the United States, a considerable amount of money is being invested in the deployment of broadband networks based, at least in part, on the premise that economic development benefits will obtain. However, there is a general lack of academic theory explaining the *mechanism(s)* by which broadband telecommunications can produce economic development results.

The purpose of this study is to investigate the impacts of broadband at the level of the firm. It adopts as its central working hypothesis the "Producer Network" concept originally developed at Virginia Tech, which suggests that economic development benefits may result from Internet users having access to multiple megabits-per-second of symmetrical, affordable bandwidth. It employs a qualitative grounded theory methodology to identify firm-level effects of broadband use.

The study's findings revealed that a majority of businesses in the case study communities were using much slower Internet connections than had been hypothesized, were using third-party, off-site web hosting, and did not believe they needed "Big Broadband." Informants to the study believed that the economic development potential of broadband in the short term depended on the ubiquitous deployment of affordable connectivity, and were more concerned with reliability than bandwidth.

The study concludes that the "Producer Network" is better understood as a long-term goal than as a model to explain the current firm-level applications of the commodity Internet. It suggests that policymakers should consider broadband not as a panacea for economic development, but as a tool whose potential for impact is influenced by a number of economic, political, social, and cultural forces originating at the community, national, and global levels. Based on the literature review and the field research, it proposes a general model for broadband telecommunications in rural economic development.

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Commonly Used Acronyms, Abbreviations and Key Terms

- **ASP** – Application Service Provider. Among other things, ASPs can host web sites remotely.
- **Backbone** – high-capacity linkages within a telecommunications network on which traffic from multiple endpoints is aggregated
- **Bandwidth** – the carrying capacity of a communications channel, usually expressed in bits per second or some multiple thereof (i.e., Kbps, Mbps, Gbps).
    - **Upstream bandwidth** – the bandwidth available to a network user to transmit information
    - **Downstream bandwidth**- the bandwidth available to a network user to receive information
- **Broadband** – high-speed telecommunications capacity. The FCC defines broadband as 200Kbps or higher, but other definitions specify higher bandwidth, typically in the range of multiple megabits per second.
    - **Big Broadband / Next-Generation Broadband** – telecommunications capacity in the range of multiple megabits per second and higher
    - **Little Broadband / Midrange Broadband** – analogous to current residential broadband offerings such as DSL, Cable Modem, and Wireless; over 200 Kbps but less than "Big Broadband"
    - **Narrowband** – less than 200 Kbps
- **CATV** – Cable Television
- **CLEC** – Competitive Local Exchange Carrier
- **Collocation** – the installation of a web or other server at an off-site location, usually in a data center with multiple high-bandwidth connections
- **DS-3** – A leased-line telecommunications service capable of providing 45 Mbps of symmetrical bandwidth
- **DSL** – Digital Subscriber Line, a "midrange" broadband technology. Variants include SDSL (Symmetric DSL) and ADSL (Asymmetric DSL).
- **EDI** – Electronic Data Interchange
- **Endogenous economic development** – economic development stimulated through the improvement of capacities of existing firms, or the growth of new firms – contrasted to exogenous economic development
- **Exogenous economic development** – economic development oriented towards the recruitment of businesses from outside a community
- **FTP** – File Transfer Protocol
- **FTTP** – Fiber-to-the-Premises
- **FTTH** – Fiber-to-the-Home
- **Gbps** – Gigabits per second
- **H.323** – A videoconferencing standard
- **HDTV** – High Definition Television
- **ICT** – Information and Communications Technologies
- **ILEC** – Incumbent Local Exchange Carrier
- **IP** – Internet Protocol

- **ISP** – Internet Service Provider
- **IT** – Information Technology
- **ISDN** – A leased-line telecommunications service capable of providing 128Kbps of data
- **Kbps** – Kilobits per second
- **LAN** – Local Area Network
- **Last-mile** – the link in a telecommunications network from a subscriber to the first aggregation point
- **Mbps** – Megabits per second
- **Middle-mile** – the link in a telecommunications network connecting "edge" aggregation points to the network backbone
- **NOC** – Network Operations Center
- **POTS** – Plain Old Telephone Service
- **Power users** – adopters of a technology that use it intensively or in nontypical, innovative ways
- **T-1** – A leased-line telecommunications service capable of providing 1.544 Mbps of symmetrical bandwidth
- **VoIP** – Voice over Internet Protocol
- **VPN** – Virtual Private Network
- **WISP** – Wireless Internet Service Provider
- **WAN** – Wide Area Network

List of Multimedia Objects

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Chapter 1: Introduction

"*This is about three things…Jobs, jobs and jobs*."
-- Local government official (Cauley, 2004)

"The number one reason to vote yes [for municipal broadband deployment] - is for economic development."
-- Community activist (Bast, 2004)

"*We're so desperate for jobs because of what's happened in the region that because of this golden egg called tobacco money, we're being goofy about how we spend money."*
-- Business owner (DB1)

1.1: Background

The deployment of broadband telecommunications infrastructure has achieved widespread acceptance among policymakers, economic development practitioners, and some academic researchers as a means to stimulate economic development in rural communities. However, the specific mechanisms that link broadband to local economic development outcomes are not well understood. Most research to date within the field has focused on state or national correlations between investments in telecommunications and economic growth. Causality has been difficult to demonstrate, and at the present time, investments in broadband infrastructures in rural communities in Virginia and across the nation are being justified on the basis of what amounts to a mixture of anecdotal evidence, intuition, and hope.

The studies that have been completed to date, while useful and instructive within their intended scope, do not provide the kind of guidance that local policymakers need to make decisions regarding the allocation of scarce resources towards broadband deployment. What is needed is a better understanding of exactly *how* an investment in broadband could translate into economic development benefits. This is a task far too broad for a Master's Thesis; however, we have to start somewhere. This study takes as its hypothesis a concept that could potentially link broadband to economic development, and employs a qualitative methodology to determine if it is "grounded" in the experiences of businesses that are currently using broadband. The ultimate

goal of this study is to develop a model for endogenous economic development in rural communities using broadband, by studying the firm-level effects of the technology in the context of the "Producer Network" concept developed at Virginia Tech.

1.2: Importance of the Problem

Rural communities across the United States have sustained a series of economic hardships over the years, making the need for new, innovative economic development strategies all the more acute. As jobs, capital, and population have fled from rural communities, many economic developers have come to view broadband telecommunications as key to their community's future. However, few policymakers actually understand what broadband can and can't do for a community. This is not entirely a deficiency on their part; at least part of the blame rests on the research community for failing to specify in concrete terms the specific nature of the linkage(s) between broadband and economic development. Regardless, it is a major policy consideration, and money is being spent on the basis of the assumption that a positive, significant, causal relationship obtains.

Broadband is a Major Policy Concern

Perhaps it was the optimism of futurist predictions of the transformative potential of broadband technology such as those offered by Gilder (2000), Evans & Wurster (2000), Tapscott (1996), or Cairncross (2001) that led to the fascination of policymakers and development practitioners with broadband in a relatively short period of time. Hollifield, Donnermeyer, Wolford, & Agunga (2000) observe that people have become "almost universally convinced" that broadband is essential for economic development – even if they lack a basic understanding of the technology. Perhaps, as Mueller (1993: p.150) suggests, because of the economic hardships faced by many rural communities, "a link between telecommunications and economic development was snapped up as quickly (and as uncritically) as a drowning person grabs for a nearby floating object." Perhaps it was the proliferation of non-academic reports on broadband by various government agencies and think tanks, and other non-neutral parties around the turn of this century, such as (Cohill, 2002; DeVol, 1999; Gartner, 2003; Leatherman, 2000; Oden et al., 2002; TIA, 2003). Perhaps, as these accounts claim, there really are tangible economic benefits

associated with broadband, which have simply not been documented in the academic literature and disseminated to practitioners. Regardless, economic development and policy audiences cannot always afford to wait for academic research to verify that a proposed policy will have the effects a plurality of their peers and other respected authorities seem to agree that it will. Like it or not, justified or not, proven or not, broadband has been thrust to the forefront of the policy debate, and the research community is in the position of trying to catch up.

Money is Being Spent

The question of how broadband works its effects for economic development is not some esoteric theoretical quibble made moot by the fact that policy has forged on ahead. Real money – often substantial amounts of it – is being committed to various projects which – independent of their particular merits – all lack a firm justification in academic research. For example, the Virginia Secretary of Technology reports that within the Commonwealth of Virginia alone, a number of communities have embarked upon initiatives that involve the construction or planning of some type of broadband telecommunications infrastructure, justified on the basis of its economic benefits. These initiatives include the LENOWISCO Planning District Commission Rural Area Network, the Cumberland Plateau Planning District Commission's broadband initiative, the eDan fiber backbone project, the nDanville metro fiber backbone, the Mid-Atlantic Broadband Cooperative's multi-million dollar Regional Backbone Initiative, the Dickenson County Wireless Information Network (DCWIN), the New River Valley Planning District Commission's proposed broadband initiative, the Town of Pulaski wireless network, the Broadband over Power Line projects in Manassas, Salem, and the Central Virginia Electric Cooperative (Huang, 2004), as well as wireless broadband initiatives in Salem, Pulaski, and Danville. Other high-profile broadband projects outside Virginia include the Utah Telecommunication Open Infrastructure Agency (UTOPIA)[1] project, the Zipp network in Grant County, WA[2], the CENIC "Gigabit or Bust" Initiative[3], the iProvo project in Provo, UT[4], and, most recently, the decision of large municipalities such as Philadelphia, PA[5] to build municipal wireless networks.

[1] http://www.utopianet.org/
[2] http://www.gcpud.org/zipp/default.htm
[3] http://www.cenic.org
[4] http://www.iprovo.net/
[5] http://www.wirelessphiladelphia.org

In Virginia, many of the broadband projects are being funded by groups such as the Virginia Tobacco Indemnification and Community Revitalization Commission, the Appalachian Regional Commission, and Virginia's Center for Innovative Technology. These groups have, in recent years, repeatedly demonstrated their acceptance of the idea that broadband leads to economic development. Furthermore, in Virginia and elsewhere, numerous examples exist of communities pledging public dollars towards broadband projects, often to match contributions made by the aforementioned funding agencies. The purpose of this study is not to argue that these are bad investments, only that a better understanding of how they might lead to economic development would either strengthen the arguments of the proponents of these projects or suggest alternate implementation paths that might be more beneficial.

1.3: Overview of the Study

In light of the policy importance of broadband telecommunications, it's important that researchers and development practitioners develop a better understanding of how the technology does – and doesn't – lead to economic development benefits. Broadband may enable multiple types of economic development benefits; however, this study will focus on the potential of broadband to enable *endogenous* economic development by stimulating positive effects within businesses that use it.

Since the analysis of secondary data sources cannot identify the underlying mechanisms and processes by which benefits might be derived from broadband, this study takes a step backward and examines first-hand accounts of key informants in the business community currently using broadband. A qualitative methodology will enable a better understanding of the processes by which broadband enables any economic development benefits it might have to be "grounded" in actual business experiences. Within this framework, a series of interviews were conducted with business representatives, community representatives, and telecommunications service providers in the communities of Bristol, VA and Danville, VA. These case study communities were chosen because they are sites of high-profile broadband deployment initiatives and were believed to be more likely than other communities to contain businesses using broadband.

The hypothesis adopted by the analysis is that the "Producer Network Effect" – described in detail in the "Theoretical Framework" section of Chapter 2 – is one mechanism by which

broadband can enable endogenous economic development. The concept of the Producer Network effect originated at Virginia Tech and suggests that broadband enables its users to become "producers" of information on the network, instead of just consumers – thereby deriving economic benefit. To test this hypothesis, the following research questions will guide the study:

What are the mechanisms linking broadband telecommunications to rural economic development?

1. Is there evidence of a "Producer Network Effect" that links rural broadband use to economic development through endogenous processes?
    a. What are the firm-level applications of broadband telecommunications? Is information production among these applications?
    b. What are the effects of a firm's use of broadband applications on its bottom line?
    c. How do external factors (community characteristics) influence the nature or magnitude of these effects?
2. How do the firm-level effects of broadband use translate to community-level economic development?

Chapter 2 reviews the current literature on telecommunications and economic development, paying particular attention to the special case presented by rural communities, and drawing on the literature of the firm as a supplemental lens through which to examine the micro-level effects of broadband more closely. Chapter 3 outlines the methodology adopted for this study. Chapter 4 presents the findings of the primary data collection. Chapter 5 reflects on the implications of the findings, and suggests appropriate future directions for policy and research.

Chapter 2: Literature Review and Conceptual Framework

> *Once available, [ICTs] can readily become not simply deliverers of content (to those with "access"), but also and crucially they can become the means for the production, distribution, and sale of "content" locally or globally; and, moreover, beyond content, they provide the basic infrastructure for production, distribution, sales and service delivery in any area of activity which has a significant information, knowledge or learning component. ICTs, it should be clearly understood, are the "satanic mills" of the Age of Information, but contrary to those "satanic mills", these present the opportunity for very widely dispersed application and use.* (Gurstein, 2003: p.11)

This chapter establishes a theoretical framework for the study, grounded in the findings of previous literature as well as the conceptual orientation of the Producer Network. A number of literatures address various aspects of the research question; however, the three most central are the economic development literature on telecommunications, the literature of the firm on telecommunications, and the economic development literature on the special needs and challenges of rural communities. This chapter will identify and discuss the key insights that these and other literatures suggest for this study's research question, but more importantly, will demonstrate that no academic work to date has directly addressed the question in the manner proposed by this study's methodology. Finally, the theory of the Producer Network will be presented as a means to address the gap identified in the current body of knowledge.

2.1: The Economic Development Literature on Telecommunications and Economic Development

The academic literature suggests a variety of ways telecommunications can play a role in economic development. McGovern (1992) classifies them into four key categories: business attraction and/or retention, diversification of the economic base, enhancement of a community's quality of life and service delivery, and increasing the competitiveness of existing firms. The first of these suggests an exogenous development process, while the latter ones suggest more

endogenous processes. In fact, multiple mechanisms may be at work, an insight that should prevent analysts from focusing too exclusively on one mechanism as "the" link between broadband and economic development. Hudson and Parker (1990) suggest that broadband may contribute to economic development in terms of efficiency, equity, and effectiveness; they also point out that economic development benefits may manifest themselves in the form of new job creation, business attraction/retention, improvements in the quality of life, or higher-paying jobs. Williams (1991) as well as the Economic Development Association of North Dakota (EDND, 2000) also distinguish between exogenous and endogenous impacts of broadband: business attraction and improving/retaining existing businesses, respectively. Although the theory of the Producer Network implies an endogenous process, subsequent discussion will clarify its role as one potential mechanism among several linking broadband to economic development. Thus, the potential for exogenous factors should not be dismissed.

Necessary But Insufficient – Broadband as an Enabling Infrastructure

A common practice within the economic development literature is to treat broadband as an indirect accelerator, catalyst, or enabler of economic development, which presumably is driven by other forces (Huang, 2004; TIA, 2003). Perhaps the most commonly-cited explanation of the economic impacts of broadband is that it is a "necessary, but insufficient" condition for development (Deller, 1997; eCorridors, 2002; Edwards, 2002; Grant & Berquist, 2000; Heather E. Hudson & Parker, 1990, 1992; Parker, 1996; Williams, 1991; Wilson, 1992) . Perhaps the most eloquent formulation of this proposition is offered by Williams:

> Do telecommunications infrastructure investments alone create economic development? The answer is generally no, because telecommunications is usually seen in a facilitating role; that is, its presence enhances opportunities for payoff in other investments such as in business development, improving residential life, or efficiency in delivery of public services. In our development research, the overall generalization has been that *telecommunications is a necessary but not sufficient condition for economic development*. However, what is developed, when it is developed, who benefits, and who pays for it remain topics of continuing debate. And so does the definition of economic development which may variously refer to jobs, attracting or retaining businesses, or enhancing the quality of life. (1991: p.39-40)

"Necessary but Insufficient" is the same economic status that is by convention assigned to more traditional types of infrastructure (Deller, 1997; Gillis, 1991). Following the advice of

Mueller (1993), it is instructive to look back at the common properties of infrastructure *in general*. Arsen (1997) provides an excellent review of the role of physical infrastructure in economic development and concludes that while the particular effects of infrastructure vary from place to place and over time, infrastructure can facilitate economic growth by either attracting new firms to a community when it lowers their operating costs, or by increasing firms' productivity. This observation suggests that infrastructure can have both exogenous and endogenous influences. Suarez-Villa (2000) also examines infrastructure as a general concept, and maintains that it is capital-intensive, takes a long time to recover investment, has benefits that are largely intangible, often has to be provided well ahead of demand, and can actually create its own demand once built. He suggests that infrastructure plays an important role in the regeneration of knowledge and the reproduction of creativity, as well as providing access to educational resources, knowledge networks, and labor markets (Suarez-Villa, 2000). Black (2004: p.34) also offers a more expansive definition of infrastructure, noting that the framework through which agglomeration and knowledge spillovers influence innovation can be thought of as a type of "local technological infrastructure" in its own right. Hudson (1984) suggests that the presence of other infrastructure may be necessary for the benefits of telecommunications to be realized. Dholakia & Harlam (1994) observe that other types of physical infrastructure – the more "traditional" types – remain important today, and telecommunications' importance should be considered in terms of how it ranks relative to these. This is a point well taken, and it is incumbent upon scholars to keep telecommunications "in perspective" in any model that they design.

However, the argument that "broadband is necessary but insufficient" is a fairly trivial conclusion, and provides a limited basis upon which to formulate policy. Some policymakers have made arguments for broadband's application to economic development by interpreting the "necessary but not sufficient" criterion as what amounts to a logical converse of the "field of dreams" approach; instead of claiming that "if you build it, they will come," they argue that "if you don't build it, you know they won't come." (Cauley, 2004; Heather E. Hudson & Parker, 1992; Read & Youtie, 1995). Hudson and Parker (1992: p.35) contend that ""Laying fiber-optic cables across the desert will not make it green. But the absence of modern telecommunications services will block economic development in any oasis." Statements like these have certainly influenced the allocation of significant resources to broadband deployment projects. However,

in the absence of a theoretically grounded description of a mechanism by which telecommunications is related to growth, such statements are dangerously close to being non-falsifiable – a problem which is exacerbated by the persuasive power of the anecdotal accounts from a handful of industrial location executives usually advanced in its support. This assumes that industrial recruitment is the only way to do economic development, and moreover, it is for all practical purposes an atheoretical statement.

Partial Theories of Telecommunications in Economic Development

A number of other perspectives are more specific in their theoretical approach to the relationship between telecommunications and economic development. One school of thought suggests that the key role of broadband telecommunications infrastructure in economic development is its ability to diminish the importance of location, and in the extreme, render distance "irrelevant" (Cairncross, 2001; Edwards, 2002; Heather E. Hudson & Parker, 1990; Oden et al., 2002; Williams, 1991; Wilson, 1992). The most extreme statements, such as "geography is dead," have largely been discredited, but there is some truth to the proposition that for some processes within some industries under certain conditions telecommunications can reduce the relevance of physical location – for example, by acting as a substitute for travel.

Another popular way to conceptualize telecommunications in economic development is as a "factor of production," or input to a variety of businesses, noting that it is involved at some point, directly or indirectly, in the production of just about every good in every sector of the economy – playing a similar function to the railroads of a previous era (Cronin, McGovern, Miller, & Parker, 1995; Malecki, 1996; Williams, 1991; Yilmaz & Dinc, 2002). (Cronin, Herbert, & Colleran (1992) identify telecommunications as a "productive infrastructure," noting that it is a "vital and pervasive" input into other sectors. These statements are not far removed from some of the principles of classical Economics – specifically, the theories surrounding technology *in general* as an input to the production process, and the theories that outline the economic properties of information. The notion that technology is good for economic growth is far from new; in 1956, Solow operationalized technology as an input to the production process that increased the productivity of labor and capital and was the primary driver of growth in the Neoclassical model (Solow, 1956). The theory of technological progress as a development

consideration has been elaborated further by the contributions of (Mansfield, 1968; Paul M. Romer, 1990; Paul M. Romer, 1994). Telecommunications is also a factor of production in the sense that it conveys information, which it itself an economic good with unique properties. It is relevant to the current discussion insofar as the Producer Network concept suggests that there is an economic advantage to be had as a consequence of being a producer of information. Shapiro and Varian (1999), Romer (1990), and Cortright (2001) observe that information is nonrival but partially excludable (distinguishing it from a pure public good) and tends to be expensive to produce but inexpensive – if not costless – to reproduce. The implication of all this is that information can be a source of value creation within an organization once produced, since the marginal costs of reproducing another unit are low but the expected marginal revenue from that unit is likely to be higher– thanks to intellectual property institutions. To sum up, whether it is understood as a technological input or a medium for the conveyance of information, telecommunications infrastructure may be considered a factor of production. This is a useful building block for a more complete theory, but is not, by itself, an adequate guide for policy concerning broadband telecommunications and economic development.

A third theoretical approach to the study of telecommunications infrastructure in economic development is to conceptualize it as an amenity that figures into the location preferences of industries. Hackler (2003a, 2003b, 2004) adopts this approach in her study of the location preferences of high-tech manufacturing and information technology firms. She concludes that telecommunications infrastructure appears to be a factor in the location preferences of these high-tech companies, and that public policies to promote telecommunications may result in growth so long as no other "binding constraints" exist (i.e., human capital or resource deficiencies, absence of complementary infrastructures, etc). These findings resonate with many economic development practitioners, who for a number of years have attempted to create agglomerations of high-tech industry. The location preferences of high-tech industry have been thoroughly researched, and prominent contributions include (Arrington, 1986; Borrus & Stowsky, 1998; Cortright & Mayer, 2001; Glasmeier, 1991; Hackler, 2000, 2001; Malecki, 1986; A. R. Markusen, Hall, & Glasmeier, 1986; Read & Youtie, 1994; Rees, 1986). While the attraction of high-tech industry is not really contemplated as a direct outcome of the Producer Network concept, it is useful to keep in mind that it is a distinct concept from the

problem of telecommunications in economic development, but is often the most familiar "high-tech" development strategy among practitioners.

Quantitative studies of the relationship between telecommunications infrastructure and economic growth indicators

The previous section outlined a number of theories that inform most of the current scholarship pertaining to telecommunications and economic development. This section considers the work that has been done to observe and measure the impacts of telecommunications on economic performance. Malecki (2004) attempted to correlate a wide variety of factors, including knowledge jobs, population, innovation capacity, advanced education, high-tech industry location, and many others, with the presence of Internet backbones. The study findings suggested that bandwidth investments are influenced by factors other than merely population density, including "economic dynamism" and the presence of doctoral-degree granting institutions. Another study that took telecommunications as its independent variable was (Yilmaz & Dinc, 2002). Their research involved the relationship between "telecommunications investment" and output growth in the service sector at the state level. Their findings suggested that telecommunications investment (determined at the state level) is positively related to output growth in the service sector. Roller and Waverman (2001) investigated how telecommunications infrastructure impacts economic growth by examining evidence from 21 OECD nations over 20 years. Dholakia and Harlam (1994) employed a regression analysis in an attempt to put telecommunications in perspective alongside other factors in terms of its ability to predict measures of prosperity such as annual pay or per capita income. Ramirez (2005) and Hudson and Parker (1992) observed correlations between telecommunications and economic development at the macro (state and national) scale.

However, correlation does not imply causality, and Roller and Waverman (2001: p.912) rather harshly pointed out that "policy suggestions of increased infrastructure investment based on this kind of evidence are without merit." A consensus in the literature is that it is far more difficult to prove causality than demonstrate correlation in the relationships between broadband and economic development (Heather E. Hudson, 1984; Ramirez & Richardson, 2005; Schmandt, 1990). Still, a number of studies do attempt to directly address the problem of causality. The

most prominent contributions to the question of causality with respect to broadband and economic development have been made by Cronin and a number of his colleagues in a series of studies from 1991-1995. In the initial study, national time-series data were analyzed to reach the conclusion that causality in the relationship between telecommunications and economic development is bi-directional – in other words, high levels of telecommunications investments can cause economic growth, and vice versa (Cronin, Parker, Colleran, & Gold, 1991). In later studies, the bidirectional causality would be tested and validated for the state (Cronin, Parker, Colleran, & Gold, 1993) and local levels of analysis (Cronin et al., 1995). Interesting as they may be, these findings do not "settle the question" of broadband's role in economic development. While they provide evidence that telecommunications investment may result in economic growth, they do not, and cannot, speak to the "how" questions – the mechanisms that drive the supposed causal relationship. Hollifield et.al (2000) note that these studies are limited in the sense that they focus only on the natural economic results of the presence of telecommunications, not purposeful telecommunications initiatives. This is a critical omission from a policy standpoint, since what is really needed is a theory that can speak to the question of whether or not local investments in broadband telecommunications have merit from an economic development perspective, and if so, how. Furthermore, it is highly significant that these studies use the *city* or the *state* as the unit of analysis – their results can only inform our understanding of *macro-level* trends. These sorts of studies, while they lend credibility to the *general idea* that broadband is good for economic development, do not provide much direction for policymakers at the local level. Finally, there is an urban bias among the quantitative studies – for the good reason that the secondary data sources many of these studies rely on are much more difficult – if not impossible – to come by in rural communities.

Qualitative Case Studies: examples and anecdotes

There have also been a number of qualitative case studies of the impact of broadband on economic development. Wilson (1992) studied the role of telecommunications in rural development, and purposefully selected 5 communities on the basis of their incorporation of broadband into economic development strategies. Schmandt (1990), using a set of 12 case studies, concluded that telecommunications was significant to economic development but noted that causality was difficult to determine. Walcott and Wheeler (2001) compared the location of

businesses to the location of fiber-optic backbones in Atlanta, GA. Read and Youtie (1995) present a case study of another Georgia community's strategy of deploying telecommunications infrastructure for economic development. Ford (2005) and Kelley (2003) conducted comparative case studies of "similar" communities in Florida, in an attempt to demonstrate that differences in telecommunications investment had caused differential development outcomes. These case studies, while they provide concrete examples and anecdotes of broadband having had an impact, still do not address the question of *how* it worked its effects.

2.2: The Literature of the Firm – Broadband's Micro-Level Effects

The applicability of many of the above-referenced studies to the current research question is limited by the fact that they are "macro-level" studies, focusing on economic outcomes at the national or state level, but shedding little light on the question of what local processes cause these outcomes. Williams (1991:p.24) explains the level of analysis distinction as follows:

> If we take a micro level view of how telecommunications adds value, we will typically identify particular points or processes in the operation of a business organization that can be facilitated by the use of telecommunications. This in contrast to a more macro-level view where in a community, region, state, or even nation, we tend to identify the necessary availability of telecommunications as an infrastructure component for overall development. In the latter, we look at the aggregate effect of telecommunications uses or potential rather than in a specific business or organization.

Hudson (1984) also notes that "microstudies" are more amenable to the development of theory. These types of studies are less common in the economic development field, but if we expand our focus to include a different set of sources from the business community – the literature of the firm – we can get a better idea of what is going on inside the "black box" of the firm. Because the Producer Network concept implies that broadband enables something to happen at the level of the individual economic actor (the firm or the entrepreneur), the literatures of the firm, entrepreneurship, management, business strategy, and microeconomics become relevant to the discussion, and shed considerable light onto some relevant theoretical propositions that can serve as a point of departure for this research. Williams (1991: p.25) suggests that the link between telecommunications and economic development lies in "… how

telecommunications can enhance the performance of a worker, a production line, or overall operation."

The table below summarizes the effects of information technology in general, and telecommunications in particular, identified in the literature of the firm.

Effect	Author(s)
Reduce Transaction Costs	(Roller & Waverman, 2001). (Cieslik & Kaniewska, 2004) (Akel & Phillips, 2001) (Read & Youtie, 1995) (Cairncross, 2001) (Litan & Rivlin, 2001)
Increase Productivity	(Heather E. Hudson & Parker, 1990; Hyman, Gamm, & Shingler, 1995) (Williams, 1991) (Oden et al., 2002) (Cronin, Colleran, Herbert, & Lewitzky, 1993) (Parker, 1996) (Read & Youtie, 1995) (EDND, 2000) (Leatherman, 2000) (Buckley et al., 2000) (Litan & Rivlin, 2001) (Mansfield, 1968)
Increase Efficiency / Process enhancement	(Hyman et al., 1995) (Buckley et al., 2000) (Martin & Matlay, 2003) (Wolf, Zee, & NetLibrary Inc., 2001) (Fraumeni, 2001) (Kolzow & Pinero, 2001)
Reduce Downtime	(Hyman et al., 1995) (Heather E. Hudson & Parker, 1990) (Williams, 1991)
Reduce Inventory	(Heather E. Hudson & Parker, 1990; Hyman et al., 1995) (Kolzow & Pinero, 2001; Williams, 1991)
Expand markets	(Heather E. Hudson & Parker, 1990; Hyman et al., 1995) (Oden et al., 2002) (Williams, 1991) (Martin & Matlay, 2003) (Tapscott, 1999) (Caves, 2001) (Fraumeni, 2001) (Heather E. Hudson, 1998)
Reduce travel costs	(Heather E. Hudson & Parker, 1990; Hyman et al., 1995)
Enable decentralization	(Heather E. Hudson & Parker, 1990; Hyman et al., 1995) (Williams, 1991)
Improve product quality and differentiation	(Heather E. Hudson & Parker, 1990) (Oden et al., 2002) (Keen, 1986)
Provide more efficient services	(Heather E. Hudson & Parker, 1990) (Korchak & Rodman, 2001)
Reduce costs	(Heather E. Hudson & Parker, 1990) (Williams, 1991) (Leatherman, 2000) (Kolzow & Pinero,

	2001) (Korchak & Rodman, 2001) (Litan & Rivlin, 2001)
Enhance internal communications within an organization, i.e., branch plants → HQ	(Wilson, 1992) (Williams, 1991) (Keen, 1986) (Martin & Matlay, 2003)
Enhance external communication along a supply chain (i.e, EDI)	(Buckley et al., 2000; Martin & Matlay, 2003) (Tapscott, 1999) (Cairncross, 2001) (Heather E. Hudson, 1998) (Kolzow & Pinero, 2001) (Litan & Rivlin, 2001)
Create improvements along a firm's value chain	(Williams, 1991) (Papp, 2001) (Tapscott, 1999)
Stimulate and support innovation	(Oden et al., 2002)
Facilitate training, organizational learning, and knowledge transfer	(Martin & Matlay, 2003; Williams, 1991) (Black, 2004; Suarez-Villa, 2000)
Improve decision making	(Williams, 1991)
Cutt distribution costs	(Williams, 1991)
Reduce the use of labor or improve labor efficiency	(Williams, 1991)
Increase the scope and efficiency of management	(Williams, 1991) (Litan & Rivlin, 2001)
Make pricing more competitive	(Williams, 1991)
Stimulate new business growth /entrepreneurship	(Akel & Phillips, 2001)
Facilitate disintermediation	(Akel & Phillips, 2001) (Valovic, 1993)
Improve relationships with customers/suppliers	(Akel & Phillips, 2001) (Keen, 1986) (Kleist, 2003) (Buckley et al., 2000) (Tapscott, 1999) (Good & Schultz, 2000)
Substitute for capital in the production process	(Cronin et al., 1995)
Facilitate flexible specialization and restructuring	(Valovic, 1993) (Martin & Matlay, 2003) (Cairncross, 2001) (Heather E. Hudson, 1998)
Create new marketing opportunities	(Valovic, 1993) (Kleist, 2003) (Martin & Matlay, 2003) (Good & Schultz, 2000)
Create new services and business practices	(Ramirez, 2001) (Cairncross, 2001) (Kolzow & Pinero, 2001)
Enable e-entrepreneurship / lower barriers to entrepreneurship	(Phillips, 2002) (Heather E. Hudson, 1998; IALR, 2004)
Automate of mundane tasks	(Wolf et al., 2001) (Cairncross, 2001)
Support teleworking	(TIA, 2003) (Williams, 1991) (Malecki, 1996) (Grant & Berquist, 2000) (Valovic, 1993) (Eldib & Minoli, 1995; Gillespie & Richardson, 2004; Grant & Berquist, 2000; Heather E. Hudson, 1998; Kolzow & Pinero, 2001) (Clark, 2000) (Heather E. Hudson, 1998) (Kolzow & Pinero, 2001)
Enable e-Commerce	(Akel & Phillips, 2001; Amor, 2002; Boyett & Boyett, 2001; Buckley et al., 2000; Burns, 2001;

	DuBrow, 1995; Fraumeni, 2001; Kolzow & Pinero, 2001; Korchak & Rodman, 2001; Leatherman, 2000; Pinero, 2001; TIA, 2003; Wolf et al., 2001; Zhu, 2004)
Lower barriers to entry	(Burns, 2001)
Increase cooperation between organizations	(Renkema, 2000)

2.3: Community Influences

This extensive collection of firm-level effects of technology and telecommunications represents a "menu" of possible gains that firms can realize from their broadband connections. However, the realization of benefits from telecommunications is neither automatic nor guaranteed. Authors in both the economic development literature and the firm literature note that broadband does not exert its effects in a vacuum. Hudson (1984) notes that cultural, political, and social factors within a community may affect how telecommunications is used by businesses, and Ramirez and Richardson (2005:p.306) claim that "there is an interplay between policy, technology, community, and organizational variables in shaping community-based networks."

The literature suggests a number of community characteristics that may act as mediating variables influencing the impact that telecommunications has on the firms that use it. These variables need to be included in any data collection instrument that seeks to elicit the experiences of field informants, and should not be left out of a model of the firm-level effects of broadband telecommunications. Community leadership is one of these, and is required in the first instance to acquire the enabling infrastructure (Parker, 1996), then to serve as role models for how to use it (Parker, 1996), and finally to facilitate the changes that the capabilities introduced by the infrastructure may bring about (Moore, 2004). Values and attitudes are also important – communities need to place value on computer literacy (EDND, 2000).

One of the most critical community variables that may enhance or impede the effects of telecommunications is the concept of technological literacy. As one account puts it, the Digital Divide is as much about awareness of the value of telecommunications, having access to relevant technical training, and having an occupation where telecommunications may translate into tangible benefits as it is about having access to the technology itself (Ramirez & Richardson, 2005). Oden et al. (2002) identifies two potential barriers to the ability of businesses to exploit

new communications technologies: lack of access to the technology itself and lack of the knowledge and ability to use the technologies *effectively* to improve performance. [emphasis added]. Gurstein (2003) makes a key contribution with his observation that people must not only have access to technology, they must also be able to leverage it *effectively* in practical, productive ways. Williams (1991) also underscores the importance of using the technology for productive applications.

The industrial composition of a community may impact the effect that telecommunications has on local businesses. First of all, some sectors are in a position to derive more benefit from the use of telecommunications than others, and second, if a community's economic base is dominated by branch plants, they may have different needs than smaller or independent firms – in particular, an increased need for intra-firm (inter-establishment) communications (Malecki, 1996; Yilmaz & Dinc, 2002).

2.4: Rural Development

As noted above, the purpose of this study is chiefly to understand the mechanisms by which broadband telecommunications can affect economic development benefits in *rural areas*. This aim requires a brief review of the unique challenges and circumstances that make rural economic development a special case of economic development. Such an understanding helps to design appropriately tailored research as well as policy, and also underscores the need to conduct research that has the aim of informing development policy options for rural communities.

Rural Economic Problems

A number of external economic forces have had profoundly negative impacts on the employment base and demographic composition of rural areas. First, the process of globalization that has transformed the national and world economy has worked its effects at the local level in the form of "deindustrialization," the migration of manufacturing industry out of rural communities, often to lower-cost locations overseas. Many communities that had looked to a single industry or sector for generations as a dependable source of middle-class job security are now faced with alarmingly high unemployment rates and a significant skills gap between displaced workers and available jobs. Similarly, the decline of resource-based industries, such as coal mining and tobacco farming, has also created economic hardship in some rural

communities. As the employment base of rural communities declines, the tax base that local governments used to depend on from the companies and the workers they employed has eroded, reducing their capacity to formulate and execute policies that could create new opportunities.

A secondary effect of the changes in the industrial composition of rural America has been a pronounced shift in the size, age, and education of the population of rural communities. Rural population totals are declining, as those individuals with the means and/or the education to find work elsewhere are forced to leave. Of particular concern is the "brain drain" of the most talented, young members of a community to other regions motivated not by opportunism, but by necessity. The remaining population is statistically older, poorer, and less well-educated than those that leave. Besides creating a special set of challenges for rural economic developers and government officials, this also underscores the urgency of finding solutions to the economic problems of rural America.

The Rural Penalty

Many rural communities suffer from a comparative disadvantage with respect to urban places, known as the "rural penalty," resulting from:

- low population density
- remoteness
- economic specialization in less knowledge-intensive sectors

(Edwards, 2002; Gillis, 1991; Heather E. Hudson & Parker, 1990; Leatherman, 2000; Malecki, 1996; Parker, 1996; Williams, 1991; Wilson, 1992). The rural penalty, in conjunction with the employment and demographic factors mentioned above, works to create a growing gap in income and living standards between the rural and urban regions of America. There are a number of accounts that suggest that improving the telecommunications infrastructure of a region can counteract the effects of the rural penalty, usually on the basis that telecommunications reduces the importance of distance (Heather E. Hudson & Parker, 1990; Williams, 1991; Wilson, 1992). Malecki (1996), however, cautions that there are other problems of rural areas that may prevent telecommunications from offsetting the effects of the rural penalty: first, the remoteness and terrain of rural areas may constrain the build-out of the necessary infrastructure, second, that there is a shortage of technologically-skilled entrepreneurs

in rural areas, and third, that many rural businesses lack the technological and managerial skills to leverage telecommunications effectively. Thus, we are presented with the interesting contradiction that on the one hand, rural businesses need telecommunications to mitigate the adverse effects of spatial remoteness, while on the other hand, other factors may inhibit their ability to gain access to or leverage such technology.

The Digital Divide

Another phenomenon that appears to militate against the potential benefits rural communities might gain from access to advanced telecommunications is the "Digital Divide" – between the "haves" and the "have-nots" of technology in American society (Congress, 2001; EDND, 2000; Edwards, 2002; Tony H. Grubesic, 2003; Gurstein, 2003; Kolzow & Pinero, 2001; Leatherman, 2000; Parker, 2000; Ramirez & Richardson, 2005; Strover, 2001). The digital divide reflects the spatially, economically, and demographically unbalanced pattern of Internet access – skewed substantially towards the urban, affluent, well-educated, non-minority segments of the population. The seminal, touchstone work on the Digital Divide is the 1999 "Falling Through the Net" report by the National Telecommunications and Information Administration, which took up the task of both operationalizing and quantifying the problem. The study found that rural Americans – regardless of income or other defining characteristic – are less likely to have access to the Internet than their urban counterparts (NTIA, 1999). Other, more recent, perspectives have expanded on its implications for particular areas, modeled it spatially, proposed policy options that would work to correct its effects, and many other value-adding elaborations. The implication for rural communities is relatively straightforward: to the extent that being on the wrong side of the Digital Divide is an economic disadvantage for a community, and to the extent that economic disparities have a way of reinforcing themselves in a vicious cycle, rural areas are at substantial risk.

The Relevance of Rural

Beyond the reasons mentioned in the Introduction, there are a number of reasons to study the Producer Network Effect in rural communities. First, the original articulation of the Producer

Network Effect does not suggest that it applies only to rural or urban communities. As stated, it appears to be presented as a general theory:

> *Anyone, **any community**, **any region** that does not have the capacity at reasonable cost to be a producer, a provider, of large-scale, high volume information and services to the networked world has a severe disadvantage in our global, networked economy…*(Mayer et al., 2004), Emphasis added.

Taking the above statement at face value, one would accordingly expect that any effects observed in rural communities could also be observed in urban communities, although perhaps on a larger scale. In fact, if one finds any effects at all in rural communities, it would lend strength to the position that the Producer Network concept is indeed a general theory.

The predominantly urban focus of the academic literature on economic development offers little or no direction to policymakers in rural communities – or else provides them with direction that may be inappropriate for their particular context. In the absence of relevant academic discourse on the subject, rural policymakers have little alternative but to make decisions based on the "conventional wisdom" about broadband, which, as was discussed earlier, may or may not be well-informed.

Why are the problems of rural America relevant to a larger policy context? One can make the argument that the fate of the country as a whole is, to a certain extent, inextricably linked to that of its rural areas, which support urban regions both economically and culturally. First, rural areas provide a source of surplus labor and a market for the manufactured goods of more developed regions. Second, rural areas play an important role in the preservation of national identity, as they are perceived by many to embody the core values of our nation's cultural heritage (Edwards, 2002) . For these reasons, policymakers as well as academics have wrestled with the economic problems facing rural areas for a long time.

2.5: The Current Geography of Information Production

Since the hypothesized mechanism of endogenous economic development through telecommunications is the production of information over the network, additional insight may be obtained from the literature on economic geography. Concerning this possible linkage, Zook (2000, 2004), has suggested that the companies that create the content of the Internet have

clustered spatially in key regions (205). In addition, Zook offers a definition of "informational products" as the sale of physical items, the sale of digital products, the use of a service, the use of a search engine, or the "delivery of convenience" through portals (206). He distinguishes between content *production* and content *hosting*, noting that these are two distinct activities with different spatial distributions, and that very often, firms that produce content host it on a server located elsewhere. This is a critically important observation for this study. He observes that the domain name registrations on the commodity Internet are spatially concentrated – primarily into major urban centers[6]. Following Moss and Townsend (1997), he argues that the administrative contacts of domain name registrations act as a proxy – albeit not a perfect one – for the site of content production for a business.

Other contributors to the literature on economic geography have dealt with telecommunications. For example, Grubesic (2002), and Grubesic & Murray (2002, 2005) examine the impact of geography on the availability of broadband telecommunications – in particular, DSL – and further observe that the scarcity of spatial data on telecommunications-related geographic features will necessarily result in the introduction of some error into the spatial analysis of telecommunications. Walcott and Wheeler (2001), in their study of the impacts of a fiber-optic network in Atlanta, GA, relate the spatial concentration of business locations to that of fiber-optic infrastructure. They argue that

> …Access to the location of information, as well as to the information itself, functions as a crucial modern commodity. For telecommunications, this translates into locations as proximate as possible to the backbone of fiber-optic system, which is usually centered in a downtown location because of the concentrated presence of transaction-intensive users and high-quality buried infrastructure already in place. (2001: p.326)

These findings are consistent with those of Zook (2000), as well as Gerwig (1998) and Reichard (1998), who argue that irrespective of the physical site of content production, its distribution onto the network (i.e., the location of the server computer) tends to be centralized at locations with access to fiber-optic backbones, which are far more likely to be urban than rural. The "Bringing Home the Bits" study by the National Research Council (National Research Council (U.S.). Committee on Broadband Last Mile Technology, 2002) observed that the local hosting of Internet content may remain limited as long as Internet Service Providers continue to offer

[6] An illustration of this in map form appears at http://www.zooknic.com/Domains/US_July_1998.pdf

asymmetrical bandwidth and discourage the operation of servers on home networks. Korchak and Rodman (2001), in a survey of small manufacturers in the U.S. found that only 4%, 12%, and 37% of small businesses, medium-sized businesses, and large businesses, respectively, hosted their own content on-site. This is an extremely relevant observation, since it calls into question what seems to be a fundamental spatial assumption of the Producer Network concept – that the site of information production (which requires, at a minimum, sufficient human capital to create the information) and the site of information distribution (which requires, at a minimum, a server and a fat pipe to the Internet) are necessarily one and the same.

2.6: The Literature that Informs Policy

Most policy regarding broadband telecommunications and economic development is informed not by traditional academic research, but by a "gray literature" consisting of a number of widely circulated research reports which have achieved the status of a *de facto* authoritative source to which a majority of economic developers and policymakers defer.

These reports have been prepared by various government agencies, think tanks, industry associations, and other groups. They are long on vision – all claiming the importance of broadband for economic development – but, in most cases, short on methodology and data to back up their claims. These "touchstone" papers are regularly cited by policymakers as justification for the inclusion of broadband in economic development planning efforts. "The Leatherman Report" (Leatherman, 2000) addressed the benefits of eCommerce, the Digital Divide, rural telecommunications infrastructure, and a number of other issues . The Appalachian Regional Commission's "Links to the Future" report (Oden et al., 2002), which focused specifically on the Appalachian region, argued that Information and Communications Technology (ICT) could benefit economic development by enabling innovation, product and service quality improvement, and productivity gains, as well as expanding the market reach of businesses, and documented the importance of ICT-producing industries, telecommunications infrastructure, and local telecommunications policies to the region. The Virginia Tech eCorridors report – "Strategic Technology Infrastructure for Regional Competitiveness in the Network Economy" – was an 11-volume guide to the use of a "geodesic mesh" fiber-optic network for communities, and was predicated on the assumption that "next-generation" telecommunications capacity (multiple megabits to all network nodes) is an essential contributor

to the economic development and quality of life of a region (eCorridors, 2002). The Telecommunications Infrastructure Agency's "The Economic and Social Benefits of Broadband Deployment" (TIA, 2003) claimed that broadband is an accelerator of economic development – "with broadband access, productivity increases, jobs are created, wages grow, new industries are created" (TIA, 2003: p. 6). The Gartner Group conducted the "One Gigabit or Bust Initiative: a Broadband Vision for California" study on behalf of the Corporation for Education Network Initiatives in California (CENIC) in 2003, and concluded that the state of California could realize competitive advantages from the deployment of a broadband infrastructure with symmetrical, ubiquitous, high-quality bandwidth of not megabits per second, but 1 *Gbps* to every premises to support enhanced personal communications and next-generation applications. (Gartner, 2003). Cohill (2002) has also advocated pursuing target bandwidths that are several orders of magnitude higher than what we have today. Not all perspectives in this subset of the literature are pro-broadband, however. Studies by groups such as the Heartland Institute (see, for example, Bast (2004)) for a paper that is highly critical of broadband for economic development.

The problem with these papers is that while for the most part, they remain objective, they were created to address a specific *perceived* policy need – i.e. the need to justify investment in broadband or argue against it. Many of them contain sound research, and are worthy of inclusion in a literature review of broadband and economic development; however, they, like the academic literature to date, fail to get at the root of the question – the theoretical specification of the underlying mechanism that links the telecommunications capacity to the outcomes they predict or document.

2.7: The Gap in the Literature: The need for this research

A substantial body of literature has been referenced during the course of this discussion, but all of it fails in one way or another to provide what is needed to guide local broadband deployment policies: a clearly specified, operational theory that describes a mechanism linking broadband telecommunications to economic development. It was demonstrated that the conclusion that "broadband is necessary but insufficient" is trivial at best and non-falsifiable at worst – and either way, is not nearly specific enough to inform policy. A number of theories suggest partial solutions to the question of how telecommunications may relate to economic

development in general, but stop short of offering a micro-level measurable mechanism for the relationship. Most of the quantitative studies cited have an urban bias - not by the fault of the researchers – but because they must rely on secondary data that are rarely available for rural regions. In addition, these studies are typically undertaken at a more macro- level of analysis (i.e., city, state or nation). The case studies in the literature begin to provide anecdotal support for the firm-level impacts of broadband, but most often document the outcomes of whatever process by which broadband influences economic development rather than attempt to explain it. The literature of the firm provides a much more finely-grained micro-level perspective, but provides no clear guidance concerning how firm-level effects might generalize upwards to the community level as economic development. This research aims to synthesize these partial solutions into a theoretical framework. While the "gap" in the academic literature identified in this literature review cannot be completely addressed by a single study of this one's scope, the section that follows describes one perspective from which to begin the project of narrowing the deficiency in the collective understanding of broadband telecommunications and economic development.

2.8: Theoretical Framework: the "Producer Network"

The gap in the literature on telecommunications and economic development, which can be described in the simplest terms as a lack of research on *how* telecommunications influences economic development at the *local* level in *rural* communities, can and should accommodate a number of theoretical perspectives. However, most approaches to the problem to date have been atheoretical in their orientation – which is one of the justifications for the current research. On the most fundamental level, this study is a *search* for new theories that speak to the aforementioned gap. As a point of departure into this endeavor, the study adopts as its hypothesis an existing theoretical *concept* that has been informally proposed but remains underspecified.

There are multiple dimensions to "economic development." Probably the one most familiar to rural policymakers – and the electorate they serve – is the set of policies targeted towards the attraction of business activity to a community from outside, referred to within academic circles as "exogenous" economic development. The "gray literature" of policy-oriented

papers on telecommunications' role in economic development frequently plays up this type of strategy, but it is not the only way to approach the problem. A trend growing in momentum within the academic study of economic development, largely in response to the disappointing track record of industrial recruitment as a development strategy, is to focus more on the cultivation of business activity *from within the community*, which may be referred to as "endogenous" economic development. (For a more detailed discussion of the historical progression of economic development theory and practice, see Bradshaw and Blakely (1999)). The author shares the conviction of a growing number of economic development theorists that endogenous economic development holds significant promise for rural areas, and is an effective, sustainable complement to more traditional exogenous strategies as part of a diversified economic development policy portfolio. Since the role of broadband telecommunications in endogenous economic development has received minimal research attention to date, the current research will attempt to build theory that addresses this dimension of rural economic development.

The remainder of this section will outline the central working hypothesis of this study. As the Methodology will outline in more detail, this research is being conducted as a "grounded theory" investigation. A pure grounded theory study typically approaches the problem domain with no prior theoretical framework, and inductively builds a theory based on – "grounded" in – field data and observations. This study deviates slightly from the classical approach; while its purpose remains to inductively build theory from data, it adopts at the outset a hypothesis which it seeks to situate within a grounded theory. This was motivated by the opportunity to use the current research to gain insight into an intriguing concept known as the "Producer Network" – an idea unique in its endogenous framing of its economic development implications.

The "Producer Network" concept originated at Virginia Tech as a vision to explain one possible dimension of the transformative potential of broadband telecommunications. Erv Blythe, Vice President for Information Systems at Virginia Tech, articulates several of its key propositions in more detail in an excerpt from a 2004 grant proposal developed jointly by the Department of Urban Affairs and Planning and the Virginia Tech eCorridors program:

Anyone, any community, any region that does not have the capacity at reasonable cost to be a producer, a provider, of large-scale, high volume information and services to the networked world has a severe disadvantage in our global, networked economy…

[the Internet's] greatest potential lies in its transformation to a global producer network enabling community members to leverage the infrastructure for economic development…

[Producer Network] infrastructure is designed and built under the assumption that every access point (network user) must have the potential to become a producer and distributor of services and information through the local network infrastructure. This implies that there is symmetrical bandwidth of at least several megabits per second, and that it is affordable. (Mayer et al., 2004).

Other articulations of this concept appear in (eCorridors, 2002; Van Gelder, 2004). It should be noted that since the Producer Network concept is a broad vision as opposed to a specific theory, its proponents sometimes add corollaries, inferences, or ancillary propositions to more clearly elucidate the relevance of the Producer Network to a given context, which are not mentioned in the version reproduced here. In an effort to take as its point of departure a cleanly specified and analytically efficient set of propositions embodying the "core" concepts, however, the current research will adopt as its definition of the "Producer Network" the version outlined in the quoted statements above. From these statements, we may distill several key theoretical propositions.

1. At the individual level, there is some sort of advantage associated with producing information and services for the consumption of "the networked world."
2. At the community level, having the capacity for citizens and businesses to be a producer on the network yields economic development benefits.
3. The "Producer Network Effect" is enabled by broadband network infrastructure with the following attributes:
    a. Ubiquity ("every access point")
    b. High Bandwidth ("at least several megabits per second")
    c. Symmetry ("symmetrical bandwidth")
    d. Affordability ("and that it be affordable.")

The Producer Network concept is not a *theory*, properly understood, since it is underspecified – offering a high-level explanation for one way broadband *might* influence economic development without operationalizing it in terms of measurable variables. Furthermore, it is not explicitly an *economic development theory*; it is a more broadly targeted statement that suggests a potential impact of ubiquitous telecommunications capacity on society in general, but it has strong economic development implications. This study was originally conceived out of an interest in this concept, and began as an effort to quantify and elaborate upon it. However, as the research design became concrete, the study evolved from a focused examination of the Producer Network concept into a more general theory-building exercise that took certain key propositions of the Producer Network concept as its hypothesis. In practice, this meant that the Producer Network concept influenced the direction of the literature review, was reflected in the development of field research instrumentation, was discussed in interviews, and ultimately was integrated into a grounded theory of telecommunications and local economic development in rural communities.

Chapter 3: Methodology

> *"The centerpiece of grounded theory research is the development or generation of a theory closely related to the context of the phenomenon being studied."*
> (Creswell, 1998: p.56)

This study employed a qualitative methodology and a grounded theory mode of inquiry to identify variables and theoretical propositions at the local level that describe the firm-level effects of broadband telecommunications, and searched for evidence of the Producer Network Effect. The ultimate goal of this research was the development of an analytical and theoretical framework – *grounded* in field observations as well as the literature – that can be used to guide future empirical investigations, and the research design was approached as a means to this end.

A series of semi-structured interviews were conducted in purposefully chosen case study communities with purposefully chosen informants representing telecommunications service providers, community experts, and local businesses. Questions were strategically included in the interview guides to reflect hypothesized effects of broadband suggested by the literature, but the format was open-ended enough to allow previously unanticipated concepts to emerge. Interviews were transcribed and analyzed, using the nVivo software package, for recurring themes. A model was constructed through the comparison of the themes that emerged from the field data with the hypothesis and the effects suggested by the literature.

3.1: Precedents for Qualitative Economic Development Research

Unlike most economic development studies, which tend to be quantitative in nature, this project employed a qualitative methodology. Qualitative research designs are appropriate in cases where the problem to be investigated is not sufficiently well understood to operationalize *a priori* in terms of measurable variables and relationships. A quantitative investigation of the Producer Network Effect is not possible at the present time because the theory, as it was originally articulated, is underspecified; it is not specific enough to operationalize into a set of measurable, quantifiable variables and observable relationships. A qualitative design was chosen to approach the problem from an inductive as opposed to a deductive mode, seeking to build – or

in this case, elaborate – theory, rather than test it. This approach to data collection – in which the theory emerges from the field observations and may or may not resemble the original hypothesis (if one is used at all) is known as *grounded theory* (Creswell, 1998; Merriam, 1998). There are precedents for this kind of approach in Economic Development research; for example, Ramirez (2001) used grounded theory to study remote and rural Information and Communications Technologies (ICTs) in Canada, citing a lack of established theory as justification for his methodology. Edwards (2002) developed a multi-site case study with grounded theory, noting its utility for the inductive generation of new theories. This study's methodology is similar to Edwards' work, with such features in common as the use of multiple communities for validity control and the purposeful selection of communities on the basis of broadband availability.

Studying Regions by Studying Firms

Markusen (1994) provides excellent methodological guidance on the use of key informant interviews as a data source in economic development research. She notes that many of the concepts that have emerged in modern theories of economic development, such as flexible specialization and innovative milieus, are very much embedded in the local context and do not lend themselves to analysis using secondary sources or highly structured data collection instruments such as surveys. She suggests that in addition to their inductive application, interviews, properly conducted, can be used to test hypotheses, noting that "interview findings can suggest either consensus (for or against) or lack of it on hypothesized causal connections" (1994: p.478). This is precisely the role that interview data play in this research project. Markusen also notes the importance of being able to distinguish between levels of analysis (establishment, firm, industry, and region), and provides numerous practical guidelines for selecting informants and executing the interview. The work of Healey & Rawlinson (1993) and Schoenberger (1991), to whom Markusen defers for a more detailed discussion of interview mechanics, provide excellent technical guidance on interviewing within a business setting. To sum up, a qualitative, grounded theory research design employing interviews as a primary data collection technique, has a acceptable degree of precedent in the literature to which this work seeks to contribute to justify the methodology described herein.

3.2: Research Question

This investigation was guided by a general research question with multiple sub-questions, which are best represented hierarchically:

- What are the mechanisms linking broadband telecommunications to rural economic development?
    - Is there evidence of a "Producer Network Effect" that links rural broadband use to economic development through endogenous processes?
        - What are the firm-level applications of broadband telecommunications? Is information production among these applications?
        - What are the effects of a firm's use of broadband applications on a firm's bottom line?
        - How do external factors (community characteristics) influence the nature or magnitude of these effects?
    - How do the firm-level effects of broadband use translate to community-level economic development?

At the most fundamental level, this study aims to provide a better understanding of the mechanisms that link broadband telecommunications to economic development. This research hypothesizes that one potential mechanism is the Producer Network Effect. To assess this hypothesis, it will be necessary to ask a number of sub-questions, which aim to determine if information production is a firm-level application of broadband, what firm-level effects it leads to, and what mediating variables at the community level come into play.

3.3: Hypothesis

The availability and affordability of broadband telecommunications will enable businesses and entrepreneurs to become "producers" of information, which will result in firm-level benefits such as efficiencies and expanded markets, which will have a positive effect on the firms' bottom linse and enable expansion of operations, the hiring of new employees, or increased investment in the community. The net effect of these firm-level benefits, summed over

all the businesses in a community that derive benefits from broadband, will be endogenous economic development. This can be represented graphically, as follows:

A Hypothesized Framework for the Producer Network Effect as a Component of an Endogenous Mechanism for Rural Economic Development

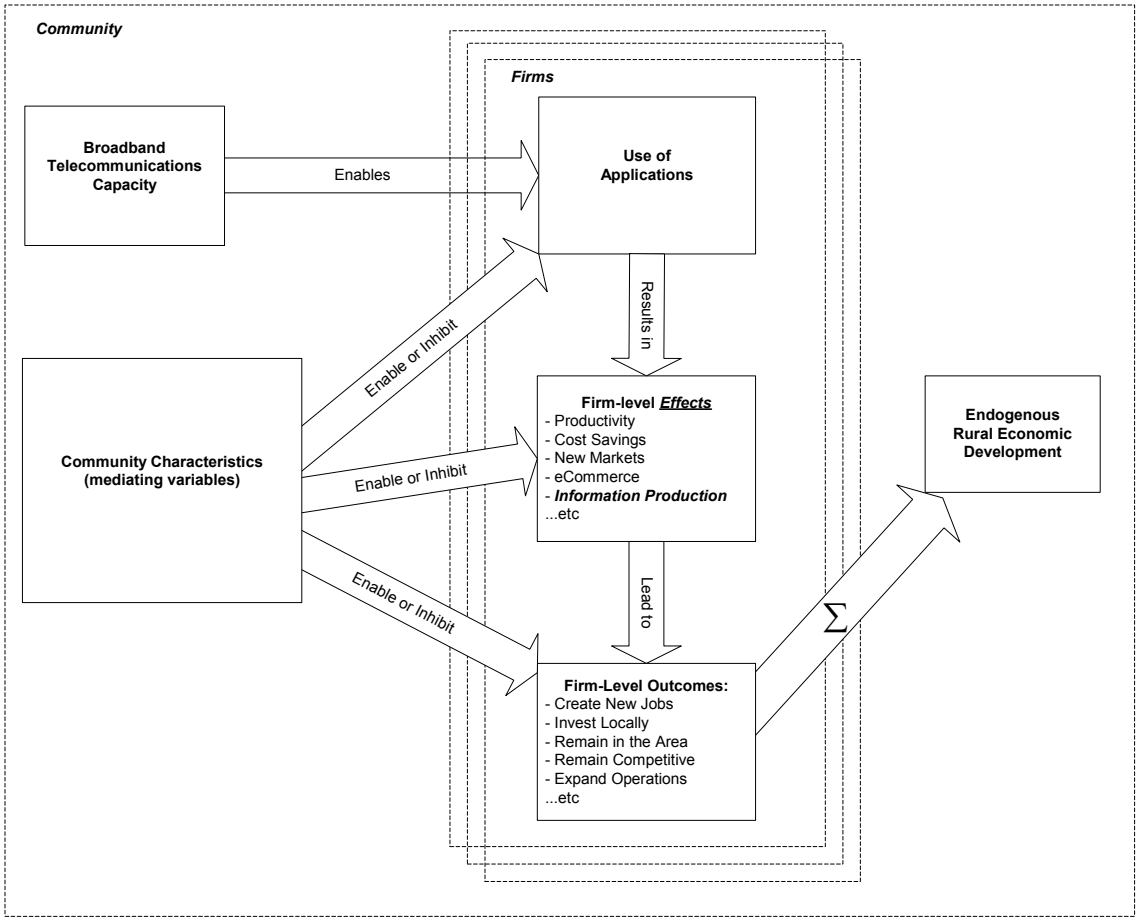

Figure 1: A Conceptual Model of Endogenous Rural Economic Development using Telecommunications

This model is a visual synthesis of the literatures reviewed in Chapter 2. The differences in levels of analysis are reflected in the demarcation between processes that occur at the community level and the firm level. Firms realize beneficial effects only through the use of applications (the technology itself is not sufficient). Community variables play an important mediating role as they enable or inhibit the use of applications, the realization of effects, and the translation of broadband effects into strategic outcomes as suggested by the authors that

addressed literacy and related topics. As the model indicates, the Producer Network Effect is hypothesized to be one of several potential effects of broadband use at the firm level. The purpose of the data collection outlined below will be to attempt to determine whether the practical experience of businesses bears out the hypothesis, and/or if other factors are at work.

3.4: Data Collection Methods

To obtain primary data in the context of the qualitative research design chosen for this study, interviews were conducted with key informants in the case study communities. Three groups within each community were identified as potential sources of information.

1. Informants from businesses using broadband, which provided a perspective on:
    a. The effects of broadband within their operation
    b. External factors (community influences) that facilitated or inhibited these effects
    c. Bottom-line results of the broadband effects
    d. Other businesses to contact
2. Informants from government, chambers of commerce, or economic development groups, which provided a perspective on:
    a. The most important sectors within a community
    b. Perceived effects of high-speed telecommunications
    c. Suggested firms to contact
3. Informants from telecommunications service providers, which provided a perspective on:
    a. The availability of high-speed telecommunications infrastructure
    b. The services demanded by businesses
    c. Customers of high-speed telecommunications services to contact

Sampling

As suggested by the qualitative nature of the proposed research, the bulk of the data came from interviews with purposefully chosen informants. This required sampling decisions to be made at two levels: *where* to study the phenomenon and *whom* to interview within that setting (Merriam, 1998). While the research *settings* were chosen purposefully at the outset, the

individual *informants* were selected on the basis of a snowball sampling strategy from within those communities.

Selection of Case Study Communities

Two case study communities were purposefully selected as research settings: Bristol, VA and Danville, VA. There were a number of reasons these communities were chosen. First, both communities seemed to have the potential for broadband to be available to the business community, so it seemed likely that business informants currently using broadband could be located. This was evidenced by the fact that, in the case of Bristol, the city Utilities Board had deployed a Fiber-to-the-Premises network and was currently providing services to businesses, as was confirmed by its website. In Danville, a high-profile fiber-optic backbone initiative had been installed, and a local ISP was providing wireless access in cooperation with a local development-oriented foundation.

Both communities were small enough to begin to address the question of the impacts of broadband in rural communities; both are minor urban centers within more rural communities. As independent cities in the Commonwealth of Virginia, these communities are obviously not "rural" in the strict sense. However, as mid-sized towns with some available broadband, these communities represented a compromise between rurality and availability of data.

Both communities possessed attributes making them relevant to the theory; Bristol had the capacity to provide a much higher level of broadband service than most any other community (recall the original Producer Network concept's estimate that multiple megabits per second would be needed). In Danville, the eDan project was originally marketed as a means to "enable a Producer Network" (IALR, 2004) – a distinction that certainly seemed to warrant further investigation in the context of a study such as this one. Finally, in both communities, a number of people were accessible to the researcher as "gatekeeper" informants – points of entry into the community.

The following table provides a profile of the two case study communities, highlighting key demographic, economic and telecommunications-related variables.

Profile of Case Study Communities[7]

Variable	*Bristol, VA*	*Danville, VA*
BASIC DEMOGRAPHICS		
Population	17,367	48,411
Median Age	41.3	40.5
Racial Diversity		
White	92.50%	53.90%
Black or African American	5.60%	44.10%
American Indian and Alaska Native	0.20%	0.20%
Asian	0.40%	0.60%
Native Hawaiian and Other Pacific Islander	0.00%	0.00%
Some other race	0.20%	0.50%
HUMAN CAPITAL		
High School Graduate or Higher	72.4%	68.5%
Bachelor's Degree or Higher	17.0%	13.9%
ECONOMIC VARIABLES		
Labor Force Participation	53.8%	57%
Unemployment	3.5%	5.7%
Median Household Income	$27,389	$26,900
Per Capita Income	$17,311	$17,151
Families Below Poverty Level	13.2%	15.9%
Industrial Composition		
Agriculture, forestry, fishing and hunting, and mining	1.30%	0.10%
Construction	4.60%	4.40%
Manufacturing	23.80%	27.20%
Wholesale trade	4.20%	2.60%
Retail trade	15.20%	14.00%
Transportation and warehousing, and utilities	3.80%	3.00%
Information	2.60%	1.30%
Finance, insurance, real estate, and rental and leasing	4.80%	4.10%
Professional, scientific, management, administrative, and waste management services	6.10%	5.30%
Educational, health and social services	17.60%	21.80%
Arts, entertainment, recreation, accommodation and food services	6.90%	8.60%
Other services (except public administration)	6.20%	4.70%
Public administration	3.00%	3.10%
TELECOMMUNICATIONS		
Services Available	FTTH, DSL, Cable	DSL, Cable, Wireless

[7] http://factfinder.census.gov; http://www.ialr.org/technology/eDanInternetInfrastructure.php; www.danville-va.gov; www.bvub.com

Broadband Initiatives	BVU-Optinet	eDan, nDanville

Selection of Informants

A "snowball" sampling method was used to identify and recruit interview subjects for this study, whereby an initial contact was made with a known expert within the community, and new contacts were made on the basis of their recommendations and referrals. Rao and Perry (2003) note that snowball sampling is an appropriate, established method for choosing subjects in cases where little is known about the topic under study, and the best source of information is likely to be a relatively small group of experts with first-hand knowledge. In both communities, the initial contact was either a community informant or telecommunications service provider, as they were more accessible than business informants. In both communities, the initial informant was able to provide useful, relevant references. The process continued until the responses began to become "saturated" – that is, informants were saying the same things and no new information was being obtained.

At the conclusion of the data collection process, one telecommunications service provider, two community informants, and five businesses had been interviewed from each community, for a total of 16 informants. The following table provides an overview of the informants interviewed over the course of this study. Per the provisions of the Informed Consent agreement, anonymity of individuals and specific companies has been preserved through the assignment of a code number to each informant. Code numbers follow the format <D|B><B|C|P><n> where *D* stands for Danville, *B* stands for Bristol; *B*, *C*, and *P* represent Business, Community, and Provider; and *n* is an arbitrary number not related to the sequence of the interviews.

Profile of Informants

Code	Community	Informant Type	Sector/Type	Approx. Size (#employees)	Internet Connection	Local/Remote Website
BB1	Bristol	Business	Manufacturing	101-200	5Mbps up/down between sites; dual Internet connections @ 512Kbps up / 256Kbps down and 1.2Mbps down / ~256Kbps up	Local
BB2	Bristol	Business	Manufacturing	101-200	1.2Mbps up/down for Internet; 2x DS-3 dedicated link to parent company	Local
BB3	Bristol	Business	Retail	201-500	128Kbps up/down @ retail sites; 10Mbps up/down connecting corporate office to dist. Center	Remote
BB4	Bristol	Business	Manufacturing	51-100	3Mbps down / 512 Kbps up	Remote
BB5	Bristol	Business	Hospitality	11-20	unknown	Remote
BC6	Bristol	Community	Local Government	101-200	unknown	Remote
BC7	Bristol	Community	Chamber of Commerce	6-10	768Kbps down / 256Kbps up	Remote
BP8	Bristol	Service Provider	Municipal Utility	21-50	unknown	Local
DB1	Danville	Business	Manufacturing	21-50	128Kbps up/down	Remote
DB2	Danville	Business	Services	21-50	128Kbps up/down	Remote
DB3	Danville	Business	Services	6-10	unknown	Unknown
DB4	Danville	Business	Services	1-2	T1 (1.5Mbps)	Remote
DB5	Danville	Business	Engineering	1-2	T1 (1.5Mbps)	Remote
DC6	Danville	Community	Business Incubator	3-5	T1 (1.5Mbps)	Remote
DC7	Danville	Community	Public Education	201-500	Fractional OC-3 Backhaul; various wireless connections between sites	Local
DP8	Danville	Service Provider	Private ISP	21-50	2x DS-3 (~90Mbps)	Local

Interview Content

Three similar yet distinct sets of interview questions were created for this study, with each containing questions targeted to one of the three informant groups. The interview guides employed unstructured to semi-structured interviewing techniques in order to facilitate the development of an emergent theory. The guides did not serve as a structured script for each interview. Instead, each guide contained a set of general themes to be addressed with each informant, accompanied by a detailed list of potential probes that could be used in cases when the conversations with the informants did not naturally address certain key issues. Initial versions of the interview guides were developed with only the literature to suggest potential questions; however, later interviews incorporated some of the emergent themes that were mentioned by previous informants. This is an example of the "convergent interviewing" technique described by Rao and Perry (2003) whereby new questions are incorporated into future interviews, until no new questions are raised, indicating saturation of the topic.

A common set of themes was addressed in each interview, regardless of informant type. First, everyone was asked what their current Internet connection was, although for various reasons, not all of the informants were able to answer this question. Everyone was also asked a question pertaining to applications of broadband – e.g., "what do you do with your connection?" Most informants also had an interest in economic development, and were willing to weigh in on the potential ways broadband might affect economic development, its "weight" relative to other factors, and the influences of community-level variables on the potential impact of broadband.

Beyond this "common core" of question themes, informants were asked some questions specific to their role as a service provider, community informant, or businessperson. Service providers were asked what services they offered, where they were available, what the business demand was for those services, and who (or what types of businesses) were the biggest bandwidth consumers – particularly in terms of upstream bandwidth, which could be evidence of information production. Community informants, who were for the most part all directly or indirectly involved in economic development activities, were asked about the industrial composition, the importance of small/entrepreneurial/home-based businesses, the presence of an entrepreneurial culture, and were probed more extensively to describe mediating "community" influences. Businesses were asked to comment on the effects that their use of telecommunications had, and what "strategic impacts" those effects enabled.

A number of "emergent" themes were discovered early on in the interview process that had not been contemplated during the initial design of the interview guides (and are thus not included on the guides in the Appendix). First, the issue of remote content hosting was raised. Since this concept has the potential to alter the spatial dimension of the Producer Network concept, it was deemed important and was included in future interviews. Second, the observation that many businesses were effectively using "little broadband" connections – or even less – to create value from the use of innovative applications led to the inclusion of a question aimed at determining how much bandwidth a business really needed, and if the recommendation of multiple megabits per second suggested by the Producer Network concept was necessary or reasonable.

The original interview guides are included below as Appendix C.

Interview Process

The preferred format for the interviews was a face-to-face meeting at the informant's place of business, lasting approximately one hour, and tape-recorded for transcription. In these "ideal" situations, the first order of business was the administration of the Informed Consent Process, whereby the Informed Consent form, which detailed the purposes of the research and identified all potential risks/benefits for the informant, was presented and explained. Informants were given the opportunity to ask questions, think it over, or opt out of participating. Once the informant signed the IC form, the recording device (a compact digital recorder) was turned on and the interview began. The informant was introduced to the main themes of the research – and often this was enough to stimulate an entire hour's worth of discussion. In cases where the informant was not as descriptive or talkative, the probes were used.

In a few cases, however, it was not possible to follow this interview format. For one thing, some informants became extremely engaged and continued talking for up to two hours, without any additional prompting from the researcher. In one instance, the informant refused to be recorded on the grounds that he was going to be discussing information that was somewhat controversial and could reflect badly on certain high-profile figures. In that case, detailed notes of non-sensitive aspects of the conversation were taken, which was agreeable to the informant. In a few other cases, the informants could not schedule a face-to-face meeting, but asked if they could conduct the interview via telephone. These requests, as with all requests made by the

informants, were accommodated. When telephone interviews were conducted, the Informed Consent form could not be physically signed by the informant, but a review of the Informed Consent process was conducted verbally, and the interview was not recorded, thus lowering the risk to the informants. Detailed notes were taken for the purposes of analysis, and some of the telephone interviews were nearly as long as the face-to-face ones. Regardless of interview format, every effort was made to remain in compliance with the spirit of the IRB requirements, and the interview processes were appropriate to the nature of the data being collected and furthered the overall goals of the research.

3.5: Validity Threats Inherent to the Methodology

There were a number of potential threats to both the internal and external validity of the research that were introduced by the design decisions underpinning the methodology. Following the advice of Maxwell (1996) and Merriam (1998), this section acknowledges their presence at the outset, and considers both the level of risk posed by each validity threat and the strategies implemented in the research design to mitigate them.

With respect to internal validity – the extent to which the findings match reality for the population under study – a number of hazards exist. First, the size of the sample could be too small to capture all the effects of broadband at the firm level, and could fail to include perspectives that might lead the interpretation of the results in an entirely different direction. The risk of this, however, appears to be minimal, since towards the end of the interviews, the same concepts were surfacing, indicating that "saturation" was being approached. Another potential risk is known as "key informant bias" (Maxwell, 1996), which tends to be linked to the use of a snowball sampling methodology. Key informant bias is introduced when subsequent informants suggested by initial respondents are part of the same social network, and provide much the same perspective as the first informants did.

In terms of external validity – the extent to which research findings are generalizable – a number of potential threats need to be addressed. First, unstructured interview research often leads to findings that are deeply "embedded" in the local context (A. Markusen, 1994; Maxwell, 1996; Merriam, 1998). This can produce far more meaningful findings for the population under study, but may limit the extent to which those findings can be generalized to dissimilar populations. The location of the research – in the two case study communities – could bias the

findings towards results that are not typical for other communities. However, since the goal of this study was simply to create a model of firm-level broadband effects grounded in the experiences of the businesses that use the technology, it seems plausible that many of the effects observed in the case study communities *would* be observable elsewhere – and if that turns out not to be the case, subsequent quantitative analyses will reveal the outlier effects.

Strategies to mitigate Validity Threats

An understanding of the validity threats that present a risk to a research study is essential to the interpretation of its findings. This study does not claim *universal* generalizability, and it acknowledges that a larger sample size could potentially improve external validity. Having said that, there are a number of measures that were built into the research design to minimize the potential for validity hazards to exert a distortionary influence over the findings.

Triangulation

Within qualitative research designs, the most common technique for dealing with validity threats is *triangulation*, or multiple sourcing (Maxwell, 1996; Merriam, 1998). In a study that relies on interview research as the *primary* data source, it is desirable from a validity standpoint that they not be the *only* data source. The methods discussed below, while they do not address all the potential negative influences of external and internal validity threats, improve confidence in the findings.

Multiple Case Sampling

Miles and Huberman (1994b) have emphasized that the value of multiple case sampling as a means to improve validity. They note that "multiple-case sampling gives us confidence that our emerging theory is generic - because we have seen it work out - and not work out - in particular ways" (Miles & Huberman, 1994b: p.29), and add that the use of multiple cases gives on confidence in "analytic generalizations" (Miles & Huberman, 1994b: p.30). They suggest using as many cases as will give one confidence in the findings – constrained, inevitably, by practical considerations. This is what has been attempted in the current investigation; more cases would have been desirable, but the necessarily limited scope of a Master's thesis, as well as the limited availability of resources, precluded the use of more than two.

Prior examination of Secondary Data

While the main premise for the use of qualitative research methods was the fact that the kinds of effects that were of interest to the research question could not be readily understood from an examination of secondary data, there were still some ways that secondary sources were brought to bear. First, to help address the problem of community influences, a demographic and economic profile of the case study communities was constructed prior to field data collection, to help inform the development of meaningful research questions. For demographic data, standard Census information was consulted – specifically, the community "QuickFacts" data retrieval option, since only a summary demographic profile was necessary. Economic conditions, and specifically the industrial composition of the regions under study, were ascertained through the use of the Department of Commerce Bureau of Economic Analysis's Regional Economic Information System (REIS) and the Virginia Employment Commission's ES-202 dataset. Initial assessments of the availability and pricing of broadband services were performed by accessing the websites of the key telecommunications service providers in the communities under study. In Bristol, this was the Bristol, VA Utilities Board (http://www.bvub.com) and in Danville, this was Gamewood (http://www.gamewood.net).

Multiple Snowballs

The "key informant bias" mentioned above was a particular concern, since a snowball sampling method was employed as the primary means for recruiting informants. To lessen the likelihood that all informants were part of the same social network, multiple "root" informants were selected within each community. The relationship between the informants in the snowball sampling network may be visualized as follows:

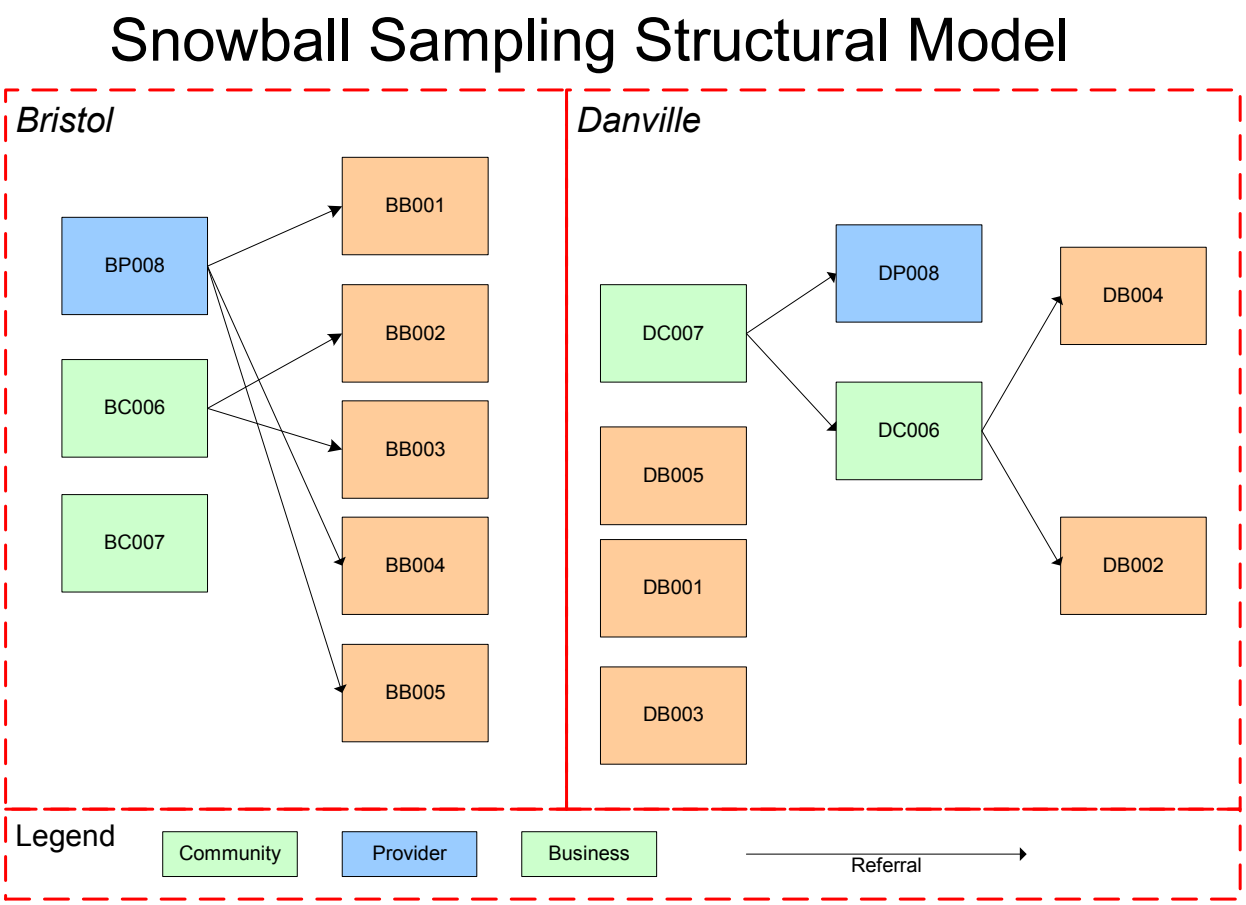

Figure 2: Snowball Sampling Diagram

Investigating Internet Content Provision with whois and traceroute and VisualRoute

One factor that turned out to be highly relevant to an understanding of the Producer Network Effect was the physical location of Internet content, such as company websites. Most of the informants were knowledgeable about whether their content was hosted locally or remotely, but to gain a more accurate understanding of where the content resided, a rather unique type of secondary sourcing was used. Following Zook (2000), the UNIX utility programs `whois` and `traceroute` were used to determine an approximate physical location for informants' websites. As this procedure is rather technical, it is described in more detail in Appendix D. This added value to the study by confirming and documenting the tendency of

many businesses – and particularly small ones – to host their content off-site. This technique has the potential to serve as a primary data source in a future study, an in an expanded form, could produce useful insights into the relationship between virtual locations on the Internet and physical sites that require broadband telecommunications.

3.6: Data Analysis Procedure

The primary goal of this research was to identify relevant variables and theoretical propositions suggested by the interview response data to develop a grounded theory of firm-level broadband effects, including Producer Network effects, as a mechanism for endogenous economic development in rural areas.

Following the methodological guidance of Miles and Huberman (1994a), beginning before any data are collected, and continuing throughout the process of interview transcription, a set of codes/themes/headings/categories were devised, based on the literature, to represent relevant pieces of information including community characteristics, effects of broadband, and any observed Producer Effects.

As discussed above, most of the interviews were digitally recorded, with a few exceptions. All recordings were transcribed by the researcher. In compliance with IRB confidentiality requirements, each informant was assigned a code number, the form of which wa described above. Initially, the digital audio files were played on the computer and the conversation was manually typed; later on, however, the conversations were dictated using voice recognition software, to improve transcription time. In cases where the informant refused transcription or the interview was conducted over the telephone, detailed notes were taken during the course of the interview itself, and immediately thereafter – or as soon as was practical – the notes were re-typed to expand on shorthand notations and fill in any missing pieces of information while they were still fresh in the researcher's mind.

Once all the data were collected, passages were identified in the transcripts that corresponded to the pre-defined codes. In addition, *open* or *In-Vivo* coding was used to create additional codes that emerged from the text (Ryan & Bernard, 2003). As suggested by Merriam (1998) and Ryan and Bernard (2003), qualitative data analysis software was used to manage the large volume of interview data efficiently, keep track of coded text, and discover patterns within the data. Based on availability and suitability to task, the *nVivo* software package was employed

to analyze the data. An example of its application to the interview coding process appears below.

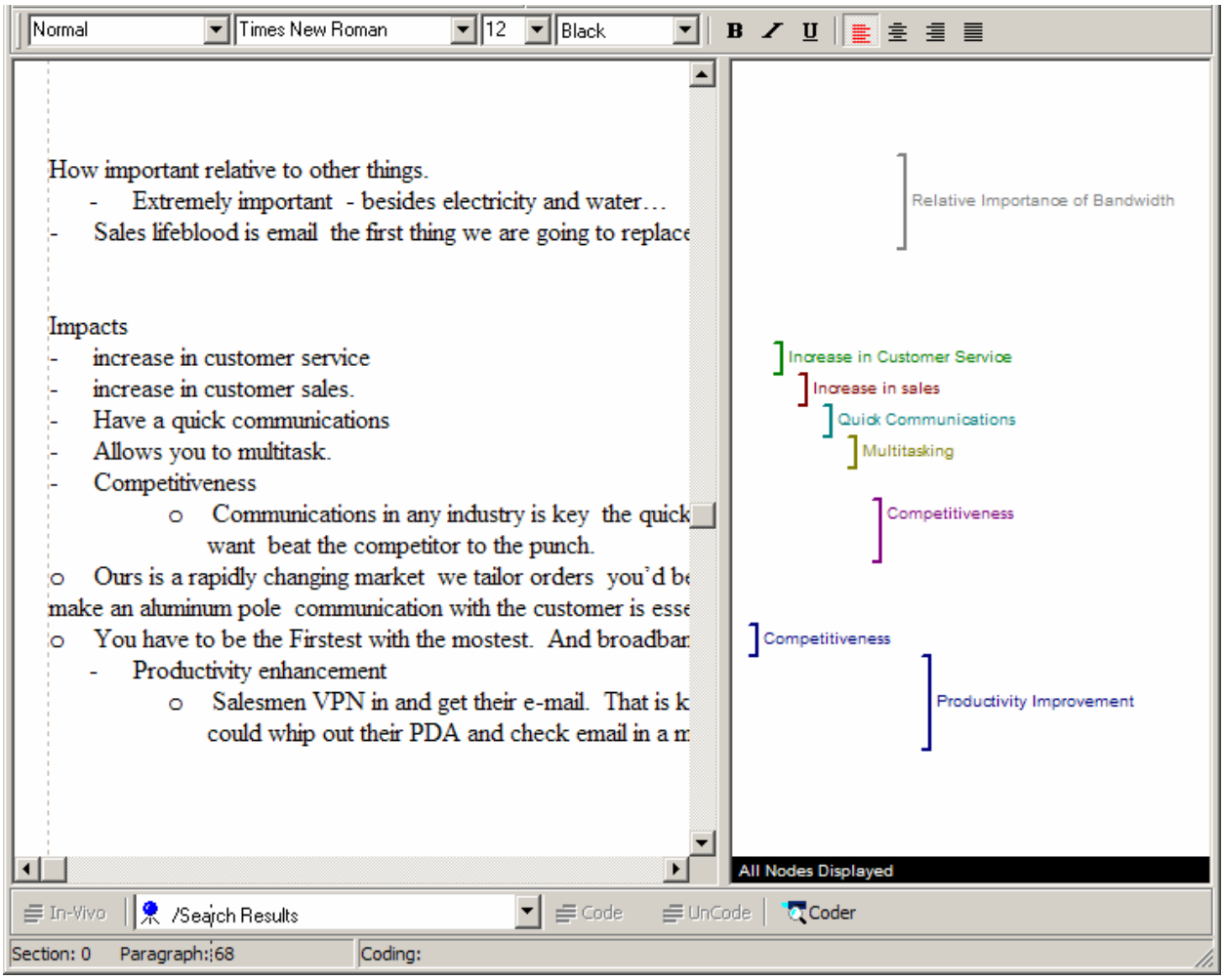

Figure 3: Coding interviews with nVivo

The coding process revealed a number of recurring themes across many, if not all, of the interviews. nVivo provided the ability to arrange the codes hierarchically, and allowed concepts to be moved around into a logical framework. The graphic below depicts the hierarchical coding capabilities of nVivo, as the nodes in the right pane are "children" of the "parent" nodes in the left pane. A priori codes, including concepts from the literature, as well as preliminary hypotheses, were entered into the system as "free nodes" (not members of a hierarchy) until their appropriate niche in the emerging structure of the findings was determined.

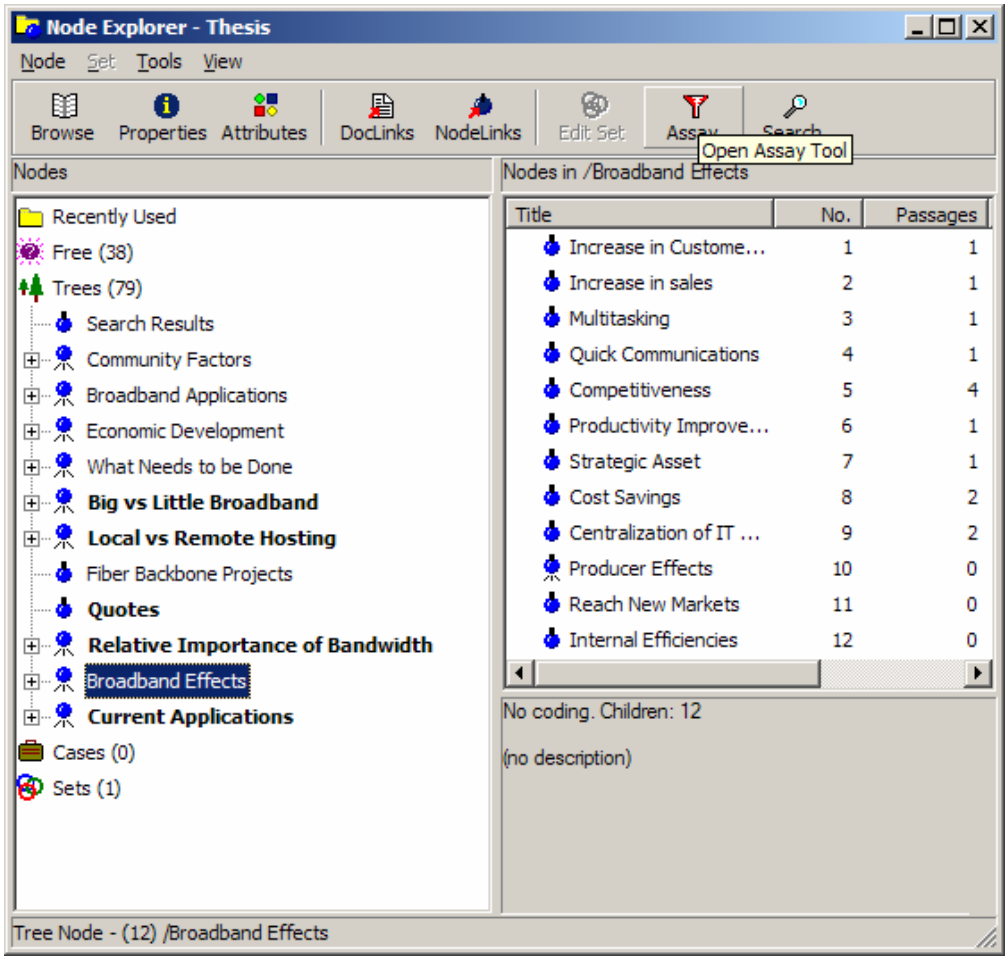

Figure 4: Hierarchical Coding list in nVivo

The creation of a theoretical model from categories and patterns of codes is the central analytic task of the grounded theory mode of inquiry (Ryan & Bernard, 2003). Accordingly, the transcription, coding, and other steps in the analysis of the findings culminated in the creation of an operational model of the firm-level effects of broadband telecommunications in rural communities, with the idea that such a model could enable a better understanding of the hypothesized Producer Network effect or provide an alternative mechanism to explain how broadband is connected to endogenous economic development.

Chapter 4: Findings

> *"Real wealth is improving people's lives in producing something… that's the production side of your network – just shuffling electronic bits around does not produce anything – unless you are making something you can put in your hand or solving a complex problem that no one else wants to solve.*" (DB5)

Once the key findings from the interviews were assembled in one document, and arranged hierarchically, it became clear that a number of distinct themes were recurring across the informants' responses to the various predetermined – and emergent – topics of discussion. These topics of discussion, which are adopted as the structure of this chapter, are as follows. Note that not all informants addressed every issue.

- **Current Connectivity and Applications of Broadband**: Informants described their current Internet connection and what they were doing with it.
- **Effects of Broadband**: Informants described what their use of telecommunications had enabled them to do.
- **Strategic Outcomes of Broadband Effects**: Informants reflected on the relevance of the effects enabled by telecommunications to a business's bottom line, and outcomes such as expansion and employment.
- **Big vs. Little Broadband**: Informants weighed in on the question of how much bandwidth they believed to be sufficient for their own applications and those within their community.
- **Local vs. Remote Hosting**: Informants revealed whether their content was hosted on or off-site, and commented on this as a general trend.
- **The Relative Importance of Bandwidth**: Informants compared telecommunications to other business inputs, such as infrastructure and technological literacy.
- **Producer Network Effects**: Informants spoke directly to the Producer Network concept.

- **Broadband and Economic Development**: Informants reflected on the potential ways broadband could influence economic development.
- **Community Influences**: Informants identified mediating variables at the community level that could enhance or inhibit the effects of telecommunications.
- **Informants' Recommendations for Policy Change**: Informants offered their own suggestions for improvement of their communities.

4.1: Presentation of Findings

The remainder of this chapter will summarize the main points raised by the interview informants with respect to each of these topics. There was a surprising amount of consensus among the informants on most all of the topics, which, as was mentioned in the previous chapter, lends confidence to the belief that saturation was being approached. The detailed findings will be presented in subsequent pages, grouped by topic, and will be summarized at the end of this chapter.

Connectivity of Businesses Interviewed

Nearly all of the informants did not have as fast a connection to the public Internet as had been predicted. Informants DB1 and DB2, both manufacturers, had only a 128K ISDN connection as their primary link to the Internet, and informant BB3, representing a retail chain, used 128K connections to interconnect their stores. A 128K connection is not considered "broadband" by anyone's definition, but they reported that it was adequate for their needs, as will be discussed in more detail below. Informant BC7 used a 768K symmetrical fiber-to-the-premises (FTTP) connection at their office, and informant BB2 used a 1.2Mbps FTTP connection to the outside world. Informant BB1 had dual, redundant Internet connections to their corporate headquarters (512K down / 256K up FTTP, and 2 Mbps SDSL), as well as a dedicated 768Kbps connection to their subsidiary in Mexico. The fastest Internet connection employed by an informant in this study was 3Mbps up / 512Kbps down, in the case of BB4.

However, for intra-firm connectivity, in the case of Wide-Area Networks or branch plant linkages to corporate headquarters, much higher bandwidths were reported. Informant BB3 used

a 10Mbps FTTP connection to link their corporate headquarters with a retail distribution center four miles away. Informant BB1 used a 5Mbps FTTP connection to interconnect 5 branch manufacturing facilities within the same community, and also employed a 10Mbps connection to the corporate headquarters, since this was where all WAN traffic was being routed. Informant BB2 used 2 DS-3 connections (@ 45Mbps each!) to connect to their corporate headquarters in Pennsylvania.

The need for high-speed communications between establishments of the same firm was not surprising – especially for the branch manufacturers – since this was predicted by the literature. However, the bandwidth of the businesses' Internet connections – many of which were shared by a substantial number of employees – was much lower than expected, especially given the fact that one of the case study communities had a fiber-to-the premises deployment. The adequacy of these lower-than-expected bandwidths for the businesses' operations will be discussed below.

Broadband Applications used by Businesses

In all interviews, an effort was made to determine the various things that businesses were *doing* with their Internet connections, since the study's theoretical framework, in which the Producer Network hypothesis is situated, suggests that telecommunications does not directly result in economic development, but rather enables applications which generate firm-level effects that have strategic outcomes in terms of the firm's bottom line, leading to economic development. An excellent overview of broadband applications may be found in the National Research Council's "Bringing Home the Bits" study (National Research Council (U.S.). Committee on Broadband Last Mile Technology, 2002). In this study, business informants reported using the following applications:

- Website
    - eCommerce
    - Informational
    - Customer Service
    - Internal Collaboration and Document Sharing
    - Remote updates
- File transfer

- Point-to-point connectivity
- Virtual Private Networks (VPNs)
- Internet Access
- E-Mail
- Voice-over-IP (VoIP)
- Videoconferencing
- Online banking
- Communication with Suppliers
    - EDI (Electronic Data Interchange)
    - FTP (File Transfer Protocol)
- Remote data warehousing
- Remote database access
- Credit card and check validation

This list represents a subset of the numerous applications documented in the National Research Council's study. What is most striking – and perhaps most salient to the current research – is that these applications, in general, do not require "Next Generation" bandwidth, as compared to more entertainment-oriented applications such as HDTV.

All the informants – business, community, and service provider – had a website. They differed on the basis of function. Informant DB2 was running a site that had some eCommerce functionality, enabling customers to print packing slips, Net-30 customers to post invoices, and credit cards to be accepted using the services of http://www.authorize.net. Informant DB4 noted that one of his neighbors in a business incubator used his website to host an online catalog that linked to his internal systems.

Informant DB2 identified his website as primarily for information and customer service. While there was no transaction-processing on this website, there were a number of advanced, interactive features that allowed customers to place an order, track its progress through the plant, and, as the informant put it, "gives our customers access to as much information as we have." Informant BB3 characterized their website as "99% informational", noting that the website was not the major focus of their IT infrastructure, but rather, it was geared towards providing a more efficient experience for the consumer in their retail stores.

Informant DB1 used his company's website as a tool for internal and external collaboration, posting all types of documents that might otherwise be sent as attachments, including engineering data, test graphs, common forms, handbooks, and internal documents, allowing everyone to have instant access to the same information without the quality degradation associated with FAX transmission. DB1 noted that it should not be taken as given that there is a logical progression in the life cycle of a company's web presence from a static website to eCommerce, although a number of studies take this position. For example, Martin and Matlay (2003) reference a study in the UK which describes an "Adoption Ladder" of increasing integration of the Internet into business practices, and a number of other scholars point to the distinction between a web presence and e-commerce (Amor, 2002; Boyett & Boyett, 2001), DB1 claimed that eCommerce is not important to his business, but sharing data is. Interestingly, all this was being done using a 128Kbps Internet connection. It should be noted, however, that this website, along with a majority of all the others, was hosted off-site by a third-party hosting provider – a topic meriting more detailed discussion in its own right in a subsequent section.

Community informant BC7 reported that an increasing number of small businesses are seeking to assume responsibility for updating their own websites, although most of them continue to have them hosted by a third party. Web update traffic, usually in the form of an FTP connection, can be considered an application in its own right.

Informants DB1, and BB2 reported that they made extensive use of their Internet connection to transfer large files. BB2, a manufacturer, transferred customer requirements for product orders, and DB1, a "high-tech" manufacturer, reported that they no longer had an engineer on-site; he works remotely from Maryland and sends/receives the output of product test programs (files approximately 1.5MB each) across the main office's 128K connection. BP8, a telecommunications service provider, noted that many of their customers in the medical profession (not interviewed) used the network to transfer medical records, patient charts, X-rays, and other medical imaging.

As mentioned in the "Connectivity" section, point-to-point communication was the most bandwidth-intensive application reported in use by informants. Informants BB2, BB1, and BB3 employed point-to-point connections, supporting such applications as accessing remote databases, ERP (Enterprise Resource Planning) systems, accounting systems, and e-mail servers,

backing up critical data, mirroring servers, sharing data between manufacturing sites, linking all time-clocks back to corporate headquarters, and running a web-based intranet for corporate use.

A number of informants reported that they ran VPN connections over their Internet connections, allowing employees secure remote access to the internal corporate network. BP8 noted that the CEO of a major manufacturer used a VPN connection over FTTH to work out of her home. BB1 and BB2 emphasized the importance of VPN connections to the productivity of their traveling sales force. BB4 reported using a VPN to connect to an out-of-state branch plant. DB4, a strategic web design firm, reported using a VPN connection to access and administer the servers of overseas clients.

All informants reported using their Internet connections for desktop web browsing. Among the more productive uses of this application were online purchasing and procurement from vendors (BB4), and the downloading of service literature by repair technicians (DB2).

Likewise, nearly all informants mentioned e-mail as a simple yet important application for their business. BC7 noted that 70% of small businesses in the community were using e-mail, and BB4 referred to e-mail as "the lifeblood" of his sales force. BB4, along with BB1, BB2, BB3, considered e-mail to be a critical application.

BB1 and BB3 reported using EDI or a similar technology to communicate with their suppliers. EDI is an old technology, and it requires little bandwidth. Still, it continues to enable businesses to realize savings of time and money in transactions along their supply chain. BB3 noted that some suppliers actually have physical frame relay circuits connecting them on a dedicated basis, and that FTP is also used as a means of communication along the supply chain.

Informants also cited the use of the Internet in support of financial transactions. BB3, a retail chain, reported using the 128K ISDN connections at each of their stores to transmit credit card and check approval requests through the corporate office. BB3 also used the same connection to transmit customer purchasing data back to the corporate data warehouse. DB2 used the Internet for online banking; in particular, international wire transfers.

VoIP appeared to be an emerging application not yet implemented in most organizations, although several informants, such as BB4, believed that making the transition from traditional POTS to this technology would result in substantial cost savings. DP8, a service provider, went so far as to suggest that VoIP would "drive the next wave of bandwidth demand."

Broadband Effects

Having observed some of the things businesses are doing with their Internet connections, the next salient question is "what firm-level effects have the use of these applications enabled?" The literature suggests a number of these, such as increased productivity, cost savings, and expansion of markets. The following effects were reported by business informants as a result of their use of telecommunications.

A commonly reported effect of telecommunications use by businesses interviewed – which translates directly into a bottom-line "strategic impact", is cost savings. BB3 noted that their organization had been able to realize cost savings through the substitution of e-mail communication for long distance phone calls. Since BB3's retail chain encompasses 63 sites, counting corporate offices and distribution centers, this type of savings adds up. Plus, they are enabled by a "narrowband" technology over a 128K Internet connection. BB4 likewise anticipates realizing cost savings by using IP-based telephony. DP8, a service provider, believes that the potential savings associated with VoIP will be a driver of its adoption by businesses. BB1 reports a cost savings was realized on the interconnection between manufacturing sites when they switched to the local Fiber-to-the-Premises deployment. BB1 notes that "At one time we were running through a frame-relay T1. At the cost of a frame T1 I was able to go from T1 to 5Meg *and* lower my costs. I was able to slash my bill as well as increase my speed. Now I have a 5Meg line @ $375 a month." An important point to note here is that in many cases, multi-establishment firms will require interconnection regardless of cost. In this case, broadband had positive effects not because it enabled any new applications, but simply because as a commodity input *which was already being purchased,* the FTTP connection was cheaper.

A number of informants reported that the Internet has allowed them to become more productive. BB4 and BB2 report that mobile employees, such as salespeople, are made more productive through the ability to connect to the company VPN and check e-mail remotely. BB4 also notes that having the capacity to communicate quickly improves efficiency and allows employees to multitask. BB3 observed that the connectivity to all their retail sites enabled quick and efficient processing of transactions. BB1 described how EDI – and other forms of supply-chain paper-saving communications – improved productivity indirectly because "that's more time in the field… people are selling and not doing data entry." Internal efficiencies can also be realized through the centralization of applications. B0003 described how the availability of

sufficient bandwidth (for them, that was 128Kbps!) enabled the migration of servers back to the corporate offices, communicating with the client machines via web interfaces.

The Internet also enabled a number of the informants to reach new customers. DB2 noted that 40% of his company's total business now comes from Internet sales; a remarkable statistic, given the fact that just 2 years ago, almost none of their business came from online customers. DB2 notes that this has helped to offset the decline in their local customer base, many of whom were associated with the textile industry. BB2 noted that while exact figures were not available, their company's Internet sales could potentially constitute a significant number of sales. BB4 attributed an increase in sales to online business. BB1 reported that their eCommerce website had reached new customers.

DB1 and DB2 noted the importance of their web presence as an advertising venue, and more importantly, a vehicle to project a positive image.

> *[When people see that] we post this data online, it blows [them] away. From a marketing standpoint it communicates that we're serious about what we do, that we mean business, that we're efficient, that we respond quickly… it's perfect for enhancing your image.* (DB1)

DB2 uses their website to promote an industry certification they have earned, drawing in more business.

Another effect may be inferred from the *absence* of broadband; as DB1 reports, "there were a lot of cumbersome ways that people were conducting business." In other words, the interview data suggest that firms without connectivity may lose efficiency by doing things "the hard way."

Strategic Outcomes

Considering all the above-mentioned effects – productivity, cost savings, new markets, and the like, the next question is, "how do these effects translate to a business's bottom-line?" Within the literature of the firm, a number of authors have addressed the implications of telecommunications, and information technology more generally, on factors such as profitability, competitiveness, the hiring of new employees, investment in new plant and equipment, expansion of operations, remaining open or in the area, etc. – which translate directly into

economic development benefits for a community (Büchel, 2001; Evans & Wurster, 2000; Good & Schultz, 2000; Martin & Matlay, 2003; Papp, 2001; Shapiro & Varian, 1999; Valovic, 1993). A few informants reflected on the strategic impacts of telecommunications during the course of their interview.

BB4 describes telecommunications as a "strategic asset," noting that "even having a phone set up for somebody in sales… that's all impact." BB1 noted that cost savings associated with being able to obtain a faster connection at a lower cost paid for itself, observing that for their operation, interconnection of multiple facilities is their most important use of telecommunications, and that if priced too high can become a substantial overhead expense and, in the extreme case, "cause you to defer expansion." BB4 reported that their business had "experienced double-digit growth every quarter," and indicated that telecommunications had contributed positively to this outcome by helping the organization operate more efficiently.

BB1, BB3, and BB4 all stressed the issue of competitiveness, noting that communications was key to responding quickly to customer needs, and that in competitive, commodity markets, "people can get it down the street if you can't ship it immediately. If you can't get it first you don't get the sale. They need to have orders now, in the system, to ship it out. 'In by 3, out by 5'". BB3 added that:

> *When you have a fixed commodity you have to provide a unique and valued service to the consumer – whatever you can do in terms of efficiency you are helping your company's bottom line. Anything you can do for efficiency – when margins are slim – will be a benefit. We are helping the bottom line by connecting more efficiently.*

Perhaps BB4 put it most succinctly when they observed that "like the saying goes, in a competitive market you have to be the 'firstest with the mostest'. And broadband helps you do that."

Big vs. Little Broadband

The original phrasing of the Producer Network concept specifically mentions the kind of bandwidth needs that it predicts will be necessary to enable Producer Network Effects, stating that the necessity for every user to be able to produce information services on the network

"implies" that symmetrical bandwidth of multiple megabits per second needs to be available and affordable (eCorridors, 2002; Mayer et al., 2004; Van Gelder, 2004). In the first interviews conducted over the course of this study, it became clear that businesses seemed to be getting by on much, much less than that. This raised the question of whether it necessarily follows, as the original theory indicates, that one needs "Next Generation" broadband to be a producer of information. Since significant findings regarding this question could substantially alter one's understanding of the Producer Network concept's application to policy, a portion of each subsequent interview was devoted to addressing the question "how much bandwidth do businesses *really* need?"

"Little Broadband" was adequate in many cases

One of the major early surprises of this study was the realization that not only were few businesses subscribing to "Big Broadband" services – in areas where they were available – but more importantly, many of them didn't see a need for additional bandwidth for the applications they were using. DB1, whose entire manufacturing facility gets along on a 128Kbps connection – all the while leveraging their web site for internal file sharing – provides the following account:

> *I just can't justify it spending $1000 [for a T1] so I can surf the Internet quicker. The 128K is adequate for uploading data, FTPing data up to the website… I am sending my engineer in MD – who works out of his home – these 1.5MB data files… we don't even have an engineer on the premises anymore. It takes about a minute to send on my 128K connection … it ain't that big a deal… we can conduct our business pretty darn well with this 128K connection.*
>
> *…most people don't need T1 speed to change their world dramatically. If people could get their hands on reasonable speed at a reasonable price, for most businesses it would be more than adequate.* (DB1)

The consensus seemed to be that for most small to medium sized business applications, a "midrange" broadband offering, comparable to today's DSL, Cable Modem, or 802.11 Wi-fi, was sufficient to satisfy most needs.

If you have the middle of the road broadband connection for a small business you can do email, FTP, and keep [a remote] website up and running… [you need something] faster than dial-up… But not a T1- that's too expensive. We use the standard BVU FTTP connection which runs at 768K, and that has been just fine. (BC7)

For those informants that did host a website locally, such as BB2, all of their servers sat behind Internet pipes of no more than T-1 speed. This was also sufficient, they reported, for their VPN applications. BB1, who also ran an eCommerce server, reported that

You need a balance [between upstream and downstream bandwidth]. I'd love to have it equal, but you pay through the nose – it's $400 a month for 768K up and down. Whereas the 512K down and 256K up is $40.00. 512K is currently enough. We are using the nTelos link – ADSL – for redundancy and it is faster – maybe 1.2 megs down and still not much up. The eCommerce server is behind the nTelos link. (BB1)

Informants that had faster connections often reported less than full utilization:

The highest bandwidth things we do would be data mining, large file transfers - quite a bit of utilization on the 10 meg connection – [but] even then we don't push the pipe over 20% - based on BVU monitoring. (BB3)

3 Mbps down, 512 Kbps up. That's handling our needs.... We've never eat up the bandwidth here. No BVU stats but we haven't, trust me. (BB4)

However, this finding was not universal, especially in the case of interconnecting establishments within the same firm over a WAN:

We needed bandwidth which our T1 couldn't give us… [FTTP] was the answer… [now] we will have all the bandwidth we need … (BB1)

Reliability was often more important than speed

Many informants, especially those with slower connections, made the observation that the reliability of a connection could be a more critical factor for business applications than its bandwidth.

> *In terms of Bandwidth – the width of the transfer is not critical – as long as I have the connection, it doesn't matter if the transfer takes a minute or an hour… To me, connectivity is more important than the speed. The speed will cut down on the surfing and make you selective. But, if you don't have the connectivity, you can't do anything, period. It's very important to have the connectivity… [but] The connectivity is far more important than the speed in my view.* (DB5)

> *[For] uploading stuff to the web, FTPing, this digital 128K is more reliable than my Adelphia [cable modem]. And someone has explained technically why that is – but if I was working on something at home and I needed to upload it, I'd bring it out here. It's more reliable. It always hangs on Adelphia if I have a bunch of stuff to do. Whereas here, I hit "send" and it's slow, but it's methodical and it doesn't crap out on you.* (DB1)

> *We cannot have downtime. We have extensive redundancy built in because downtime is not an option. For a short period of time, we can survive on very little bandwidth: the stores are designed to run on as little as 56K… [but] longer than that, we lose functionality….Network connectivity is less about bandwidth and more about persistent connectivity. Speed is a wonderful thing, but when you get into cost and flexibility and redundancy… I could get DSL to 85% of my stores, but I don't want that Quality of Service.* (BB3)

Big businesses may need more bandwidth – but they can get their own

The informant pool contained representatives of both small and large businesses. One would expect that the larger employers would tend to need more bandwidth, but this is not

always the case. As DB1 pointed out, a company's need for bandwidth depends more on its internal processes than the size of its facility and the number of employees. However, for those that need more bandwidth, the informants of all types (business, community, and service provider) agreed that they will have no trouble getting it.

> *The reality is, if it's a big business… [that's] going to employ 350 people, who will all need internet and phone, they'll have the CLECs beating on their door to get their business. So they're going to get all the lines they want – and they're going to get them at the best prices that I'll never get. So those guys – no matter what community they end up in – they'll trench the lines in if they have to just to accommodate them. (DB1)*

> *[Large Danville Business] has 2 T-1 lines. One in this building and one up the street – well, this is an operation that employs 550 people… the capital investment in that building is huge in terms of equipment – do you think the $1000 he pays a month for a digital line has any significance? He could care less. It's chicken feed." Whereas in a business like mine, it's a lot of money.* (DB1)

> *If a company is coming in, and they're going to build a building, they can afford a cotton-picking Internet connection. To me, it's old technology. A utility.* (DB5)

> *Around here [economic developers] think that if you give them low taxes and a practically free building and a fast pipe – they will come. Not so. The big companies can afford it anyway.* (DB3)

This is illustrated extremely well by the example of Informant BB2, who had *two* 45Mbps DS-3 lines linking his facility to the corporate headquarters, but didn't know how much the service cost, noting that the parent company foots the bill, and "probably just pays the MCI tariffed rates." If companies coming into a community from outside have little trouble in obtaining the telecommunications services they need, this casts some doubt on the notion – often used as a justification of infrastructure construction projects – that telecommunications infrastructure is a decisive factor in industrial recruitment. DB1 noted that "clearly if [a prospective company] went to a community where they said 'we can't even get you a digital line', you're not in the

running – but people can use the existing infrastructure to get people broadband – it's more a matter of price point." The question of whether telecommunications has its greatest impact on endogenous vs. exogenous economic development will be considered in more detail below.

There are bottlenecks elsewhere on the Internet

One particularly interesting perspective on the bandwidth question is the observation that the speed with which one accesses network content is not solely a function of one's own Internet connection. BB4 pointed out that:

> *There are bottlenecks on the Internet – people don't always realize that they are reaching out to another site and – not everybody has scaled completely to high-speed broadband. – so you could be querying a server with Frame or ISDN or DSL – you just don't know*. (BB4)

As an illustration of this, he points out that even though they have a 3Mbps x 512Kbps broadband connection at their facility, they still can't videoconference with their corporate headquarters because the headquarters uses a 128Kbps ISDN connection. Along the data path through the Internet between a server and its client, bandwidth of the connection is determined by the link with the least throughout. This seems as though it could limit the practical data rates achieved by "Big Broadband" on the commodity Internet, many of whose hosts are still living in a "Little Broadband" world.

Who needs "Big Broadband?"

As mentioned previously, the discovery that many businesses were getting by – and doing some pretty innovative things – using what is widely considered to be a narrowband connection, raised the issue of which customers, or which applications, still needed "Big Broadband" of the multiple-megabit variety that was deemed a prerequisite for the Producer Network Effect. BC7 suggested that as a rule of thumb,

> *[It] depends on how many people you have at your site, and what people are sending and doing with their connection. For most average (meaning small) businesses the middle of*

the road connection is OK -- [but] if you are a large business, you will probably want a T1. (BC7)

DB4 suggests that the transition from dial-up to "Little Broadband" may have more of an impact than the transition from "Little Broadband" to "Big Broadband":

Moving forward from the Narrowband Modem based sort of dial-up connection to what we consider to be broadband has been very important. Umm, but I don't think that from the end point of connectivity that upping that thing to some sort of T3 equivalent-I don't think it's very important in most cases. (DB4)

A number of informants noted that there were certain types of businesses and "power users" that would require "Big Broadband" within a community. DC6 and BP8 identify engineering firms and graphic design firms as likely candidates for a faster connection. DP8 suggests that banking and health-care customers do not necessarily need a faster connection, but they may require a second one for the purposes of redundancy.

Some of the self-proclaimed "power users," however, acknowledged that what they had was probably overkill for the average user:

I have FTTH – the POP is on the corner of a 60 acre farm that I own, and I trenched 12 fibers myself into my house. I get 90 Mbps. I do videoconferencing from my home… But that's unusual. And it's a good example of how it can be used, but it's not a model of how it should be done everywhere. I mean, most homes don't need 12 strands of fiber…. And, I think it's even more capacity than I need. Again, I'm usually using a 768 or 512 connection, doing Videoconferencing. And I have many times that capacity. (DP8)

The idea that you need multiple megabits into the home, ... generally speaking, isn't really consistent with what people do. Most people aren't developers like I am… I've got a situation where I have to move front end applications… OK, that's 20 megabytes; now I've got to move a database… there's 80 megabytes. [In those cases] it's really helpful. But that's not what most people do -that's not normal. (DB4)

Other informants questioned the demand for advanced services in rural communities:

> *In this community right now today I bet you there aren't 10 people that really and truly have a need for serious broadband – bigger than T1…*
>
> *In some communities people will pay for speed… but in a community like this, people won't even pay for a second phone line. You tell them they can get a T1 for 50 bucks a month extra – only 10% of your households will take it.* (DB1)

One of the service provider informants suggested a possible reason for this perceived lack of demand was the fact that most applications do not require "Big Bandwidth":

> *Let's look at it this way. What can people do with it **right now**? Let's assume that more people want to stream things. You can stream adequate audio at 64 Kbps, or 100 Kbps… If you look at the sites right now where people are doing streaming video, they are typically streaming video at 331 Kbps - right now. That will obviously increase. We do full-scale Videoconferencing, and the highest we can go with the equipment is 768Kbps… and it actually works better at 512Kbps. I guess the feeling is that most users are adequately using e-mail and web applications… [but] I think the thing that is going to drive the continued progression of demand for broadband is going to be voice over IP.* (DP8)

The bandwidth doesn't have to be "here"

Another argument raised by a number of the informants, which will be examined in more detail in the section on "Local vs. Remote Content Hosting" is that the "Big" bandwidth doesn't need to necessarily be in the "Last Mile" that connects the subscriber to the distribution network. DB2 notes that from the perspective of a business operating a website (hosting it elsewhere, in this case) the critical link lies between the website user and the hosting provider, not between the business itself and the hosting provider. Following this logic, it's less critical that site updates transfer to the server quickly than it is that the user does not have to wait for the page to load. Another observation was made by DB4 – that it is essential to have "Big Broadband" in the backbone, lest that Last Mile begin to slow down as more users subscribe to the service over time.

Intelligent application design conserves bandwidth

Although Gilder (2000) predicted that in the future the rate of increase in bandwidth would outpace the rate of increase in computing power, and applications should be designed to "waste bandwidth" and conserve computing power, the interviews suggest that the opposite is true. BB3 reports that his company's application design team focuses on low-bandwidth applications (they are using a 128Kbps connection) whose web-based interfaces are, on average, less than 10KB in size. DB4, whose business focuses on web design, remarks that "it's just part of intelligent application design… to minimize that data transfer between point A and point B." Is this a case of necessity leading to invention – i.e., efficient applications – or is the lack of bandwidth holding back their progress?

People will settle for less if they can't afford Big Broadband

Perhaps an answer to the above question is simply – it doesn't matter. People, and the businesses they create, adapt to adversity and come up with creative ways to make the most of what they have. DB1 notes that they have little alternative to their 128Kbps connection: "Right now, though, in this neck of the woods, your options are essentially dial-up, then jump to T1. There is no wireless or DSL in between." DC7 uses the analogy of water in the desert to describe what happens in the absence of readily available "big broadband": "if it costs too much to buy water from the big 10" pipe, people will just continue to use the 3" pipe that is already there…"

Local vs. Remote Content Hosting

There is an implied spatial assumption underlying the Producer Network concept that users of the network will want or need to originate content – to "produce information" – *from their physical premises*. When I ran this by the informants, a majority of them seemed to think that this was neither desirable nor necessary, and did not reflect the current architecture of the commodity Internet.

Third-Party Hosting was Extremely Common

All of the informants' organizations had a web presence, and a majority of the businesses and community informants hosted their web pages on a server housed at a location other than their physical premises[8]. In this type of scenario, referred to as "web outsourcing", several arrangements are possible: either the business owns a web server and locates it in a third-party hosting provider's secure datacenter (collocation), or the web site content is entirely housed on a machine owned by the hosting provider (web hosting) (Reichard, 1998). In either case, the computer from which the website originates is located in a physically secure data center with 24x7 monitoring and technical support, and is nearly always located near multiple Internet backbones. This alleviates the need for the website's owner to take on the responsibility of managing a web server, and gives them access to much more bandwidth than they would have had access to otherwise (Gerwig, 1998).

Further probing of the location of informants' websites using the UNIX *traceroute* and *whois* utilities (described in Appendix D, below) revealed that a majority of the remotely hosted websites were located in considerably larger cities and the case study communities, substantiating the claims by Zook (2000, 2004) that the spatial distribution of the physical sites of content production on the Internet reflects a strong urban concentration.

Both the telecommunications service providers (DP8 and BP8) claimed to offer hosting and collocation services to businesses. As it turned out, informant DB5 currently collocates a server at DP8's facility, and BC6 and BC7's websites are hosted by BP8. Out of all the informants, only two of the businesses, one of the community informants, and (of course) both of the service providers host their website in-house. The rest use a third party.

DC7 observed that economic developers often erroneously assume that a business is precluded from doing eCommerce if they lack a broadband connection to their physical premises capable of sustaining the server: "*You don't need the infrastructure to run a business here – you don't host it here. What you need is the knowledge that you don't have to have it*."

[8] The "Profile of Informants" in Chapter 3 documents whether each informant hosted their web content locally or remotely.

He went on to add that:

> *So actually all I need is basically a [mid-range] broadband connection to get over to [the hosting provider], and I can probably even do it on a telephone line. So if I want to set up a business on the Internet, I don't need it here in Virginia. So, when they start saying that in order to have a business you gotta have broadband… that's not really true if it's a small business.* (DC7)

The informants were in agreement that this practice was typical for most small businesses:

> *Off-site hosting is typical of most ecommerce operations, particularly small ones – Mom and Pop, home-based businesses, etc…. I think with a small organization I think it's a lot more commonplace to see the hosting element for any kind of e commerce transaction outsourced.* (DB4)

> *[For small businesses] doing eCommerce – the best way is to use an external provider. Security is an issue –and you need to know enough about them to keep them online 24x7.* (BC7)

One informant, reflecting on his own experience with on-premises web hosting, concluded that for his operation, the collocation option was much more attractive.

> *When I was in Danville I had the server in our basement. When the server was in our home you always worry about a power outage... I find it is much easier to have it at [Local ISP].* (DB5)

Large companies were more likely to host their own content

DB4 observed that larger organizations typically have their content hosted internally, because of availability of resources – both bandwidth and IT infrastructure, availability of skilled in-house IT staff, a greater need to interface with other internal systems, and company culture. This turned out to hold true for two of the largest manufacturers in the sample, who hosted their websites internally. DB3 noted that:

ASP hosting works better for smaller companies and individuals because they don't need to know [how it works]. They FTP it in and it works. But when you get a little bigger, you find that – the software companies for example – they want their own control. They want their own IT staff and they want to make changes immediately. They want direct access to their hardware – right now…ASP guys charge an arm and a leg to have the kind of support to change stuff when you need it… The big guys want their hardware where they can put their hand on it. (DB3)

Reasons for outsourcing a website

There are a number of reasons companies outsource the responsibility for hosting their website. Gerwig (1998) explains that

> Hosting companies can offer corporations secure facilities with state-of-the art equipment, 24/7 monitoring, and far more bandwidth than the average company would be willing to pay for. Their hosting facilities are closer to or are directly connected to a variety of Internet backbone providers' networks. The IT expertise of the hosting companies' staffers also means that customers have access to technical professionals who can handle a variety of servers, platforms and applications. (1998: p.20)

An obvious reason for a rural business to outsource its web hosting is that hosting providers, almost by definition, have access to much higher bandwidth than the business could obtain or afford at their physical premises.

I wouldn't consider taking on and physically hosting a server. I mean there's no point – if I've got an option of putting a server in a data center where it's got you know 3 , 4 9 different points of connectivity to the Internet, and redundant systems - redundant backup systems - serious security at the facility - you compare that with the option of putting it in here. Somebody's gotta come in here and clean and everything else - and in a normal situation I just would rather not have those servers here. (DB4)

One of the service providers also suggested that network security was a concern:

There's a good argument to be said that a business does not want to host their own website ... they really don't want people coming past their firewall unless they're running two networks inside their building. . Because, you really don't want your financial systems running on the same network where you have your commercial web space. (DP8)

Maintaining a content production and distribution infrastructure is not within most businesses' core competencies

Any systems administrator responsible for the care and feeding of a production server will tell you that it's a full-time job. This sentiment was echoed by the most technically adept informants – both of whom work full or part time in the area of web design.

I think that the running of Web servers or and application servers of any kind is a multi disciplined endeavor. And I can't imagine a scenario in which the average person in addition to the various business skills they would need to be successful is also going to go out and invest the time to procure the skills to be able to do something like that. (DB4)

Acquiring the capabilities to run an application server is, quite frankly, outside the capabilities of most people. It's not the kind of thing where you can just sit down and read "Web servers for dummies" or something... you've got to learn to do it. (DB4)

Most small businesses are doing third-party hosting because if they do it themselves they need the expense of hacker protection, firewalls, antivirus, and somebody that knows about the internet and ISP business. They need to know a lot about system administration etc. to do that which is a full-time job. (BC7)

Even if one possesses the knowledge and expertise to host the content themselves, that fact does not necessarily mean that they should do so. Two small business owners in the sample

had nearly identical views on the issue of local vs. remote hosting: don't do it if it's outside your "core competencies."

> *Two fundamental rules of business are 1) to survive – more money in than goes out. 2) Know what business you're in. And many folks don't know what business they're in… and as a result they get into extraneous things like managing their own server – and many times it can cause them to become overextended.* (DB5)

> *You need to focus on your core competencies. Period. And you need to figure out if something is outsourceable, and if you can outsource for less than you can do it yourself you need to outsource it…. Just because I know about website content management doesn't mean I want to be a RedHat sysadmin and it doesn't mean that I need to sit around and figure out how to plug up every hole that comes up every two days* (DB4)

> *We have outsourced our actual information website because of the volume of work… we definitely have the expertise to maintain it – we just don't have the time.* (BB4)

> *I don't want to keep a server up and running myself. I'd rather pay someone else to do it. There are a lot of providers out there that do that.* (DB2)

Indeed, web hosting is a highly competitive market, with over 6,000 providers nationwide (Reichard, 1998) and attractive rates. DB1 comments that hosting is a "commodity." This puts it within the financial reach of most small and medium-sized businesses, and it is typically seen by these organizations as much more cost-effective than purchasing the equipment and expertise to manage it in-house.

Why we care about where content is hosted

The potential – and based on these accounts, the likelihood – that a website will be physically hosted at a different location than its creator has significant implications for the theory of the Producer Network. In one sense, it turns the logic of information production on its head.

It implies a tendency towards concentration in content distribution consistent with the findings of Zook (2000), as opposed to a tendency towards decentralization, as was suggested by the original theory. This merits additional consideration below.

Relative Importance of Bandwidth

In an effort to guard against the tendency displayed in some of the literature to consider telecommunications in isolation, all informants were asked to estimate how important telecommunications was to their organization *relative to other factors*. Community informants most often replied that "it depends on the business"; for example, one of the informants did an informal survey of the bandwidth needs of his peers, and found that

> *You go into a place like [Large Danville Employer] and they have one T1. Just one. But you go into a place like across the street, they have dial-up. They didn't need it. You go into an insurance company that is across the street and they have 3 people… they HAD to have a T1 because if they were doing business with State Farm it was mandated that they had to be able to talk – so sometimes the people that were using higher speed were not the people I was expecting. After I did it it started making sense – I began under the incorrect assumption that the people with big buildings and lots of employees would be the ones needing high speed – and that isn't it. It's about what the product is.* (DB1)

A number of the businesses interviewed considered bandwidth to be an important input relative to other factors. BC7 declared that "As an organization we couldn't survive without it." DB4 claimed that I wouldn't be here if I didn't have it – it's integral to what I do. Broadband has allowed me to port my life from one continent to another." Others were more measured in their statements, noting merely that "If we didn't have it we'd have to go back to doing business the way we used to" (DB2) and "If we didn't have it, it would be a hindrance to do without it now that we've got it. We'd have to do things the old-fashioned way over dial-up. The productivity of our mobile users would be inhibited." (BB2). DB5 concluded that "I doubt that I could have done the projects that I did without access to the Internet."

Others compared broadband to a utility. DC6 believed that "it is directly comparable to electric utilities and telephone for an average company… [although] there are exceptions… that

need more bandwidth." BB4 concluded that "it is extremely important… besides electricity and water."

Informant observations on Producer Network Effects

Some useful feedback on the theory of the Producer Network was obtained by explaining its main premises to the informants, and asking them if they saw any evidence of this in their own experience. Responses on this question were mixed – however, the most significant value-added from this line of questioning came from the cases where the informant suggested new dimensions to the problem that had not been incorporated into the formulation of the theory at the outset.

Would people become producers if the bandwidth was available?

This question, posed after a thorough explanation of the theory had been provided, was intended to capture the informant's assessment of information production, enabled by "big broadband," as an economic development strategy in their community. As mentioned above, reviews were mixed. For example, one informant suggested that only a small segment of the population would be potential "producers":

> *In any community those types of people – those entrepreneurs or outsourced employees that are doing that – are limited – in a blue collar town – or most of the rural areas of VA – you're talking about a tiny percentage of the people that are ever going to fit that bill...* (DB1)

> *... I think the theory is accurate, but I think we're trying to paint a broad brush across communities and justify spending money for these producer types – when you're doing this on a broad basis for a tiny segment of the population. And in a rural area, I think it's even less people….* (DB1)

It'll happen with certain people – like me, my kid … there will be certain segments of the population that will become producers for sure — but the reality is that if they wanted to live here and be a producer bad enough and they had the right business model – in the short term they'd pay for the T1 until it dropped. Or they work out of their home using Adelphia internet at 45 bucks a month… and if the fiber somehow comes into the home and it costs another $20 a month, they'll say "I don't need it – I'm happy." (DB1)

… We're spending millions of dollars dumping fiber in the ground on the basis of this producer network that is going to be for this small group of people… and most of them are never going to need what we think they're going to need. (DB1)

Informant DB5 concurred, and offered his perspective as a high-tech entrepreneur:

If you had a few thousand folks like me, that would be useful, but only 1 or 2 % of the population would be able to use high-capacity Internet….

Only a few people can be what Peter Drucker classified as knowledge workers… somebody has to produce something. (DB5)

These findings raise several interesting considerations for the Producer Network as an economic development theory. If they are correct, it would seem to suggest that only a small subset of the population would benefit from broadband by becoming producers of information. Obviously, this doesn't incontrovertibly prove or disprove anything, but it does raise important questions that relate to the potential for broadband to make a difference in the face of other mediating influences from the community level analysis and above.

As an illustration that these findings were not universally true across the sample, one informant had a completely different take on the matter, arguing that if enough bandwidth was available and affordable, you wouldn't be able to stop people from using the Internet or becoming producers. He observed that "It doesn't matter who they are… they are interested." He advised the creation of a "Community Technology Center" where people could simply walk in and get one-on-one assistance with their e-business questions, along with the deployment of ubiquitous, affordable midrange broadband (like wireless) to give people a good "first bandwidth

experience" – contending that these factors would lead to the creation of a culture of support similar to those found in Northern Virginia that attract high-tech companies. He said the immediate effects of indigenous information production by local entrepreneurs would likely be small, but measurable – "There will be an impact, but it's not going to be a tidal wave – people may only hire one person to run the website in the course of a year – but sum that over 100 firms and then you have some economic development." (DB3)

A greater barrier than the bandwidth availability is the ability to use it

DB5 and DB1 brought up an issue that had not been previously considered during the course of the Producer Network conversation, when asked "If everybody had ubiquitous broadband, how valuable would it be?"

> *They can have a Ferrari sitting in the front yard but if they can't drive it doesn't matter … I don't think it would help my mother… if she can send email that's fine. … Just to have bandwidth to get more spam quicker is not productive.* (DB5)

> *Don't get so worked up about the broadband… do what you need to do to stay competitive as a community but understand if you think that's going to put your community back on the map, you're dreaming – how can you educate people to be more sophisticated and compete?* (DB1)

The themes of productive and effective use, as well as the technological literacy of the population, are themes that will appear again – and be discussed in more detail – in the section that follows, which takes up the topic of Economic Development more generally.

Economic Development

A significant share of the interviews – particularly with community informants and service providers – took the form of an open-ended discussion on economic development loosely structured around the themes presented below. The objective was to ascertain how a person with firsthand experience in a community in which broadband was being touted as an economic

development tool viewed its potential to effect local change. A number of themes emerged from these discussions, and several informants proposed strategies for improving the economic development strategies of their communities.

The relationship of broadband to economic development

A number of different perspectives emphasized the role of broadband in the recruitment, enhancement, and entrepreneurship aspects of economic development. Several definitions of economic development reflected the informants' preference for a particular strategy.

> *Economic development is what services, geography, and facilities a community can provide to attract a business. And it's a necessary requirement to have adequate bandwidth to meet whatever needs any new business might require… and they'll know what they want.* (DP8)

> *Economic development is providing broadband to industries at a price which is viable to bring in business.* (DC7)

> *When it comes to economic development, you're just not talking about what you bring in. You're talking about sustaining – or maintaining – the businesses that you have… to keep them from going somewhere else.* (BP8)… *80% of your new jobs are created by existing companies* (BC6)

Mechanisms linking broadband to economic development

As the discussion progressed, several processes by which broadband might lead to economic development benefits were suggested. Informants identified at least 4 ways broadband could have an impact on economic development:

1) Lowering the overhead costs of businesses (DC7)

2) Bandwidth as a quality of life issue:
   "*Adequate bandwidth in the community is a quality of life issue now. And as a quality of*

life issue there need to be enough alternatives for people that they're comfortable that this community can afford them what they expect for making it an attractive community for a plant to want to locate in"(DP8)

3) As a "necessary but insufficient" condition for development, in the sense that its absence could be a barrier to development:
"*Would somebody move elsewhere if they did not have this [broadband]? [For industrial recruitment] if you don't have it, you're not even on the list."* (BP8)

4) As a means to revitalize a community through a two-stage process beginning with entrepreneurship through e-commerce, which creates a "culture of support" that makes the region attractive to high-tech industry, which tends to cluster. (DB3).

The extent to which broadband can have an impact on economic development

Most of the informants were realistic and conservative in their assessment of the magnitude of the potential impact of broadband on economic development. A few in particular offered cautionary caveats:

You know, it's not a fiber that spits gold out the other end - it's a tool that just looks like nothing to most people, that you've got to figure out how to use. (DB4)

The people in the know, both economic developers and elected people – they really don't understand. They have some mythical idea that having broadband and fiber loops through the community is going to be a huge economic development tool. And I don't see it as being a tool at all. It's expected, like water. Are they going to come to a community and build a building if they tell you that you can't get them water and sewer? Of course not. Same thing with the lines. It's just expected. I just don't see this as the tool that people think… (DB1)

Clearly, if you have high-speed at low cost, for some businesses that will have meaning. For many businesses it won't but for some it will – I think the problem is that people think it has more significance than it does. (DB1)

Effective use of productive applications

One extremely important theme that emerged from the interviews was the notion that broadband needs to be put to productive use to have any economic development benefits, and not all uses of broadband are productive. This is in line with Gurstein's (2003) concept of "effective use," which focuses not just on availability of infrastructure but also how it will ultimately benefit individuals or communities. One informant articulated this point very well:

This must be used for more than entertainment …to use this for entertainment doesn't produce anything. Conference centers are great – people come to town, they employ a few low-end people, maybe some hookers, they get drunk, etc., but that's not creating real wealth. Real wealth is improving people's lives in producing something… That's the production side of your network – just shuffling electronic bits around does not produce anything – unless you are making something you can put in your hand or solving a complex problem that no one else wants to solve. (DB5)

The information economy – everybody is feeding each other information – only works for so long – until you run out of gas – somebody has to have money to buy them – or else you pay them in chickens like they did at the Best Little Whorehouse in Texas. (DB5)

Producing electronic documents is the presentation, not the product.
You've got to have something to do with it. Running an excel spreadsheet is a waste of time. And I don't think that watching movies is an economic activity. (DB5)

Broadband's role in recruitment, capacity building, and entrepreneurship

A question posed to all the informants who seemed knowledgeable about economic development – the community informants, the service providers, and some of the businesses –

was whether broadband had a larger impact an a certain type of economic development (i.e., recruiting new businesses, providing aid to existing businesses, or growing new ones). The consensus was: all of the above.

> *I think that whether it's broadband or capital or anything else, all three of those factors are intertwined. I think it's a commodity that people need and demand of the businesses ... it is what generates the need that you're trying to bring into an area ... whether that's rail, utilities, broadband, transportation, capital ... it's all generated by the business needs. And I don't think it's whether you're trying to attract new, or whether you're trying to sustain existing, or whether you're trying to grow new businesses ... they're all key factors based on the business need to run the operation*. (DC6)

> *I think that when it comes to attracting new businesses into the area, certainly in a lot of those kinds of businesses that are very desirable, it's just a threshold for entry into the consideration process. It's something that you just have to have. In terms of trying to improve and enable Existing Businesses, I think it's helpful and again it's a cornerstone- but it's like 2 percent of the battle because 98 percent of the battle is figuring out how to do it.* (DB4)

The importance of small businesses and their needs

Interview informants noted the importance of small businesses for economic development, reflecting the observations of studies such as Birch (1987). BC7 estimated that in Bristol, small businesses made up approximately 70% of the total business population. BC6 quoted the familiar statistic that small businesses create 80% of all new jobs. The needs of small businesses, particularly in terms of web hosting and bandwidth, have been discussed in previous sections; the point, that is well worth noting here, is that their telecommunications needs are typically quite different than those of large businesses.

The importance of home-based businesses and their needs

There is a growing subset of small and entrepreneurial businesses that operate out of their owner's home. Cohill (2002: p.9) contends that "In the Knowledge Economy, the business district where much growth will occur is the residential neighborhood, as more and more small businesses begin in and stay in homes." Phillips (2002) examines the potential of a residential setting to serve as a "high-tech incubator" for small businesses using the Internet for eCommerce and other applications. While he notes that the Internet enables inexpensive expansion of a business's market, he raises concern over the unknown profitability of online sales, the potentially large capital investments associated with eCommerce, and potential problems with zoning that could be encountered by small businesses operating in residential neighborhoods. Based on the initial articulation of the Producer Network concept, it would seem plausible that the home could be a site of information production.

The concept of home-based businesses is highly relevant to the theory of the Producer Network; if "every node has the capability to become a producer of information," - thus decentralizing economic activity – we might expect to see, as Cohill (2002) suggests, the residential neighborhoods becoming the business districts of the future. Accordingly, the community informants and service providers were asked about the number of home-based businesses in the community. Admittedly, the responses to these questions are rather subjective, but they were solicited because in any given community, the number of businesses operating out of the home is difficult to document. DB3 observed that in his community, a significant number of people work from home. DB5 actually does work from his home. BP6 (a service provider) reported that a number of his customers in certain types of occupations are taking advantage of high-bandwidth connections to their homes and closing down office fronts in favor of running the business out of their home, freeing up the overhead costs of the rent. BC7 notes that the ability to operate out of the home depends on the type of business, identifying businesses such as graphic design and photography as amenable to working from home over a broadband connection.

The Importance of Entrepreneurship

The theory of the Producer Network is actually a very entrepreneurial idea. The notion of decentralized content production from the edges of the network, from every node, runs counter to traditional notions of work in an organizational context, and implies a greater degree of autonomy (and potentially risk) on the part of the newly minted "producer." An increasing amount of attention is being paid in the economic development literature to the importance of new business formation as a strategy to replace lost jobs within a community. A number of studies, such as MacKenzie (1992), Burns (2001), and (Feldman, 2001) describe the entrepreneurship process in general terms, the former with respect to its viability as a community development strategy. Allen & Weinberg (1988) introduce the concept of business incubation as an economic development strategy to improve the chances of success of entrepreneurial ventures, and Lewis (2001) looks specifically at the incubation of high-tech startups. Sankaran (2004) looks at the potential of technological entrepreneurship to affect regional transformative change, and notes the importance of a supportive community milieu. With this in mind, informants were asked to comment on the relationship between broadband and entrepreneurship.

A consensus appeared to exist on the idea that broadband lowers barriers to entrepreneurship. DB5, himself an entrepreneur, suggested that "if you can get people connected, there may be people out there who can have a great idea and make a successful business out of it." (DB5) DB3, likewise an entrepreneur, observed that "Broadband offers the ability to get to these people and say 'hey, there's a better way.'" DB3 noted, however, that there was a certain element of risk involved…. "I will take great financial risks… because I will – but other people are not so willing." DB3 also suggested that initial entrepreneurial activity could lead to the creation of a culture (what we would call an innovative milieu) within a community that served to attract other businesses. This raises the possibility that mediating cultural variables, such as risk aversion and entrepreneurial culture, could potentially influence the impact of broadband in terms of Producer Network Effects.

Business incubators: a special case

Because one of the community informants was the director of a business incubator, an additional dimension was introduced to the discussion of broadband and economic development – specifically, what is the role of broadband within the walls of a business incubator? DC6 notes that "Andrew Cohill always observed that the economies of scale of people understanding how to use the Internet… is half the challenge to a small business ramping up and using it… [and] the incubator provides support on that." (DC6). DC6 believed that bandwidth helps recruit tenants to the incubator. DC6 also cites the role of a business incubator in "changing a mindset" – noting that

> *By the time [incubator tenants] leave here, [broadband] usually is in their portfolio. And I expect for most of them – not all of them, and there are still a couple of exceptions – but for most of them, when they leave here, it'll probably be in the top 3 criteria … hopefully, by the time they leave here, they are thoroughly addicted to broadband.* (DC6)

General business principles

A handful of the informants led the discussion of broadband and economic development back to a discussion of "first principles" of business success. Since this is a micro-level study of firm-level effects, these principles were exactly the kind of information that deepened by understanding of what was going on inside the firm. Three key concepts emerged from these conversations, and insofar as they help to explain how broadband can relate to principles of business operation, they are worth repeating here. First, broadband can help businesses interact with their customer base across space; second, as discussed above, broadband can introduce efficiencies; and third, broadband can "support and enhance human relationships" (Cohill, 2002: p.14).

Know and Reach your Customers

> *The first and most important criterion in any business is figuring out who your customer base is. And, whether or not you've got a product that is of interest to the customer base, whether or not you're in a position to deliver it, and being in a position to deliver it has a*

lot of components to it-that's where Broadband comes into play with a business like mine. It reduces the geographical limitations. (DB4)

Seek Out Efficiencies

If you look at an existing business, they're always opportunities in any business to improve processes within the business and to gain efficiencies There are those opportunities to do things smarter and better and quicker ... and Technology is one of the key enablers of that, and the broadband connectivity just expands the scope of what it is you're able to do. (DB4)

Relationships are Everything

The local leaders just don't understand the complexities of business-to-business relationships. I think it is that that people around here that haven't lived in it don't understand its significance. They just think the infrastructure is here, businesses will come – they can't figure why they don't… they don't realize that the relationships are what drives businesses. (DB3)

Community Influences

One of the aims of this research design from its inception has been the need to take the community context into account, to gain a better understanding of which influences and effects observed at the firm level are properly attributable to broadband, and which are attributable to external influences from community-level variables. A desirable outcome of this study would be to identify some of these community-level variables, which could then be operationalized into a model that could be tested quantitatively. To this end, informants were asked what attributes of the community had the potential to enhance or inhibit the effects of broadband – acting as "mediating" influences. Several key factors emerged, which are listed and discussed in more detail below.

Community Leadership and Politics

Power and control in key decision making processes was a concern that kept surfacing during the interviews, particularly for the informants in the Danville community. DC7 notes that "vested interests in this region are the biggest impediment to progress," and can inhibit the viability of public-private partnerships of the type that might improve broadband access. The general feeling was that there was a limited amount of public debate on important issues. (DC7, DB1). DB1 noted that

> *I don't mean to sound critical, but I believe in open discussion, and there's too much going on in our community that's being driven by a few people and there's no discussion.* (DB1)

A number of informants also noted that economic development professionals evidenced a general lack of awareness on broadband issues, though they acknowledged that this was improving. DC6 noted that "It used to be that the economic developers just knew the price of the utilities- electric, rail, the cost of truck and transportation, all of that they knew like the back of their hand. *There was no e-infrastructure analysis whatsoever*."

Amenities and Culture

The informants were in general agreement that the attributes of a community that define its desirability as a place to live had the potential to exert an influence over a telecommunications-based – or any other – economic development initiative. With regard to amenities and culture, respondents offered several interesting observations:

> *I think that our area of the state has quality of life issues that are – should be pushed – but they're not pushed enough* (DC7)

> *A lot of economic development is social. You need something that people want – charm – education – leaders with a vision – and regrettably most small towns … just don't have it.* (DB5)

> *When you're catering to people making economic decisions – locating firms – they're thinking where will their kids go to school – where will they eat– without those, do you think somebody's going to bring their business here?…* (DB5)

The schools in the region absolutely suck … _____ is a gourmet-free zone. Want "something with tablecloths?" - you're out of luck. Not one decent restaurant. Outback is the best you get. (DB5)

The local skill base

Human capital has been a staple variable in economic growth models, and it would be inappropriate to fail to mention it in this context. It has already been noted that a number of the informants believed that knowing how to use the technology was as important as having access to the technology. Several challenges were mentioned with regard to the local skill base:

Half the population is basically nonproductive. At least half – maybe more. It's hard to drag that share of the region along with you. These people are not trainable. (DB5)

People don't have the dedication to education. I was all for computers in the classroom but now I am going the other way… do you have to have a class to dial a telephone now? (DB5)

In terms of technological literacy… [I'm] not sure if the skill set is there or not. But I will say that it wouldn't do you any good to have the knowledge without the infrastructure and vice versa. (BC7)

Industry Composition

Intuitively, it would seem that the sectoral composition of a community would have an impact on its ability to realize benefits from broadband, since a number of informants argued that the relevance of broadband to a business depends on the nature of its internal operations. However, none of the informants commented on the importance of particular sectors – for them, the ownership structure of the firms in a community was more important.

A community's industry mix (in particular, whether firms are owned locally or from outside) … may determine the speed and impetus with which it can make a difference because most of them don't have the internal IT staff – most of the IT staff is going to be at corporate headquarters with a skeleton crew usually in the branch plants (DC6)

What you're going to see is a lot of corporate headquarters providing the network administration and doing most of the setup – so you don't have that same core of knowledge workers in the remote location…. And you don't necessarily have the same appreciation that you would have had had they been exposed to the networking changes and the broadband requirements etc. (DC6)

Entrepreneurial culture

Many studies suggest that the presence or absence of an "entrepreneurial culture" in a region can act as a catalyst for or an impediment to entrepreneurial activity. The literature is divided over the question of whether or not such a culture can be created as a result of policy interventions, and whether the personal characteristics of the entrepreneur are innate or can be cultivated. One of the informants weighed in on these questions, as follows:

I think entrepreneurial cultures are something that have to be cultivated over time – and in particular, in economies that weren't dependent on small business startups. … I think you have to nurture entrepreneurial climates. (DC6)

So where you had strong branch plant success, you usually had less entrepreneurial need because they could find jobs either in the coal mines, farming tobacco, or in a large manufacturing facility – and as those things become less abundant, you find more of a need for the business startups. I think quite often the skill sets are there, [even though] people may not have aimed them as starting a small business, but for instance you had some of the entrepreneurs who were very assertive within some of the manufacturing facilities or on a farm or in the coal fields…The skill sets for their starting their own business may not have been necessary but it doesn't mean that they didn't have an

entrepreneurial spirit… so I do think you can nurture them [entrepreneurs] anywhere… [but] - it's much easier when they're in a climate where they have role models. (DC6)

Larger Structural Economic Issues

An argument could be made that many of the economic problems of rural communities are symptoms of larger structural economic issues, and therefore not readily correctable by local policy interventions like broadband deployments. This question was posed to a number of the informants, who responded, in several cases, with chilling candor:

All this idea of retraining employees… it all sounds good but the reality is the state of NC lost ~25,000 manufacturing jobs. Number one, there aren't openings at 25,000 McDonald's or whatever the service sector is – and the second thing is the reality is that you've got a middle-aged guy with three kids that's now out of work – and is trying to put food on the table – he may not be enrolling in the CC because now he's working 3 jobs to try and pay the bills so his family doesn't starve – it is a harsh cold reality. (DB1)

We're going to lose a generation or two. These folks right now who are unemployed, and those coming through high school now –it's too late for them. We need to focus our efforts at the middle school level to get these kids prepared for technology jobs. (DC7)

What will probably need to happen in the intermediary [sic] *is that you're going to see a change in the skill set that's required. We're going to need to have an influx of some skills from outside, try to re-utilize the people that can be utilized in capacities within the new business scenario ... and some people are going to leave and go elsewhere to the places that are trying to hang on to the low end of the [economic] totem pole*. (DB4)

What needs to be done

The informants – even those whose primary job function did not include an economic development role – were very passionate about economic development, and many of them were forthcoming with strategies for improving the economic situations of their communities through

the use of broadband telecommunications. The central themes or "best practices" are summarized below.

Build the capacity to use what you have

DB1 noted that "*To me, how you use what you've got is more important than broadband,"* and recommends policies to help educate local businesses on the potential applications that broadband – and IT in general – could have for their business, enabling them to "work smarter" and realize efficiency gains. This echoes, almost verbatim, the perspective of Cohill (2002). DB1 suggested that this is a more effective policy choice than constructing backbone infrastructure. "*We don't have industry that needs high-speed [Big Broadband]. We're getting all worked up about fiber and spending millions of dollars – we would be far better of if we could somehow get inside all these little businesses and help the utilize what they have, or make small investments in better computers or maybe a little bit better connection – but people don't know how to utilize the technology."* (DB1)

Change a Mindset

A number of the informants suggested that a shift in the general mindset of their community – including businesses, citizens, and elected officials – would enable them to realize greater returns from broadband. DC6 recalls a conversation in which a local expert on telecommunications and economic development impressed upon her the importance of changing the mindset of a community to make an economic impact. DC6 observed that the availability of broadband within the business incubator helps to change the mindset of the tenants, and the Main Street wireless, by putting technology into people's hands, has the same effect. DB1's organization provides evidence of what a mindset shift might look like:

> *When postage went up we asked ourselves why we were paying it when we have email. That's when we started thinking what do we have that we do in-house that we can do online… when I help people with websites I'm always asking them – OK, you've got your brochure online, but how can you use it? A credit application – or any of the paperwork – and we've all gotten in the mindset that all the paperwork we used to fill out … asking if it is appropriate to put it online. We're in that mindset*. (DB1)

Build a culture of support

DB3 contended that one of the reasons high-tech industry clusters in certain areas is what he terms the "culture of support" – otherwise known as the "innovative milieu" in economic development literature. He outlines what is needed as follows:

> *In Alexandria, near the AOL complex* [sic]*, there is a community and several NOCs. Massive redundancy. Mirroring, even within the NOC. No worries in terms of catastrophe. And because they have technical people, programmers, others right there they can fix what they need to do – and that breeds a culture of support. So for the enduser its easy to get help because it's so easy to do it and the culture is there.* (DB3)

> *You can't get the high-tech companies in here. – even if you put a fiber in the ground that won't bring them here – they're only going to come if you have that culture because they feed off of that culture. You need to create something from within before you can get the external recruitment.* (DB3)

> *But if you can put the broadband out in the community – not just to a few big companies – who can afford it – then you foster that understanding of the technology which over time can lead to the culture you want to create.* (DB3

Make midrange broadband ubiquitous and cheap

One of the keys to changing a mindset and building the culture of support, all the informants agree, is access to ubiquitous, cheap broadband. Not necessarily multiple megabits, either – they all seemed to favor a wireless solution on the basis of its low cost and rapid deployment. The goal, they insisted, is to give people a positive first impression of broadband, which will go a long way towards creating the necessary mindset. This, they believe, more than offsets any of wireless's technical shortcomings. DB3 elaborates:

> *You have to change the mentality – you need to give people time to learn about it and this is the beginning of the grassroots… Ubiquitous, affordable wireless can build the mentality and change the mindset. Then you can lure software companies down here.*

"they've got broadband and people know how to use it." Then it's like other places where the culture exists [and software companies want to cluster around other software companies – pools of talent and complementary firms] (DB3)

DB1 contrasted wireless to some of the fiber-optic projects that have been undertaken or contemplated in his community:

[If] somebody had said, hey, for about a tenth of that investment, we're going to go into all these rural communities and give them wireless access… we can connect to them, get them speed today… we'll accept the downside of wireless… I think you'd have far more bang for your buck in a lot shorter time frame. (DB1)

Develop a community technology center and help lower barriers to eCommerce

DB3 suggested that one way to increase technology literacy within a community – which, all informants agreed, was a necessary complement to the availability of infrastructure in order to derive any real economic development benefits from it – was to establish a Community Technology Center (CTC) where businesses could just walk in the door and get advice/assistance on eBusiness matters, such as the difference between "regular" and eCommerce websites, which DB1 emphasizes is huge. DB3 remarks that "if people knew how easy it was and how broadband could help their business, they would be more receptive," and that the CTC, because it provided an opportunity for businesses to network (in the human sense) and build the relationships whose importance was noted earlier, could also play a role in developing the culture and the mindset deemed so essential.

Plan for backhaul

One last component of the informants' recommendations is an admonition, from DP8 and DB3, not to neglect the middle-mile distribution infrastructure as you build out the ubiquitous wireless mentioned above. As people adopt the technology and demand grows, the wireless network would need to scale upward, requiring more backhaul onto the distribution network. If a wireless provider had no alternative wholesale bandwidth provider other than the local

incumbent, said incumbent could potentially charge prohibitively high rates and leave the WISP unable to expand. Plan ahead, the informants advised, to avoid such a scenario.

4.2: Summary of Findings

- **Current Connectivity and Applications of Broadband**:
    - Most businesses had considerably slower connections to the Internet than anticipated, with a majority of them using midrange or "Little Broadband" connections, and only a few using the kind of bandwidth the Producer Network concept predicts as necessary.
    - Most businesses studied were only using a subset of the considerable number of broadband applications that required relatively low bandwidth to use effectively.
- **Effects of Broadband**:
    - Many of the effects predicted by the literature of the firm held for the informant sample, including productivity, cost savings, and expansion of markets.
- **Strategic Outcomes of Broadband Effects**:
    - A number of business informants believed that a strong relationship existed between their telecommunications capacity and their business's overall profitability, competitiveness, expansion decisions, and other major bottom-line outcomes.
- **Big vs. Little Broadband**:
    - A majority of informants believed that for most small to medium sized business applications, a "midrange" (a.k.a. "little") broadband offering, comparable to today's DSL, Cable Modem, or 802.11 Wi-fi, was sufficient to satisfy most needs.
    - Informants with a midrange connection reported that it was adequate for all their current applications. A number of informants with a "Big Broadband" connection actually reported under-utilization.
    - A number of informants pointed out that other attributes of a telecommunications connection, such as QoS (Quality of Service), reliability,

and redundancy, were more critical to their operations than the connection's bandwidth.

  - Reasons for not having a "Big Broadband" connection included availability, affordability, lack of need, and lack of awareness of how it might be beneficial.
  - Informants reported that large businesses may need more bandwidth than smaller ones, but they usually have no trouble procuring it from existing telecommunications carriers since cost is less of a factor.
  - One interesting possibility raised by the informants was that even if one adopts "next-generation" bandwidth, the fact that others with whom they need to communicate may not have done so limits the benefit of the high-speed connection. In other words, businesses may reach a point where they are no longer the bottleneck.
  - Informants seemed to believe that a relatively small subset of "power users" within a community would be likely to need "Big Broadband."
  - Informants suggested that while "Big Broadband" was needed in certain parts of the network, such as the backbone and distribution layers, it was not as essential in the "Last Mile."
  - In many cases, applications are designed to conserve bandwidth and can function on less than "Big broadband" effectively. This appeared to be especially true for the relatively simple applications that were most established in their use by businesses.
  - Even if businesses have a demand for "Big broadband," if its cost is prohibitive, they will make do with less bandwidth.

- **Local vs. Remote Hosting**:
  - A majority of small and medium-sized businesses used third-party (remote) web hosting services, rendering their physical facility's last-mile connection less important from the perspective of content production.
  - Large companies with dedicated IT staff were more likely to host content in-house.

    - A number of informants believed that the technical skills necessary to effectively host a website in-house were outside of most small and medium-sized businesses' "core competencies."

- **The Relative Importance of Bandwidth**:
    - Nearly all informants believed that the relative importance of bandwidth "depends on the business" and the level of communications required by its specific internal processes.
    - Most businesses that used broadband connections rated them as important inputs relative to other factors, often comparing telecommunications to more traditional utilities.
- **Producer Network Effects**:
    - Most informants that commented directly on the Producer Network concept seemed to doubt its relevance to their current situation.
    - A number of informants believed that even if the bandwidth suggested by the theory were available, a relatively small subset of the population would be likely to become "producers."
    - Several informants observed that a greater barrier to becoming a "producer" than the bandwidth availability is the ability to use it.
- **Broadband and Economic Development**:
    - Informants identified a number of ways broadband could have an impact on economic development, including lowering the overhead costs of businesses, improving the quality of life in a community, as a "necessary but insufficient" condition for development, and as a means to revitalize a community through the creation of a "culture of support".
    - Most of the informants were conservative in their assessment of the magnitude of the potential impact of broadband on economic development.
    - Informants observed that broadband needs to be put to productive use to have any economic development benefits, and not all uses of broadband are productive.

- Informants identified small businesses, entrepreneurial businesses, home-based businesses, and businesses in incubators as special cases where broadband might have a more significant effect.

- **Community Influences**:
  - Informants believed that the nature of the leadership of a community – in terms of governance structure, level of public participation, and awareness of technology-related issues on the part of elected officials and economic developers could impact the potential benefits of broadband.
  - The informants agreed that the amenities and cultural attributes of a community that define its desirability as a place to live had the potential to exert an influence over a telecommunications-based – or any other – economic development initiative.
  - Informants observed that the local skill base was a critical mediating variable influencing the potential of broadband to have economic development benefits. Technological literacy was extremely important, but deficiencies in basic skills could preclude much of the development potential of broadband form being realized.
  - Informants noted that a community's industry composition was relevant in the sense that some sectors were more intensive users of telecommunications, and also that businesses owned by outside parent companies tended to not have local IT staff.
  - Informants suggested that the presence of an entrepreneurial culture could play an important role, but were generally in agreement that it could be cultivated through policy interventions.
  - On a more fundamental level, many informants pointed out that many of the economic problems of their communities were caused by endemic structural forces, and that broadband was not likely to overcome these more pervasive problems.

- **Informants' Recommendations for Policy Change**:
  - Businesses need to build the capacity to use what they have as a first priority; improving connectivity should be a secondary goal

- Policies need to work towards changing a community's mindset
- Communities need to build the culture of support (innovative milieu) that exists in more urban high-tech regions.
- Communities should concentrate broadband deployment projects not on the backbone or middle-mile, but on last-mile efforts that make broadband ubiquitous and cheap. At the same time, however, they must ensure that sufficient backhaul infrastructure is available to allow the last-mile to scale with demand.
- Communities should pursue strategies that will help lower barriers to eCommerce for citizens and businesses, such as the establishment of a community technology center.

4.3: Limitations of Findings

This chapter sought to capture the most relevant themes contained within a sizeable body of interview data. The observations and viewpoints expressed are by definition embedded into the local context. One might argue that had a different set of informants been selected, a different set of findings might have emerged. Indeed this might be the case; however, the sample size was sufficiently large and diverse to impart a reasonable degree of confidence to these findings. Besides, a case can be made for just about any research project that a large sample would have increased validity. In the end, practical considerations precluded the collection of additional data.

The statement that the findings are embedded in their context does not mean that generalizations may not be made to other cases under any circumstances. After all, the central purpose of this study was to discover variables and theoretical propositions at the local level that would help to operationalize a mechanism linking broadband telecommunications to endogenous economic development in rural areas. There is no reason why one cannot extract the "general" theoretical propositions that are not overdetermined by contextual influences and weave them together as a general theory that could then be tested in another location for transferability.

Chapter 5: Discussion and Conclusions

"You know, it's not a fiber that spits gold out the other end - it's a tool that just looks like nothing to most people, that you've got to figure out how to use." (DB4)

This study's findings contribute to the collective understanding of broadband's role in economic development by providing a glimpse into the dynamics and impacts of its utilization within firms. From the findings, a number of insights emerged, regarding the potential bottom-line outcomes of broadband's integration into a business, the specific effects of broadband technology that can lead to those outcomes, the applications can that produce those effects, and the mediating variables at the community level that profoundly influence all the other factors. At face value, the findings of this study lead one to believe that:

1) Businesses that wish to do so are not currently precluded from being "producers" of information – even if they have relatively slow Internet connections – because of the ability to host Internet content off-site.
2) The applications that businesses appear to derive the most economic benefit from using do not require "Next-Generation" bandwidth.
3) From an economic development perspective, a more immediate need exists for the ubiquitous availability and affordability of "midrange" broadband connectivity.
4) Businesses need training to improve their ability to effectively and productively use the information and communications technologies that are currently available.

Furthermore, the findings provide no evidence to suggest that the "Producer Network" concept explains how broadband might influence economic development in the case study communities, but rather imply that the "Producer Network" is better understood as a long-term goal than as a model to explain the current firm-level applications of the commodity Internet.

From the insights of the field research, a number of variables and relationships emerge that, taken together, serve as a model of a general mechanism by which broadband might influence local economic development in rural communities, which is presented and explained in a subsequent section. This chapter will carefully interpret the findings discussed in the last chapter, and will consider their implications for policy as well as future academic investigations.

5.1: Reflection on Key Findings

Several of the findings that emerged from the field research are particularly relevant to the development of theory, the formulation of policy, or both, and as such, merit more detailed discussion.

How much bandwidth do businesses need?

The debate between "Big Broadband or "Next Generation Broadband" and "Little Broadband" is central to this study and can be approached in several ways. The findings reveal that the selected businesses in the case study communities were using considerably less bandwidth than anticipated. This is a very controversial observation indeed if it is translated uncritically into a policy recommendation (i.e., "We don't need to promote Next-Generation connectivity after all!"). However, the nature of the problem is not fully illuminated until one considers *why* the businesses did not opt for higher bandwidth. There were essentially two reasons informants did not use higher-speed connections than they did. First, for many informants, higher-speed service was desired, but was priced above their ability to pay. Note that this is not to say that said service was "unavailable at any price"; in 2005, in just about any given community – even most rural ones – the incumbent carrier of last resort will provision (build and activate) a leased-line connection of T-1 or above to just about any premises. The problem is that in rural areas, such a connection may be astronomically expensive – well over $1000.00 per month. What most of the informants were interested in purchasing, but was unavailable in their communities, was a midrange (sub-T1) broadband connection that was reliable and could be obtained at a reasonable cost. The other reason that businesses did not have higher-speed connections was that they did not believe they needed them. A majority of informants believed that their current connection was adequate for everything they were doing – or in the case of a few of them that had more bandwidth, underutilized.

The former reason illuminates an idea that *does* translate into policy: businesses will simply not adopt and will make do without broadband if it is cost-prohibitive. The latter reason invites more push-back, such as claims that businesses cannot be reasonably expected to demand what they do not understand; that if a business is not familiar with compelling applications and e-business models that are relevant to what they are doing, they will see no need for "Next-Generation" broadband. This is the familiar "chicken-and-egg" problem of broadband demand,

and arises from the fact that it is, economically speaking, an "experience good" that people must use (or understand the benefits to be derived from use) before they demand it. It touches on the *awareness* component of technological literacy, which will be discussed below in terms of its policy implications. If one were to synthesize these two reasons businesses did not adopt broadband, a more accurate statement describing business demand for broadband might be that if the cost of a broadband connection exceeds a businesses' estimate of its potential benefit, the business will be highly unlikely to adopt it.

There is, however, a *temporal* dimension to the big vs. little broadband debate that seems to have been overlooked in economic development circles. Big Broadband, for all its technical merits and potential for transforming the way we live, work, and play, remains more of a long-term goal than a realistic short-term economic development consideration. There are several reasons for this. First, the Producer Network concept, as well as this study's informants' observations that an individual user's realized network performance is limited by the bandwidth of the slowest person/server with which they wish to communicate, suggest that the real transformative potential of Big Broadband will not be realized until it becomes ubiquitous. Realistically, and by definition, no community-level broadband deployment initiative can achieve this goal. Furthermore, its realization may be delayed into the foreseeable future as a result of politically powerful incumbents resisting the disruptive potential of ubiquitous Next-Generation connectivity. The development, adoption, and diffusion of "Next-Generation" pointless to try and commercially market an application that *required* Next Generation bandwidth to function in a world that lacked the infrastructure, and even if the infrastructure were in place, it would take a nonzero amount of time for enough potential users to adopt the Next-Generation bandwidth to the point that application developers could go ahead and design the applications without having to make them backward compatible for the late adopters. As it is now, to appeal to the widest user base, network applications are mostly designed to operate adequately under the lowest common denominator of bandwidth, and scale up if more is available.

Thus, while Big Broadband may indeed have the potential to transformatively change the way businesses operate – instead of just allowing them to operate faster in the same ways they do now – the realization of this potential is a long way off. We have a set of economic problems facing us *now* that demand immediate solutions – or at least, partial remedies that work at least

some of their effects in a time horizon that will benefit the current generation. In the meantime, it is necessary to formulate policy on the basis of *what is possible*. Economic developers must do the best they can to affect positive change within the set of conditions they are given, which includes such factors as centralized content, low-bandwidth e-commerce, and a bottleneck in the last mile. *In the short term,* it may not be as productive to ask "How will Next-Generation Internet applications transform the operations of my business community?" as it is to ask "What can I do to maximize the positive impact of the commodity Internet (via the 'productive subset' of its applications) for my given set of firms and entrepreneurs?" *In the long term*, it may be absolutely necessary for economic developers to develop a strategy for promoting the integration of Next-Generation technologies into existing businesses operations, but given the fact that a number of factors outside of any local policymaker's control seem likely to delay the ubiquitous deployment of Next-Generation Internet, it seems to be premature at the present to focus on such a "Big Broadband" strategy to the exclusion of short-term, higher-impact strategies employing more standardized and accessible technologies. Fortunately, a community's economic development strategy generally always incorporates both short-term and long-term goals, so these two aims need not be mutually exclusive. What is critical is the understanding that Big Broadband – and by extension, the Producer Network concept that depends on it for its operation – is a long-term goal instead of an outcome that can be attained in the near term through local policy interventions.

Where will content be hosted?

Upon a casual examination, the discovery that most of the websites on the Internet are physically hosted in a different location than the organizations they represent, seems to refute the Producer Network concept. The spatial logic of the Producer Network assumes that ubiquitous broadband will allow content provision to migrate from the core of the network to the edges, while all current studies of the geography of the Internet suggest that this is not taking place. There are a number of issues underlying this apparent tension, two of which are particularly salient.

First, even if ubiquitous broadband were available to every premises at sufficient data rates to support content hosting, there are a number of other reasons why content might remain

hosted where it is hosted now – in the data centers situated along high-speed fiber-optic backbones in urban areas. The value proposition of third-party hosting providers is not based solely on bandwidth, but also their economies of scale, redundant diverse connectivity, system administration skills, 24x7 monitoring, physical security, environmental control, backup power, etc. This provides a solution (and indeed, often a cost-effective one, since there are a sufficient number of hosting providers to stimulate price competition) that addresses concerns of small and medium-sized businesses relating to security, lack of in-house expertise, and the need to stick to core competencies. These concerns are not likely to go away if and when ubiquitous Next-Generation broadband became available to every premises. Furthermore, consider the fact that the hosting providers, like any viable business, are likely to have strong survival instincts, and at least some of them will attempt to devise innovative sources of value to retain their customer base. At any rate, they are not likely to fade quietly into obsolescence if the day ever comes when they are not the only ones with fast pipes.

On the other hand, it's easy – and incorrect – to conflate "web pages" with "Internet Content." There are a number of different types of Internet content, including voice, data, and video; there are a number of protocols besides the familiar HTTP, and there are a number of network-aware applications besides web browsers. It may be the case that it is efficient to host web pages from a centralized location, but there are other types of network content, such as streaming multimedia, remote monitoring, file transfer, videoconferencing, and others that for various reasons *do* need to be distributed from the point of creation. As will be discussed below, the Producer Network concept has in mind that Next-Generation broadband will enable *all* types of Internet content to be hosted from the edges of the network, and suggests that this has the potential to fundamentally change the way we live, work, and play.

The bad news, then, is that the discovery of how prevalent remote website hosting is for small and medium-sized businesses isn't as significant as first imagined; it does *not* disprove, contradict, or refute the Producer Network concept. The good news for rural communities is that businesses lacking Next-Generation broadband are not necessarily precluded from implementing e-Commerce. However, as informant DC7 observed, rural businesses often lack the knowledge that remote hosting is an option and that they don't need to host a website from wherever they happen to be located. This is a perception that can be corrected through policy, as will be discussed in more detail below.

Who can realistically be expected to become "producers?"

This remains an open question. A majority of the interview informants that weighed in on this question believed that only a small subset of a rural community's population, characterized by a high degree of technological literacy and an entrepreneurial spirit, would be likely to leverage broadband technology for economic gain by "producing" content. However, the fact that many people share this opinion does not constitute incontrovertible proof that information production is a waste of time as an economic development tool.

It might be better stated that on one hand, economic developers need to realize that there are barriers to entry – in terms of the need to purchase the requisite computing hardware and telecommunications capacity, as well as the substantial learning curve one must ascend before being able to produce network content. As a result of these barriers, there is a real potential for economically or educationally disadvantaged members of a community to be precluded from participation. If information production is to be a primary source of income, there is the need for an entrepreneurial spirit – which entails a certain amount of risk tolerance – thus making information production as a vocation an imperfect substitute for wage labor.

On the other hand, none of these barriers are necessarily insurmountable. More affordable technology and increased access to training in its use are policy directions that spring readily to mind. And if one believes that an entrepreneurial spirit can be cultivated (which is not a settled issue), policy may be able to make a difference there as well. Despite this, the fact remains that this is not going to be an option for everybody in a community unable to find employment in other sectors of the economy. It may be a partial solution, but it is by no means a panacea.

What applications are "productive?"

The findings suggest that of all the applications of broadband – a varied and diverse list – sample businesses within the case study communities are only leveraging a subset towards productive ends. This deserves some qualification. In one sense, only a subset of broadband applications may be *directly* productive in the sense that they are commonly employed by firms to realize measurable effects (e.g., efficiency, new markets, etc.). However, in another sense, even "unproductive" applications, such as gaming and various forms of multimedia

entertainment, may be *indirectly* productive insofar as they are able to improve a community's technological literacy or stimulate demand. Thus, the productive/unproductive dichotomy is a very useful construct in the sense that it illustrates the fact that not all broadband applications achieve the same community objectives, but it is incomplete in the sense that it abstracts away from the indirect economic effects of applications that have non-economic direct effects. Clearly, a richer, more detailed understanding of the complex interplay between applications and community objectives is in order. This is a question for future research.

What effects can community variables introduce?

One of the most important findings of this study affirms the relevance of a point that has been made time and again for economic development strategies in general for the case of broadband: that it does not exist in a vacuum. The community influences identified by the informants and reflected in the model (below) derived from their insights are "mediating variables" that can either enhance or inhibit the ability of businesses to effectively leverage productive broadband applications towards tangible firm level effects, and may also intervene in their ability to translate these effects into firm-level outcomes that aggregate to economic development. Community influences are pervasive, and are at least as important as the technology itself to the question of whether a community will be able to derive economic development benefit from broadband. However, the firm and the community are only two of the levels of analysis that come to bear on a community's ability to derive economic development benefit from broadband. There are a number of "external" influences, operating at the national or global level and largely beyond the scope of community control, which may override local variables. Thus, while it is of critical importance that community leaders attend to the improvement of community–level factors within their control as they attempt to leverage broadband for economic development, it is also necessary that they realize the potential limitations of broadband as a public policy intervention in a more general sense, which merits discussion in a subsequent section.

5.2: Relevance of the Original Hypothesis

The hypothesis of this research was that endogenous economic development benefits could be realized as a result of businesses and individuals becoming producers of information, enabled by the ubiquitous availability and affordability of broadband. The field observations seem to suggest that the current state of affairs within the two case study communities, as revealed by the experiences of a sample of businesses, community experts, and telecommunications service providers, does not fit into this model, for the following reasons:

1) Because of the availability of third-party hosting services, which a majority of businesses in the study were using, businesses are not precluded from being producers of *certain types* of content – specifically, informational and e-commerce web pages – under today's conditions, even if they have what would normally be referred to as a "Little Broadband" or "Narrowband" Internet connection.
2) The subset of broadband applications which business informants were using and had indicated led to significant positive outcomes on their operation were *not* applications that required the multiple megabits of "Next Generation" bandwidth assumed necessary by the Producer Network concept.
3) The number of people in a community that would function as content "producers," even if broadband were ubiquitous, seems likely to be low, and the technological literacy of the community may be a greater barrier than the absence of infrastructure.

These findings require a certain degree of qualification. First, while item 1) correctly observes that the existence of ASP hosting providers enables firms without sufficient broadband access to run a server to implement e-commerce or deploy informational web pages, it could be misinterpreted to conflate "information production" with "e-commerce" or "having a website," which was discussed earlier in this section. The Producer Network concept implies a much richer and expansive definition of content production, so to say that this counters the logic of the hypothesis is not completely true. Practically, however, there was no "information production" taking place by the sample of informants in the case study communities beyond simple web pages and e-commerce, so the statement is not a false one. The fact that advanced content production was not observed in the case study communities does not suggest such activities are unimportant; rather, it underscores the fact that this research cannot speak directly to the

Producer Network concept. Second, item 2) draws the distinction between "productive" and "nonproductive" applications. While this distinction is believed to hold in the context of the *direct* economic effects of broadband applications, it is somewhat an oversimplification of the complex interrelationship that is believed to exist between broadband applications and community objectives – a question that was discussed previously. Finally, item 3) reflects a conclusion of a majority of the informants, which casts doubt on the potential of the Producer Network to result in economic development benefits, but does not conclusively disprove the existence of such potential. This, too, has already been addressed in some detail.

Retrospectively, the Producer Network concept was inappropriately incorporated into this study as an economic development theory to describe the status quo. The findings reveal that it fails in this role, which would probably be viewed as a trivial, completely predictable outcome by its architects and proponents. However, through its misapplication, a considerable amount of light has been shed on what the Producer Network concept really *is* all about.

The Producer Network concept is a *vision*. It is, in many ways, a *goal*. As such, it is descriptive only in the sense that it offers a possible description of a state of affairs that has not yet come to pass in rural communities – as this study confirms – but *could* plausibly obtain under the right conditions. Since academic research by definition requires the existence of data upon which to base its findings, it cannot speak to the Producer Network concept directly. (One possible exception to this conclusion would be if a rural community could be found that *did* have Producer Network capabilities.) The Producer Network concept is not intended to be translated directly into an economic development strategy with the expectation that short-term economic benefits would result. Furthermore, it embodies a definition of "content production" not limited to simple web page hosting or e-Commerce, but rather encompassing the transmission of voice, data, and video traffic *from the edges of the network*. The importance of technological literacy and human capital – absent from explicit mention in the articulation of the theory used as the basis for the hypothesis, but considered an implied corollary – was underscored by the field research, revealing that future studies incorporating the Producer Network concept into their theoretical framework should make this connection explicit.

This research did not invalidate the Producer Network concept by any stretch of the imagination. The data which were collected were influenced, no doubt, by the choice of research setting and sampling methodology, and simply could not speak to the theory. The Producer

Network concept, as a model for economic development in a future scenario where broadband is ubiquitous and content production has been decentralized to the edges of the network, cannot be observed and studied in a community where neither of these conditions are met. Critics of this study will inevitably argue that the methodology of this study was inappropriate to address the phenomenon of interest. With the benefit of hindsight, it could be conceded that the case study communities of Bristol and Danville should probably not have been selected, since they did not have the affordable, ubiquitous next-generation broadband mentioned as necessary in the Producer Network theory. However, in defense of the methodology, I submit that one would be hard-pressed to find any community in America – particularly a rural one – that has this kind of telecommunications capacity. The "Directions for Future Research" suggest ways that the methodology could be improved to better address the Producer Network Concept.

5.3: The Emergence of a Model for Rural Economic Development through Telecommunications

Even though the hypothesis of the Producer Network Effect was rejected as a model for describing the *current* state of affairs, all is not lost. The research findings suggest the emergence of a more general theory describing how broadband relates to endogenous economic development through firm-level effects. The inductive discovery of a new theory emerging from the field data is a common outcome of grounded theory research, and indeed, it is somewhat unusual to begin a grounded theory investigation with an *a priori* hypothesis, as was done in this project.

Because the Producer Network concept was incorporated into the conceptual framework of the research as a component of a more general theoretical model of the interplay between community-level and firm-level influences and effects, the overall framework may still be salvaged, even thought the specific hypothesis of the Producer Network did not bear out in field observations. The field observations did help to flesh out and confirm some of the elements of the model presented as FIGURE 1, and suggested that there are at least two parallel and complimentary mechanisms linking broadband to rural economic development: an endogenous process and an exogenous process.

The endogenous process is structurally equivalent to the original hypothesized model in FIGURE 1, although the attributes of model components have been modified in light of the field observations. The model is constructed in terms of two levels of analysis: the community-level and the firm/entrepreneur level. Broadband telecommunications, defined by a "reasonable" midrange level of bandwidth, ubiquitous coverage, financial affordability, as well as a quality of service sufficient to support most business applications, enables the "effective use of productive broadband applications," in the presence of favorable "community characteristics."

Community Characteristics are mediating variables, and include technological literacy on the part of local businesses; the presence of an entrepreneurial culture and supporting milieu (in the case of entrepreneurship); the presence of industries that stand to benefit from broadband – and are not controlled by external influences to the point that local initiatives will be irrelevant to them; the education of leadership on the role of broadband in economic development – tempered with a realization of the limits of its impact; the institutional and political capacity to implement

innovative change; the presence of capital and basic infrastructure, an attractive local culture and the presence of amenities that make a community a place people want to live.

In the context of a setting where broadband exists in the presence of these characteristics, existing firms and entrepreneurs can leverage the technology for competitive advantage and bottom-line gains. The sum of these gains over all the broadband subscriber firms in a community should theoretically be a tangible, measurable economic development benefit. However, in this model, the firms are not a "black box" – rather, their ability to derive benefits from broadband in an appropriate community context depends on a micro-level process encompassing effective use of productive broadband applications, firm-level effects, and firm-level impacts.

"Effective use of productive broadband applications" is a loaded phrase, incorporating both the "Effective use" concept of Gurstein (2003) and the idea that broadband must be put to "productive" use to have any economic development impact, as suggested by Informant DB5. It is, however, the core of the model – and if one had to summarize the whole findings of this study in one sentence, it might go as follows:

> *The endogenous mechanism by which broadband enables economic development is the effective use of productive applications by firms and entrepreneurs in the context of favorable community characteristics*.

Importantly, productive applications are, for the most part, not on the cutting edge of technology. They have been standardized, accepted by the business community, and are readily integrated into traditional business processes. With the exception of point-to-point interconnection of multiple establishments within a firm, which is really nothing more than an extended internal LAN, they do not typically require next-generation bandwidth. Voice over IP functions effectively on under 100Kbps, H.323 videoconferencing works well with 512 Kbps; and as our informants' experiences revealed, even someone with a 128Kbps connection can update a web page. It may indeed require 100Mbps to transmit HDTV, but to the extent that HDTV does not serve a productive function within the enterprise, it is irrelevant to any discussion of endogenous economic development that relies on a "productive applications" framework. (It may have considerable amenity value, but that is a distinctly different theoretical proposition).

Effective use of productive applications may translate into firm-level effects if the right community characteristics are present, as outlined above. These "effects" are distinct from

"outcomes" in the sense that effects are directly realized from the use of applications enabled by broadband, and the outcomes are bottom-line gains that sum up across firms to equal an economic development benefit. For example, under this framework one might envision a scenario in which a 1 Mbps wireless connection enabled a business to implement H.323 videoconferencing. The *effect* of this might be a cost savings realized with a reduction in driving (and with gas prices currently over $2.00 a gallon – as of 2005 – this could be a substantial savings!). The *outcome* might be that the cost savings enabled the firm to hire an additional employee – perhaps a technician in their IT division to maintain the videoconferencing equipment. If other firms realized similar outcomes, although none of them are particularly significant by themselves, taken together, they could sum to a significant measurable improvement in employment and/or income for the community.

The model also illustrates that broadband may also influence rural economic development through a parallel exogenous development mechanism, which was not the focus of this study, but is frequently cited in the literature and kept getting mentioned in the interviews. It is included here for completeness – to remind readers that 1) exogenous mechanisms are a distinctly different concept than what has been discussed throughout this study, and 2) a community's economic development "portfolio" needs to include both endogenous and exogenous strategies. The exogenous mechanism may be quite simply summarized as follows: the presence of broadband telecommunications as defined above, in the context of favorable community characteristics (the last 3 on the list being especially significant), could result in outside firms making location decisions to come to a given community, resulting in exogenous economic development. The calculus of a firm's location decision-making has been well documented in the literature, and is therefore represented as a "black box" in this model.

This model, depicting both endogenous and exogenous mechanisms for rural economic development using broadband telecommunications, is presented as a point of theoretical departure for future research, and provides a framework for subsequent studies to situate their findings. Future research may add new variables to the model, identify variables that are insignificant, or propose a completely new framework. Insofar as this model represents a theoretical approach to the problem that has been absent until now, it is believed to be a relevant and worthwhile contribution to the science and practice of economic development.

A Proposed Mechanism to Explain the Role of Telecommunications in Rural Economic Development

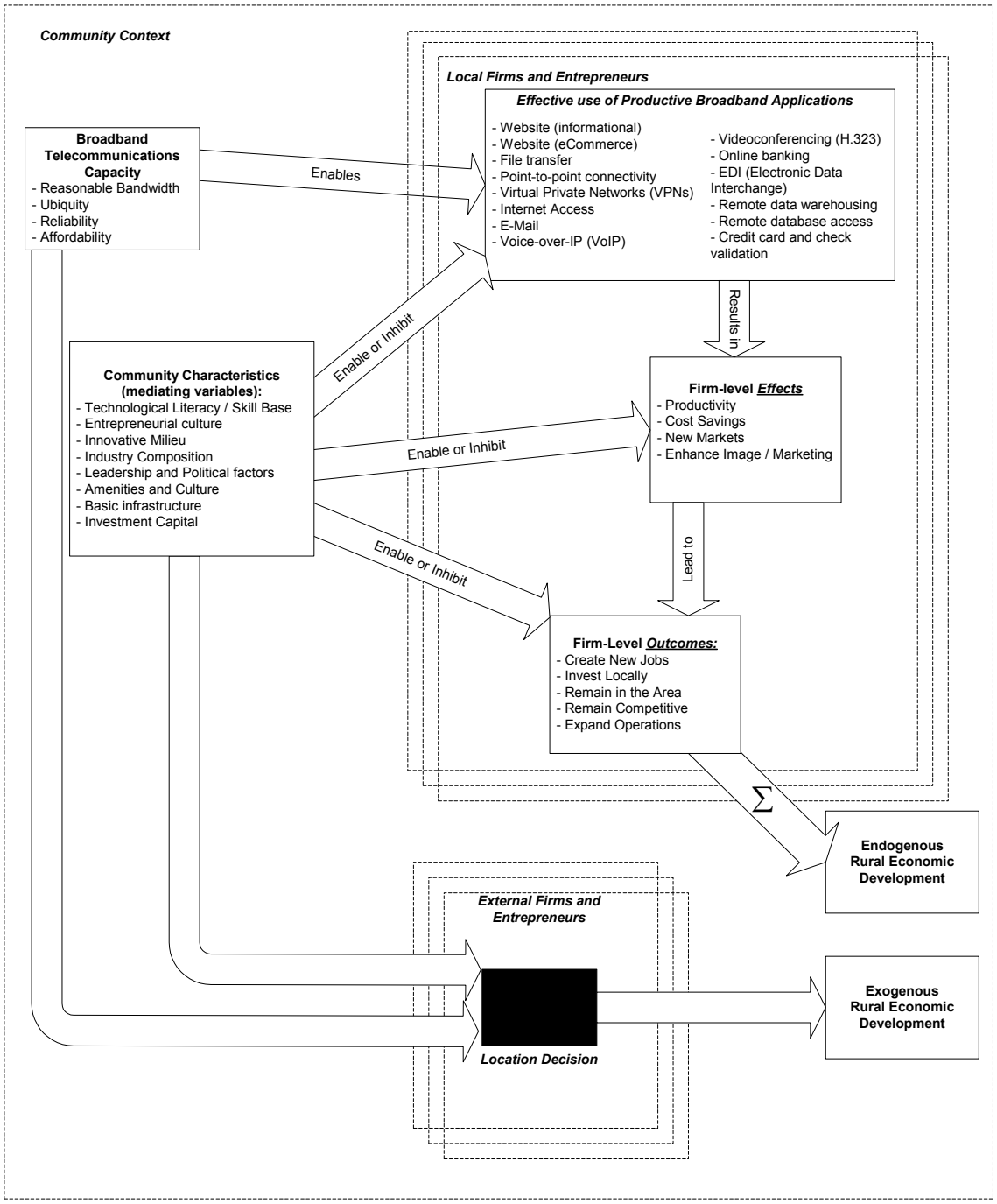

Figure 5: An emergent model for economic development through telecommunications

5.4: The Big Picture: Situating broadband telecommunications within a broader policy context

It may be that one of the most important contributions this study makes to the general understanding of the relationship between telecommunications and economic development is the observation that telecommunications – and any policies that seek to stimulate their deployment – exist within a larger policy context that extends beyond any given community. To be sure, the economic, social, cultural, and political "mediating variables" that operate at the community level and may inhibit or enhance the potential of broadband to stimulate economic development are critical, and are rightfully understood as the objects of meaningful policy in their own right. However, to understand the "big picture" within which telecommunications must ultimately be implemented and evaluated, it is necessary to take a step backwards and consider, for a moment, how broadband fits into the way policy is formulated in the American context.

As was noted in the literature review on rural economic development, and as the interview informants mentioned on several occasions, many of the economic problems that local development policies attempt to redress, such as deindustrialization, brain drain, and the graying of rural America, are fundamental, endemic, and structural in nature, having their origin – and most likely their resolution – beyond the scope of any given local community. To make the claim that the deployment of broadband telecommunications infrastructure will be the panacea solution that will reverse the adverse effects of these and other "wicked" problems is not only incorrect, it is dangerous. If policymakers and the electorate become so enamored of a single policy solution's ability to "save them" from their problems, it may be pursued to the exclusion of other, less glamorous, policies that could perform the necessary function of addressing other "messy" aspects of multifaceted problems, such as the "mediating variables" identified in this study's model.

Unfortunately, this appears very similar to what has happened with broadband telecommunications. It has risen to prominence as a policy issue far more quickly than the limited amount of research linking it to economic development seems to justify. Mueller (1993: p.150), observing that "a link between telecommunications and economic development was snapped up as quickly (and as uncritically) as a drowning person grabs for nearby floating

object" may be on to something. That the policy emphasis on broadband has proceeded so far ahead of academic research on the subject may be at least partially explained by the fact that broadband fits very neatly into the form of "mediated" politics that exists in the United States, circa 2005.

The concept of broadband telecommunications for economic development meets many of the needs of a political culture that is characterized by a multitude of interests vying for the attention of leaders and relevance with the public, a media that caters to – and creates – short attention spans through the use of sound bites, and compressed time horizons for policy implementation. Policymakers operating in such a context have strong incentives to support "quick fixes" that can be expressed in simple, politically palatable terms. Policies that overtly or by implication cast broadband as a panacea fulfill this objective. Broadband is noncontroversial; it resonates with the body politic due to a belief, subconsciously accepted for many years, that "the progress of technology will save us." Broadband is a complex, technical concept; since very often neither the electorate nor the policymakers understand it, it can be imagined to fulfill all kinds of social needs. It *sounds good*. Broadband is almost effortlessly converted into impressive sound bites – for example, by adding the prefix *e-* or *i-* to the title of an economic development program. For better or for worse, broadband seems to have rapidly risen to panacea status in the political realm. Regardless of whether the emperor has any clothes, it will be difficult for the proponents of broadband for economic development – especially those that have invested considerable public funds – to step back to more moderate positions. However, this is probably what really needs to happen.

There is nothing wrong with researching – and if justified, even promoting – broadband telecommunications as an economic development strategy. Indeed, the magnitude and scope of the problems the broad and diverse field of economic development seeks to address necessitates all researchers focusing on a specific subset of the problem domain in any given research investigation. The central take-home point of this section is that any researcher or practitioner of telecommunications in economic development needs to be aware that this specific research and policy question is enmeshed in a deeper context characterized by fundamental economic, political, cultural, and social questions with no easy answers. In such a context, there are no magic bullets.

5.5: Recommendations for Policy

The findings of this study and their implications suggest a number of recommendations for policymakers to consider. These are grounded in the literature as well as the experiences of the interview informants, and address the ways broadband related to economic development, deployment strategies, technological literacy, the Big vs. Little Broadband debate, the geography of the Internet and the local vs. remote hosting question, broadband demand by businesses, effective use, community influences, and other factors. What follows is far from an exhaustive list of policy options that pertain to broadband and economic development, but rather represents the most relevant action items that were suggested by the field research.

Recognize that there are multiple ways to think about broadband in the context of economic development, and that these suggest different policy directions.

In any community, an economic development "portfolio" consists of both exogenous (targeted outside the community) and endogenous (targeted inside the community) strategies. Broadband telecommunications can play a role in both of these. The endogenous mechanism, by which broadband improves the capacity of existing firms to realize internal efficiencies, reach larger markets, and register bottom-line improvements, as well as lowering barriers to entrepreneurship, has been the focus of this study. It is important to understand that this is a distinct concept from the exogenous dimension of broadband, whereby it can serve as an amenity to attract high-tech firms. Both the endogenous and exogenous processes are important and complementary, and neither should be focused on to the exclusion of the other.

Be aware of the timeframe various strategies may take to produce results.

In the case of broadband telecommunications, the strategies that may be necessary for long-term competitive advantage are not necessarily the best strategies for short-term economic development results. This does not make one better than the other; the two are complements, not substitutes. However, there is a real policy lesson to be learned here. Many of the strategies that focus on "Next Generation" broadband, such as the Producer Network concept that formed the hypothesis of this study, are really better understood as visions for a future time with different

telecommunications costs and business models. In the near term, given the short implementation window of public policies in the United States, policymakers must devise strategies that can be carried out in the context of the economic conditions, business models, access technologies, and broadband applications presently available. Long-term solutions should not be neglected, but policymakers need to be able to identify strategies that speak directly to the status quo, as opposed to strategies that depend for their functioning on some sort of transformative change having already taken place.

If you're going to build something, put it in the hands of as many people as possible.

Perhaps the most high-profile policy intervention oriented towards the use of broadband in economic development is the physical deployment of the infrastructure that enables broadband telecommunications, such as fiber-optic networks. At times, it seems that too much emphasis is placed on the particular access technology used, along with its theoretical capabilities, as opposed to the capabilities it enables on the part of its end-users. However, the interview accounts suggest that accessibility and affordability are more important than bandwidth and whatever access technology one may prefer. There are limitations of various technologies and tradeoffs between them, but from an economic development perspective, a premium needs to be placed on putting whatever technology is deployed in the hands of as many people as possible. To realize the maximum economic development benefit *in the near term*, it may be beneficial to shift the priority of current broadband initiatives from the construction of expensive, high-capacity middle-mile distribution networks with few end-users to last-mile solutions that (albeit at the expense of capacity) reach more end-users. Given current technologies, this almost naturally implies the use of wireless infrastructure. This is not to say that the middle-mile is not important – indeed, if a wireless system is constructed without some consideration paid to the likelihood of increasing backhaul requirements over time as the network scales up, the impact of such a project could be severely constrained. It is, however, to confirm and underscore the central importance of the Last Mile to the potential of broadband to affect economic change in a region.

If you're going to develop policies targeted towards eCommerce, understand the geography of the Internet.

It is not essential that a company wishing to implement eCommerce have the capacity to host a website from their physical location. Shout it from the rooftops. This is an essential fact that needs far more emphasis in policy settings, for two reasons:

1) Rural businesses need to be made aware of the fact that they can leverage the potential benefits of eCommerce, even if they cannot afford the kind of connection or lack the in-house expertise that would be necessary to host a web server. eCommerce is within the reach of most any business.
2) Because a web site can theoretically be hosted anywhere and businesses are not currently precluded from running web sites even if they have low bandwidth connections, the statement that "our businesses need to be able to do eCommerce" is not really a valid justification for a broadband deployment project.

Of course, the fact that *web site* content can be hosted from anywhere does not mean that all other types of content can. The ASP hosting model does not apply to the full range of voice, data, and video that the Producer Network concept takes as its definition of network content. This study has revealed that "eCommerce" and "information production" are not synonyms.

Broadband implementation projects aimed at economic development need to be driven by business need.

An infrastructure deployment project aimed at economic development that does not take into consideration the level of service, price point, and quality of service demanded by businesses may find itself wanting for subscribers. Businesses evaluate a broadband adoption decision in a manner not dissimilar than other costs – thus, if it's not affordable, they will continue to do without – and as this research has shown, businesses can be exceptionally creative in finding ways to "get by" on less than we think they need. This decision can be understood, in its simplest terms, as a cost/benefit decision: if the cost of a broadband connection exceeds a businesses' estimate of its potential benefit, the business will be highly unlikely to adopt it. Furthermore, businesses have a set of needs distinct from residential users of broadband that seem to prioritize reliability over speed in some cases – so Quality of Service needs to be taken

into consideration. However, the requirements of particular business processes create more specific needs, and we must be careful not to paint them with broad strokes. Another critical point to keep in mind is that businesses *may not know what they need,* or they may not currently be making the highest and best use of broadband in their operations. This suggests a related goal: the promotion of technological literacy.

Prepare your community to make effective use of technology.

Both the literature and the interview informants noted that *how one uses* the technology they have is every bit as important – if not more so – than what technology they have. infrastructure – whether distribution or last mile – cannot be planned for in isolation. As the model suggests, the absence of technology literacy in a community can constrain the ability of businesses to make effective use of productive broadband applications. Therefore, policy interventions that focus on training, and specifically showing businesses how to incorporate ICT into their existing operations, may have a significant positive effect – even in the absence of the construction of any new infrastructure. Another dimension to this aspect of the problem is the concept of *awareness*; having access to the technology and the skills to use it are still insufficient if the technology is not made relevant. Businesses need to be made aware of e-Business models that are relevant to what they are doing. Awareness is also necessary on the part of a community's leadership; time must be taken to educate the community's elected leaders and economic developers on the true potential of broadband - which means changing a mindset from the simplistic "broadband will save us – build it and they will come" mentality to a more qualified, moderated assessment of how broadband can benefit the community.

A number of specific policies help to further the goal of technological literacy within a community. One of the interview informants suggested that a community technology center should be established as a one-stop resource for businesses to get assistance and consultation regarding the integration of e-business into their operations. Existing "best practice" examples of e-businesses consultancy organizations currently active around the area include the Cumberland Plateau Electronic Business Village (EBV),[9] the Business Assistance Center at

[9] http://www.cpebv.com

Radford University,[10] The Virginia Electronic Commerce Technology Center (VECTEC),[11] and the Blacksburg Electronic Village (BEV).[12] There is a role for community colleges, as well as outreach divisions of larger universities, to play in the promotion of technological literacy.

Education is not the same thing as training. Training in a specific field such as eCommerce or Information Technology more generally is no substitute for a basic education or the kinds of experiences and personal growth that are derived from postsecondary education. The instrumentalization of education into the strategic cultivation of a specific skill set that is currently in demand is an inappropriate course of action for communities to take, and is part of "the big picture," discussed below.

Understand the community influences that can make or break the potential of broadband to have economic development impact.

Broadband, like every other local policy option, does not exist in a vacuum. This study has suggested that a number of community characteristics, such as culture, political climate, business climate, amenities, institutions, the presence of an innovative milieu and basic infrastructure, all act as "mediating variables" that can enhance or inhibit the extent to which broadband has an impact on economic development. Some of these variables may be within the control of local policymakers to change over time, if it appears that they are exerting a negative influence. However, it is also important to be aware of the fact that there are other influences that have their origin outside the local context.

Don't lose sight of the big picture.

Many of the economic problems of rural communities are endemic, caused by forces external to a community and often largely beyond its control. Broadband, when ubiquitously deployed and effectively used, may allow some businesses to increase their competitive advantage and may allow some enterprising individuals to become high-tech entrepreneurs, given the right cultural and institutional support. But that's about it. It's not going to be a panacea, and it's not, by itself, going to reverse the profound, deeply structural problems such as deindustrialization, the brain drain, and the graying of rural America. The economic situation of

[10] http://btp.radford.edu/ba/
[11] http://www.vectec.org
[12] http://www.bev.net

a community is inextricably bound up in its cultural, social and political context, and so is the extent to which technology can make a difference. These and other factors at the community level must be brought along together and there is no simple deterministic solution that will speak to all aspects of the rural economic development conundrum. To think of broadband as a panacea is both incorrect and dangerous, insofar as it can create a false sense of security and distract policymakers away from other, equally important, economic development issues.

5.6: Directions for Future Research

There are a number of questions that this research leaves unanswered, as well as a number of new ones it suggests. This research, as originally proposed, was intended to be a starting point for a substantial program of research, and it appears that there is indeed much that remains to be done. This research has suggested some of the ways telecommunications *could* have an effect on economic development in rural communities, and has identified a number of variables that seem to be relevant across multiple cases. From this contribution, there are a number of paths that can be taken.

First, there is a burning need to quantitatively *measure* the economic development impacts suggested by this study, and determine how they rate relative to other strategies. This is a vital question for policy, since scarce resources must be allocated to a finite set of economic development initiatives, and telecommunications is only one strategy among several. Indeed, this was the original research question of this study, but had to be postponed and the current qualitative study conducted in its place due to the fact that the variables to be measured had not yet been identified. Hopefully, the current research has at least partially removed this obstacle. A number of research questions emerge from this broad heading. For example, what are the magnitudes of the bottom-line firm-level benefits of telecommunications, such as cost savings, revenue increases, internal efficiencies, and increased profit margins – and are they significant? Just how much of an impact do the firm-level effects of telecommunications have on a community's economic development? Is it as significant as, say, landing a branch manufacturing plant? What are the indirect effects of these firm-level effects on other sectors of the economy? This is a classical, more rigorous economic question that can be approached through the use of established tools and techniques such as Social Accounting Matrices (SAMs).

Answers to these sorts of quantitative questions would be extremely valuable to an academic and practical understanding of how important telecommunications really is to rural economies.

This study really did not do justice to the Producer Network concept. The design decision to study communities that would later turn out to not have the kind of bandwidth needed to enable a Producer Network Effect did not invalidate the results of the current study, but it did sharply curtail the extent to which it could say anything at all about the Producer Network. However, the concept of the Producer Network remains fascinating, and in the future may be critical to our understanding of the way the Internet impacts communities. For one to really test the economic development potential of the Producer Network, one would need to choose a research setting that was far more advanced in terms of broadband availability than the communities chosen for the current study. Look for places that have the capacity to produce content from the edges –confirm this– and then see if the producer network effects (the economic development benefits of producer network capacity) are being realized. However, the characteristics of such a community (particularly the likelihood of it being urban or in another country that leads the U.S. in broadband penetration) may limit the generalizability of any findings discovered there to the original goal of understanding its implications for rural communities.

If it turns out to be the case that a suitable case study community (rural with ubiquitous broadband) cannot be found to study the Producer Network, consider *creating* one. Given the popularity of the issue among policymakers, it does not seem outside the realm of possibility for an outreach-oriented operating unit of a research university to secure funding to equip a rural community with ubiquitous, Next-Generation broadband, and then document what happens. Besides the research design advantages of facilitated data collection and a greater degree of control over the environment, a side effect of such a scenario would be that any economic benefits resulting from broadband would accrue to the residents of the test-bed community, thus creating "real" economic development as part of a research project.

This study has revealed several ideas that translate into research programs in their own right. First, the current research suggests that broadband telecommunications affects change in a community – economic development or otherwise – through the applications it enables, but different applications may have different effects. The distinction between "productive" and "nonproductive" applications is an oversimplification, and is only the tip of the proverbial

iceberg. More research is needed to provide a framework for the understanding of how different broadband applications can translate into various community objectives, including, but not limited to, economic development. Second, the importance of community influences as mediating variables in the relationship between broadband and economic development has been observed, but remains only vaguely specified. A meaningful study could be designed around each of the different community characteristics identified as relevant by the informants in the current research.

More work remains to be done regarding the spatial dimensions of broadband and economic development. The pioneering work of Zook and others has provided a framework and technique for measuring the degree of centralization in Internet content provision. But more relevant from a policy standpoint is the question of how one might *stimulate* decentralization of content provision to the edges of the network. And, perhaps even more fundamentally, what are the economic advantages of being a locus of content production? One could perhaps study the existing places and see what economic impact (in terms of multipliers, etc) the data centers have. Maybe the decentralization of content production to the edges would be a benefit to rural communities, but so far we lack a satisfactory explanation of how it might take place or how much impact it would really have if it were to take place. In a more general sense, framing future research questions that concern broadband and economic development in geographic terms could prove to be illuminating. An approach grounded in economic geography – and armed with all its modern analysis techniques – seems appropriate to the question, given its strong spatial implications.

Beyond telecommunications, we need more basic economic development research that attempts, in various ways, to discover solutions to various aspects of the "wicked" economic problems of rural communities, which make the lack of high-speed Internet access pale in comparison. It imperative that researchers resist the temptation to get distracted by the hype surrounding telecommunications, or be lulled into a false sense of security that "once we figure this out, we're done". The role of broadband telecommunications in economic development is certainly meaningful for rural communities, but there are a number of other economic development issues that are at least as relevant, if not more so. We as economic development researchers must never lose sight of the big picture, even as we are inevitably forced by our research designs to focus in on one aspect or another of what remains a complex and interrelated

set of issues. The most formidable barriers to economic success in rural America are social, cultural, educational, and political – not technical. The technology, for all the attention recent economic development policy has paid it, is, ironically enough, the easy part.

Appendices

Appendix A: Virginia Tech IRB Approval Letter

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Institutional Review Board

Dr. David M. Moore
IRB (Human Subjects)Chair
Assistant Vice President for Research Compliance
CVM Phase II- Duckpond Dr., Blacksburg, VA 24061 0442
Office: 540/231-4991; FAX: 540/231-6033
email: moored@vt.edu

DATE: February 17, 2005

MEMORANDUM

TO: Heike Mayer School of Pub & Internat Affairs 0113
Stephen Peery

FROM: David Moore

SUBJECT: **IRB Expedited Approval:** "Producer Network Effects for Rural Economic Development" IRB # 05-114

This memo is regarding the above-mentioned protocol. The proposed research is eligible for expedited review according to the specifications authorized by 45 CFR 46.110 and 21 CFR 56.110. As Chair of the Virginia Tech Institutional Review Board, I have granted approval to the study for a period of 12 months, effective February 17, 2005.

Virginia Tech has an approved Federal Wide Assurance (FWA00000572, exp. 7/20/07) on file with OHRP, and its IRB Registration Number is IRB00000667.

cc: File
Department Reviewer Max Stephenson 0113

Appendix B: Informed Consent Form

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants
in Research Projects Involving Human Subjects

Title of Project	Producer Network Effects for Rural Economic Development
Investigator	Seth Peery, Dept. of Urban Affairs and Planning

You are being asked to participate in a study conducted by Seth Peery, a Master's degree candidate in the department of Urban Affairs and Planning at Virginia Tech. Mr. Peery is conducting this study for his Master's thesis under the supervision of Dr. Heike Mayer. **Your participation in this study is entirely voluntary.** You should read the information below and ask questions about anything you do not understand, before deciding whether or not to participate.

I. Purpose of this Research

This study's goal is to develop a better understanding of the relationship between high-speed Internet access, commonly referred to as "Broadband," and economic development. Specifically, it seeks to identify potential ways in which broadband could enable businesses to become producers of information. To address these questions, a series of interviews are being conducted in your community: with representatives of telecommunications service providers, with representatives of organizations in a position to describe community and business climate characteristics, and with representatives of local businesses. Because of the personal, face-to-face nature of these interviews, a relatively small number of participants have been selected: one service provider representative, two community representatives, and five business representatives.

II. Procedures

The research will consist of a face-to-face interview, to be conducted at your place of business (or alternate location of your choosing), lasting approximately one hour. The interview will be guided by a set of open-ended questions, but will be flexible in nature. The interview will be tape recorded for the sole purpose of later transcription and analysis as a primary data source. The tapes of the interview will be kept confidential, as described in "Extent of Anonymity and Confidentiality."

III. Risks

This study is believed to pose *no more than minimal risk* to you as a participant. The only potential risks are related to the disclosure of business information. To protect against this risk, any information that could be used to identify you or your company will be kept strictly confidential, as outlined below.

IV. Benefits

It is not expected that you will benefit directly from participation in this study, although information obtained in this study may help improve the general level of understanding with regard to the relationship between broadband and economic development, and could lead to more effective policies. No promise or guarantee of benefits is being offered as incentive for you to participate. Should you desire, you may contact me at a later time for a summary of the research results.

V. Extent of Anonymity and Confidentiality

Certain types of information may be gathered during the course of this interview that would identify you individually, your employer, your position, and other information relative to the operation of your organization. All information that could be used to identify you individually or your organization will be kept confidential, through the replacement of your name on interview transcripts and any derived analysis or publication with a code number. The list that matches names with code numbers

will be kept secure. This interview will be tape-recorded for the sole purpose of its use as a primary data source. The tapes will be kept physically secure and will only be accessible to the researcher and his faculty supervisor(s) as they are being transcribed. The tapes will be erased once they have been transcribed.

If you do not wish to divulge a piece of information because of its proprietary, classified, or competitively sensitive nature, you are not required to do so. At any time during the interview, you may explicitly designate any piece of information you provide as "confidential," or "off the record," thus ensuring its strict confidentiality.

VI. Compensation

Participants in this study are not entitled to any financial or other compensation.
On the other hand, there is no cost associated with participation.

VII. Freedom to Withdraw

Participation in this study is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled, and you may discontinue participation at any time without penalty or loss of benefits, to which you are otherwise entitled. Furthermore, you reserve the right not to answer any questions, should you choose to do so.

VIII. Subject's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities:

- Participate in a tape-recorded interview.
- Explicitly inform the researcher of any information that must be kept confidential.

IX. Subject's Permission

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____Date_____

Subject signature

NOTE: You must receive a complete copy (or duplicate original) of the signed Informed Consent.

X. Contact Information

Should you have any future questions about this research, or research subjects' rights, you may contact:

Seth Peery Principal Investigator Department of Urban Affairs and Planning 1700 Kraft Drive, Suite 2000 Blacksburg, VA 24061 540-231-2178 sspeery@vt.edu	Dr. Heike Mayer Faculty Advisor Department of Urban Affairs and Planning 213 Architecture Annex (0113) Blacksburg, VA 24061 540-231-3805 heikem@vt.edu
Dr. Max Stephenson Departmental Reviewer, Human Subjects Research Department of Urban Affairs and Planning 213 Architecture Annex (0113) Blacksburg, VA 24061 540-231-9932 mstephen@vt.edu	David M. Moore Chair, Virginia Tech Institutional Review Board for the Protection of Human Subjects Office of Research Compliance CVM Phase II (0442); Research Division 540-231-4991 moored@vt.edu

Appendix C: Interview Guides[13]

C.1: Business Informant Interview Guide
C.2: Community Informant Interview Guide
C.3: Telecommunications Service Provider Interview Guide

[13] Because of the unstructured nature of the interviews, not all questions were necessarily asked of all respondents. These interview guides functioned as an exhaustive list of question prompts and follow-up probes in the event that an informant volunteered little information. Often times, once prompted by the introductory statement for each "theme" within the interview guide, informants would volunteer a lengthy response that eventually touched upon many, if not all, of the probes, thus precluding the need to ask them directly.

IRB was informed that the interview format would be far less structured than the interview guides suggest. The researcher felt such specificity was necessary to provide IRB with a sense of all the possible questions that might be asked of informants.

Business Informant Interview Questions (DRAFT: 2005-02-11)

ORGANIZATION:	CONTACT PERSON:	PHONE:	E-MAIL:

Introduction

[The Informed Consent process will be the first order of business. During this time, a General Introduction to the research will be provided. Assuming that the informant agrees to all terms and conditions and affirmatively provides his/her informed consent, the interview will proceed.]

I appreciate your willingness to meet with me, and I won't take up much of your time.

General Questions about the Business

First I want to familiarize myself with your company. I know that [background research from a web site visit here]… but I wanted to ask s few quick questions to help me understand how telecommunications is integrated into your operation.

1. What would you say to a lay person were your core business practices?
    a. What communications do these involve?

2. What sort of linkages does your business have
    a. to other local firms?
    b. To non-local or global firms?
    c. Are these supplier, customer, contractual relationships?
    d. What communications are required?

3. Does your business's organizational structure necessitate frequent communications between sites?
    a. How many offices do you have?
    b. Are you a subsidiary or parent company?

4. Do you use JIT delivery or contract out non-core services?

5. Does your workforce participate in training and re-training activities on a regular or ongoing basis?

Internet Connection

These next few questions will concern your Internet connection, particularly as it allows you to transmit as well as receive information. Availability, affordability and reliability are key factors here, since we are concerned with how telecommunications supports your business's core processes.

6. What is the bandwidth of your organization's Internet connection?
    a. Downstream vs. Upstream?
    b. What technology (Leased Line, DSL, Wireless, FTTH, Cable, etc.) does it use?
    c. Who is the service provider?

7. Is this connection reliable?
    a. Does it provide you with the quality of service you need to support all desired applications?
    b. Are you satisfied with the reliability of this connection, or would you opt for a better one, if it were available? If it were affordable?

8. How much does your organization pay for its Internet connection?
    a. Is this more/less than businesses in your sector would pay in other locations?
    b. Are higher levels of service available at your location, but not affordable?
    c. Would you benefit from switching to a higher level of service, if it were affordable?

9. How long has your organization subscribed to its current Internet service?
    a. Do you know how long has this service been available at your location?
    b. What motivated you to subscribe to the service when you did?

Identifying Producer Network Effects

I'm especially interested in the specific things you use your connection for. I have listed a few applications here that some companies have leveraged the technology to pursue. In particular, I am interested in the extent to which broadband has enabled your business to become a "producer" of information.

10. Which of the following network applications does your business use now? In the future? [probes to be used as suggestions]
    a. e-Mail, with attachments
    b. Web browsing and research
    c. Voice over IP
    d. Teleworking
    e. Online Banking
    f. Placing orders
    g. Making payments
    h. Web site for publishing information or marketing
    i. Web site for receiving orders/payments
    j. Web site for providing customer or employee support
    k. Education and training

l. Audio/Video streaming on demand
m. Videoconferencing
n. Monitor & control for security, alarms, health applications, etc.
o. Transfer large files
p. Telemedicine
q. Online graphical applications (e.g., computer aided design, GIS)
r. Network storage and/or backup
s. Disaster recovery and loss avoidance of data
t. Communications between site locations at less than T1 speeds
u. Communications between site locations at T1 speeds
v. Communications between site locations at higher than T1 speeds
w. Wireless LAN access wherever your users may need it?

11. Do you consider your company to be a "producer" of information?
    a. If so, how?
    b. Has your telecommunications capability enabled this, or simply enhanced an existing condition?
    c. Are there still barriers to this, in terms of the capability of your telecommunications capacity?

12. Does your organization engage in e-commerce?
    a. B2B/B2C?
    b. Can you process credit cards?
    c. Offer information goods/services through the network?
    d. Marketing traditional goods/services through the network?
    e. Have you used e-commerce to launch new products/services?
    f. Does your content originate locally?
    g. ➔Where is it physically hosted? ➔

13. If you do not use the internet to process transactions, do you use it for information/advertising?
    a. Probe: Are you primarily targeting local or global audiences?

14. Has your organization's use of telecommunications allowed it to realize operating efficiencies?
    a. Cost savings?
    b. Gains in productivity?
    c. New operating processes?
    d. Disintermediation – more direct communication with customers?
    e. Access to New Markets?

Impacts of Producer Network Effects

Since I'm coming at that from an economic development perspective, I'm interested in the ways that the telecommunications capacity of your business can be translated into benefits that could be good for the community as a whole. These next few questions are meant to key in on the outcomes and impacts of the uses of telecommunications we just discussed.

15. How do you feel that you are positioned relative to your competitors:
    a. larger competitors (especially for small business and entrepreneurs)
    b. in the region
    c. outside the region
    d. with better telecom
    e. … would you say this if not for your connection?

16. Would you say that your connection pays for itself in terms of your bottom line?
    a. Recall this could mean any of the following:
        i. Raise Productivity
        ii. increase revenue
        iii. cut costs

17. Has your organization's use of telecommunications allowed it to
    a. Hire more employees?
    b. Serve new customers?
    c. Reach larger markets?
    d. Remain in the area?
    e. Expand to new locations?
    f. Provide new products or services?

18. What do you consider to be the greatest value-added that your Internet connection provides your organization?

19. How central is telecommunications to your organization? Could you operate at the same level without your current telecommunications capacity?

Relative Influences of Other Factors

It would be a mistake to talk about telecommunications in a vacuum. In these next few questions, I want to try and get at external influences that may influence the effect of the technology.

20. Besides telecommunications, what other infrastructure is essential to your business's function?
    a. How important is telecommunications relative to these?
    b. Does it complement other infrastructures or inputs?

21. What firm-level factors make it easier/harder for you to realize competitive advantage from broadband?
    a. Geographic situation
    b. Lack of in-house expertise
    c. Lack of bandwidth/affordability
    d. Competitive pressures
    e. Lack of relevance to core processes
    f. Other (specify)…

22. What aspects of the community make it easier/harder for you to realize competitive advantage from broadband?
    a. Geographic situation
    b. Level of education and computer literacy – availability of workers
    c. Capacity of institutions
    d. Social/cultural factors (intangibles; work ethic, civic participation)
    e. Business Climate (Industry mix/Key Sectors)
    f. Innovation and Entrepreneurship (milieu)

23. Are these factors more or less important than telecommunications to your firm?
    a. Firm-level
    b. Community-level

Snowball Sampling / Conclusion

24. Do you know of anyone else that would be useful for me to talk to – either a provider, community expert, or business in this community?
    a. Could I have their contact information and use you as a reference?

25. Additional Comments
    a. Here sector informants can elaborate on any of the structured responses, or provide any other information regarding their Internet connection, the way they use it, and the effects of their use of the connection, etc..

I've certainly enjoyed talking with you this [morning/afternoon]. Your information has been extremely helpful. As we discussed earlier, all information that identifies you individually or your organization, and any information that you would like to be kept confidential, will remain confidential. If you would like me to send you a copy or link to whatever findings come out of this study, I will be happy to do so.

Community Informant Interview Questions[14] (DRAFT: 2005-02-11)

ORGANIZATION:	CONTACT PERSON:	PHONE:	E-MAIL:

Introduction

[The Informed Consent process will be the first order of business. During this time, a General Introduction to the research will be provided. Assuming that the informant agrees to all terms and conditions and affirmatively provides his/her informed consent, the interview will proceed.]

I appreciate your willingness to meet with me, and I won't take up much of your time.

Industry Mix

First, I want to ask you a few questions about the kinds of businesses in ____, and their relative importance to the local economy.

2. What do you think are the most important industries in this community?
    a. Sectors? Specific Firms?
    b. Why? (e.g., major employers, exporters, high-tech, strongly linked)
    c. Have these industries grown or declined in recent years?
    d. Are these industries likely to grow or decline in the near future?

3. What new industries (if any) have emerged in recent years?
    a. In what sectors?
    b. What is attracting them to _____?
    c. Are these industries likely to grow or decline in the near future?

4. How important are small businesses to your community's economy?

5. How important are home-based businesses to your community's economy?

6. Is there a large telecommuting population in your community?
    a. Do you view telecommuting as an opportunity?
    b. Are there any "telecottages" or "telework centers" in your community?

[14] NOTE: As the field work progresses, new questions/probes may be added; however, the substance of the interview will not change. Addition of new *themes* to the Guide will not occur without first securing IRB approval.

Innovation and Entrepreneurship

One factor that may influence the extent to which broadband can have an impact on economic development is whether or not a community has a climate to support the creation of new businesses and ideas .

7. Would you consider your community to have an "entrepreneurial culture?"

8. Do you have the infrastructure (i.e., business incubators, support networks, institutions) to support new business formation?

9. Approximately how many new business starts do you have per year?
    a. Hardly any? A few? Several?

Culture and Political/Civic Climate

Now I want to ask you a few questions that help us to understand what kind of a place ___ is, beyond the usual business indicators. This helps to understand if there is something unique going on here that could make the results in your situation not translate to another place.

10. What makes ____ and its people unique?
    a. How do demographics, history, geography, etc. influence the way that change occurs in _____?

11. How are _____'s institutions positioned to take advantage of new technology? This includes political, educational, business, social.

12. What do think is ____'s competitive advantage relative to other communities, local/nonlocal; urban/rural? (should not need prompts but include them for emergency)
    a. Good K-12 education system
    b. Attractive natural environment
    c. Good higher education system
    d. Attractive/friendly community
    e. Strong competitive industries
    f. Good transportation access to major markets
    g. Skilled workers
    h. Low costs of doing business (wages, taxes, utilities, land)
    i. Access to technology (computers, telecommunications, skills)

13. What aspects of community culture might enhance or constrain broadband use and/or the benefits gained from using it?

Existing Economic Development Strategies

Now I want to take a few minutes to talk about what you're currently doing for economic development in this community.

14. What are the components of your community's economic development program?
    a. Which of these are the most important? Why?
15. In your opinion, what are the local community's main economic development goals for the next five years?

16. Do you currently use telecommunications as an economic development strategy? (in terms of marketing its availability, etc.)

Relative Importance of Broadband for ED

Having discussed your current economic development strategies, I want to really focus in on whether you think broadband is a big issue relative to other things.

17. In your opinion, how important is access to and use of the Internet for local businesses?

18. Do you think the effective use of computer and Internet technology is a key economic development challenge for your region ?

19. Do you think that improving computer and internet access, affordability to businesses will be important in your area? --- WHY???? ---
    a. In support of existing businesses???
    b. To attract new businesses???
    c. Which is more important of these two?

20. In what industrial sectors does use of the Internet, and specifically broadband, seem to be most important?
    a. Manufacturing? Wholesale and warehousing? Banking? Real estate? Health care? Travel and Tourism? Business Services? Education? Government?

21. Have you heard any complaints from local businesses that they cannot get economical access to broadband services?

22. How important is telecommunications relative to other economic development strategies?

23. With respect to broadband in your community, which policy options are the most important?
    a. Improving Access
    b. Improving Affordability
    c. Encouraging, teaching, or technical assistance existing firms to adopt the internet
    d. Improve training for Internet applications in K12 (and higher ed.)
    e. Attract or support firms that provide computer and Internet services locally

Community Readiness for Broadband

In some cases, it's not a problem of availability or affordability that prevents use of a technology. A lot of money is being awarded in grants to promote building community "readiness" for broadband.

24. What is your impression of the demand for broadband services in this community?

25. What, if anything, prevents people in this community from using the Internet, and Broadband in particular?
    a. Is there a problem with awareness?
    b. Is there a problem with skills/computer literacy?
    c. Is it not available?
    d. Does it cost too much?
    e. Do people just not need it?

26. Do you believe that most people in the local workforce have adequate computer literacy and computer skills given the needs of local companies?

27. Do you believe the local area has good training resources to improve the computer skills of the local workforce? (ex K-12, Community Colleges, Higher ed., Private training)

Other Barriers to ED

In some cases, there may be other problems more pressing than broadband that prevent it from being adopted in the private sector or considered as a policy option in the public sector. As an economic development strategy, broadband is typically considered as only one component of a diversified set of strategies. Where other areas are more critical, it may be less applicable or prioritized.

28. In your opinion what are the main barriers in the local area that might constrain economic growth? [prompts probably unnecessary]
    a. Problems with K-12 education
    b. Lack of higher education facilities
    c. Loss of young people who migrate to other areas with greater opportunities
    d. Not much for people to do
    e. Large local industries in decline
    f. Difficulty in obtaining skilled workers
    g. High costs of doing business (wages, taxes, utilities, land)
    h. Poor access to technology (computers, telecommunications, skills)

29. Are there problems with more basic infrastructure (sewer/water/roads/utilities) that might prevent broadband from having as much of an effect as it otherwise might?

Snowball Sampling / Conclusion

30. Do you know of anyone else that would be useful for me to talk to – either a provider, community expert, or business in this community?
    a. Could I have their contact information and use you as a reference?

31. Additional Comments
    b. Here community/business climate informants can elaborate on any of the structured responses, or provide any other information regarding the local industry mix, business climate, economic development strategy, etc..

I've certainly enjoyed talking with you this [morning/afternoon]. Your information has been extremely helpful. As we discussed earlier, all information that identifies you individually or your organization, and any information that you would like to be kept confidential, will remain confidential. If you would like me to send you a copy or link to whatever findings come out of this study, I will be happy to do so.

Telecommunications Service Provider Interview Questions[15]
(DRAFT: 2005-02-11)

ORGANIZATION:	CONTACT PERSON:	PHONE:	E-MAIL:

Introduction

[The Informed Consent process will be the first order of business. During this time, a General Introduction to the research will be provided. Assuming that the informant agrees to all terms and conditions and affirmatively provides his/her informed consent, the interview will proceed.]

I appreciate your willingness to meet with me, and I won't take up much of your time.

Services offered

First, I want to ask you a few questions about the high-bandwidth services you currently provide, and the kinds of customers that subscribe to these services.

32. How long have you been providing telecommunications services in this community?

33. Specifically, what services do you offer?
    a. What is their bandwidth? Upstream / Downstream?

34. How do you allocate bandwidth between upstream and downstream? ***

35. What are the rates that your organization charges for service?
    a. Residential?
    b. Business?

Geographic Extent of coverage

Something you've probably taken into consideration when you built out your network is the geographic distribution of your customer base. It is also important for this study.

36. Where are your different services currently available?
    a. Probe: Can you show me a map? It will remain confidential.

37. In which areas are those services with a high degree of upstream bandwidth available?

[15] NOTE: As the field work progresses, new questions/probes may be added; however, the substance of the interview will not change. Addition of new *themes* to the Guide will not occur without first securing IRB approval.

a. All?
b. Only some? (If so, are the reasons technical or strategic?

38. Are you meeting demand with your current facility, or
    a. Is it underutilized, or
    b. Do you need to expand?
    c. If so, where would you build out to? This will remain confidential. Why? (the presence of High-bandwidth customers?)
39. Do you notice any geographic clustering of high-upstream-bandwidth customers?
    a. In residential neighborhoods? (Suggesting home-based work and telecommuting)
    b. In business districts?

Demand for service in this area

A major debate in the broadband community is whether there is demand for broadband in rural communities, and if so, what are they using the services for? There is a real knowledge gap here in the academic community, and that's why the first-hand impressions of folks like yourself are so important.

40. What is your impression of the demand for broadband services in this community?

41. How many customers do you have?
    a. How many residential?
    b. How many businesses?

42. What sort of businesses and individuals use your advanced services (in terms of UPSTREAM bandwidth) the most?
    a. Probe: What industrial sectors use your advanced services (in terms of UPSTREAM bandwidth) the most?
    b. Probe: Are there any specific businesses that come to mind?
    c. Probe: Could you provide me with a contact person there?

43. What sorts of applications do your customers routinely use their broadband connections for?
    a. Do you know if a number of your customers are content providers?
    b. Do you ever get requests to support advanced applications not supported by your current infrastructure?

The Services' effect on businesses

We've all heard, at one time or another, the assumption that broadband relates to economic development, but it's not well understood just where the connection is. As someone who is familiar with the potential of the technology, as well as the needs of your customers, your insights would be extremely valuable.

44. What positive effects do you think broadband has for the companies that use it?
    a. Probe:
        i. Productivity increases,
        ii. cost savings,
        iii. e-Commerce,
        iv. telecommuting,
        v. new markets,
        vi. internal communication, etc.

45. Do you think that broadband is important for economic development?
    a. Specifically, What impact do you think broadband has on the economic development of this community?
    b. What is its importance relative to other factors?
        i. industry mix
        ii. entrepreneurial culture
        iii. innovation climate
        iv. existing infrastructure
        v. social, political, cultural attributes
        vi. etc…[add more from community interviews if applicable]

Snowball Sampling / Conclusion

46. Do you know of anyone else that would be useful for me to talk to – either a provider, community expert, or business in this community?
    a. Could I have their contact information and use you as a reference?

47. Additional Comments
    c. Here service providers can elaborate on any of the structured responses, or provide any other information regarding their Internet service, its location, cost, future plans, relation to development, etc.

I've certainly enjoyed talking with you this [morning/afternoon]. Your information has been extremely helpful. As we discussed earlier, all information that identifies you individually or your organization, and any information that you would like to be kept confidential, will remain confidential. If you would like me to send you a copy or link to whatever findings come out of this study, I will be happy to do so.

Appendix D: The Use of `whois` and `traceroute` for Locating Internet Content Producers

As mentioned in the earlier discussion of validity and reliability, triangulation is one method by which the accounts of interview informants may be corroborated with secondary data. During the interviews, informants were asked whether their website was hosted in-house or by a third party. Overwhelmingly, nearly all the informants were using some form of third-party hosting, which necessitated a re-examination of the Producer Network concept's relevance to the current content provision structure of the commodity Internet.

A rather unique type of secondary data can be brought to bear on the question of *where* a particular Internet content source is physically located. A standard component of UNIX and Linux operating systems are the utility programs `whois`[16] and `traceroute`[17]. The `whois` command takes as input a given Internet domain (example: vt.edu), queries a central database of domain name registrations, and returns a record providing administrative and technical contacts of the party to which the domain is registered. The `traceroute` command takes as input a host name (example: www.vt.edu) and attempts document the path (understood as a series of "hops" through routers) a data packet would take from point A to point B. It is useful in the sense that the final "hop" should, in theory, correspond to the "virtual" location of the website. For a physical location, the `whois` command can be run again against the output of `traceroute`. If the location of the domain registrant and the location of the web server are different, one may assume that the website is hosted off-site by a third party.

The use of these tools (or more correctly, the databases they query) to better understand the Geography of the Internet is certainly not without precedent. (Moss & Townsend, 1997) suggest the use of domain name registrations as a proxy for Internet content production, and Zook (2000), writing for an Economic Geography audience, describes a method for using the `whois` command to retrieve this information. The potential for inaccuracy does exist in this method, however (Tony H. Grubesic, 2002; Tony H. Grubesic & Murray, 2005; Moss & Townsend, 1997; Zook, 2000); for example, domain name records may not be kept up-to-date, the registrant's address may not be the actual site of content production (especially in multi-site corporate operations) and the registrant address may not correspond at all to the location of the web server machine. The former two hazards, while real possibilities, do not preclude the extraction of useful information from a whois database. The later hazard – that `whois` contacts do not always correspond to server locations, can be controlled for by complementing `whois` with `traceroute`, which *does* retrieve server locations.

The following example uses the City of Bristol, VA's official website, which is hosted not locally at City Hall but remotely at the datacenter of the Bristol, VA Utilities Board.

---

[16] For a more technical discussion of the WHOIS command, its official documentation may be accessed from any UNIX/Linux command prompt with the command
man whois
or online at http://man.linuxquestions.org/index.php?query=whois&section=0&type=2

[17] For a more technical discussion of the TRACEROUTE command, its official documentation may be accessed from any UNIX/Linux command prompt with the command
man traceroute
or online at http://man.linuxquestions.org/index.php?query=traceroute&section=0&type=2

```
# First, we look up the registration record for the
bristolva.org domain.

ec-linux1 @ /home/sspeery/thesis > whois bristolva.org
[Querying whois.publicinterestregistry.net]
[whois.publicinterestregistry.net]
NOTICE: [OMITTED]

Domain ID:D2713847-LROR
Domain Name:BRISTOLVA.ORG
Created On:10-Dec-1998 05:00:00 UTC
Last Updated On:22-Oct-2004 22:24:35 UTC
Expiration Date:09-Dec-2005 05:00:00 UTC
Sponsoring Registrar:Network Solutions LLC (R63-LROR)
Status:CLIENT TRANSFER PROHIBITED
Registrant ID:26353852-NSI
Registrant Name:City of Bristol Virginia
Registrant Organization:City of Bristol Virginia
Registrant Street1:497 Cumberland Street
Registrant Street2:
Registrant Street3:
Registrant City:Bristol
Registrant State/Province:VA
Registrant Postal Code:24201
Registrant Country:US
Registrant Phone:+1.54064573
Registrant Phone Ext.:
Registrant FAX:
Registrant FAX Ext.:
Registrant Email:bvamgr@3WAVE.COM
Admin ID:26078276-NSI
Admin Name:City of Bristol Virgina
Admin Organization:City of Bristol Virgina
Admin Street1:497 Cumberland Street
Admin Street2:
Admin Street3:
Admin City:Bristol
Admin State/Province:VA
Admin Postal Code:24201
Admin Country:US
Admin Phone:+1.54064573
Admin Phone Ext.:
Admin FAX:
Admin FAX Ext.:
Admin Email:bvamgr@3WAVE.COM
Tech ID:5495603-NSI
Tech Name:Bristol VA Utilities          <<< Note the technical contact is different.
Tech Organization:Bristol VA Utilities
Tech Street1:15022 Lee Highway
Tech Street2:
Tech Street3:
Tech City:Bristol
Tech State/Province:VA
Tech Postal Code:24202
Tech Country:US
Tech Phone:+1.27682161
```

```
Tech Phone Ext.:
Tech FAX:
Tech FAX Ext.:
Tech Email:dns@bvub.com
Name Server:NS1.BVUB.COM
Name Server:NS2.BVUB.COM
Name Server:
Name Server:
Name Server:
Name Server:
Name Server:
Name Server:
Name Server:
Name Server:
Name Server:
Name Server:
```

Next, we attempt to locate the physical server to which this domain is mapped.

```
ec-linux1 @ /home/sspeery/thesis > traceroute www.bristolva.org
traceroute to www.bristolva.org (216.184.64.56), 30 hops max, 38 byte packets
 1  isb-6509-1.vl108.cns.vt.edu (128.173.240.1)  0.485 ms  0.696 ms  0.610 ms
 2  isb-6509-2.vl710.cns.vt.edu (128.173.0.82)  0.580 ms  0.538 ms  0.393 ms
 3  isb-7606-1.ge1-1.cns.vt.edu (192.70.187.198)  0.689 ms  0.656 ms  0.614
ms
 4  atm1-0.11.roa.networkvirginia.net (192.70.187.194)  1.814 ms  1.976 ms
1.851 ms
 5  sl-gw20-rly-2-2.sprintlink.net (160.81.255.1)  10.026 ms  8.202 ms  7.258
ms
 6  sl-bb20-rly-3-2.sprintlink.net (144.232.14.29)  7.969 ms  7.501 ms  7.780
ms
 7  sl-bb26-rly-9-0.sprintlink.net (144.232.7.250)  7.669 ms  7.580 ms  7.627
ms
 8  sl-st21-ash-11-0.sprintlink.net (144.232.20.134)  9.680 ms  9.549 ms
38.033 ms
 9  192.205.32.181 (192.205.32.181)  12.135 ms  12.382 ms  10.296 ms
10  tbr2-p013901.wswdc.ip.att.net (12.123.9.86)  35.500 ms  36.198 ms  35.186
ms
     MPLS Label=32094 CoS=6 TTL=1 S=0
11  tbr1-cl1.attga.ip.att.net (12.122.10.70)  38.495 ms  36.972 ms  37.526 ms
     MPLS Label=32321 CoS=6 TTL=1 S=0
12  gbr6-p20.attga.ip.att.net (12.122.12.26)  24.718 ms  26.793 ms  25.780 ms
     MPLS Label=19 CoS=6 TTL=1 S=0
13  ar2-p3110.chlnc.ip.att.net (12.123.197.49)  33.898 ms  33.664 ms  33.975
ms
14  12.119.42.18 (12.119.42.18)  39.494 ms  39.751 ms  40.163 ms
15  interconnect-86-81.bvunet.net (216.184.86.81)  39.561 ms  39.909 ms
42.496 ms
16  interconnect-86-69.bvunet.net (216.184.86.69)  45.779 ms  42.036 ms
46.334 ms
17  www.bristolva.org (216.184.64.56)  41.871 ms !<10>  43.571 ms !<10>
40.335 ms !<10>
```

```
# Now we translate the IP address of the last hop to a domain
that can be looked up in whois

ec-linux1 @ /home/sspeery/thesis/man_output > nslookup
>
> 216.184.64.56
Server:         198.82.247.98
Address:        198.82.247.98#53

Non-authoritative answer:
56.64.184.216.in-addr.arpa      name = www.bristolva.org.

Authoritative answers can be found from:
64.184.216.in-addr.arpa nameserver = ns2.bvunet.net.
64.184.216.in-addr.arpa nameserver = ns1.bvunet.net.
ns2.bvunet.net  internet address = 216.184.65.4
ns1.bvunet.net  internet address = 216.184.64.2


# So the server is hosted on BVUNET.NET.  We can then do another
WHOIS lookup on that domain to try to pinpoint its physical
location.

ec-linux1 @ /home/sspeery/thesis/man_output > whois bvunet.net
[Querying whois.internic.net]
[Redirected to whois.networksolutions.com]
[Querying whois.networksolutions.com]
[whois.networksolutions.com]
NOTICE AND TERMS OF USE: [OMITTED]

Registrant:
Bristol VA Utilities Board
   15022 Lee Highway
   Bristol, VA 24202
   US

   Domain Name: BVUNET.NET

   Administrative Contact, Technical Contact:
      Administrators, DNS               dnschanges@bvub.com
      BVUOptinet
      15022 Lee Highway
      Bristol, VA 24202
      US
      276-821-6169 fax: 276-821-6240

   Record expires on 30-Sep-2006.
   Record created on 30-Sep-2000.
   Database last updated on 15-Apr-2005 11:48:53 EDT.
```

```
Domain servers in listed order:

NS1.BVUNET.COM                  216.184.64.2
NS2.BVUNET.COM                  216.184.65.4
```

The spatial relationships between hosts on the Internet are made even clearer by the use of a map. Using a program called VisualRoute (http://www.visualroute.com) the graphic below was generated for the same website – the City of Bristol – that was used in the command-line example above. VisualRoute is simply a graphical user interface to the `whois` and `traceroute` commands, with a rudimentary mapping capability. It runs a `traceroute` to the destination host, and then runs `whois` on each "hop" – as seen in the table below. In the command-line example, `whois` was only run against target domain itself and against whatever domain was determined to be the last reachable hop[18]. The intermediate "hops" are less meaningful than the endpoints, however, since a data packet may take any one of multiple routes between its source and destination. The purpose of using `traceroute` is to attempt to discover (or at least get close to) the location of the physical server that a website resides on, so that this location can then be compared to the known location of the website's owner – presumably the "producer" of content for that website. The analysis reveals that in a majority of cases, the site of content production and the site of content distribution over the network are not one and the same. This is a crucial observation, with profound implications for the construction of theory based on the data collected during the course of this study.

[18] There are several potential inaccuracies to this method; since 1) the architecture of the Internet is such that a data packet can travel more than one physical path to its destination, and 2) routers may block the type of traffic that `traceroute` uses to calculate its route, thus preventing us from "seeing" past a certain point.

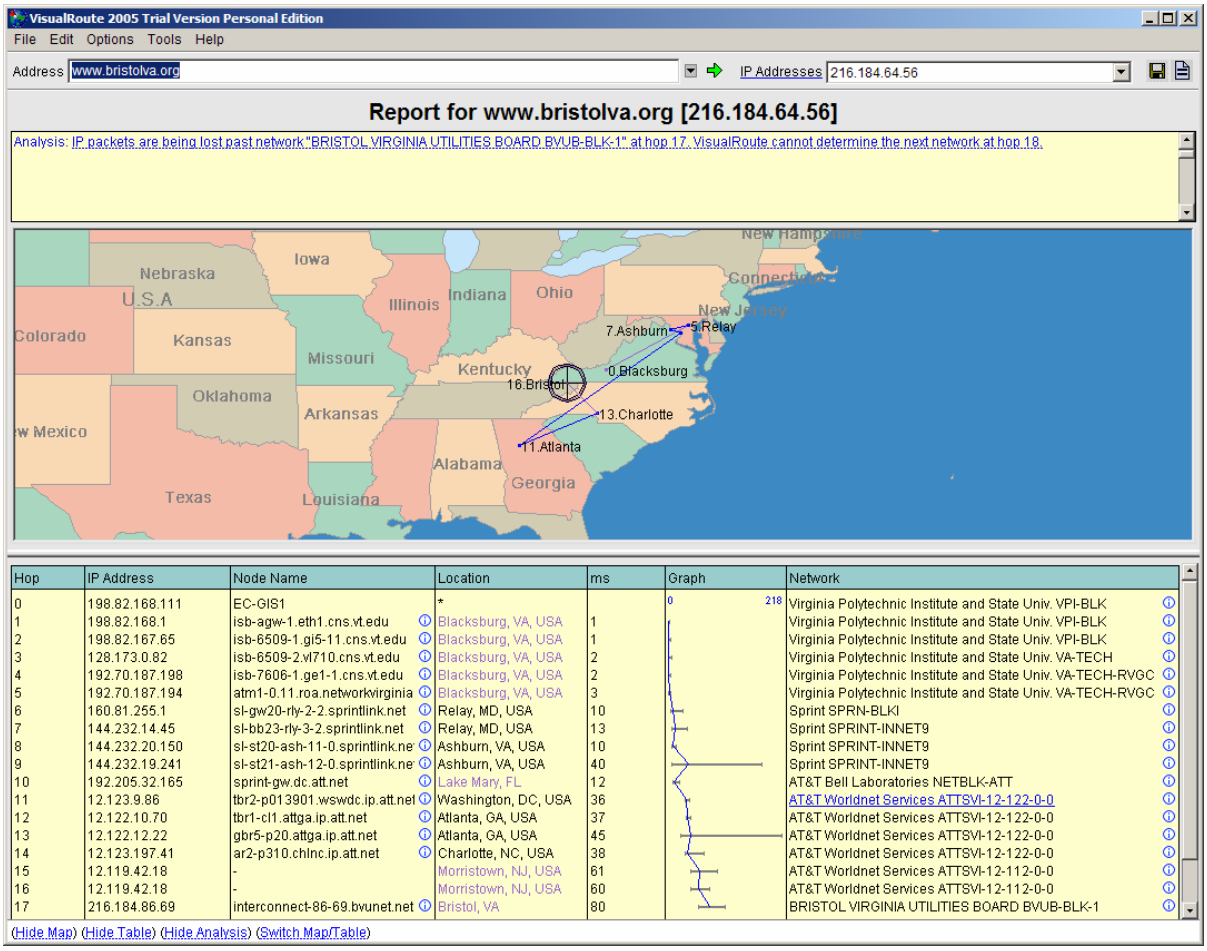

Figure 6: VisualRoute output

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Author Bio

Seth Peery
sspeery@vt.edu

Mr. Peery was born on June 5, 1981 in Tazewell, VA. A lifelong native of Southwest Virginia, he grew up in the rural community of Burke's Garden. He holds two bachelor's degrees with Honors from Radford University, which he completed in May of 2003. His major fields of study were Computer Science and Political Science, and he also took minors in Economics and Mathematics. If you're reading this, he holds a Master of Public and International Affairs degree from the Department of Urban Affairs and Planning at Virginia Tech, with a concentration in Information Technology in Society.

Mr. Peery is currently employed as a research assistant for the Virginia Tech eCorridors Program (http://www.ecorridors.vt.edu), an outreach organization reporting to the Vice President for Information Technology whose mission is to promote rural competitiveness through the deployment of advanced telecommunications infrastructure. Much of his work in this capacity has centered around the application of Geographic Information Systems (GIS) to community telecommunications planning, and he has given a number of conference presentations on this topic. He has conducted in-depth research on the legal and regulatory issues pertaining to municipal telecommunication in Virginia, and has assisted in the evaluation of the technical merits of proposed community broadband deployments. He serves as an advisory member of the Telecommunications Committee of the New River Valley Planning District Commission.

Mr. Peery has previously worked for the Virginia Electronic Commerce Technology Center (VECTEC) as both a full-time staff member and part-time consultant, and has assisted communities in Southwest Virginia with the development of Technology Master Plans. He has also worked as a Teaching Assistant in the Department of Computer Science at Radford University, and as an Intern in the Office of Economic Development in Tazewell County, VA.