Broadband in Carroll County, MD: A Review of the Market, Products, and Services

March 2007

Prepared by
Columbia Telecommunications Corporation
5550 Sterrett Place
Columbia, MD 21044
www.internetCTC.com

Table of Contents

1. Introduction 1

2. Broadband Assessment by Market and Technology 4

2.1 The County and the Nation Lack Competition in Provision of Broadband "Pipe" 4

2.2 Existing Networks Do Not Meet All Broadband Needs 5

The Cable Company: Comcast 5
The Phone Company: Verizon 6
4G Wireless 6
Satellite 6

3. Broadband Assessment by User Groups 8

3.1 Residential Users 8

3.2 Small Business and Retail Enterprise 8

3.3 Large Business 9

3.4 Local Government 10

4. Broadband Assessment by Service and Product 11

4.1 Voice Services 11

4.2 Video Services 11

4.3 Internet and Data Services for the Residential/Small Business Market 12

Digital Subscriber Line (DSL) 12
Cable Modem Service 13

4.4 Internet and Data Services for the High Capacity Market 13

Availability of Services 13
Illustration of Potential Problems for Business Users 14
Availability of Information 14

5. Broader Industry and Technology Trends 15

5.1 Network Models 15

Regional Networks 15
Metropolitan Area Network 16
First-Mile Technologies 16
Mobile Communications 19

5.2 Technology Trends 20

Telephone Networks 20
Cable Networks 20
Satellite Systems 21
Electric Utility Networks/ Broadband over Power Line 21
Wireless Systems 21

Emerging Technologies 22
Fiber-to-the-Premises 22
Ultra-Wideband 23
Hybrid Connectivity 23

6. The Political Context for County Broadband Efforts 24

7. Business Models and Case Studies for Public Broadband 25

7.1 Community Risk/Community Ownership 25

7.2 Shared Risk/Public Private Partnership 27

8. Recommendations 29

8.1 Consider a Wide Range of Broadband-Enhancing Initiatives 29

8.2 Explore Private-Sector Partnerships for Infrastructure 29

8.3 Conduct Market Research to Complement this Report 30

8.4 Expedite Franchising for New Facilities-Based Providers 30

8.5 Facilitate Communications Between Providers and Consumers 31

8.6 Encourage Communications Planning and Construction for Greenfields and New Development Areas 31

8.7 Determine Feasibility of Public Wireless Strategy 32

8.8 Determine Feasibility of Fiber Strategy to Key Development Zones 33

8.9 Build Fiber and Conduit During Other Infrastructure Work 34

Appendix 1: Table of Services by Community 35

Appendix 2: Map of Estimated Service Coverage 36

Appendix 3: Table of Internet Providers 38

Appendix 4: Table of Residential Broadband Providers 39

Appendix 5: Table of Business Broadband Providers 40

Appendix 6: Table of Performance Capabilities 42

Appendix 7: Framework of Existing Provider Categories 43

1. Introduction

The Carroll County Department of Economic Development has embarked on an effort to determine the availability of broadband products in the County. As part of that effort, Columbia Telecommunications Corporation (CTC) was contracted by the County to perform a study to examine the broadband service products and services currently available to residents, businesses, and government. CTC performed this work in the fall of 2006. This document represents a Report of the results of our findings regarding broadband availability for the following:

- Voice, video, and data services
- High capacity transport services (T1[1] and above) to business and government
- Residential and commercial broadband (cable modem, DSL, wireless) services

The County's efforts in this regard arise from a growing concern that there is insufficient broadband infrastructure, competition, and availability in Carroll County. In this, the County is not alone. Local government efforts to deploy or encourage broadband are underway in hundreds of American communities.

Significantly, this interest in greater broadband is not driven by a need for more television channels; on the contrary, the County's goals are far broader: innovation, job growth, economic development, education, and community development. In this, the County also is not alone.[2] Broadband has become such a key resource for workers and students that the United Nations has suggested it be considered a utility akin to water and electricity.

Broadband can facilitate economic development by:

- Enabling small business creation and growth
- Supporting businesses with very high bandwidth needs, such as media and software development
- Attracting and retaining businesses of all sizes
- Enabling workforce education
- Enabling telework, distributed work, and home-based businesses
- Enhancing the County's image and its reputation for pioneering projects
- Promoting major development initiatives such as revitalization zones, technology parks, and bids to attract major employers

[1] T1 is usually defined as a service providing a 1.5 Mbps (megabit per second) committed interface rate (CIR); in other words, with a T1, 1.5 Mbps is available at all times both upstream and downstream.

[2] The calls for greater broadband deployment come from organizations as diverse as the U.S. Chamber of Commerce, AARP, the National Association of Chief Information Officers, and major equipment manufacturers such as Nortel and Cisco--all of whom recognize that the United States' position as a technological and economic leader require networks that enable growth applications such as teleconferencing, telecommuting, and distance learning.

Broadband is not only widely recognized a key driver of future economic competitiveness--it is also regarded as the platform upon which Americans engage in political discourse and activity, the 21st Century equivalent of the town square, printing press, and backyard fence.

But private-sector networks are not meeting this growing demand for bandwidth and speed in an affordable manner. Though there are private-sector fiber-to-the-premises (FTTP) deployments underway in some, limited areas of the United States (including Howard, Anne Arundel, Montgomery, and Prince George's Counties), none is planned or foreseen for Carroll County.[3]

Generally, CTC sees the following broadband issues in Carroll County:

1. Lack of universal availability for small to medium-size business and home-based businesses

2. Lack of affordability for small to medium-size business and home-based businesses

3. Lack of symmetrical speeds for small to medium-size business and home-based businesses

4. Lack of very-high bandwidth offerings for larger businesses

5. Lack of affordability for businesses and institutions with multiple locations

   With respect to all of these issues, unless service providers increase the quality and quantity of offerings, these problems are likely to increase as the need for greater capacity increases.

6. Lack of availability of any broadband product in less densely-populated areas

   A gap of significance is between areas with dense population and those that are more rural. CTC found that outside the County's towns, there is limited or no choice for broadband services with respect to both the residential and business markets.

7. Difficulty of obtaining information regarding available products and pricing

   Many of the existing broadband providers rely on the Internet to provide information on their products and services. Potential customers without Internet access have limited access to information about purchasing choices, a circular problem that illustrates the disadvantages of lack of connectivity.

[3] In the course of this project, CTC analysts spoke with representatives of the major wired broadband providers in Carroll County: Comcast and Verizon. None of these companies currently has plans for deployment of FTTP facilities in the County or even for lesser upgrade of their current networks. Verizon did verify, however, that it is building FTTP in "greenfields" (new development areas) such as the Village of Meadow Creek in Westminster. According to Verizon, its policy is to only build fiber only and not copper to greenfields. All customers in a greenfield area are required to obtain fiber-based services if they want any phone, video, or Internet service from Verizon.

On the bright side, CTC concludes that the availability gap in Carroll County is not dramatic with respect to telephone service or to residential cable television services, even though there is limited or no competition in those areas.

2. Broadband Assessment by Market and Technology

In evaluating the broadband market, it is not sufficient to consider current services and demand -- we must also consider the providers' capacity to improve their networks and products, as well as the providers' commitment to meet expanding needs for performance, mobility, and reliability.

2.1 The County and the Nation Lack Competition in Provision of Broadband "Pipe"

Despite industry protests, it is increasingly apparent that the current American market precludes true broadband competition because of the impracticability of construction of numerous broadband physical networks. While there may be significant competition in provision of programming and services such as voice, email, and video—there is not significant competition in provision of "pipe" -- the infrastructure over which all of those services operate.[4] In a context in which network owners have been permitted by the FCC and the courts to "close" their networks to competition,[5] competitors can reach customers only by building their own facilities—at prohibitive cost that precludes the emergence of multiple competitors. This situation is akin to a scenario in which the national road network is owned by UPS and closed to competitors--in order to provide service, FedEx, DHL and other package deliverers would be forced to build their own network of roads and highways--a prohibitive bar to competition. The result in the communications context is comparable: a broadband monopoly or duopoly of incumbent cable and telephone companies—and not even that in rural or less-populated areas.

Even using this closed model, the incumbents do not plan to build or upgrade their networks in Carroll County. At best, these incumbent providers will move incrementally to expand capacity, but they are constrained in their investment choices by the capital markets, which reward short-term profits and punish long-term investments.

[4] It is important to distinguish between "pipe" and "services." These two distinct categories are frequently lumped together, which is not technically accurate. "Pipe" or "broadband network" refers to the medium over which one sends and receives data (and, increasingly, voice and video) over the Internet or private networks. "Services" are the various types of voice, video, and data transmissions that one can send or receive, such as, for example, Voice over IP from Vonage; email from Yahoo; streaming video from Disney. It is helpful to think of "pipe" using the traditional metaphor of the "Information Superhighway:" envision the services as the cars, trucks, and other vehicles -- and the "pipe" or network as the road over which the vehicles run. Without the road, the cars are useless.

[5] Under recent rulings, the owners of DSL, cable broadband, and FTTP systems have been permitted to close their networks to competitors – a departure from the common carrier rules under which the telephone networks have long operated and under which numerous competitive Internet Service Providers (ISPs) offered service over dial-up modems. As a result, many of these ISPs have ceased to offer Internet service—because they cannot access the distribution networks, at any price.

2.2 Existing Networks Do Not Meet All Broadband Needs

The incumbent communications carriers offer a number of products in parts of Carroll County that meet the FCC's (widely rejected) definition of "broadband" or "high speed." The FCC defines "high-speed" as "connections that deliver services at speeds exceeding 200 kilobits per second (kbps) in at least one direction." The FCC defines "advanced services" as "connections that deliver services at speeds exceeding 200 kbps in both directions."[6]

Even accepting the FCC's definition, it is clear that such speeds present problems for many broadband users -- most mass-market broadband products offer reasonable download speeds but much slower upload speeds. This asymmetry makes it very hard to function adequately from the standpoint of a business or home-office because it is difficult to send large files or conduct video-conferencing. The asymmetry suits the providers because they prefer to sell more expensive products to businesses but these products are usually prohibitively expensive. Asymmetrical speeds are functional only for those consumers who use their broadband connection primarily to download information or watch television.

The networks operated by telephone companies are limited in their technological capabilities.[7] Both the telephone and cable industries are limited in their reach: Comcast serves primarily the residential market and Verizon serves some business and residential areas but is limited by its technology.

The Cable Company: Comcast

Carroll County has one cable television operator: Comcast Cable (until recently, Adelphia) whose "footprint" includes a significant portion of residences in the County. Where it offers service, Comcast offers broadband at speeds defined by the FCC as "high speed."[8] It operates a high-quality, relatively-reliable hybrid fiber/coaxial system that is competitive for today's cable marketplace. Comcast's system, however, has only limited fiber (coaxial cable runs from the node into the home)—and is further limited in less densely-populated areas of the County.

Comcast indicates that the network is upgraded to 750 MHz and no further upgrades are approved at this time. Comcast further states that the company is currently concentrating on correcting "poor system maintenance and documentation" of the previous cable system owner, Adelphia.

---

[6] "Federal Communications Commission Releases Data on High-Speed Services for Internet Access," FCC Website, http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/IAD/hspd0705.pdf, accessed October 3, 2005.

[7] Even advertised speeds may be illusory or inconsistent. The New York Times recently noted that some "customers do not get the maximum promised speed, or anywhere near it, from their cable and digital subscriber line connections. Instead, the phrase 'up to' refers to speeds attainable under ideal conditions, like when a D.S.L. user is near the phone company's central switching office." Matt Richtel and Ken Belson, "Not Always Full Speed Ahead," The New York Times, November 18, 2006.

[8] Data Service greater than 200 kbps.

The cable company traditionally has serviced the residential market and has a very limited footprint with respect to the business areas of the County, as is generally true throughout the United States. Their limited commercial impact has not made an appreciable competitive impact on the availability or price of higher quality and speed broadband products for business.

The Phone Company: Verizon

Verizon is the incumbent local exchange carrier in Carroll County, where it offers Digital Subscriber Line (DSL) services to some portions of the County, particularly in areas surrounding its three central offices in Westminster, Sykesville, and Hampstead. Verizon also leases enhanced circuits to government and businesses at higher prices. Pricing is prohibitive for small and medium-size businesses, if enhanced circuits are even available.

DSL represents a relatively low-bandwidth form of broadband -- a network of roads, not superhighways. DSL does not even have the capabilities of a cable modem network because it is based on lower-bandwidth infrastructure. DSL runs on telephone network copper wires, which simply cannot handle the same capacity as fiber or even of Comcast's hybrid fiber/coaxial (HFC) network. As capacity requirements increase, DSL is likely to fall further behind cable.

The limitations of DSL are demonstrated by the efforts of Verizon to supplement its old copper phone networks with new FTTP networks in limited metropolitan areas, not currently including Carroll County. Verizon is building FTTP networks in many of its service areas around Washington, DC; however, Verizon has not announced plans to build such a network in Carroll County and we doubt such an announcement is likely in the next few years.

4G Wireless

4G is the term applied to promising new broadband wireless technologies. These include technologies with standards developed by working groups of the Institute of Electrical and Electronics Engineers (IEEE) and known by IEEE standards numbers 802.11 (WiFi), 802.16 (WiMAX), and 802.20. 4G also includes new generations of wireless technologies planned by the current cellular providers such as EV-DO and 1xEV-DO.

Many 4G technologies are largely untested as a widespread broadband medium – wireless broadband is a technology still in development.

To our knowledge, there is no major 4G provider serving a substantial part of the Carroll County community.

Satellite

In some rural areas of Carroll County, there is no broadband option other than satellite service, which is costly and cumbersome. Satellite technology has proven itself a competitor for delivery of one-way video and radio, but it is significantly inferior to cable modem or DSL service for Internet and interactive services. Satellite broadband cannot match cable and DSL for bandwidth, it is far more costly, and satellite transmission entails a latency and delay issue that

makes widespread Internet use unlikely utilizing existing technologies. Satellite broadband is also very costly.

The cable television and telephone providers approach to meeting connectivity needs is offering bundled voice, video, and data services over their respective networks. This model constitutes a protective approach designed to maintain old business models. This is not an approach that delivers new connectivity capabilities, provides opportunities to innovative service providers, enhances customer alternatives, or offers choice for residential and business consumers in the community.

3. Broadband Assessment by User Groups

When looking at connectivity, it is important to consider four base user groups—residential, small and retail business, large business, and government. Generally, CTC concludes that none of these user groups is comprehensively served by the current networks and products available in Carroll County.

3.1 Residential Users

Residential users typically fall into one of two groups. The first group demands a wide range of services including; high-performance Internet access, large numbers of focused entertainment channels and one or more telephones. The second group purchases a single service such as basic telephone or a high-speed data connection.

The next generation of users is likely to place high value on speed and portability of the Internet connection. Younger consumers have cellular telephones, no landline telephones, are Internet-literate and often watch time-shifted entertainment using a personal video recorder or IPTV. This generation of users is technical savvy and is not served by the telephone and cable companies "bundled" approach.

Residential services present a business opportunity for those organizations that are able to follow user demand. These organizations are seeing opportunities to provide new Internet-based programming and services. Access to unencumbered, ubiquitous, and affordable broadband is the enabler of this next generation of services.

Increasingly, the line between residential services and small business services is being erased. Home-based small businesses are a rapidly growing segment of the emerging service and information economy.

CTC concludes that this user group is not being sufficiently served by current networks and broadband products. First, many of the less-densely populated areas of the County are not reached by the cable system. Second, DSL has very limited reach in residential areas. Third, satellite and wireless broadband services are costly and only available if a residence is perfectly located to receive the signal. Finally, even those existing networks that do reach residences are not likely to be able to keep up with the growing demands for bandwidth and speed discussed above.

3.2 Small Business and Retail Enterprise

Small businesses and retail enterprises continue to grow as a user community on the Internet. Small businesses provide a direct channel to consumers for the products manufactured by large industries. Small businesses must have access to the Internet to place parts orders, enter warranty information, order materials, and provide financing for purchases—functions that can no longer be performed by fax or hard copy. Small enterprises also depend on email and Web-based access

to larger businesses that provide the manufacturing and logistics functions needed to support modern small business environments.

CTC concludes that this user group is not being sufficiently served by current networks and broadband products in Carroll County. First, the cable network does not reach most of the business areas of the County. Second, DSL products are limited in capability and are only available within a certain distance of Verizon's central offices. Third, as in the case of residential use, satellite and wireless broadband services are costly and only available if a business is perfectly located to receive the signal. Fourth, even those businesses that lease T1 services may find themselves constrained by the capacity limits of T1 circuits. Finally, higher-end products are extremely costly for a small business if they are even available.

3.3 Large Business

Large businesses have a diverse range of connectivity needs including high capacity circuits to and from key facilities, suppliers, and customers. Large businesses frequently locate near communications facilities that have been developed to serve the needs of government. Recognizing that construction costs level out as additional infrastructure is added, government can work with the private sector to share the cost of linking facilities. Government and large businesses share many of the same needs, including linking nearby facilities to support voice, video and data services at high-speed.

Large businesses have unique needs that may influence communication within the community. For example, the work-at-home trend drives the need for high-speed services to residences. Employees need telephone access, a computer and high-speed, always-on networking to meet the needs of the current business model. Work-at-home is a growing trend as employees balance the needs of their professional life with the time they dedicate to family and outside interests. Benefits for businesses include a reduction in overhead expenses because of the smaller facility requirements when more employees work offsite.

Traveling employees also need to be able to communicate from remote sites. Areas of the city and county that support the lodging industry need to provide traveling professionals with access to high-speed Internet to give travelers access to email and business information. The lodging industry is recognizing this need as travelers increasingly consider the availability of Internet access when choosing where to stay.

CTC concludes that this user group is in the same position as high-volume users in non-metropolitan areas throughout the country. High-capacity circuits may not be available and are likely to be extremely costly. Obtaining adequate circuits can cost hundreds of thousands of dollars if the phone company does not have fiber anywhere near the location to be served. The same problems mentioned above also impact large businesses with home-based or distributed workers.

3.4 Local Government

Municipal and county governments are seeing increased needs for bandwidth. The future will require adopting new ways of communicating within and among government units and to the public in order to meet the changing needs of the community. New applications and communications technology will allow government to be more responsive and efficient. New technologies, such as Internet Protocol (IP) based telephony and video can decrease costs while increasing functionality and security.

A growing issue within public safety and public works groups is the need for mobile networks that permit high-speed access to city and county databases. Public safety organizations are using these links to allow employees to submit reports, send and receive email, and access database information from the field. Public works agencies can perform many of the same functions as well as access Graphical Information System (GIS) data to determine the location of facilities to support construction or repair activities.

Carroll County is currently implementing a government fiber optic network known as the Carroll County Public Network (CCPN). As of this writing, the County has awarded a contract for project management and network operations management of the network. The network is intended to enable County and municipal users to use communications services over high-capacity, County-owned fiber optics.

4. Broadband Assessment by Service and Product

In general, the most stark communications gaps in Carroll County do not exist in the areas of traditional telephone or cable television services. Rather, the most significant gaps relate to high-speed data services--the availability and affordability of broadband products for small to medium-size business, home-based businesses, and businesses and institutions with multiple locations in Carroll County. In the medium and certainly the long-term, the connectivity deficiency is likely to increase as the need for greater capacity continues to escalate.

4.1 Voice Services

When examining local telephone service available for residential and business users, CTC found a few options that are dependent upon the user's preference – wireline, wireless, or Internet Protocol (IP) based.

- Verizon is the incumbent local telephone company in Carroll County for residential and business telephone services. Verizon does not publish its local telephone numbers in the local Carroll County Black Book telephone directory.

- CloseCall America also offers service but is also not listed in the local telephone directory. They market primarily on the Internet (www.closecall.com/local).

- Cavalier Business Communications is a competitive local exchange carrier (CLEC) that offers services ranging from unlimited local calling plans to Voice over IP (VoIP) (www.cavtel.com/business). In Carroll County, the company offers business service only and does not offer residential services.

- The County has a number of large wireless telephone providers (Verizon Wireless, Cingular, and Sprint/Nextel) but wireless coverage and signal strength vary throughout Carroll County. Wireless telephone coverage is sufficient within the larger population centers (including Westminster, but tends to decrease in signal strength and coverage as one moves farther away from a city or town. Some of the rural areas between cities and towns in Carroll County have no coverage.

- Voice over Internet Protocol (VoIP) is available from one facilities-based provider, Comcast, and over the Internet from web-based providers such as Vonage and Skype for those who have Internet connections fast enough to support VoIP. In this way, VoIP is a service that depends on data connectivity, not traditional voice connectivity.

4.2 Video Services

CTC does not believe there exist significant gaps in one-way video (television) services that have traditionally been offered over the air by broadcasters or by cable companies. In brief summary, the following video services providers are available to residents and businesses in Carroll County:

- Comcast offers cable television services
- DirecTV and Dish Network offer satellite video services
- Verizon Wireless and Cingular offer limited video services over wireless broadband to their customers in select areas where there is coverage available

4.3 Internet and Data Services for the Residential/Small Business Market

Carroll County residents and businesses have limited options for data connectivity depending on the speed and capability that is sought. As residential and business needs grow, the demand for broadband and high capacity transport services will increase and the gap between need and availability is likely to widen.[9]

The options for high-speed Internet access for residents and businesses may include Digital Subscriber Line (DSL), cable modem, wireless, and satellite, but are dependent upon location and speed.

Digital Subscriber Line (DSL)

There are availability gaps for DSL residential and business service as a result of a number of limiting physical/technical factors. First, DSL's availability is distance sensitive from the central office or DSLAM facilities (18,000 feet) of the phone company. In Carroll County, Verizon's central offices equipped for DSL are located in Westminster, Sykesville, and Hampstead. Customers in communities such as Daniels, Keymar, Millers, and others further away are not likely have access to DSL services. Provider AT&T also offers limited DSL services in the County.

Second, the phone company's DSL efforts are typically directed towards industrial parks and business locations. This practice often leaves residences without a DSL option even if they are in a DSL-capable area.

Third, existing DSL circuits may be tapped out. For example, a potential customer could be in an area where the provider initially indicates that DSL service is offered. After further research, however the provider determines that DSL service is not available at the location because of a quality problem or because all the DSL capacity in the area is already allocated.

[9] Of course, dial-up is still an option for Internet connectivity but it is increasingly inadequate to meet even the simplest connectivity needs. Dial-up Internet access is still subject to the FCC's common carriage rules (unlike broadband products, even those offered over the same phone lines) and, as a result, there are a number of local and national based dial-up Internet providers in and around Carroll County. The dial-up service options depend on the availability of local access numbers and range in price from $10 to $25 per month.

Cable Modem Service

There also exist availability gaps for cable modem service, generally as a result of cable's traditional footprint in residential – not business – areas. Historically, cable systems offered one-way video/television products, a service that is generally used in the home, not in the workplace. As a result, cable systems tend to be in residential areas even though cable companies now offer voice and data products for which a high demand exists in the business community.

Another gap arises from the suburban/rural divide in Carroll County. As is the case with DSL, cable modem services tend to be available in cities, towns, and areas of concentrated housing development. Comcast provides residential (and some small business) cable modem services to the cities and towns in Carroll County; however, some of the rural areas between and further outside the municipalities are not served. [10]

4.4 Internet and Data Services for the High Capacity Market

High capacity transport services are available for some large business users in Carroll County on a case-by-case basis. There are four providers of services such as T1, T3/DS3, Frame Relay, Ethernet/Point-to-Point, and OC3 in Carroll County. These providers are AT&T, Cavalier, Teltek, and Verizon.

Availability of Services

There are large differences in the availability of high capacity transport services (T1 and above) for larger business users from one city or town to the next and the rural areas in Carroll County. The providers are less likely to provide blanket pricing and availability statements and treat each potential customer based on individual needs.

The availability of these services is typically dependent upon the requested speed and distance from either a central office (for services such as T1 and T3/DS3) or a point of presence (POP) (for services such as Frame Relay, Ethernet/Point-to-Point, and OC3). According to Verizon, the two closest POPs for Carroll County are located in Baltimore and Frederick. If a community is located a distance from the POP they are less likely to be able to obtain T3/DS3 or higher capacity services (unless they are willing to pay exorbitant costs to cover fiber construction to their locations). As a result, large business-users in areas such as Manchester and Hampstead will likely find it more difficult and more expensive to obtain high capacity services.[11]

---

[10] Comcast representatives and Candy Humphrey (Director of Comcast Government and Public Affairs for Greater Baltimore) indicate that cable modem service is currently available within portions of all of the cities and towns in the County. She indicated she requested that the Comcast technical staff review the previous Adelphia system maps to determine cable modem service availability in the cities and towns. CTC recommends that the County formally request this data so as to maximize the chances of receiving it.[10]

[11] This data can be supplemented if Verizon were to share with the County a fiber map that would assist in determining where there is availability. In a similar process, Verizon was willing to do this in Montgomery County. We recommend that that the County initiate the request to Verizon.

Representatives of AT&T report that they have several network POPs throughout Carroll County and can therefore provide T1 and above services to all of the communities in the County.

Illustration of Potential Problems for Business Users

Internal business networks (such as those among campuses or within a building) typically operate with either a 100 Mbps or 1 Gbps local area networks. The service provider's network imposes a capacity bottleneck by forcing the businesses to connect 100 Mbps and 1 Gbps Local Area Networks (LANs) together with 1.5 Mbps circuits. To visualize this problem, imagine connecting the Baltimore and Washington Beltways with a gravel road rather than I-95.

Business such as medical facilities, biotech firms, and educational institutions require high capacity connections to transmit large files containing medical or other graphic images or to conduct meetings and training using remote conferencing. The network to support these needs is not universally available in Carroll County.

Capacity limits imposed by cable modems and T1 devices are often limiting factors for large data users. As the data needs increase, the speed limits of the available services may constrain the ability of some entities to use needed applications. For example, design companies may not be able to send maps to customers or collaborators, or may avoid locating in Carroll County. Clinics may be precluded from sending X-Rays or medical charts electronically to labs or hospitals. Residents may be severely limited in how they can telecommute from the County.

Availability of Information

The existing broadband providers follow a wide variety of procedures with large users who inquire about products and services. Verizon and AT&T handle inquiries and requests for information on services above the T1 level on an individual case-by-case basis. Verizon has a sales representative call the potential customer back to discuss specific needs. AT&T typically requests that a company profile and Dunn & Bradstreet number are provided prior to discussing specific needs.

5. Broader Industry and Technology Trends

This Section presents a broad overview of key communications networks and evolving technologies.

5.1 Network Models

Communications technology models vary by geographic scale and the services that are supported. Technologies that provide support for the first-mile[12] link may not be appropriate systems for a regional network. Here, we cover four network models: Regional, Metropolitan Area, First-Mile, and Mobile.

Regional Networks

Regional networks transport a wide variety of traffic types within a specific geographic area. The traffic may be voice, data, and various forms of video for transport or distribution. Two common examples include moving aggregated voice traffic between telephone central offices and moving video entertainment traffic from a satellite receiving station to distribution points in local cities. More recently, regional networks have been planned to support communications and monitoring devices which have become necessary for homeland security (a major region-wide initiative is underway in the Washington, DC metropolitan area). Large businesses or organizations might also have more creative uses, including data center redundancy, links between hospitals to support telemedicine, and links between universities to support distance learning and research efforts.

The most common transport supporting these types of links is based on Synchronous Optical Network (SONET) technology. Developed by the telephone companies to transport a wide range of voice and data traffic, SONET links cities in the U.S. and the continents of the world. As Ethernet-based alternatives continue to evolve, however, the use of SONET is on the decline. On a smaller regional scale, other technologies may be more cost effective. The declining cost of fiber optic cable and new technologies such as Dense Wavelength Division Multiplexing (DWDM) and high-speed Ethernet are opening up a range of opportunities for cities and counties.

Large organizations, such as government, large businesses, educational institutions and hospitals, see great value in the use of dark fiber.[13] Access to raw fiber between locations provides nearly unlimited bandwidth. Increasingly, these organizations are working together to build fiber optic infrastructure between their locations using a cooperative approach. One example is the CANARIE[14] network that links business, education, and government organizations throughout

[12] A portion of the network that connects to the end user (home or business).

[13] Dark Fiber: Fiber strands that are sold or leased without the accompanying transmission service. Customers are required to put their own electronics and signals on the fiber.

[14] See the Canarie Website for details on the organization at www.canarie.ca. CANARIE is Canada's advanced Internet development organization.

Canada and select locations in the US. Each organization has partial ownership of the fiber system, a condominium approach that provides dark fiber between locations. Other organizations have established similar models that provide dark fiber to the public on a wholesale or open-access basis.

Another significant regional network is the Los Angeles Optical Network, in which 300 miles of fiber is offered to the public on a wholesale basis. Various technologies are used to support their customers including SONET, DWDM, fiber-based Ethernet with link speeds up to one gigabit, and dark fiber to customers that want to manage their own network.

Metropolitan Area Network

The Metropolitan Area Network, or MAN, is a smaller, community-oriented version of a regional network. These networks aggregate the demand from government, education and business to build a network that links key locations in the city. The networks have a variety of characteristics that meet the needs of the local organizations. Each participant has a business goal that makes participation in the network an economic benefit. Common reasons to create a MAN include increased need for bandwidth, telephone bypass between buildings, decreased long-term costs, and increased security.

The technologies used in the core of these networks are similar to those used in a regional network, including fiber optic–based technologies such as SONET, DWDM, and Gigabit Ethernet. At the edges of network connectivity, using wireless and various types of copper and fiber-based links is more tactical. Access to the edge of the network is based on the individual goals of the user community.

One example of a MAN is the proposed Warren County, PA project, which is based on aggregated demand for voice and data services by the city, schools, libraries, public safety, and transportation agencies that serve the residents of the county.

First-Mile Technologies

First-mile technologies link a business or home owner to a nearby point of concentration, or hub. The nature of the link depends on population density, historical demand profiles and range of commercial service providers. The most common link is based on unshielded twisted pair cable (UTP) that has been installed by the telephone company. Coaxial cable that supports cable television is also common in many residential areas near cities. First-mile media is experiencing an evolution with new products and services available on existing UTP and coaxial systems and new ways for customers to use fiber optics and wireless technologies.

- *Unshielded twisted pair (UTP):* New technologies are extending the functionality of existing UTP and coaxial cable plants. Organizations have used UTP for the last 75 years to support voice communications and some low-speed data links. The creation of Digital Subscriber Line (xDSL) technologies allows voice conversation to share the UTP link with a high-speed, always-on data link. Hybrid Fiber Coaxial (HFC) systems have similarly impacted cable television providers—addition of fiber optics to cable plants has

reduced complexity, increased bandwidth and increased system reliability. Use of an HFC system, cable modem and cable-based telephone technologies expand services beyond entertainment for cable companies.

- *Fiber and UTP hybrids*: In areas with existing copper-based connectivity, some organizations use a Fiber-to-the-curb (FTTC) approach with modifications to existing systems to develop a hybrid cable plant that incorporates fiber. Typically fiber is run from the central office to the transition point, or local hub point, where the cabling system begins to diverge to serve individual customers. Active technologies are placed at the local hub to provide voice and broadband services over the shorter segment of UTP that runs to each user location. This is similar to an HFC approach in a cable television cable plant. The fiber eliminates long runs of UTP, improving signal quality and network reliability. Fiber installation is often coupled with an increase in local bandwidth to provide the additional capacity to support services such as telephone and high-speed Internet.

- *Fiber-to-the-Premises (FTTP):* Newer, all-fiber optic systems are expanding the capabilities of systems in the first-mile. New construction in greenfield[15] areas is the first to see fiber optic technology in the first-mile connection. Both FTTC and FTTP incorporate fiber optics to bring high-bandwidth capability into the first-mile connection. FTTC eliminates the need for large bundles of UTP running to the central office. The UTP in the link is relatively short and makes it possible to support multiple services such as telephone, Internet and video on demand. FTTP goes a step further by taking fiber directly into homes.

  FTTP provides multiple fibers to premises capable of supporting a full range of current services (such as cable television, telephone and Internet), along with capacity for new services that will be created in the future. The key to a fully fiber optic system is cost. FTTP will slowly be adopted until the cost of a cable plant installation is equal to the cost of building an FTTC or HFC-based system. Another factor to consider is the total cost of ownership. "The cost of maintaining an FTTP network is far less—perhaps as much as four to eight times—than the maintenance costs for HFC,"16 according to an initial study by Wave7 Optics, a vendor of FTTP systems.

  Many of the FTTP systems are in new areas of a city where copper cable was not present. With the proper mix of businesses, multi-dwelling units and residential properties, the per-drop cost of a FTTP system approaches that of other competitive technologies. The long life and high bandwidth of the fiber optic–based system tips the decision in favor of this technology.

- *Wireless:* Emerging technologies also include wireless systems. Two systems being used for wireless links include those based on the IEEE standard 802.11, also called WiFi, and

[15] No existing infrastructure.
[16] See http://www.cedmagazine.com/ced/2004/0304/03a.htm.

the emerging IEEE standard 802.16, also called WiMax. WiFi-based systems provide high-speed links over distances of about 300 feet as an alternative to cabling in homes and businesses. Emerging WiMax systems are oriented more toward last-mile connections between an access point on a high-speed network and the surrounding user community within a five-mile radius. With changes to antennas, the WiFi systems provide longer links between buildings or last-mile links in a small communities, though they have not been optimized to effectively support these types of environments. These two wireless approaches can be used together, with WiMax providing the last-mile link and a WiFi system providing low-cost local access.

Not uncommonly, businesses use WiFi units to create local "hotspots," or locations where the public can obtain wireless access to the Internet. Hotspots are commonly found at airports, restaurants, hotels, public spaces and similar locations that are accessible to the public. Table 1 presents a comparison of these technologies.

Table 1: Wireless Technology Characteristics

Technology	Distance	Data Rate (Throughput)	Interference
Ultra-wideband (emerging)	30 feet	480 Mbps	Walls
802.11 WiFi	300 feet	4 to 10 Mbps	Trees and buildings
802.16 WiMax (emerging)	30,000+ feet	60 users at 1.5 Mbps	Trees and structures
Proprietary	10 to 25,000 feet	3 to 24 Mbps	Trees and structures

A number of manufacturers that provide last-mile support offer proprietary wireless systems (those not based on IEEE standards). In many cases, IEEE standards evolve from the technologies these manufacturers develop. Current systems can support the last-mile link, providing a variety of ranges, interfaces, modulation schemes, and speeds. None of the systems, however, will interoperate with other manufacturers' equipment. These proprietary systems can be expected to move toward standards compliance as standards are approved and adopted. Because proprietary systems will be replaced by standards-compliant equipment in future, they should not be considered to be long-term solutions.

Emerging ultra-wideband wireless approaches promise the ability to deliver high bandwidth by using smart, low-power radios. The ultra-wideband approach—approved by the FCC as demonstration technology—will use frequencies that are licensed for other uses but are not being used during a particular time or at a particular location. As this approach becomes practical, another evolution in wireless technology may take place.

- *Demand for broadband in the last-mile:* Products and services that may influence the nature of the first-mile link include increasing demands for high-speed Internet, declines in the demand for landline-based telephones, the trend toward increasingly focused

entertainment, and a more technically savvy and selective consumer. Consumers who are Internet-savvy are already dissatisfied with the performance of dial-up Internet access. This emerging consumer group may drive up the demand for broadband-based access and change the demand for other types of services. For example, the cellular telephone, along with broadband Internet access and technologies such as IP telephony, is decreasing the demand for landline-based telephone service. Students and single adults increasingly depend on the cellular telephone as their primary means of communication. Similarly, many younger adults spend increasing amounts of time on personal computers (PCs) for entertainment focused on programming of interest. The increasing popularity of personal video recorders (PVRs) allows entertainment to be time shifted. Sony has started providing download content over satellite-based services that might lead to other types of entertainment downloaded to PVRs in the future.

As these consumer trends escalate, the significance of wireless first-mile links will increase.

Mobile Communications

Mobile communications are supported in two areas: (1) private systems that cities and counties build to support police and fire and (2) cellular telephone-based systems that support the general public. The needs of these two groups, however, are significantly different.

Municipal organizations need mobile support within a defined geographic area. These systems are predominately text-based and use specialized equipment that communicates on licensed frequencies. Government's need to access diverse forms of data is increasing to meet the needs of a growing user population. The growth of Geographic Information Systems (GIS) with Web-based interfaces is also expanding the user population. For example, public safety agencies use a GIS to note the existence of hazardous chemicals, and public works agencies use maps of water, sewer, and lighting systems. Public employees who use laptops also need access to this data. New wireless systems running in the 900 MHz and 2400 MHz band have been designed to provide high-speeds (about 1 Mbps) that support access in a moving vehicle with minimal interference from foliage and buildings. Many municipalities are using commercial cellular technology as a connectivity tool. It is important to note that commercial cellular based services may not be appropriate in all cases as the service may become unpredictable and unreliable during an emergency situation.

The general public has different needs, which they access through cellular telephone providers that incorporate features such as text messaging, email and Internet access into the new generations of cellular telephones. These features, along with nationwide service, make the cellular telephone a key tool of business users. The five major cellular telephone companies are building new and faster networks that incorporate higher speed data services. Higher speed service through a cellular telephone delivers about 30 to 75 Kbps, and some providers claim even faster speeds. Cellular telephone technology is now being combined with Personal Data Assistants (PDAs) such as the Palm Pilot and BlackBerry; this combination technology is likely to be one source for collecting and distributing business-related data in the future.

5.2 Technology Trends

The latest developments in technology have radically altered the Wide Area Network environment with the addition of multiple types of technology at a wide variety of price points. Only ten years ago, T-1 and dial-up links were the only ubiquitous methods of connectivity for business and home user communities. This section provides a brief overview of the variety of connectivity technologies now available to connect individuals to the world.

Telephone Networks

Connectivity technology offered by the telephone company has moved from high-priced, leased T-1 links to more affordable DSL links. Telephone companies have reduced pricing on most services and increased the mix of services offered. For example, a T-1 line that recently cost over $1,000 might now cost as little as $100 when purchased in quantity. DSL-based links can now share a line with voice traffic or, in dedicated mode, provide data throughput exceeding that of a T-1 line.

To support DSL users, telephone companies are adding fiber optics into distribution networks to reduce the length of copper cable between a central office and its satellite premises. As the length of the copper link is reduced toward 4,000 feet, the speed of DSL links can be increased, approaching 20 Mbps. Fiber optic infrastructure upgrades also improve the reliability of the network so that companies can offer additional services to their customers. In some faster growing communities not enough copper pairs are available impacting the deployment of DSL throughout the community.

In the new environment, telephone companies must cope with a changed competitive landscape. A range of providers and technologies threaten to reduce the dominance of telephone companies in voice and data services. Cable, wireless, and satellite companies are attempting to provide products at price points that compete directly with telephone companies' voice and data services. These market-based pressures reduce the ability of telephone companies to improve their network as described above. Although telephone companies continue to maintain their leadership in the business community, many home users are severing their link with the telephone company in favor of the cable and cellular telephone providers. This early decline in the number of lines leased has made some telephone providers reluctant to invest in fiber optic infrastructure upgrades.

Cable Networks

Cable television companies have implemented the newest connectivity technology to make great improvements in their systems. Over the past five years a large percentage of cable companies have added fiber optic technology, increasing reliability, increasing bandwidth and expanding services offered. Modern cable companies now provide more than 70 analog channels of video, hundreds of digital video channels, DVD-quality music, video on demand, voice telephone, and high-speed Internet access. New services such as personal video recording when combined with video on demand services will significantly change how customers receive and use cable entertainment services.

As a result of upgrades to cable company infrastructure and increases in the mix of services, residential users now consider cable modems and the services of local cable companies to be the high-performance connectivity solution of choice. High-speed Internet access and telephone service from the cable company are now becoming common in addition to traditional video-oriented services. This is likely to continue as consumers begin to adopt new Voice over Internet Protocol (VoIP) services offered by Internet and cellular-based providers. The combination of bundled voice, video, and data services will present a significant competitive challenge to existing voice and satellite providers.

Cable television companies, however, have serious customer service and image perception issues. Most consumers see cable television providers as high priced for the value delivered.

Satellite Systems

High-speed Internet service is available from satellite companies, such as DirecTV, at speeds similar to DSL links (although pricing is slightly higher). These services are a reasonable alternative for rural users who cannot obtain service from any other vendor. With a nationwide footprint for services, satellite-based connectivity technology has a substantial potential market. Upfront equipment costs, latency induced by distance to the satellite, and little meaningful marketing activity, however, make high-speed satellite-based connectivity a slow-growth technology. Satellite providers are therefore also going through a period of consolidation.

Electric Utility Networks/ Broadband over Power Line

Electric utilities are an emerging provider of high-speed connectivity services using broadband power line (BPL) technologies. The substantial existing infrastructure of electric utilities coupled with BPL technologies provides the potential to supply a wide range of connectivity services and makes a very attractive business case for the electric utilities. Combined revenues from providing webcam security, high-speed Internet, automated meter reading, demand management, and other services may help justify installation of the necessary infrastructure upgrades for BPL.

BPL technology is still in the pilot stage, however, with unresolved questions about interference. A high frequency signal in the range of 2 to 30 MHz is transmitted through an unshielded cable, which can result in significant radio interference. The debate is not whether noise or interference is created but how far away from the BPL device interference will be seen and whether it will leave an RF band or channel inoperable. The Federal Communications Commission (FCC) has responded by proposing rules that would require a BPL operator to cease operation or modify its equipment if it were found to interfere with another user.

Wireless Systems

Fixed wireless, Local Area Network (LAN)–based wireless used in the external environment, and mobile wireless (mainly cellular telephone–oriented systems) will continue to revolutionize the way businesses and their customers communicate.

Fixed wireless systems continue to expand at a rapid pace, and prices have dropped on the most common 802.11 WiFi systems to the extent that an access point costs under $40 and an interface card costs $20. We anticipate similar price performance trends for equipment that uses newer fixed wireless standards to provide increased speeds, increased distances, and additional functionality (such as equipment supporting the 802.16 WiMax standard). The early LAN-based wireless systems used by many can be expected to adopt the newer standards-based approach that is optimized for the external environment.

Ultra-wideband technology has entered the design phase, making it possible to support high-bandwidth applications over short distances—such as within the home—without interfering with existing wireless applications. Very low power levels and the sensing of "available" and "busy" frequencies allows for a large dynamic bandwidth able to support very high data rates.

Cellular telephone providers are beginning to implement connectivity technology, allowing for data transfer at higher speeds. The five largest vendors are implementing mobile, data-oriented networks that will provide Internet connectivity comparable to the fastest current dial-up connections (at throughput rates of about 50 to 100 Kbps). At least one vendor has begun implementing a service that offers throughput in the range of 300 to 400 Kbps. This will be followed by equipment supporting the proposed 802.20 standard for mobile communications. End user equipment can be expected to support multiple fixed and mobile approaches to connectivity, providing the greatest speed based on the services it senses at a particular location.

Emerging Technologies

A range of hybrid technologies in the early stages of development will provide more bandwidth for both fixed and mobile environments and will provide greater bandwidth to many users. Fiber-to-the-Premises (FTTP) and new types of wireless connectivity technology may lead to significant changes in the way we communicate. More importantly, the various types of technology are converging toward one ubiquitous, interconnected fabric of seamless communications.

Fiber-to-the-Premises

For permanent links, the cost of fiber optic components and related hardware has decreased to a point where fiber optic connectivity is only marginally more expensive than other technologies for new installations. Some models show that the increased installation cost of an FTTP system is offset by significant maintenance savings when compared to other forms of last-mile connectivity. Increased use of high-capacity fiber-based connectivity technology may make possible the provision of telephone, high-speed Internet, video programming and other services over one fiber link using only two or three fibers to a given location.

Ultra-Wideband

Wireless technology is making great advances in its ability to carry more content with less interference. New ultra-wideband technology provides LAN-like bandwidth over short ranges. When combined with FTTP, this increase in short-range bandwidth can provide broadband connectivity throughout the home without the need to install expensive wires in the walls.

Hybrid Connectivity

Another technological advance is emerging in the form of "smart" connectivity that can detect and use the technology available at various locations. Imagine plugging your laptop into an existing wired network in your office and enjoying a Gigabit Ethernet link. In your car, use the high capacity connection through your cellular telephone adapter. In rural areas outside the range of cellular telephones, use a mobile antenna to connect to a satellite-based high-speed link. At the airport, access the Internet and email using wireless Hotspot at hard-wired speeds. Currently, standards groups in the U.S. and Europe are actively discussing ways to standardize connectivity across technology types and across multiple locations. Necessary adaptations are likely to take place at the device level rather than the network level.

6. The Political Context for County Broadband Efforts

It is important to note that there is no Federal limitation or prohibition on community provision of broadband services. In addition, although some states have enacted outright prohibitions or limitations on municipal telecommunications activities, to our knowledge, Maryland is not among these states.

As the community broadband movement has grown in the past three years, the incumbent communications carriers (particularly telephone and cable companies) have undertaken efforts (through lobbying for regulatory and legislative change and through litigation) to limit or prohibit local efforts to provide communications services.

The incumbent carriers launched major efforts earlier in this decade to achieve Federal and/or state preemption of municipally-owned or operated communications networks. Legislation was introduced in numerous states and in both houses of Congress to limit municipal authority in the area of communications. At its height in 2004, the anti-muni movement reached its apex when Verizon successfully pushed a bill through the Pennsylvania state legislative process that prohibited local broadband efforts in the absence of the *permission* of the local phone company—Verizon itself.

As one commentator has noted, the response to that Pennsylvania law was a national wave of revulsion -- and a marshalling of pro-municipal forces to defeat similar bills in 14 other states where they were offered in the two following legislative sessions.[17] The industry effort to preempt community broadband was widely recognized as anti-competitive and anti-consumer. The environment changed so dramatically since the height of preemption efforts that many of the incumbent carriers are now bidding on (and, in some cases, winning) municipal wireless projects.

In our assessment, the current political climate, both nationally and in Maryland, is highly favorable to local government broadband efforts. There is growing consensus in the US that more broadband is important and that some government intervention may be necessary to stimulate broadband growth. There is also strong support in Congress and even among the public for local broadband initiatives. Perhaps most importantly, private sector carriers and financiers have identified community broadband as a significant opportunity that is of interest for investment. In contrast to the environment of only a few years ago, now is a promising time for local broadband initiatives.

[17] Jim Baller, "Community Broadband Surges Ahead in 2007," Journal of Municipal Telecommunications Policy, Winter 2006, p. 15.

7. Business Models and Case Studies for Public Broadband

This Section offers representative case studies of municipal broadband networks that may be of interest to Carroll County, including discussion of each project's business model. Over the past two years, hundreds of community WiFi projects have been initiated and many have received considerable attention. Much of the attention is centered on business models—and on the hopes of many to identify successful and proven business models for community broadband.

But it is important to note that the public broadband movement is in its infancy—and that most of the high profile projects are in the planning phase—they are years away from being fully operational. This uncertainty is not evident if one reads press releases and mass-media articles. Coverage of these projects seldom recognizes that each community develops its own, particularized model to meet its own needs—and that neither the models nor the desired outcome are the same with respect to each project. Each municipal effort is unique and, ideally, uses a business plan that is tailored to its community's specific needs.

The choice of business model may be the most crucial decision for any broadband project because the choice of whether to own the network affects the cash outlay and risk (and potentially the reward) for each community. This issue of ownership is the key issue in business model development and suggests the two general business models (each of which has numerous variations) that can be summarized as follows:

7.1 Community Risk/Community Ownership

In this model, the community owns the network and conducts operations itself or contracts out operations/management/maintenance to a private sector company. This model gives the community control over such issues as pricing, technology choice, and access, as well as maintaining the community's control over the facilities to be placed in the public rights of way to build the network.

This model also potentially entails some risk because the community's capital investment may not be recovered through operating revenue. Of course, the community also stands to benefit from any surplus or profits, and can offset capital and operating expenses through savings from migrating internal communications to the network.

Variations on this business model are followed by St. Louis Park, MN; St. Cloud, FL; Corpus Christi, TX; and the potential San Francisco fiber project.[18]

[18] San Francisco has engaged in two public broadband initiatives, one that uses wireless technology in a public/private partnership with Google and Earthlink, and one that would potentially deploy city-owned fiber optics to every home and business in the city. The instigating drivers for both projects was digital inclusion—the need to ensure that all San Franciscans have access to broadband and its benefits—but both projects also acknowledge the key needs for economic development and government communications.

St. Louis Park, MN. St. Louis Park's business model is city ownership. The city has a total commitment of $5.3 million over a five-year period. St. Louis Park's management partner operates the network and pays the city $14 per month per subscriber. The city believes that the revenues from the management partner will pay back the city's investment.

The key motivator for St. Louis Park is economic development and digital inclusion—benefiting citizens and the community as a whole by making affordable broadband available to many residents and businesses that cannot now receive it. To this end, St. Louis Park is deploying a WiFi network that will be operated and maintained by a management partner but owned and directed by the city. To ensure that access is as broad as possible, all radio nodes are solar-powered with battery backup, enabling continued operation during brief and extended power outages (up to five days). For the same reason, the city is building significant fiber optics for backhaul in order to boost the capacity of the network and allow more use and enhanced commercial products (such as 100Mbps or greater speed to selected users).

Saint Cloud, FL. Saint Cloud has deployed a city-wide WiFi network to boost broadband access and facilitate economic development. The city's business model is city-ownership. Saint Cloud invested approximately $2.4 million to deploy a city-owned network. In addition, the city pays annual fees to HP to operate and maintain the network. The city believes residents will spend locally the money they save on communications services, increasing taxes and other city revenues. Saint Cloud feels that these increased revenues will offset the city's investment and operating costs.

Corpus Christi, TX. Corpus Christi represents one of the earliest and largest city-wide wireless broadband projects (it is also one of the few city-wide projects that is already operational). The city initiated this project in 2003 in the course of determining how to improve its meter-reading system—automated meter reading over WiFi was the first application. From there, the project has blossomed to include many other internal city applications as well as a public access component. The network is currently overseen by a nonprofit. Internal city communications are integral to the mission of the network, but that mission is also broader and includes digital inclusion, stimulating competition, and economic development.

San Francisco. San Francisco's fiber project would be the first of its kind for a major American city (significantly, there are numerous municipal fiber-to-the-premises projects in Europe and Asia, as well as in small and rural American communities). The city commissioned a recently-completed feasibility study that recommended incremental deployment of fiber optics in three stages: first, a backbone of fiber to meet internal city needs, including public safety and emergency communications; second, a large pilot of fiber-to-the-premises in the city's development zone that would target key economic development and digital inclusion goals; and third, long-term deployment of fiber-to-the-premises throughout the city. The report recommends that the fiber be owned and maintained by the city—but that the city not provide services—rather, any service provide could contract to use the fiber on a non-discriminatory, "open access" basis. The project is motivated by the city's desire to spread the economic, social, and other benefits of broadband to all citizens and businesses—and to compete globally in an increasingly-digital economy.

7.2 Shared Risk/Public Private Partnership

In this model, the community attempts to share the risk with the private sector by developing a partnership in which the community makes takes some but not all financial risk.

For example, the county may offer free or low-cost access to valuable community assets such as the public right of way, real estate, lamp posts, utility poles, or fiber optics—the risk here is the lost opportunity to use those assets for other purposes, as well as the risk of private sector default or misuse of city property.

A variation of this business model is followed by the San Francisco wireless project. San Francisco's wireless project is still being debated by the Board of Supervisors as of this writing (some policy makers favor a city-owned model). Under the current plan, the city will facilitate access to city assets so that Earthlink and Google may build and own a citywide WiFi network. Google will offer a free tier of service (at 300 kbps symmetrical) and Earthlink will sell higher-speed tiers. The city will receive funding of up to $300,000 per year (depending on Earthlink's sales) to finance digital inclusion projects. The city will also have opportunity to use the network for some internal communications needs.

In another variation of this model, the community may provide the access to assets discuss above, *and* agree to finance the network as an "anchor tenant," providing payment for services but not taking on an ownership role. The risk to the community (in addition to those discussed above) is that the services may not meet expectations and the funds may not be well-spent. In the case studies presented below, versions of this business model are followed by Philadelphia and Minneapolis.

Philadelphia, PA. The network is owned by Earthlink and overseen by a nonprofit (in an evolution from city-control). The city has not invested directly in the network though it did assist in funding of the business plan and other planning activities. In addition Philadelphia has agreed to be an anchor tenant, purchasing several million dollars in services over the first five years of operation.

From the first, the Philadelphia planners cited digital inclusion as their motivator and Philadelphia has selected and published eligibility requirements for reduced cost service for certain residents (the criteria are listed at www.wirelessphiladelphia.org). Philadelphia is evaluating using network revenues to assist education, training, and equipment digital inclusion efforts. It is important to note that WirelessPhiladelphia has elements of other goals as well—the city explicitly cited economic development and city communications services as key drivers.

Minneapolis, MN. Minneapolis has a payment rather than investment model for its network. The city has guaranteed payments to the network owner/operator, US Internet. The estimated payments are $2.4 million upon contract signing, and $1.3 million each year for 10 years. In return, the city receives access to the network for public safety and internal government communications.

The driver for Minneapolis is public safety. That city is negotiating a wifi network that will serve the public as a nice added benefit to its core interest—a robust, public safety broadband network. Minneapolis plans to serve public safety over a licensed frequency and a proprietary interface–resulting in a high level of security for sensitive, public safety, data transfers. The city's focus on public safety is also clear in its business plan.

It is essential to note that this brief summary cannot replace customized analysis in the context of the community's goals and objectives. Any community's business (and technology) model should turn on the community's goals and objectives.

8. Recommendations

8.1 Consider a Wide Range of Broadband-Enhancing Initiatives

Given the level of interest expressed during the field-work for this project, CTC recommends that Carroll County consider initiatives to encourage a variety of services to support its business, government, and residential users, including:

- Specialty data transport services for government, medical, educational and business ventures
- Low-cost, introductory level wireless products to make broadband more widely available;
- Homeland security and public safety networks
- Dark fiber initiatives, particularly to key development and enterprise areas such as office/technology parks
- Other opportunities that optimize the connectivity infrastructure currently deployed in the County

CTC recommends that the County consider undertaking a process to determine the interest of the private sector and others in participating in the process of expanding broadband networking throughout (or in select areas of) the County. Detail could be elicited either through a formal information request (such as a Request for Information) or an informal survey and interview process of potential private sector partners. Either of these processes would also enable the County to encourage creative proposals and expressions of interest from a wide variety of potential partners, including financiers, equipment manufacturers, construction firms, systems integrators, Internet Service Providers, and the public.

Among other areas, such a process could elicit such information as:

- Availability in the current market of financing for municipal broadband projects, including potential terms and conditions
- Specific pricing for construction, equipment, and integration services
- Interest in leasing dark fiber on the part of existing and potential service providers, both facilities-based and not, as well as financial parameters
- Public and community group interest in expanded broadband

A few specific potential opportunities are recommended below for evaluation. These should not be considered as the only promising strategies; rather, they are a small subset of the totality of potential projects, but these were specifically identified as particularly promising during the analysis for this Report..

8.2 Explore Private-Sector Partnerships for Infrastructure

CTC recommends exploring a partnership with service providers with existing conduit in the public right of way. For example, the power company generally has significant conduit infrastructure and spare conduit. If the County is able to reach agreement on collaboration with

one of these providers, it may be possible to cost-effectively build County fiber (or fiber shared with the provider) to facilitate access by companies and areas not currently served. The phone and cable companies generally are not open to such arrangements and tend to see them as competitive threats, but the power companies (and other facilities-based providers with fiber or conduit already in the County) may be more open to such collaborative approaches.

8.3 Conduct Market Research to Complement this Report

We recommend following up on the results of this Report with a modest amount of market research of both the residential and business markets. Market data can assist to determine whether the business community and public in the County see a need for broadband and to determine what features they require (such as speeds, throughput, symmetrical service) and what prices they are willing to pay.

We recommend a combination of surveys and interviews to estimate market potential**.** The data gathered in this process can be further leveraged at a later time for marketing purposes—to attract private sector partners that may be interested in this community's market potential.

Our experience suggests that general analysis should focus on discerning patterns and trends. In addition, any subgroups of interest (such as demographic groups) should be individually examined to illuminate areas of similarities and differences. Statistical tests appropriate to the research questions and format of data should be used to identify significant relationships between variables and significant differences between subgroups. Any open-ended responses should be coded and tabulated.

The results will yield qualitative data that can be of significant value.

8.4 Expedite Franchising for New Facilities-Based Providers

Carroll County may consider implementation of a process that expedites the County's process for granting franchises to facilities-based providers to offer video service. This process can include such features as:

- Model Franchise Agreement and Ordinance
- Web-based permit application submission
- Expedited plan and permit review
- Electronic permitting
- Expedited inspections

It is important to note that even such an expedited process may not attract new broadband providers. Generally speaking, the major carriers are not focusing at the current time on jurisdictions with areas of low population density. Verizon, for example, has built some fiber-to-the-premises plant (known as "Fios") in Howard County but has no current plans to enter Carroll County, despite the County's invitations and requests for meetings.

8.5 Facilitate Communications Between Providers and Consumers

It is often difficult for a new customer to locate information on service providers. Local phone books do not provide contact information and the Carroll County Black Book telephone directory has incomplete information regarding existing service providers. [19] If the customer can obtain access to the Internet it can be frustrating to browse through the myriad of provider web sites to obtain local service providers and even more frustrating to compare prices and packages.

The providers prefer to handle each potential customer on a case-by-case basis. Actual service availability locations are considered proprietary information so marketing by location is limited. The actual availability of service relies on the provider's infield testing. To further complicate the matter providers require different information from customers prior to initiating a field test. AT&T requests that the company provide a profile and Dunn & Bradstreet number prior to discussing specific needs.

To ameliorate this problem, Carroll County should consider working with the existing broadband providers to compile, verify and provide the following information to residents and businesses:

- Information on available broadband services over the County website, the Carroll Technology Council's website, and local community websites (potentially through links to the two above)
- Joint consumer education campaigns on providers and services available including printed, web, and video-based messages.

A key part of making these sites useful is to obtain the cooperation of the major providers such as Verizon and Comcast. Both can be approached with a "carrot" strategy that would demonstrate to them the free advertising benefit of these projects. It is in their interest to be able to provide the information on their own services rather than having it provided by a third party so that they can be confident in its accuracy.

8.6 Encourage Communications Planning and Construction for Greenfields and New Development Areas

CTC recommends that communications carriers and developers be encouraged to deploy high-bandwidth communications infrastructure during development of new residential and commercial areas. Developers should be made aware of the high market value and desirability of fiber deployment in the rights of way and structured wiring within buildings. The County should therefore maintain an ongoing project of joint meetings and education opportunities with developers and providers regarding anticipated economic development and residential development in Carroll County. These meetings will also permit the service providers to budget and plan for expansion of their infrastructure.

[19] As of December 2006, Comcast had an incorrect published telephone number in the Carroll County Black Book telephone directory. Verizon does not publish a telephone number for the public to call in the Carroll County Black Book telephone directory.

8.7 Determine Feasibility of Public Wireless Strategy

To address the growing performance gaps, we recommend that Carroll County consider further technology planning by conducting a feasibility study of the potential for a County or municipally-owned broadband network or a private-public partnership to facilitate construction of such a network.

Among other goals, this task can help identify the County's internal communications needs and the public's external business and residential needs. On the basis of that demonstrated need, the County can initiate a process to deploy or facilitate private deployment of a broadband network through a series of RFIs, RFPs, and related strategies.

CTC recommends evaluation of a network that would incorporate WiFi technology (in the County's more densely-populated areas), WiMax (to reach more rural areas), and fiber optics (for aggregation and "backhaul" of the network traffic).

The County's future internal communications needs and the public's external business and residential needs can be addressed with such a network.

Wireless represents the lowest-cost means by which to quickly deploy broadband to underserved areas and stimulate competition. If the County is interested in such stimulus, we recommend preparation of a wireless strategic plan to assess public and community needs; to determine what assets the County can put toward wireless deployment (such as utility pole access and hub buildings); and to evaluate the potential to encourage broadband development through a series of solicitations for private partners. The strategic plan would evaluate the appropriateness of any of the following emerging models for public broadband:

- Universal Access Model: Deployment of ubiquitous wireless access by a public or private entity, providing free access to residents or at selected locations. For digital inclusion, this model can be applied to the market as a whole, or in targeted areas. Examples of this model are the City of St. Cloud, FL and the pending San Francisco/Google network.

- Branding Model: The community allows the private entity to use the community's name for their service offering. The jurisdiction's brand name is often a valuable asset for a private partner. The City of Aurora, IL plan uses elements of this model.

- Anchor Tenant Model: The public entity encourages a private entity to deploy the network by agreeing to purchase capacity for public service applications. An example of this model is the City of Minneapolis.

- Open Access Model: The entity encourages a private company to deploy a ubiquitous broadband network that connects all residences and businesses. Any private sector service provider can then access the network to deliver retail services to the residences and businesses. The City of Boston's recently announced plans may evolve into an open access model. The City of San Francisco's agreement with Earthlink requires that the

WiFi network be open access. The City of Seattle is attempting to spur development of an open access fiber-to-the-premises network.

- Digital Inclusion Model: An entity deploys a community-wide or a selected geographic area for the purposes of closing the digital divide. Elements that this model needs to address include training, required end-user equipment, support, content, and funding. The Philadelphia model has elements of the digital inclusion model, as does San Francisco's.

- Community Operations Model*:* In this model, the County or a public entity associated with County deploys a network to provide voice and data service to its employees while on the job. The network is not marketed to residents, but residents could make use of spare capacity for access. An example of this model is Oklahoma City.

- Community Ownership with Private Partnerships Model: A public entity collaborates with one or more private companies to deploy the network and provide services. The partner can be used to support components of an ISP or lease access to the network itself. Examples of this model include the City of St. Louis Park, MN.

As part of this planning process, the County could also implement a wireless pilot to test market interest, build community support, and evaluate technologies.

Communities throughout the United States and Europe are increasingly turning to various forms of municipal broadband to meet community needs. Here in Maryland, major projects are underway in Ocean City, Baltimore, and on the Eastern Shore. In Virginia, community-wide wireless initiatives are in various stages of deployment in Alexandria, Arlington, and the City of Fairfax. The District of Columbia is preparing an RFI to elicit ideas and interest in regard to wireless. Less ambitious projects that provide wireless in downtown areas (as opposed to community-wide) are underway in Rockville, Silver Spring, and other Montgomery County municipalities.

8.8 Determine Feasibility of Fiber Strategy to Key Development Zones

Such a wireless project would not be sufficient to meet the needs of businesses in the business parks, technology parks, and high traffic business areas of the County. CTC recommends that the County evaluate the feasibility of building and operating fiber optics to areas key to the economic development of the County such as the Westbranch Trade Center and the area known as MD Route 97/Air Business Center. Even in the short-run, nothing short of fiber optics is likely to meet the needs of large business users. Increasingly, broadband is a decision-point for where a business locates. These areas in Carroll County will not be attractive to businesses if they do not feel confident that private carriers will offer them adequate connectivity at reasonable prices. This is a gap into which the County may wish to step in order to meet its economic development goals.

CTC therefore recommends that the County undertake to evaluate the technical and business feasibility of building fiber optics to these select areas and leasing capacity on that fiber to businesses and to communications carriers.

It is CTC's understanding that one private provider, QIS.net, has already expressed interest in developing some form of partnership with the County to deploy fiber in targeted areas. This possibility should be evaluated as part of a broader evaluation of strategies for the long-term benefit of the County. As is discussed in Section 5.1 above, in our experience there are significant, attainable strategies for cost-effective deployment of fiber by local government.

8.9 Build Fiber and Conduit During Other Infrastructure Work

CTC recommends that the County use every opportunity to add to existing fiber and conduit infrastructure. Any county or municipal project should be viewed with an eye toward providing long term cost efficiencies on communications infrastructure. To this end, CTC recommends adoption of a County-wide fiber optic build policy. The policy should include detailed specifications for installation of fiber optics during any work in the right-of-way including scheduled capital improvements, sewer or water line replacement or repair, sidewalk or road repair, electrical work, and road construction. Ideally, this policy should be adopted by the County and the municipalities so that all may benefit from the low incremental cost to install fiber or conduit during roadwork or utility installation due to the economies associated with labor and equipment.

Similarly, as every private-sector right-of-way project offers partnership opportunities, the County would benefit from uniform requirements and procedures for using commercial carrier construction to simultaneously install fiber or conduit, or negotiate conduit or dark fiber as part of the permit application process.

CTC further recommends that the County collaborate with individual municipalities to adopt similar policies within their jurisdictions

Appendix 1: Table of Services by Community

Table 2 lists available services by community.[20] Please note that actual availability will need confirmation on a case-by-case basis, especially for telephone network based data services such as DSL, T1, and T3.

Table 2: Summary of Available Services

Table 1: Available Services By Community

Community	Zip Code(s)	(1) Area Code & Exchange(s)	Verizon Central Office	Available Services					
				(2) DSL	Cable Modem	(4) EvDO	(5) Wireless	(6) T1	(6) T3
Daniel	21784	(410) 203, 313, 418, 461, 465, 480, 750	No	(3)	X	X	X	X	X
Eldersburg	21784	(410) 549, 552, 795, 970	No	X	X	X	X	X	X
Finksburg	21048	(410) 549, 552, 795, 970	No	(3)	X	X	X	X	X
Hampstead	21074	(410) 374, (443) 507, 508	Yes	X	X	X	X	X	X
Keymar	21757	(410) 775	No	(3)	X	X	X	X	X
Lineboro	21088 (PO Box)		No	X	X	X	X	X	X
	21102	(410) 374, (443) 507, 508	No					X	X
Manchester	21088 (PO Box)		No	X	X	X	X	X	X
	21102	(410) 374, (443) 507, 508	No					X	X
Middleburg	21757	(410) 775	No	(3)	X	X	X	X	X
Millers	21102	(410) 374, (443) 507, 508	No	(3)	X	X	X	X	X
Mount Airy	21771	(301) 829, 703	No	X	X	X	X	X	X
New Windsor	21776	(410) 635	No	X	X	X	X	X	X
Sykesville	21784	(410) 549, 552, 795, 970	Yes	X	X	X	X	X	X
Taneytown	21787	(410) 756	No	X	X	X	X	X	X
Union Bridge	21791	(410) 775	No	X	X	X	X	X	X
Westminster	21157	(410) 848, 857, 871, 875, 876	Yes	X	X	X	X	X	X
	21158	(410) 848, 857, 871, 875, 876						X	X
Woodbine	21797	(410) 489	No	X	X	X	X	X	X

(1) Verizon reports that due to number portability, exchanges can be ported to or from another area. Services are not exchange specific.

(2) Service available per Verizon, at&t, Quantum and Cavalier. Availability must be determined by actual address, distance from the Central Office, and circuit availability.

(3) Per Verizon and at&t, unable to verify service is available

(4) Service available per Verizon Wireless. EVDO speeds may vary depending on exact location.

(5) Service available per Verizon Wireless, but coverage areas are spotty outside of actual communities. Freedom Wireless offers service in Finksburg.

(6) Service available per Verizon, at&t, Quantum and Cavalier. Availability depends upon distance from Central Office and applications to be used. May require special access charges or construction charges.

[20] An important note about this data and the data in all these tables: we collected this data by relying to a substantial degree on information released by the existing providers. We asked for the information based on telephone dialing prefix and zip codes. This information is helpful, but *overstates* actual availability. The providers are very protective of information that shows what services are available at a given location. They claim that their sensitivities are based on security concerns and competitive positioning. Unfortunately, the key reason providers are not usually forthcoming is they often do not know the availability of broadband at given location unless they are able to test on a case-by-case basis.

Appendix 2: Map of Estimated Service Coverage

Figure 1 shows the estimated coverage area of Verizon's DSL service within the County. As the Incumbent Local Exchange Carrier (ILEC), Verizon's DSL service availability is likely the most accurate portrayal of DSL availability in the County[21]. As shown in Figure 1, DSL coverage is limited to areas within a given proximity of a Central Office (CO) or a remote DSL Access Multiplexer (DSLAM).

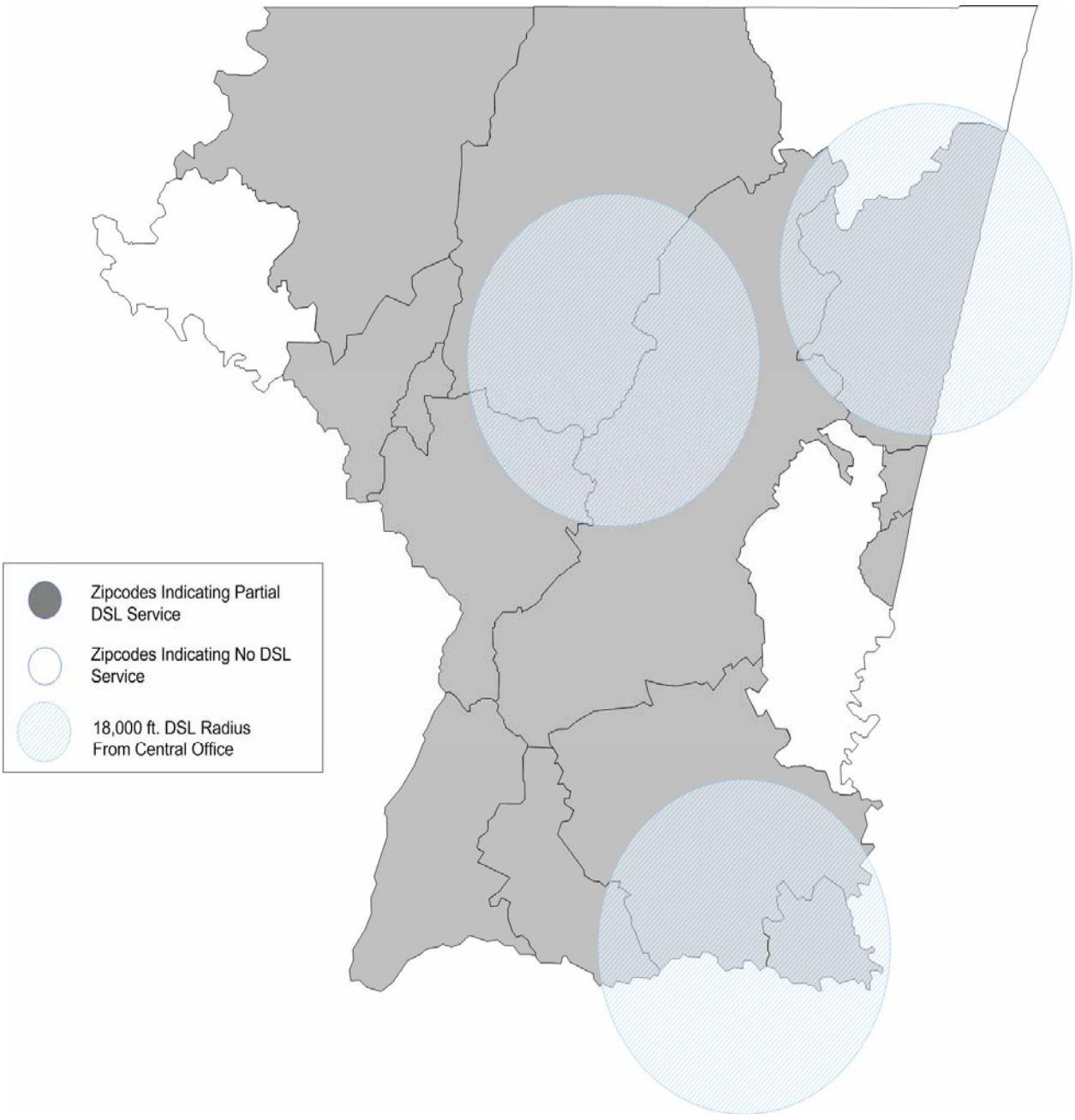
In contrast, cable modem service is generally available anywhere a cable provider has plant. In Carroll County, cable modem service is available in every zip code, although service may not be available where Comcast does not have existing cable plant. Cable modem service can often be limited in areas where population density does not warrant the cost of cable plant construction.

Cellular broadband services are limited to those areas where subscribers can receive RF coverage. The location of cellular towers is often dependent on population and usage density and traffic. Satellite reception is typically more universal than cellular coverage, although a clear line of sight of the Southern sky is required to receive satellite transmissions. Both cellular broadband and wireless broadband is available in every zip code in Carroll County.

Please note that actual availability will need confirmation on a case-by-case basis.

[21] In most markets, other DSL providers lease circuits from the ILEC, in this case Verizon.

Figure 1: DSL Service Coverage Map



Appendix 3: Table of Internet Providers

Table 3 outlines the partial list of Internet Providers available in Carroll County. It is important to note that many of these services (as is noted above) are available only in small pockets of the County to selected customers.

Table 3: Internet Providers (partial)

Provider	DSL Facilities Based	DSL Reseller/ Added Value	Cable Modem	Cable Modem Reseller/ Added Value	Satellite	Dial Up Telephone	Wireless	EVDO/ UTMS	ISDN, Frame Relay, Other
AT&T	✓								✓
AOL		✓		✓		✓			
Cavalier Business Communications	✓	✓							✓
Comcast			✓						
Earthlink						✓			
Freedom Wireless							✓		
HughesNet					✓				
Localnet Corp						✓			
NetZero		✓		✓		✓			
PeoplePC						✓			
Quantum Internet Service (QIS)	✓					✓			✓
Teltek		✓							✓
Verizon	✓							✓	✓

Appendix 4: Table of Residential Broadband Providers

Table 4 shows the available services for residential users, based on the providers' coverage claims and organized by zip code.

Table 4: Residential Broadband Providers

Table 3: Residential Broadband Providers

Service	Cable	DSL					Wireless Broadband		Satellite	
Provider	Comcast/ Adelphia	Verizon	Quantum	CloseCall America	Megapath	at&t	Freedom	Verizon	HughesNet	Earthlink
Zip Code(s) Not Serviced or Unable to Verify		(1) 21048, 21102, 21757				(1) 21048, 21074, 21088, 21102, 21757, 21771, 21776, 21787, 21791, 21797	(1) 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797			
Zip Code(s) Partially Serviced		(1) 21074, 21088, 21102, 21157, 21158, 21771, 21776, 21784, 21787, 21791, 21797					(1) 21048			
Zip Code(s) Serviced	21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797		(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1) 21784, 21157, 21158,		(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797
HSD	4 Mbps / 384 kbps 6 Mbps / 786 kbps 6 Mbps / 2 Mbps	768 kbps / 384 kbps 3 Mbps / 1.5 Mbps	1.5 Mbps / 384 kbps 3 Mbps / 768 kbps 9Mbps / 1.5 Mbps	3 Mbps / 768 kbps	1.5 Mbps / 384 kbps	Standard 1.5 Mbps / 128 kbps Preferred 3.0 Mbps / 384 kbps	Freedom 1 - 1.5 Mbps / 256 kbps Freedom 2 - 3 Mbps / 384 kbps	400-700 kbps / 60-80 kbps	Home - Up to 700 kbps / 128 kbps Pro - Up to 1.0 Mbps / 200 kbps ProPlus - Up to 1.5 Mbps / 200 kbps	Up to 700 kbps/ 128 kbps
Pricing	$42.95 for non-cable subscribers for 4 Mbps $59.95 for 6 Mbps (both services)	$17.99 for 768 kbps $29.99 for 3 Mbps	$24.95 for 1.5 Mbps plus install $34.95 for 3 Mbps plus install $49.95 for 9 Mbps plus install	$29.95 for 3 Mbps	$80.00 for 1.5 Mbps	$19.95 for Standard $29.95 for Preferred	Freedom 1 - $29.95 plus $99 install Freedom 2 - $49.95 plus $99 install	$59.99 monthly access w/ 2-yr customer agreement and qualifying voice plan	$59.99 for home (700 kbps / 128 kbps) plus $399.98 equip. & install. $69.99 for Pro (1 Mbps / 200 kbps) plus $399.98 equip. & install. $79.99 for Proplus (1.5 Mbps / 200 kbps) plus $399.98 equip. & install.	$69.95 for 700 kbps plus $599 install
"Always On"	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Network	HFC	DSL	DSL	DSL	DSL	DSL	Wireless	Wireless	Satellite	Satellite
Infrastructure Needed	Hybrid Fiber-Coaxial Cable, COAX wiring indoors.	Proximity to Central Office, Twisted Pair Wiring Indoors	Proximity to Central Office, Twisted Pair Wiring Indoors	Proximity to Central Office, Twisted Pair Wiring Indoors	Proximity to Central Office, Twisted Pair Wiring Indoors	Proximity to Central Office, Twisted Pair Wiring Indoors	Laptop + wireless PC card, handheld devices	Laptop + wireless PC card, handheld devices, cell reception	Need clear line of sight to the South, Satellite dish	Need clear line of sight to the South, Satellite dish
Mobile Use	No	No	No	No	No	No	Yes	Yes	No	No
Voice	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	No
Widely Available	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Possibly

(1) Coverage varies in all of these zip code areas. Must call provider for availability and/or signal strength.

Appendix 5: Table of Business Broadband Providers

Table 5 shows the available services for businesses users based on the providers' coverage claims and organized by zip code.

Table 5: Business Broadband Providers

Table 4: Business Broadband Providers														
Service	Cable Modem	DSL					Wireless Broadband		Satellite Broadband		Higher Speed/Capacity			
Provider	Comcast/ Adelphia	Verizon	CloseCall America	Quantum Internet Service	Megapath	at&t	Freedom Wireless	Verizon	HughesNet	Earthlink	Verizon	Cavalier	Teltek	at&t
Zip Code(s) Not Serviced or Unable to Verify		(1) 21048, 21102, 21757				(1) 21048, 21088, 21102, 21757, 21776, 21784, 21797	(1)21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797							
Zip Code(s) Partially Serviced		(1) 21074, 21088, 21102, 21157, 21158, 21771, 21776, 21784, 21787, 21791, 21797				(1) 21074, 21157, 21158, 21771, 21784, 21787, 21791	(1) 21048							
Zip Code(s) Serviced	21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797		(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797			(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1)21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797	(1) 21048, 21074, 21088, 21102, 21157, 21158, 21757, 21771, 21776, 21784, 21787, 21791, 21797
Broadcast Video	Yes	No	No	No	No	No	No	Limited	No	No	No	No	No	
High Speed Data	Sm. Bus. Lite- 256kbps/ 256 kbps Sm. Bus. Basic - 4 Mbps/ 384 kbps Sm. Bus. Plus - 6 Mbps/ 768 kbps Sm. Bus. Deluxe - 6 Mbps/ 1.5 Mbps	3.0 Mbps / 768 kbps 7.1 Mbps / 768 kbps	3.0 Mbps / 768 kbps	3 Mbps / 768 kbps 12 Mbps / 2 Mbps	1.5 Mbps / 384 kbps Full T1 Bonded T1	1.5 Mbps / 384 kbps Full T1	Freedom 512k Frac. T-1 - 512 kbps / 512 kbps Freedom 768k Frac. T1 - 768 kbps / 768 kbps Freedom 1 M Frac. T1 - 1 Mbps / 1 Mbps Freedom Full T1 - 1.5 Mbps / 1.5 Mbps	400-700 kbps / 60-80 kbps	Small Office - Up to 1.5 Mbps / 300 kbps Business Internet - Up to 2 Mbps / 500 kbps	Up to 700 kbps/ 128 kbps	T1, T3/DS3, Frame Relay, Ethernet/Point-to-Point, OC3	T1, DS3, Point-to-Point, Ethernet	T1	T1, T3/DS3, Frame Relay, Ethernet/Point-to-Point, OC3
Pricing	Sm Bus. Lite- $42.95/mo. Sm. Bus. Basic- $99.95/mo. Sm. Bus. Plus- $129.95/mo. Sm. Bus. Deluxe- $199.95/mo.	$59.95 for 3.0 Mbps to $79.95 for 7.1 Mbps	$34.95 for 3 Mbps or $59.95 for 3 Mbps with static IP	$59.95 - $79.95 for 3 Mbps $169.95 for 12 Mbps	$80.00 for 1.5 Mbps $600.00 for Full T1 $1069.00 for Bonded T1	$49.95 for 1.5 Mbps	512 kbps - $199 plus $299 install 768 kbps - $259 plus $299 install 1 Mbps - $299 plus $299 install 1.5 Mbps- $450 plus $299 install	$59.99 monthly access w/ 2-yr customer agreement and qualifying voice plan	$99.99 for Small Office plus $699.98 equip. & Install. $179.00 for Business Internet plus $699.98 equip. & Install.	$69.99 for 700 kbps/ 128 kbps plus $599 install	T1 $575-625 T3/DS3 $6800-$7800 Frame Relay - dep. upon speed needed & distance Ethernet/Point-to-Point - dep. upon speed needed & distance OC3 - dep. upon speed needed & distance	Varies, different tariffs for bundled packages	Varies depending on location	T1 $500-600 T3 $6,000-12,000 Frame Relay - dep. upon speed needed & distance Ethernet/Point-to-Point - dep. upon speed needed & distance OC3 - dep. upon speed needed & distance
"Always On"	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Network	HFC	DSL	DSL	DSL	Line-share DSL (need Verizon phone)	DSL	Wireless	Wireless	Satellite	Satellite	Fiber	Use Verizon network or construct own	Use Verizon network or construct own	Fiber
Infrastructure Needed	Hybrid Fiber-Coaxial Cable, COAX wiring indoors.	Proximity to Central Office, Twisted Pair Wiring Indoors	Proximity to Central Office, Twisted Pair Wiring Indoors	Proximity to Central Office, Twisted Pair Wiring Indoors	Proximity to Central Office, Twisted Pair Wiring Indoors	Proximity to Central Office, Twisted Pair Wiring Indoors	Laptop + wireless PC card, handheld devices	Laptop + wireless PC card, handheld devices, cell reception	Need clear line of sight to the South, Satellite dish	Need clear line of sight to the South, Satellite dish	Fiber	Fiber	Fiber	Fiber
Mobile Use	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No
Voice	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Widely Available	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(1) Coverage varies in all of these zip code areas. Must call for availability and/or signal strength.														

Appendix 6: Table of Performance Capabilities

Performance capabilities of DSL, cable modem, EVDO, WiFi, and Ethernet are shown in Table 6. Although each of the services qualifies as "broadband," performance varies greatly.

Table 6: Performance of Selected Services

Provider/Type of Service		Upload Speed (kbps)	Download Speed (kbps)	Upload Transfer Time (Minutes) of File in kb (kilo bits)				Download Transfer Time (Minutes) of File in kb (kilo bits)			
				3,920,000	24,000	480	400	3,920,000	24,000	480	400
				1 1/2 Hour Movie	Presentation w/ Graphics	Presentation w/o Graphics	640x480 Photo	1 1/2 Hour Movie	Presentation w/ Graphics	Presentation w/o Graphics	640x480 Photo
AOL	Dial-Up	56	56	1,166.66667	7.14286	0.14286	0.11905	1,166.66667	7.14286	0.14286	0.11905
Comcast	Cable Modem	384	4,000	170.13889	1.04167	0.02083	0.01736	16.33333	0.10000	0.00200	0.00167
		786	6,000	83.12129	0.50891	0.01018	0.00848	10.88889	0.06667	0.00133	0.00111
		2,000	6,000	32.66667	0.20000	0.00400	0.00333	10.88889	0.06667	0.00133	0.00111
Verizon	EvDO	80	800	816.66667	5.00000	0.10000	0.08333	81.66667	0.50000	0.01000	0.00833
		80	800	816.66667	5.00000	0.10000	0.08333	81.66667	0.50000	0.01000	0.00833
		80	800	816.66667	5.00000	0.10000	0.08333	81.66667	0.50000	0.01000	0.00833
		80	800	816.66667	5.00000	0.10000	0.08333	81.66667	0.50000	0.01000	0.00833
		80	800	816.66667	5.00000	0.10000	0.08333	81.66667	0.50000	0.01000	0.00833
Verizon	DSL	384	768	170.13889	1.04167	0.02083	0.01736	85.06944	0.52083	0.01042	0.00868
		1,500	3,000	43.55556	0.26667	0.00533	0.00444	21.77778	0.13333	0.00267	0.00222
TBD	Wi-Fi	1,000	1,000	65.33333	0.40000	0.00800	0.00667	65.33333	0.40000	0.00800	0.00667
		2,000	2,000	32.66667	0.20000	0.00400	0.00333	32.66667	0.20000	0.00400	0.00333
TBD	Fiber-Ethernet	10,000	10,000	6.53333	0.04000	0.00080	0.00067	6.53333	0.04000	0.00080	0.00067
		100,000	100,000	0.65333	0.00400	0.00008	0.00007	0.65333	0.00400	0.00008	0.00007
		1,000,000	1,000,000	0.06533	0.00040	0.00001	0.00001	0.06533	0.00040	0.00001	0.00001

Appendix 7: Framework of Existing Provider Categories

Table 7 summarizes existing categories of provider and how they impact Carroll County.

Table 7: Provider Framework

• **Internet Access:** *AOL-dialup* *Comcast-cable* *EarthLink-dialup* *HughesNet-satellite* *MSN-dialup* *PeoplePC-dialup* *Verizon-dialup, DSL, other* *Other National & Local Providers*	The one area where competition does exist is for low-priced dial-up service—which is not a broadband service. Many residential customers will remain with dialup service, at least for the immediate future—broadband is more expensive (or not available), so customers are unlikely to switch unless they perceive a higher value with a high-speed connection. Digital Subscriber Lines (DSL) and cable modems offer reliable and cost-effective Internet access. DSL and cable modem service are currently available in some locations in Carroll County. T1, Frame Relay, and ISDN access is currently available in Carroll County. HughesNet and EarthLink are satellite-based providers that offer an Internet service that does not require use of a telephone line. These satellite options are available nationwide.
• **High-Speed Data:** *AT&T* *Cavalier (Business only)* *Comcast/Adelphia* *HughesNet* *QIS* *Teltek* *Verizon*	Fixed wireless services offering multi-megabit connectivity across unlicensed radio spectrum are extending high-speed data services to locations not served by traditional copper or cable networks. Relatively inexpensive to deploy, many of the systems deployed are built by smaller entrepreneurs not associated with any of the larger incumbent service providers. Verizon and Competitive Local Exchange Carriers (CLECs) like Cavalier provide T1 and other connectivity services in Carroll County.
• **Long Distance Telephone (primarily for large business users):** *Verizon* *Cavalier (Business only)* *Wireless Providers* *Others*	Large users of telephone services in Carroll County are likely to pursue or have already pursued discounted long distance services. Given the competition, long distance services are a commodity with low gross margins. In addition, the applicability of Internet-based long distance service is increasing due to vendor and technology developments. In the next few years, long distance is likely to become a no-cost or bundled service.

- **Local Telephone:**
  Verizon
  Competitive Local Exchange Carriers – Cavalier Business Communications
  Wireless Providers
  VoIP Providers

The incumbent telephone company is not the only competitor for local telephone service. The capability and reliability of wireless services is increasing, and Personal Communications Service (PCS) providers have a long-term objective of becoming alternative local telephone providers. Incumbent telephone providers have already seen a decrease in services due to wireless options. In 2005, wireless telephone usage surpassed traditional landline telephone service and continues to grow.

To compete with Verizon and other competitive service providers in Carroll County, new entrants will need to obtain a large local or low-cost call area, and number portability will be essential. Otherwise, if a new entrant's local calling area is restricted to specific town limits, the competition will have a perceived advantage. During the registration process and negotiation of interconnect agreements with the Incumbent Local Exchange Carriers (ILECs), new entrants will need to address issues related to the local call area and number portability.

The bundling of local and long distance telephone services, as well as wireless service in some areas, allows providers to become "one-stop" services for business and residential customers. Many business and residential users are looking to new alternatives to traditional landline local telephone service. Alternative service providers, such as Vonage and Skype, provide voice services over the Internet. These VoIP offerings require a robust Internet connection and quality of service (QoS) to provide adequate voice communications.

- **Television/Video:**
  Dish Network-satellite
  DirecTV-satellite
  DSL Providers
  Comcast-cable
  IP Video Providers (CinemaNow, Movielink, etc.)

Comcast operates an interactive Hybrid Fiber Coax (HFC) system in Carroll County. This system was recently acquired from Adelphia. Comcast offers a Broadcast Basic and Expanded Basic cable lineup, digital tiers of cable service, and several additional digital services, such as HDTV, movie channels, pay per view, and music. They also provide digital video recording (DVR), video on demand (VOD), and multi-tier cable modem service in Carroll County.

Direct Broadcast Satellite (DBS) offers an alternative to traditional cable television. With a smaller dish than its predecessors, aesthetics are not as strong an issue as in the past. The cost of DBS continues to decline. With digital quality, near video-on-demand, and newly introduced two-way Internet access, we expect DBS to increase its share of the cable television market.

Video programming over DSL may provide some competition with traditional cable television. Some independent telephone companies have successfully offered cable television services over telephone networks and Incumbent giant AT&T has announced ambitious plans (as yet unexecuted) to upgrade phone networks to offer video. As

Carroll County is not within AT&T's footprint, this is unlikely to impact Carroll County. Verizon's fiber-to-the-premises is not likely to reach Carroll County anytime soon and Verizon confirmed to CTC that it does not plan to build Fios to Carroll County at the current time.

IP (Internet Protocol)-based video programming competes with video on demand (VOD) programming offered by traditional cable providers. This service is becoming more popular due to its flexibility and convenience for users. IP based services, such as CinemaNow and Movielink, offer movies and video programming that are downloaded from the Internet. These services allow customers to watch the programming at times and places that are convenient for the user. Cable television VOD programming does not have the mobility advantage that IP-based service offers, since customers of cable VOD must watch the programming on a television connected to the cable system.