Washtenaw
LINKMICHIGAN

Regional Telecommunications
Planning Program

Report 2004

<DRAFT>

Merit Network

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Section 1 - Introduction

This report is the final deliverable for Merit Network, Inc.'s consulting for telecommunications planning under the LinkMichigan initiative for Washtenaw County.

1.A. Planning Effort Overview

The county desired to design a Telecommunications Plan and develop strategies that will significantly improve the availability, cost, and quantity of advanced Internet and telecommunications services for all constituents in the county. The county wanted to plan a way in which high speed Internet access and other advanced telecommunications services could become available to all communities throughout the county including government, business, education, healthcare, families, and individuals. Through a competitive RFP process, the county hired Merit Network, Inc. of Ann Arbor, MI as its consultant to complete this work.

Dial-up connectivity is available throughout the county. But dial-in Internet service using PC modems will not accommodate the needs of next-generation applications on the Internet, and yet the "last-mile" access challenge is traditionally one of the largest in network planning. Inherent in this challenge are the cost of this last-mile access and the general lack of interest of most service providers in serving sparsely populated areas at a price that is perceived as affordable. Washtenaw County has the challenge of being rural and having sparse population in some areas, e.g., Dixboro Road and 5 Mile Road. Although areas such as Ann Arbor have technology offerings that rival almost any major metropolitan area in the country, there are very key areas that are un-or under-served.

In its May 14, 2001 report, the Michigan Economic Development Corporation (MEDC) stated, "Access to high-speed telecommunications services is the most important state infrastructure issue for the new century. Whether for business, government, healthcare, or educational purposes, higher-speed access is increasingly becoming a necessity – not a luxury." The report further states that no strategic policy initiative or program is more important in meeting the charge of sustaining, on a long-term basis Michigan' s economic growth than the activities described in the LinkMichigan initiative. Therefore, improving access to high-speed telecommunication services is the most important state economic infrastructure issue for the new century – not roads, not water, not buildings – but networking.

The MEDC report predicted that if these policies and programs were successful in bringing broadband to all areas of the state that it would mean an increase of $440B in State Gross Product and 500,000 new jobs to the State over the next ten years. Conversely, if broadband was not brought to all areas, the competition for businesses and jobs from other states could be potentially disastrous for the State of Michigan. The report cited numerous indications, such as automotive suppliers are increasingly requiring suppliers to communicate electronically with them for procurement, collaborative engineering and inventory management.

The MEDC provided funds for "regional planning" in the state to determine how best to bring broadband to all areas. All 83 counties participated in these planning efforts, and "regions" were formed that varied in size from one county to fifteen. Washtenaw County chose to be a single-county planning. For the remainder of this document, the county will be referred to as "the region," consistent with LinkMichigan terminology. This reference is partly for convenience, but also because the county restriction was primarily due to how grant funds were administered for this planning project. Nothing stops Washtenaw County from defining "region" in a more productive or expansive way for service providers.

Leadership for the statewide effort comes from the MEDC and the Michigan Broadband Development Authority (MBDA). The state-wide effort included four initiatives: aggregating statewide telecommunication purchase, implementing taxing and permitting fairness, creation of a funding authority (MBDA) to encourage investment, and providing funds for regional telecommunication planning of last mile solutions. For more information about the statewide effort, including supporting legislation, see linkmichigan.michigan.org.

1.B. Broadband Defined

In planning broadband services, the first step is to define what broadband really is. Some might say this seemingly simple challenge is actually a reflection of the challenges to come, because there is no clear definition of broadband. Further, even when a definition is settled upon for working purposes, it changes over time as technology advances.

The Federal Communications Commission has a working definition stating that; "Broadband refers most commonly to a new generation of high-speed transmission services, which allows users to access the Internet and Internet-related services at significantly higher speeds than traditional modems. It has the potential technical capability to meet consumers' broad communication, entertainment, information, and commercial needs and desires."

This *service*-focused definition of the FCC differs from the more technical definition of broadband historically as a telecommunications *facility* in which a wide band of frequencies is available over which to transmit information. Because a wide band of frequencies is available, information can be multiplexed and sent concurrently on many different frequencies or channels within the band, thus allowing more information to be transmitted in a given amount of time.

The FCC recently removed from its definition a specific statement as to speed ("200 kbps in each direction"). Although there is not unanimity on how fast broadband really is, and "fast" evolves over time, a good number of people would agree that an access loop in the range of 1 - 2 Mbps downstream and .5Mbps upstream is an aggressive definition of a broadband service rate -- for today. A conservative perspective would say that half that sped is an acceptable goal for near term broadband deployment. For this planning effort,

Merit assumes the conservative perspective will be the medium, and the aggressive is the near term goal.

1.C. Washtenaw County's Planning Activities

The region's planning effort focused on six main areas of work:

1. Developing "Key Indicators Assessment" which is a basic technology paper for the audience of local planners.
2. Completing an infrastructure inventory to determine what services exist in the region, and developing a Geographic Information System-based (GIS) tool;
3. Developing a "Strategic Statement of Direction" for telecommunications that can be part of the County Plan.
4. Developing strategic models including community assessment instruments.
5. Community educational forums.
6. Development of model "telecommunications friendly" ordinance provisions and standardized permitting processes.

This report is a summary of items 1-5 above. Item 6, the model ordinances, was completed by Carlisle/Wortman Associates, Inc. with technical support from Merit, and is presented under separate cover.

1.D. Washtenaw County Region Management

The planning project was supervised by a steering committee and technical committee, which provided ongoing management, coordination with the consultants, and supervision of all aspects of the project. The Steering Committee representatives were:

Gordon Darr, Dexter Area Technology Advantage
Russell Dotson, Milan Area Chamber of Commerce
Gretchen Driskell, Mayor, City of Saline
Shelle Manning, Clerk, Northfield Township
Bob Pierce, Chelsea Area Chamber of Commerce
Steve Pierce, HDL, Ypsilanti
Deborah Vandermade, Ann Arbor Area Chamber of Commerce
Bill Wagner, Manchester
James Walter, Supervisor, Pittsfield Township

The Technical Committee representatives were:

David Behen, Director, Washtenaw County ITS
Terry Brinkman, Principal Planner, Washtenaw County Department of Planning and Environment
Margaret Cline, Chief Information Officer, Eastern Michigan University
Susan Lackey, President, Washtenaw Development Council

Alan McCord, Senior Director, Planning and Coordination, Information Technology Central Services, University of Michigan
Shahzad Rauf, Technology Analyst, Washtenaw County ITS
Kimberly Wraight, GIS Coordinator, Washtenaw County Department of Planning and Environment.

1.E. Consultant and Partners

Merit Network, Inc., directed all aspects of the consulting and the preparation of the final report. Merit is a leading ISP in the State of Michigan connecting Michigan's state universities and other educational, research non-profit entities in the State to the worldwide Internet. Merit staff included, Mary Eileen McLaughlin, responsible for the overall consulting plan design, management and execution as well as the final report content and editorial review; Mike Mosher, responsible for client relations, provider inventory data collection, GIS mapping coordination, engineering plan support and *Fiber* technology paper; Bob Leptich, responsible for the business case design, and recommendations outline; Brian Cashman, responsible for the *Leased Circuit* technology paper and engineering plan specifications; Jim Moran, responsible for the *Cable/DSL* and *Powerline* technology; Andy Rosenzweig responsible for the *Wireless* technology paper; Myrissa Moore responsible for administrative support for the final report.

The Institute for Geospatial Research and Education (IGRE) located at Eastern Michigan University in Ypsilanti, Michigan supported Merit's GIS effort in developing the shapefiles for the telecommunications infrastructure and user needs aspects of the data collection, developing the web-enabled telecom survey forms and service boundary capture tool. IGRE is under the direction of Michael Dueweke and Dr. Yichun Xie. The Institute is a leader in the mapping field, and has worked on numerous township, city and region projects.

1.F. Project Funding

The Michigan Economic Development Corporation provided a grant to the county and the County of Washtenaw provided the local matching funds.

1.G. Key Challenge of the Planning Effort -- the "Last Mile"

Local access to Broadband (high-speed) networks is the main technical problem that needs to be solved. This is frequently referred to as the "last-mile" problem in which connections between the end users and providers are the bottleneck in high-speed communications. "Last mile" infrastructure builds have been a persistent problem because those builds are relatively low-return-on-investment propositions and because of their sheer number.

Investments in telecommunications infrastructure in the 1990's focused on the high volume national and regional backbones where return-on-investment was likely to be high on high-volume traffic. Millions of miles of fiber optic cable were placed on these routes in anticipation of broadband demand.

The predictions of Broadband demand that drove this construction were based on the same types of applications under discussion here, and the case for those is even stronger today than it was then. Unfortunately, the capital markets did not make balanced and complementary investment in the local, "last-mile" infrastructure. The result today is an overcapacity on national and regional backbone routes with constricted capacity on the local networks which are supposed to act as feeders. Some of the infrastructure is now available for pennies on the dollar in bankruptcies.

Had the local infrastructure have been built out in balance with the national and regional, more of the backbone would likely be in use. If the construction had been roads rather than communications infrastructure, it would have been the equivalent of building only Interstate highways while leaving the access roads two-track dirt lanes. The Interstates (national and regional backbones) have only light traffic volumes (under capacity) because the congested local roads prevent drivers from reaching the Interstate in large numbers.

The downturn in the economy and the "burst" of the industry bubble has left little investment capital available for building of local infrastructure. The "build it and they will come" model of the 1990's has been replaced by more cautious investment approaches. While most industry analysts are still confident that demand will eventually rise so as to make use of all the existing national and regional capacity, businesses are unfortunately not rushing to build local infrastructure with the same fever with which they build the national and regional backbones in the 1990's.

Normal "free-market" forces will be particularly difficult in some areas, particularly in difficult-to-serve and low population density areas where the aggregate demand picture is murky. In these low population density areas, service providers often have difficulty developing a profitable business case.

And while some of Washtenaw County is a model in terms of broadband connectivity, i.e., those areas associated with higher education and biomedical research, there still are many areas of the county that are underserved. This range of deployment is more exaggerated in Washtenaw County than in other areas of the State. There are significant long-haul fiber resources in the county, and this is a key advantage. Understanding where these are, how much is available, and how these resources may connect to local resources is a key task. This abundance of long-haul fiber, however, does not necessarily translate into resources for the challenging last mile.

It is a "chicken-and-egg" investment challenge: companies or towns considering a high-cost infrastructure build find it a difficult decision since it is hard to predict if and how consumers will make use of the network. Consumers might be willing to pay for innovative online services, but the actual demand cannot be measured until such services

are available. Service providers, content providers, and Application Service Providers (ASPs), do not want to incur the cost of developing those applications without the assurance that high-speed networks are available to a large enough volume of customers.

Leadership and planning are the keys to solving this problem. Given the current economic climate and the dysfunctionality of the free-market mechanism with regard to investment in Broadband development, a government and/or industry sponsored organization to drive Broadband and related growth is necessary.

The *Strategic Plan* of this report will address this key activity. The *Strategic Models* recommend concepts to address the more typical focus of broadband deployment, i.e., the technology infrastructure or "network planning".

1.H. Recommendations Summary

This report contains a number of recommendations. The *Strategic Plan* section details these, and provides a list of recommended actions in the next 30-90 days. However, in addition to these time-critical tasks, there are several key actions which are, in Merit's view, required in order for broadband to be deployed as the county envisions. These include:

- The deployment of a regional backbone, which is a combination of fiber and wireless. This backbone should be considered the main artery for the county. It will concentrates user traffic and bring the fundamental network everywhere and connects out to the world-wide Internet. It enables new providers to offer a range of services. Ownership of the network can take a number of forms depending on the desires of the county, however, it is recommended that the county *sponsor* getting the network built. Additionally, much of the network may already be "built" in that facilities exist that may able to be leveraged as in fiber rights to use. (For example, Ann Arbor has fiber connecting traffic lights. Some strands may be able to be used for telecom services.) Note that this plan assumes that some entity *owns* the infrastructure and that it is not leased from a telco. It is Merit's view that the current telco price model for high bandwidth services is not affordable, and as bandwidth needs continue to expand, the model becomes less attractive. This bypass of the incumbents, even by a new private enterprise which may well build and own the backbone, will be troublesome to the incumbents.

- The establishment of a carrier neutral collocation facility, which is essentially a data center housing the equipment of service providers. Service providers establish a presence here, and exchange traffic and routing information. User traffic and be concentrated at different points in the county, and hauled to this collocation site. Customers can individually build to the site and have a choice of service providers. This is the physical place that user traffic is concentrated. The advantage to service providers is that they build to one point, and not to every single user.

The above two recommendations will help expedite the emergence of broadband services in the counties, enable new service providers, hopefully with new business models and cost structures to emerge.

But broadband planning is much more than just the network plan. Thus a key recommendation is the formation of a leadership group and its technical subcommittee. Visionaries are necessary for fundamental advances, and the leadership group -- referred to as the Broadband Council -- should be the county visionaries. Some key areas of their work, are recommended to be:

- Getting connected -- themselves and key public areas. Use engenders need, and need means more customers for providers.
- Public relations/presence/policy. Broadband planning should be *formally* integrated into all regional planning so that when the Water Board or Road Commission meets, there should be the question, "Say, where's the broadband representative?" This will be an ongoing effort for acceptance. In addition, there should be policy-planning initiatives to expedite service, and the county's ordinance models are a significant start. The effort now is to get those models passed in the localities.
- Education. Continue the educational forums that have occurred, stressing best practices, success stories and creative models. In addition, work with businesses to understand the *operational changes* that must take place in their businesses to take best advantage of broadband services -- new customer service models, adoption of network-served applications, new back-office systems -- and many others.
- Negotiating contracts for the regional backbone and the collocation facility and for bulk purchasing on behalf of businesses.
- Supporting the network deployment plan from a business perspective.
- Work with neighboring county groups -- the county border doesn't mean much to a service provider. Perhaps help leverage the population in Brighton and Howell to the advantage of an Ann Arbor provider.

Some key areas of the work for the technical subcommittee are:

- Keep up the infrastructure inventory. Document opportunities to share infrastructure.
- Form a user group and document emerging technologies.
- Be a source for general technical support and referral -- be able to answer the question, "Who can I call."
- Do capacity planning for businesses to help leverage purchasing.
- Provide loop (last mile) construction information.
- Recommend the type of backhaul that is appropriate for businesses or anchor tenants in developments.
- Do RFPs for regional network and collocation.

Section 2 - Key Indicators Assessment

2.A. Overview

The goal of this work was to develop essentially a "Technology -101" paper. The audience is the local planners, so that when they are discussing broadband technologies and initiatives, they are knowledgeable of basic terms, concepts and implications.

Appendix IV documents in at a semi-technical level the different technology options that could be used in building networks. The material will help to provide the planning constituency, including potential investors and potential providers, with basic information on how the technologies work, their cost, relationship to one another, pros and cons relative to bandwidth, ease of deployment, geographic considerations, etc. In addition, the material can function as a reference to the network planning guidelines in the *Strategic Models* section of this report. This Appendix is divided into the following topic areas:

- Wireless;
- Fiber;
- Lease Circuits;
- Cable and DSL;
- Satellite;
- Powerline Communications.

2.B. Summary

The most favored technology is fiber because it is essentially unlimited bandwidth as long as the end equipment that "lights" the fiber evolves. In addition, the service provider owns their own plant, vs. buying it from some other service provider as is the case with leased circuits and cable and DSL. But fiber is expensive and difficult to cost-justify for some demand scenarios. Some figures specific to this region are presented in the *Network Plan* Appendix III.

For more sparsely populated areas that are anticipated to grow, an interim technology implementation of wireless is likely the most viable. This achieves the goal of the provider owning their own plant.

For those areas where population is sparse and not anticipated to change much, satellite is the likely solution for the present and foreseeable future. (Powerline communications is technically possible, but given the existing power deployment in this country it is a challenging technology to cost-justify.)

It is highly recommended that individuals involved in the planning effort internalize the basics of each of these technologies presented in Appendix IV and continue to keep abreast of changes in the industry.

2.C. Service Options Matrix

In the appendix is a chart summarizing service options that are typical for given bandwidth scenarios and relative to population densities. These are *general* guidelines for service options, but can be used for general planning purposes.

Section 3 - Inventory of Current Telcommunications Infrastructure

3.A. Background

Merit worked with its partner Control Room Technologies of Lansing, Michigan to complete a comprehensive inventory of the service providers throughout the county. The purpose of the inventory was to identify the services currently available, map those services, and provide a summary to analyze the gaps in services, both geographically and in breadth of services. The inventory was conducted using publicly available resources, personal interviews, and interviews over the phone. MEDC enlisted the support of American Megacomm, Inc. (AMI) to create and maintain a set of survey forms and a provider database in Microsoft Access format for the provider inventory. Merit provides copies of MS Access database files in the project CD.

MEDC and AMI also took on the task of collecting information on the biggest, statewide providers. Companies like SBC, Verizon and Charter were surveyed by AMI, and the data collected is in the MS Access database in the project CD. Merit also recruited the services of Control Room Technologies (CRT), of Lansing, to assist Merit in the service provider inventory.

Geographic Information System (GIS) mapping was used to map this inventory as well as user profiles, because GIS is becoming a standard for understanding any data that has a physical component. It is a highly useful tool for decision support, and is very valuable when doing network planning. It also has the flexibility to work with any data model that the region may decide to use.

3.B. Inventory and Mapping Process and Challenges

The process for obtaining specific information of broadband providers in Washtenaw County began by separating the providers into four categories: potential DSL providers; cable providers; wireless providers and private fiber providers.

Potential DSL providers were culled from a long process starting with a list of all licensed Competitive Local Exchange Carriers (CLEC's) licensed by the Michigan Public Service Commission (MPSC) to do business within Washtenaw County. From this list, CRT consultants contacted all of the companies in order to determine if the company was doing business in Washtenaw County and whether or not the company provided DSL service. Once the list was verified, the companies were contacted again for more specific information including a contact name and phone number that could be used as a resource for potential customers. Additional research was performed using online resources to cross-tabulate these results.

The area's cable providers were limited to the largest cable company in the nation: Comcast. Comcast provides high speed Internet access via its cable television lines. They are the primary cable provider in Washtenaw County.

The wireless ISP's (wISP's) were more difficult to determine. There was no documented list to begin the search, so CRT started the process by contacting the known wISP's. Consultants visited the county in order to obtain copies of local weekly newspapers in the hopes of obtaining a list of wISP's in rural areas of the county. Some information was gathered in this manner by examining the advertisements that existed in rural newspapers. Finally, an Internet search was conducted.

The compilation of private fiber providers began by contacting the city of Ann Arbor's Building Department. This contact was made in order to get a list of all companies that had applied for permits to occupy the Rights of Way. Once this list was obtained, CRT contacted the city attorney's office to gain information from the permit holders. Contact information was then gathered and calls were made to update that information and provide it as part of this report.

No single process or procedure was perfect. A combination of activities and research was necessary to obtain the most comprehensive list available. CRT estimates that our results are 90% accurate as to a total list of broadband providers in the county. There are several resellers of broadband service, and this complicates the task of listing every provider available. Nevertheless, CRT believes that the list of broadband providers submitted within this report is an excellent first step in providing public policymakers and potential customers a comprehensive list of broadband providers in Washtenaw County.

Internet Service Providers, for the most part, were very cooperative and provided the best and most complete information. Telephone companies were the most difficult to contact and from whom to obtain data. CRT created this table and ranked each provider as to their "cooperativity level":

Provider "Cooperativity" Ranking

Company	Score
Broadwing	3
Bullseye Telecom	1
Century Tel Michigan Network LLC	3
Covad Communications	2
GlobalCom	2
IC.Net	1
KMC Telecom II	1
LDMI	1
Level 3 Communications	1
MCI WorldCom Services	2
McLeod USA	2
Norlight Telecommunications	2
Opave.com	3
Provide.net	1
PCS Broadband	1
Synergy Broadband	2
TC3 Telecom	1
TDS Telecom	1
Turnkey Network Solutions	3
US Signal	2
XO Michigan	2

Score Details:
***1** = Most cooperative, all questions answered, participated with all details of the interview (such as disclosure of each POP address, etc.).*
***2** = Cooperative, some data provided, did not participate with the details of the interview.*
***3** = Provider did not participate.*

3.C. A Snapshot in Time

It is critical to realize that the provider inventory is a snapshot in time of the networking landscape of region in 2003. This data will change considerably over time, and today' s inventory won' t be useful in 18 months. Considering the value and expense of this effort, as it was very costly to create, the county should consider how they could keep this information up-to-date. All regions in the state are considering this challenge and the MEDC is also concerned. In the meantime, it is possible to use the forms and data structures used for this work, and to do another "snapshot" in approximately one year. Alternatively, the county could find a means to encourage providers to actively submit information on their own schedules and by their own staffs, thus distributing the labor expense of this effort.

In addition, there are new developments that must be tracked. For example, *IEEE Spectrum* reports in its September 2003 issue that in May of this year Verizon, BellSouth and SBC got together and agreed on a common set of specifications for fiber to the curb,

"FTTC" equipment. The significance of this agreement is that in the past, although vendor equipment was built to a common standard, it typically had separate implementation specifications. This agreement has two benefits: 1) it should make it more cost effective for vendors since they have a clear specification to which their large customers agree, 2) and the customers can have interoperability among vendor equipment. It is hoped this agreement would expedite FTTC deployment providing fiber to a neighborhood or business area, with only the drop into the household or business to be built. The three telcos are reportedly currently considering responses from vendors to their requests for proposed equipment built to the agreed specifications. But as interesting as this development may seem, the most "ambitious" telco deployer is quoted as having a 10-15 year time frame for implementation(!).

Another key development is the passing of the 802.16 wireless standard in early 2003, which is positioned to do for wide area network (WAN) what the 802.11 standards did for the local area (LAN). Essentially, the access plant could evolve to contain a significant wireless component, freeing the last mile from the constraints and expense of terrestrial technologies and expediting deployment -- hopefully sooner than 10-15 years. The industry forum focused on this effort is called WiMax. The same *IEEE Spectrum* issue noted above has a report on this activity.

A third example would be the proposed opening of cable television plant to all providers similar to the "equal access" requirements of the ILECs. The FCC website (www.fcc.gov) lists a number of initiatives in this area, e.g., requiring CATV companies to allow subscribers to buy Internet service from any ISP, with those ISPs being allowed to use the cable plant to access the subscriber.

Lastly, the National Rural Telecommunications Cooperative (NRTC) has announced a partnership with WildBlue Communications, Inc. and the National Rural Telecommunications Cooperative (NRTC) announced today a distribution partnership whereby NRTC Members will offer WildBlue's two-way satellite broadband service in the continental United States. WildBlue enables customers virtually anywhere in the continental United States to get high-speed Internet service via satellite. NRTC membership includes over 1,100 rural telephone and electric companies. NRTC members will begin marketing the WildBlue broadband service to homes and small offices in 2004.

If the region determines it is valuable to keep this inventory maintained, they will either need to find someone locally to support it, or train (and provide incentives to) the providers to get their information into the GIS inventory themselves. This plan would not work as a single region initiative. It would need to be a statewide effort, with all the counties using a common GIS-based telecommunications inventory system. Merit has provided a GIS application to the 13-County Heart of Michigan region. The application exists to allow updating, and wider use of this application could lead to a statewide effort. The counties would have to lead the effort.

3.D. GIS Mapping

A key effort of the inventory work was to map the providers by region. Merit partnered with the Institute of Geospatial Research and Education (IGRE) at Eastern Michigan University to create not only a county map of the providers, but also provide a Geographic Information System (GIS) software toolset for the region to use to more completely understand and analyze available networking. Plots of region information are included in the report in Appendix V.

Merit acquired basemap data described in the chart below, e.g., political boundaries, hydrography, roads, and mapped this data. To this information was added data on economic planning regions obtained through discussions with economic developers. With the assistance of IGRE, Merit acquired Census data for the region as well.

On the CD that accompanies this report are the shapefiles for the user data and inventory data that was collected and used in this study. Merit has included instructions on using ArcExplorer, a freely available GIS viewer. This allows anyone with access to the shapefiles to view the GIS data layers for Washtenaw County.

The map layers described above can be "turned on" or off as the user requires whether using the free ArcExplorer. For example, a user could turn on the road layer, the economic development layer and the private fiber layer to view the confluence of this information for decisions on how close a lateral is to a fiber route and whether road right of way permits will be required. This tool, and the data provided should be a valuable decision support tool.

Again, to keep up the inventory requires time and effort. If the county could find a means of encouraging providers to submit their information on their own schedules and through their own staffs, the data would be updated and the cost for updating would be distributed.

3.E. DSL, Wireless, and Cable Provider Listing

The following table lists the telecommunications corporations, Internet service providers and cable providers identified as serving the county. It is interesting to note that the telecommunication and cable companies were originally created to provide telephone and cable TV service, respectively, to the area. Today, it is expected that they may well all additionally offer DSL or Cable Modem Internet services. (Not all companies listed here participated in the inventory.)

DSL/Wireless Providers – Washtenaw County

Bullseye Telecom
Jeff Dhaenens, Technical Contact
25900 Greenfield Road Suite 330
Oak Park, MI 48237
Phone: #1-248-784-2537

Covad
Sales
110 Rio Robles
San Jose, CA 95134-1813
Phone: #1-800-636-3500

GlobalCom
Jackie Lopez, DSL Provisioner
333 West Wacker Drive 15th Floor
Chicago, IL 60606
Phone: #1-312-895-8818

IC.Net
William Lockwood, Director of Sales
106 North 4th Ave
Ann Arbor, MI 48104
Phone: #1-734-988-0090 x500

LDMI
Dick Blair, Product Manager
27777 Franklin Rd. Suite 500
Southfield, MI 48034
Phone: #1-48-440-4181

McLeod USA
Bill Bunn, Sales
6400 C St. S.W.
PO Box 3177
Cedar Rapids, IA 52406
Phone: #1-877-283-4487

Opave.com
Steve Dout, President
PO Box 580
Chelsea, MI 48118
Phone: #1-734-475-3135

PCS Broadband
Kevin McLaughlin, Sales
1410 W. Ganson
Jackson, MI 49202
Phone: #1-734-734-7900 x203

Provide.net
Maria Shelden, Manager
663 S. Hewitt St
Ypsilanti, MI 48917
Phone: #1-888-484-4200

Synergy Broadband
Norm Roe, President
455 E. Eisenhower Pkwy Suite 74
Ann Arbor, MI 48108
Phone: #1-734-222-6060

TC3 Telecom
Crystal Markwell, Sales
1114-F South Winter St
Adrian, MI 49221
Phone: #1-517-265-7872 x112

TDS Metrocom
Jim Smoltz, Manager Southwest MI
33057 Schoolcraft Rd
Livonia, MI 48150-1618
Phone: #1-734-421-5123

XO Communications
Bart Weddle, Sales
11111 Sunset Hills Road
Reston, VA 20190-5339
Phone: #1-800-539-0214 x2859

Comcast
Shannon M. VanSach
Paralegal Administrator
29777 Telegraph Road
Southfield, MI 48034
248-233-6735

3.F. Fiber System Owners Listing

These organizations own fiber systems services in the county. Most Internet service providers listed provide point-to-point connections for customer sites, and/or they provide wireless access to the Internet. Note that these are the providers that were identified for this inventory survey. The region may find that issuing and RFI/RFP for private fiber results in identifying other providers interested in the region.

Washtenaw Intermediate School District, and Washtenaw County Government are listed here as they maintain substantial fiber backbones connecting the K-12 school districts and governmental agencies across sections of the county.

Fiber Providers

KMC Telecom II, Inc
Eric Harris, Regional City Director
7800 Equitable Drive
Eden Prairie, MN 55344
Phone: #1-952-974-1612

Level 3 Communications
Mike Bellamente, Account Rep
1025 Eldorado Blvd
Broomfield, CO 80021
Phone: #1-720-888-6788

MCI WorldCom Network Services
Enterprise Fiber Sales
2250 Lakeside Boulevard
Richardson, TX 75082
Phone: #1-800-465-7187

Broadwing
1122 Capital of Texas Highway South
Austin, TX 78746-6426
Phone: #1-800-267-2394

American Fiber Systems
Bill Ciminelli, Transport Services Sales
100 Meridian Centre Suite 250
Rochester, NY 14618
Phone: #1-585-340-5400 x132

Century Tel Michigan Network
17 S. High Street Suite 1250
Columbus, OH 43215

McLeod USA
Chad Bruder, Sales
17117 W. Nine Mile Road Suite 1200
Southfield, MI 48075
Phone: #1-248-663-5122

Merit Network, Inc.
Mike Mosher, Link Michigan Program Manager
4251 Plymouth Road
Arbor Lakes, Bldg 1 Ste 2000
Ann Arbor, MI 48105
Phone: #1-734-936-0287

Norlight Telecommunications
Terry Birk, Directory of Operations
275 North Corporate Drive
Brookfield, WI 53045-5818
Phone: #1-262-792-7770

Turnkey Network Solutions, Inc
Thomas Glass
637 76th Street, SW
Grand Rapids, MI 49509
Phone: #1-616-455-9840

US Signal
Timothy Hall, Vice President
20 Monroe NW Suite 450
Grand Rapids, MI 49503
Phone: #1-616-998-7035

Washtenaw County Govt.
Douglas Perlin
110 North 4th
Ann Arbor, MI 48104
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Washtenaw ISD
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Information Systems Manager
1819 South Wagner Road
P.0. Box 1406
Ann Arbor, MI 48106
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3.G. Satellite Internet Service Providers

These organizations provide Internet services above the level of dial-in modem service via global satellites. Many sources characterize this as wireless service to the Internet. Note that these are the providers that were identified for this inventory survey. Since they utilize satellites, the service is available across the entire Region (as well as the entire country.) Local resellers provide subscriptions to these services.

Satellite Based Internet Service Providers

Provider	Provider Contact
Hughes Network Systems	Public Relations Dept. 11717 Exploration Lane Germantown, MD 20876 301-428-5500
Infosat Telecommunications USA	David Orton Dir. Of Business Development & Marketing PO Box 2268 Blaine, WA 98231 604-523-4116
Starband	Sheila Blackwell Dir. Of Corporate Communications 1760 Old Meadow Rd. McLean, VA 22102 703-245-6410

Tachyon	Andrew Wheeler Dir. Of Sales 5808 Pacific Central Blvd. San Diego, CA 92121 973-994-4696

3.H. Mapping Deliverable CD Documentation

Following is a list of files included on the Mapping CD that accompanies this report, and brief description:

ArcExplorer 4, the reader required to view the maps, is included on the CD, but can also be downloaded from:

http://www.esri.com/software/arcexplorer/aedownload.html

Folder: ArcExplorer

File name	File type	Description
AEJavaSetup	Application	Installs ArcExplorer 4
j2re-1_4_0-win-i	Application	Installs supporting JRE Java plug-in
using_arcexplorer_java	Pdf document	User guide for ArcExplorer 4

Folder: Basemap Data: Geographic Framework Version 2a.

File name	File type	Description
Metadata	Folder	Contains pdf and html metadata* documents for all the shapefiles** comprising basemap data.
allroads_155v2a (Roads)	Shapefile	All Roads in region
City_155v2a (Cities)	Shapefile	All Cities in region
Contours	Shapefile	Topographic Contours for region
region_155v2a (region)	Shapefile	region Boundary
drain_155v2a (Drains)	Shapefile	Drains in region
hydro_155v2a (Hydrography)	Shapefile	Hydrography for region
Lake_155v2a (Lake_Polyline)	Shapefile	Polyline data for lakes in region
lakepoly_155v2a (Lake_Polygon)	Shapefile	Polygon data for lakes in region
Landmarks	Shapefile	Landmarks data from USGS Digital Line Graph (DGL)100k

* Metadata: Data about data. Metadata describes how and when and by whom a particular set of data was collected, and how the data is formatted.

**Shapefile: Industry standard definition format for storing the location, shape, and attribute information of geographic features is a GIG system.

Mcd_155v2a (Townships)	Shapefile	Township Boundaries
railroad_155v2a (Rail Roads)	Shapefile	Rail Roads
river_155v2a (River_Polyline)	Shapefile	River Polyline
rivrpoly_155v2a (River Polygon)	Shapefile	River Polygons
Sections	Shapefile	Public land survey sections data
[County Name]_drg24k	TIF image file	USGS Digital Raster Graphic (DRG)
[County Name]_Landuse	Shapefile	Landuse/Land Cover data
village_155v2a (Villages)	Shapefile	Villages in region

Folder: Census_BG_data (Census Block Group Data)

File Name	File type	Description
Census_metadata	Folder	Contains pdf and excel metadata documents for Block Groups
Census_block_groups	Shapefile	Block Groups for region
Employment(censusBG)	Shapefile	Employment data extracted from Census Block Group data
Med_household_income(CensusBG)	Shapefile	Income data extracted from Census Block Group data
Population_Density(CensusBG)	Shapefile	Population data extracted from Census Block Group data

Folder: MapInfo_data (Telecommunications Data)

File Name	File Type	Description
MapInfo_metadata	Folder	Contains pdf metadata documents for Mapinfo layers
Cable_OB(mi_cable_overbuild)	Shapefile	Cable Overbuild Coverage
Cable_SA(mi_cable)	Shapefile	Cable Coverage Area
CLEC_SA(MICLEC_B)	Shapefile	Competitive Local Exchange Carrier (CLEC) service area
CLEC_SL(MICLEC_P)	Shapefile	Competitive Local Exchange Carrier switch locations
POP(Mi_pop)	Shapefile	Point of Presence locations
Wire_center_COL(MIWCPT)	Shapefile	Wire Center Central Office Locations
Wire_center_SA(MIWCREG)	Shapefile	Wire Center Service Areas
Wireless_areas(mi_wireless)	Shapefile	Wireless Areas

Folder: Provider Inventory Data

File Name	File Type	Description
CableModem_Point	Shapefile	LinkMichigan Cable Modem Distribution Hub

		Locations
CableModem_Polygon	Shapefile	LinkMichigan Cable Modem Distribution Hub Service Areas
Eco_Dev	Shapefile	Economic Development Zones for region
Fiber_Wireless_Point	Shapefile	LinkMichigan Private Fiber Fixed Wireless Access Point Locations
Fiber_Wireless_Polygon	Shapefile	LinkMichigan Private Fiber Fixed Wireless Access Point Service Areas
Fixed_Wireless_Point	Shapefile	LinkMichigan Fixed Wireless Access Points
Fixed_Wireless_Polygon	Shapefile	LinkMichigan Fixed Wireless Access Points Service Areas
ISP_POP	Shapefile	Internet Service Providers Point of Presence Locations
ISP_Wireless_Point	Shapefile	Internet Service Providers Fixed Wireless Access Point Locations
ISP_Wireless_Polygon	Shapefile	Internet Service Providers Fixed Wireless Access Point Service Areas
Private_Fiber_POP	Shapefile	Private Fiber Point of Presence locations
Telecom	Shapefile	Telecom Point of Presence

3.I. Installation Instructions for ArcExplorer 4.0.1 Java edition:

Downloading ArcExplorer 4.0.1 for Windows

System Requirements

- Operating System: Windows 98/2000/NT/XP for Intel, Service Pack 4, 5, or 6a (6a is recommended)
- Disk Space: 13 MB
- JRE: 1.3.1_02 or 1.4.0 with Java Plug-in.

ArcExplorer 4.0.1 requires JRE 1.3.1_02 or 1.4.0 (java plug-in for running ArcExplorer 4.0.1.) **Note that you must run the JRE prior to launching ArcExplorer 4.0.1**

ArcExplorer can be downloaded from:
http://www.esri.com/software/arcexplorer/aedownload.html

3.J. Installing ArcExplorer 4.0.1 for Windows

To begin installation, navigate to j2re-1_4_0-win-i.exe file in the ArcExplorer folder and double click to start installation, follow the onscreen instructions.

Then navigate to AE4JavaSetup.exe in the same directory and double-click the file and follow the on-screen instructions.

After installation, click Start | Programs | ArcGIS | ArcExplorer 4.0.1 to open ArcExplorer 4.0.1.

You can also read some detailed installing and getting started instructions from the "using_arcexplorer_java" pdf user guide for ArcExplorer 4.0.1. Read chapters 1

3K. Adding Shapefiles to ArcExplorer:

1. Click the add layers button, the first button on the top left corner of the main menu bar.
2. Browse to the shapefile you want to add
3. Click file to add
4. Click the add layers button, the file gets added.
5. To add more files, repeat steps 3 and 4.
6. Click Close button to close the catalog.

3.L. Adding Image Files:

1. Click the Add Layers button to open the Catalog.

2. Click the File Type dropdown and choose Image Files.

3. Navigate to the folder that contains an image.

4. Click an image to add.

5. Click the Add Layers button.

6. Repeat steps 4 and 5 to add more images.

7. Click the Close button to close the Catalog.

Please refer to the ArcExplorer user manual "using_arcexplorer_java" for detailed instructions. The user manual pdf document is located in the ArcExplorer folder in the CD.

3.M. Inventory Data Collection Summary

The data collection process was complex, time consuming and stressful. As had been anticipated, due to provider business issues and survey methodology that was required, the data is less than 100% complete.

In general it was found that infrastructure existed in the places where it would typically be expected -- higher population concentration areas, but services and infrastructure were far from ubiquitous.

Merit would be happy to provide a number of recommendations relative to how this effort could have been centrally directed more effectively, which may well have implications for future efforts, but those recommendations are outside the scope of this report. Providers were not always forthcoming with pricing information, and pricing changes often. There are commercial products available for purchase that are updated regularly. For example, pricing information for telco services is available for Local Exchange Carrier services from Triquad/Universal Access. This product, called Lattis.Pro, costs between $4000 - $6000 for an annual license. It may be a useful tool if detailed pricing is required.

It would be most advantageous if all regions in the state could use a GIS system for this effort. The State needs a *State view*. A GIS system, if deployed throughout the State, could provide this view, but the counties would have to lead the effort to get it deployed.

Two main goals for the future should exist in the region to ensure that the time and money spent on this effort is not wasted: 1) A means to encourage, entice or require providers to add information to the GIS system should be devised and implemented; 2) In the interim, some committee or staff member should take ownership of the system and the database integrity.

3.N. Summary of GIS-Support Tool (Web-enabled Survey Forms and Service Boundary Capture Tool)

In this component of the work, Merit subcontracted to a leader in GIS mapping and data processing, the Institute for Geospatial Research & Education (IGRE) at Eastern Michigan University (EMU). A description of the work and background on IGRE follows.

The Challenge: The AMI Telecom Survey instrument (Regional Planning Group Broadband Provider Inventory Form) was not designed to *map* telecom service areas. However, the raw data is not particularly useful to planners and others unless it can be turned into *information*. The most practical way to turn the data into usable information is to map it. In order to map product service areas using these forms, you have to find a way to visualize service boundaries. Service boundaries could be provided via CAD files

or paper drawings from the providers, but you would still need to manually associate the AMI Survey records with associated graphical representations of the service boundaries in order to map them.

Web Based Solution: For this project, we designed two tools to semi-automate this data collection process so that the County meets its goal of, having the collected information able to be "…overlaid on existing County Planning maps and [can be] updated easily over time." The first tool developed was an Internet based questionnaire and related AMI and Merit Network databases, which captured telecommunication's survey data. The second tool is a customized ArcIMS (ESRI Internet Map Service) Internet application. These two tools were integrated to provide telecom service providers with a means to complete the questionnaire and map telecommunication service areas Online. Captured data is exported from the Web applications to shapefile format.

Deliverables: The products developed for this project are comprised of 1) a copy of the AMI and Merit Network Telecom Survey Forms and database structure, 2) compiled code for the online mapping tool and, 3) a written User Manual that simply explains the data capture process and post processing requirements.

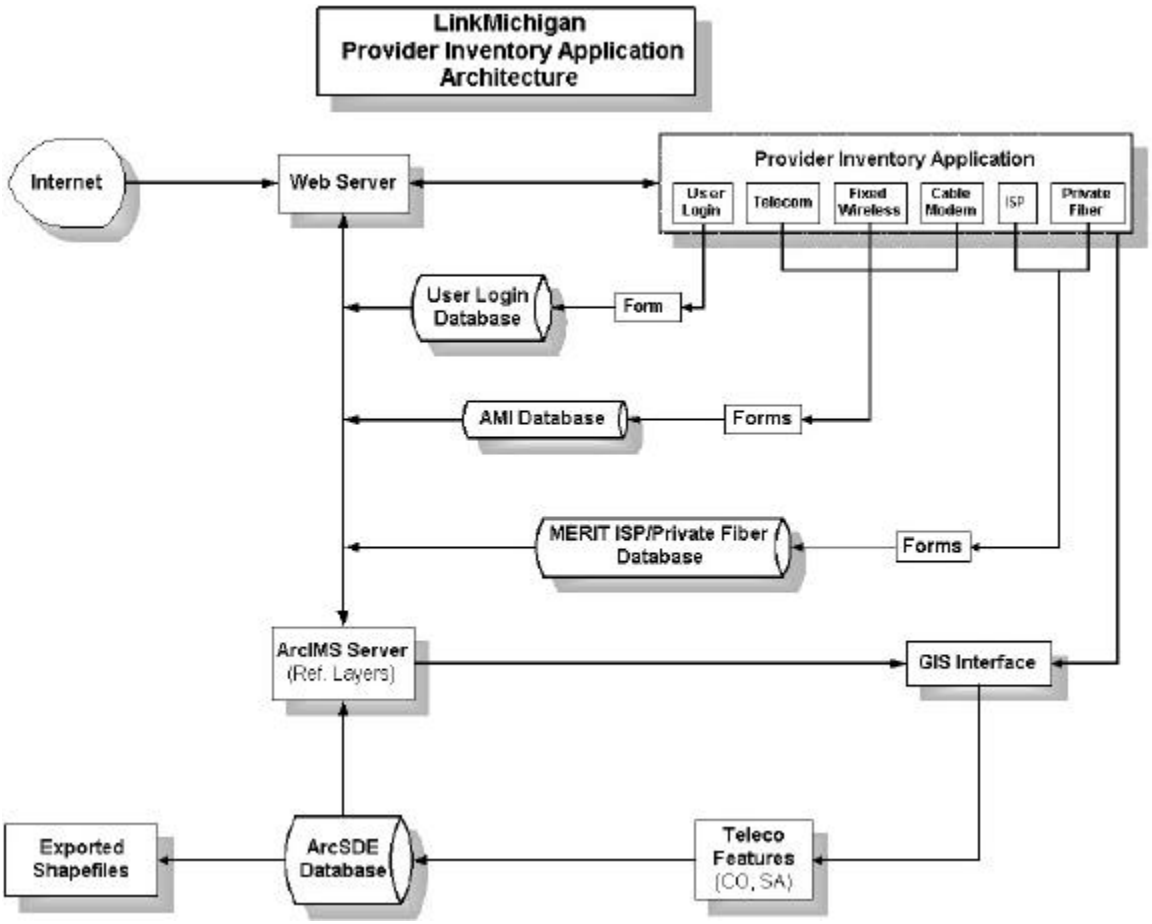
Scope of Work: The developers at the Institute for Geospatial Research & Education (IGRE) at Eastern Michigan University (EMU) used their knowledge of Online development tools to Web-enable the Regional Planning Group Broadband Provider Inventory Forms designed by American Megacom, Inc and Merit Network. These forms were integrated within an ArcIMS Website using a customized user interface to provide a means to map service areas captured by the Inventory Forms.

To identify service areas associated with the telecom survey questionnaire, IGRE developers customized the ArcIMS user interface and developed online mapping tools to integrate survey form data with map features created by the provider. The tools are accessed via an Internet browser and allow the telecommunication's provider to view both the survey forms and the map interface simultaneously. For any particular service, when the form requests the location of a service area, the provider uses the map interface and selects a tool to draw a polygon feature, which then represents the appropriate service area boundary.

Both the form data on the questionnaire and the spatial feature created by the ArcIMS service are recorded to a database. Captured data is exported from the Web application to shapefile format for use on any GIS application.

Please refer to two additional files for more information regarding the applications. 1) PI_SDE_architecture, a jpeg image and 2) SystemRequirements_SDE, a Word document.

Following is a schematic diagram of the application architecture:



LinkMichigan Regional Telecommunications Planning Program

Provider Inventory Application

System Requirements

Part I. Software requirements

1. Operating System: Microsoft Windows (2000, XP, Server).
2. Web Server: Windows IIS 4.0/5.0
3. Servlet Engine: Tomcat 3.2.x
4. Web Browser: Microsoft Internet Explorer 5.0, or higher
5. ArcIMS: ESRI ArcIMS 4.0.1.

6. ArcSDE: ESRI ArcSDE 8.2 for Oracle
7. DBMS: Oracle 9i
8. ArcMap: ESRI ArcMap 8.x

Part II. Hardware Requirements

1. CPU: Pentium 1.0 GHz, or higher
2. Memory/RAM: 512 MB Minimum, 1 GB or higher Recommended
3. Disk Space: 200M, or more

Section 4 - Strategic Plan

4.A. General Background - LinkMichigan Purpose

As stated in the *Introduction* section of this report, the primary goal of the region in the LinkMichigan planning effort was to design a telecommunications plan and develop strategies that will significantly improve the availability, cost, and quantity of advanced Internet and telecommunications services for all constituents in the region.

The LinkMichigan planning work addressed four key areas, i.e.,

1. An infrastructure inventory to determine what services and facilities exist in the region, and the presentation of this information in a usable format for the planner and others;
2. Assessing user needs in terms of network demand in the future;
3. Assessing technology options for implementation planning;
4. Defining an implementation plan that is affordable and doable.

This section addresses the fourth task and Washtenaw County's goal of developing a *Strategic Plan* to include telecommunications services. It includes recommendations of both policy level activities as well as specific technology options to meet user demand in the specific areas identified as key by the economic developers. A key funding source is the MBDA, and discussion of the procedures for dealing with MBDA are presented. An implementation timeline is presented with key milestones.

It should be noted that although these *Strategic Plan* recommendations are specific to Washtenaw County, many of them are indeed generally applicable to any region in the State, or for that matter, the country. They are the basic activities that should be undertaken if the goal for ubiquitous broadband deployment is serious. Of course the *Network Planning Guidelines* in the *Strategic Models* are more specific to Washtenaw County, but the technical network planning for broadband is just part of the effort. It is Merit's view that if a concerted, energetic effort is made to implement all of the *Strategic Plan* recommendations as follows, that the goals of the LinkMichigan planning effort can be met.

4.B. Overview of Recommendations

Future demand that crosses all market segments can in part be inferred from current internet deployment rates and from the trajectory of bandwidth demand growth over many years that show no sign of slowing. In addition, the convergence of communications networks indicates that the need for an IP (Internet Protocol)-based broadband infrastructure is required. Lastly, it is anticipated that network-based application serving will significantly change the software model for small and medium sized business.

These trends are real, and most technologists and many service providers have some sense of the potential future impact on networks. But the typical user today does not make an inference from past bandwidth growth to future needs and adjust their budgets, likely is not spending much time stewing on network convergence, and has never met an ASP (Application Service Provider). There is a demand gap. Broadband providers may understand trends, but are reluctant to commit resources until demand is actually demonstrated.

Since demand drives the supply, one of the key ways to obtain more broadband services in an area is to increase that demand. To increase demand, users must become more aware of trends in networking and technology that will transform their operations. Thus, continuing education is required so demand can be articulated and users can begin to incorporate the advantages of broadband into their personal, business and institutional plans. This section suggests ways to accomplish this.

Of course network capabilities must be present to meet this demand. And today the availability of network services is not as expansive or as cost effective as might be desirable for current requirements, and particularly for a future that includes the evolution in demand. In other words, the current infrastructure is inadequate. As part of the recommendations that follow is a deployment plan for the region that will help to expand services and make that expansion cost effective for providers to deploy services and users to take advantage of them. Fundamental to this recommendation is the notion of a "carrier-neutral collocation facility" which is essentially a purpose-built space where both provider traffic and backbone traffic will be able to be aggregated.

Therefore, *it is recommended that the county build this network and collocation facility, or at minimum, cause it to be built by sending out an RFP for the components, managing vendor bids and even helping to secure funding and/or MBDA loans. Note that this does not mean governmental ownership -- a new, private corporation could be formed to build this network.* Also note that a model for this exists in that the National Science Foundation, in its 2nd solicitation for the NSFNET in the early 1990s, succeeded in having commercial vendors respond to its solicitation in a heated competition to be the designated backbone provider, even though no money flowed from NSF to the backbone providers and no one was precluded from being a provider. (Money did flow from NSF for a short time to regional networks who were key customers. Thus NSF funded the buyers as was noted previously in this report as a successful model in some European countries.)

This region has a number of challenges that have most likely impeded deployment and may well continue to do so unless the recommendations below are followed. First, it has a relatively large rural component with a geographically dispersed population. This makes it difficult for a large provider with a required rate of return that is high to make a solid business case for the entire region. Many providers target first for deployment "First Tier Cities" such as Chicago, NYC, Los Angeles, Atlanta, etc. Then come the "Second Tier Cities" like St. Louis, Kansas City, etc. But Milan is certainly further down the deployment list for large carriers, and the crossroads of Dixboro and Five Mile Roads

probably will never make the list. It is Merit's view that the most viable providers will be smaller, more local providers. The *Physical Network Deployment Recommendations* below describe how to encourage smaller providers to build and how to make it cost effective. Key to these deployment recommendations is regional sponsorship of the carrier-neutral collocation facilities and a regional backbone.

Merit believes that the implementation plan below could, optimistically, achieve the initial implementation within one year if the comprehensive plan is addressed. The network and POPs could feasibly be complete by next summer if all goes well. Doing pieces of the plan, or not prioritizing the tasks or skipping some, could well lead to an implementation that would begin several years out.

One *key point* about the physical *Network Planning* recommendations is that incumbent providers will likely not receive well the fact that there is a network plan being built that does not rely on their leased circuits, but assumes new, owned infrastructure, and effectively introduces a new competitor into their areas. The region should not be surprised if there is resistance. More importantly, the region should expect that the incumbents will attempt to offer alternative "solutions" that likely will include leased circuits that the region pays for indefinitely, thus ensuring the incumbent's stranglehold on the infrastructure availability and pricing.

Expediting demand, user education and technical deployment are all part of the "implementation plan" and all require leadership. These activities will not happen, at least not expediently, in an ad hoc fashion. Leadership is the fundamental effort underlying all these components of the recommended implementation plan. Thus continuing the leadership provided thus far by the LinkMichigan Steering Committee is a key recommendation.

4.C. Leadership

There is more to Broadband than just building or improving infrastructure. In order to truly drive broadband deployment and usage, there must be work at many levels. *Leadership and focused planning are the keys to getting this work done*. Given the current economic climate and the dysfunctionality of the free-market mechanism with regard to investment in Broadband development, a government and/or industry sponsored organization to drive Broadband and related growth is necessary.

Communities that are able to put the infrastructure in place will find themselves at a competitive advantage as the existence of a local infrastructure will clarify demand and demonstrate the existence of a market required by service and content providers.

"Priming the pump" with local infrastructure will act as a catalyst for individuals, businesses and institutions who will then be able to take advantage of the currently-knowable benefits of Broadband as well as to innovate, create, and find new applications that will enhance their personal, social, and business lives.

4.C.1 Formation of Leadership Group

This section describes how the leadership for the implementation plan may come about, what are some of its roles as well as recommended specific tasks.

It is recommended that a "Broadband Council" be formed to continue to drive the implementation plan. The overall task is to be a *business resource* in the broadband development activities. In general, the Broadband Council would continue the activities of the LinkMichigan Steering Committee but would integrate more formally into ongoing local and regional planning activities.

This council may evolve from the LinkMichigan Steering Committee, or perhaps other local participants may be identified. It may be a separate private corporation, LLC or even an Authority. Legal counsel should be consulted to determine the best model for the region. It will be important for the council to have some level of legal capability to make business arrangements, issue RFPs, negotiate contracts, and apply for funding. This *legal* capacity is viewed as critically important. In other words, a volunteer organization, regardless of the strong commitment of its members, is not powerful enough for the tasks that lie ahead. For the purposes of the remainder of this paper, the organization will be referred to as the "council," understanding that the region may choose to have it take some other form.

The Broadband Council should include key participants from government, business, media and public relations, economic development organizations, healthcare, education, and broadband service providers. Some of the important qualities of the participants are 'thought leaders' in the community; strategic thinkers; those who are known and well-respected by the community; knowledge and commitment to the community; those who have solid financial analysis expertise; those knowledgeable of local issues and sensitivities; contract expertise; and importantly, those who are truly interested and able to devote focused time to this effort. It is understood that this last quality may be difficult to obtain from a volunteer council.

The council should immediately form a Broadband Technical Subcommittee. The overall task of the Technical Subcommittee is to be a *technical resource* in the broadband development activities and to direct ongoing planning. Some of the important qualities of the participants are familiarity with local infrastructure; technical knowledge including Internet protocols, routing, switching, equipment and network topologies; current job function that relates to networking which will keep the knowledge current and help relationship-building; knowledge of and commitment to the community; ability to apply rational engineering economics to designs; true interest and ability to devote focused time to this effort. As with the Broadband Council, this last quality may be difficult to find particularly since talented technical personnel are a scarce resource.

This structure is similar to what the county has had in place for the LinkMichigan planning, and perhaps the individuals from the steering and technical committees will continue to participate. However, a strong effort should be made to hire at least one full-

time individual who will project manage the tasks of the Council and Technical Subcommittee and be able to devote full time attention to the challenges and tasks ahead.

The following two sub-sections of this *Strategic Plan* section address some of the specific tasks that the Broadband Council and the Technical Subcommittee should do. These tasks are summarized in an action plan at the end of this section. It is recognized that some of these activities may well be underway already in the county, but it was beyond the scope of this project for Merit to survey and document all current broadband planning activities.

4.C.2 Broadband Council Tasks

The tasks of the Broadband Council fall for the most part into five main categories: a) Getting connected; b) Public Relations/Presence/Policy; c) Education; d) Negotiating contracts; e) Support of the network deployment plan. Some tasks do not fall cleanly into a category, or they actually cross category boundaries. For these tasks, a category was chosen where it best fits. These tasks include the following:

4.C.2.a Getting Connected

It is difficult to drive growth in broadband deployment unless the "drivers" have broadband themselves and incorporate it into their daily business and personal life. As stated in the *Quantitative User Needs* section, once connected, people's view of how to take advantage of the network changes dramatically. Related to this overall task, the Broadband Council should,

- Complete an assessment of broadband capability for all council members.
- Set minimum standards for connectivity, e.g., 256 kbps or greater.
- Gain sponsorship for costs to deploy to the council members' businesses and homes.
- Direct the technical subcommittee to estimate costs and issue an RFP to fully deploy.
- Manage the deployment to a specific timetable.

4.C.2.b Public Relations/Presence/Policy

It is critical to keep the implementation plan and the broadband deployment effort in the forefront of the community's view of important activities. "Community" in this sense is more than just end users, but includes policy-making entities, construction and development organizations and local governments who control permits. A number of activities can accomplish the objective of good PR and promotions that illustrate "presence" of the council and its goals. Example tasks include:

- Regional planning, funded by the MEDC has been done in twenty-six counties throughout the State. Three million dollars has been spent by the MEDC, and local groups have contributed additional cash match. Challenges are the same in many areas. The scope of this effort focused specifically on this region as required, but there is advantage to knowing what is happening in other regions, particularly adjacent ones, and leveraging commonalities. It is recommended that the Council contact the LinkMichigan Regional Planning contact in at least the adjacent regions to determine how the groups might work together. There is a caution, however: This county decided to be a single-county planning area for several reasons. If the "region" expands too greatly, it may delay implementation due to complex decision-making, political sensitivities and other complications. At minimum, PR experiences could be coordinated and experiences shared, and compatible network planning leveraged.

- Have a major PR presentation of the final report with the clear message that the collocation facilities described below and a regional network *will* be built. If possible, have the RFPs for the collocation facility and the network itself ready to be distributed.

- Broadband planning *must be formally integrated* into all county and regional planning activities. To accomplish this, the council must be recognized as a peer organization. This may be achieved through PR, but likely will be accomplished by the legal structure of the council (which requires legal advice to determine). The goal should be that the council is represented systematically in all activities that address business park development, zoning and permitting, public works including road and utility construction, and other areas. In this way, the broadband requirements will not be overlooked and in fact may be able to leverage the other activities. An example of what may happen if this is *not* a goal is the experience of a relatively large metro area in Michigan: fiber was pulled to connect a substantial number of traffic lights. However, no integration of this effort with the LinkMichigan Steering Committee planning, or any other network planning in the area was done. Businesses along the route are likely not even aware that fiber runs within feet of their front doors. Broadband planners were not able to provide input to, and possibly cost-share the build of this very useful resource.
    - Based on knowledge obtained above, "piggy-back" on public works projects such as water mains, sewers and roads under construction. They represent an opportunities for easy and cost-effective construction of underground ducts for fiber or for placement of aerial fiber.

- Work with local property developers and business park developers prior to construction so that network infrastructure and links to the POS are done as part of construction. See Appendix I entitled "Business Park Broadband Readiness" for the technical requirements that can be provided to builders.

- Promote businesses, organizations and relationships that provide critical supporting roles to broadband deployment including local technical training organizations, technical consulting, IT-integration firms, network security experts. Local user groups should be identified and/or directed to the Technical Subcommittee.
    - Working with economic development and Chamber of Commerce organizations, develop and distribute literature to promote existing support businesses and organizations addressed above, as well as their capabilities.
    - Identify gaps in where businesses in the technical support areas addressed above are lacking, and target and actively recruit businesses to fill those gaps, especially through the use of remote offices that leverage broadband.
    - Hold regular meetings, preferably in an existing forum, where service providers and the key organizations listed above can share ideas and develop joint ventures. For example, an ISP might be happy to deploy a hotspot in a local restaurant and share profits if the restaurant provides the space and marketing.

    - Regularly publish success stories where this is already working, particularly with local examples.

- Begin planning to have all local government organizations have a strong web presence with concrete plans for e-Government rollout. Citizens should be able to perform common government-citizen tasks such as applications for permits and licenses, viewing property taxes, tax bills, bill payments. It is recognized that this is a lengthy effort involving many people and bureaucracies. But if the issue is sponsored and socialized by the council, it may be the genesis for a new local business and even a grant to complete the effort.
    - Complete an assessment of current eGovernment capabilities, gap analysis and future plans.
    - Assist government organizations with applying for grants, loans or other funding means.

- Because it is believed that broadband cannot be understood until it is used, the council should coordinate efforts to provide free broadband access at various public venues and events such as city halls, county offices, fairs and service club meetings. The council should develop the policies for this free access that may limit it to only certain web sites or resources. The free access might require the user to register the first time and authenticate thereafter, and the council would need to settle on appropriate policies and mechanisms for authentication (with assistance from the Technical Committee).

- Organize and publish an *electronic* newsletter. Include success stories. Solicit major project information, upgrade plans and new service information from providers.

- Identify and help provide incentives for local businesses and institutions to offer their services online. Key players include: banks and other finance-related businesses, publishers and printers, retail stores, travel agencies, healthcare organizations, and restaurants and caterers. Cash may be difficult, but what do these businesses value? Local economic developers have good intuition and information on this topic, e.g., PR, advertising, access to profiles that economic developers have, help getting the presence online, etc.

- Convene regular meetings attended by these key players (above) and service providers at which ideas and capabilities can be shared so that services can be refined to meet needs or perhaps joint ventures could be developed.

- As stated in the policy section below, the Broadband Council should establish a means to track legislative initiatives and policy initiatives in other locales, states and countries.

- Begin a policy planning initiative with its first goal to investigate the extension of USF funding to an organization like the Broadband Council (see Subsection G for a description of USF). Invite a strong, respected, local legislative representative to chair a policy task force. A second, parallel goal should be to determine how

subsidizing end users' connectivity can be accomplished. This will expedite the "connectivity spurs demand" cycle.

4.C.2.c Education

Since education is key to closing the "demand gap" discussed in the introduction to these recommendations, some key activities of the Broadband Council related to education will be to:

- Establish a central clearinghouse for information that is of value to the community. This would include legislative initiatives and policy alternatives discussed previously, NRTC updates, publications of telecom policy specialists, listing of local businesses that provide technical support, where local training can be obtained, e.g., college courses, grant and government sponsored business loan and tax credit information. Also include the inventory of available infrastructure, service provider service offerings and contact information, promotional material on technology vendors.

- Encourage service providers and support organizations to sponsor broadband kiosks with all the information listed above available via the web. Have these kiosks in public areas and ensure that they are permanent fixtures vs. the free access sites identified above in promotions that might be available just for a particular event. Key task: ensure that they are well maintained and that the information is not aged. The antithesis of the goal would be to have a user fail to gain information due to the network, or see information that is obviously outdated or unusable.

- Hold meetings and workshops to provide community members with the background necessary to understand and make informed decisions on Broadband. It is acceptable to talk about the 'bleeding edge' even if that is unavailable in the area. It gets the community thinking and lowers the perceived risk of today's technologies. Have guest speakers who are respected industry representatives. Don't be reluctant to call upon the big names.

- The permitting process can delay construction of facilities. Many local entities do not realize the significant detriment their delay can cause. Educate those people who stand in a key place in the series of events for approval. For example, the Michigan Township Association (MTA) recommends to its constituents that they have a policy in place prior to approving permits. They suggest that entities delay permit approval until a policy is in place and many local entities do not have the time or expertise to develop a far-reaching policy. The council could draft a policy, provide it to the MTA, socialize it with them, and encourage them to provide it to their constituents. This same effort could take place with the Michigan Association of Counties (MAC) and the Michigan Municipal League (MML).

- Continue to track the efforts of the METRO Authority and any amendments to the METRO Act.

- One continuing challenge is the County Road Commissions that in many areas of the state are a significant bottleneck in getting rights of way approved. The METRO Act did not explicitly address the road commission responsibilities. It is anticipated that the METRO Act may be amended to include County Road Commissions, which would be a significant benefit in expediting right of way approvals. In the interim, Merit recommends that the economic developers work to encourage the road commission to be proactive in supporting rights of way. Additionally, Merit recommends that the region closely track court cases (e.g., Northville Schools vs. Wayne County Road Commission).

- Provide connectivity at public education forms. A caution, however, is that if access methods are too slow at the venue, there is likely significant backlash from attendees. Have it at a well-connected location, or don't have connectivity at all. (Canned presentations can work well if connectivity is bad.)

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4.C.2.d Negotiating Contracts

A key aspect of "aggregating demand" is negotiating bulk purchasing agreements for a group of constituents. Not only is the volume more attractive to providers, but there is the possibility of including members in the group who might otherwise not be of any interest, individually, to a service provider. Streamlining contract negotiation will also help expedite deployment. This issue may be of particular concern to smaller local providers who do not have a high profit margin. Some specific examples would be:

- Try leveraging buyer power to gain concessions to build infrastructure to underserved areas.

- Establish standard contracts or contract templates with consistent terms and conditions. Legal advice should be solicited in this regard, but some key conceptual items to include would be, standard non-disclosure agreements that allow the sharing of existing and future price information (often this is restricted); develop clauses that allow multiple organizations to purchase off the same terms and pricing; include a "market adjustment" clause that says periodic review of the contract price will occur and the price may drop due to market pricing dropping (then long term commitments can be signed without the fear of economic conditions making the pricing ridiculously high in a few years.

- Investigate whether a consortium similar to MiCTA for Michigan non-profits or the "Quilt" for research and education entities is possible to form, i.e., is there an argument for a community of interest in the entire geography that could then leverage significant buying power.

- Develop agreements so multiple organizations can share costs. For example, cost out the total price for a business park or residential development to construct fiber from the location to the POP. Then propose a revenue contribution that would cover the capital costs. The joint effort should be far cheaper than each organization or home building.

- Investigate whether ISPs in the county can receive the county designation as an "Essential Service Provider." If it is possible, it will expedite the permitting process.

- Coordinate contracts for anchor tenants at the collocation space to use the space that is managed by a 3rd party collocation vendor.

- Educate users of the value of the collocation space and joint capacity planning.

- Provide support for various loan and grant applications, e.g., MEDC, MBDA, USDA.

4.C.2.e Support of the network deployment plan

The subsection labeled *Deployment* has specific network recommendations and a comprehensive description of what is required for a carrier-neutral collocation facility or POP. The activities in this section are in support of that network deployment recommendation.

- Begin investigating the funding and business plan requirements for a provider of a regional/county backbone and the collocation facility, using the network planning guidelines in the *Strategic Models* section and the collocation and POP description below. Assume in the RFI/RFP that goes out (by the Technical Subcommittee) that Broadband Council may be the "buyer" but that other private entities are invited to sponsor the deployment and to propose the business arrangements to make this feasible. (For example, a fiber construction company may decide to build the fiber to the colo, and simply be the provider, for subscription fees from users, in operating it.)

- The new MITC (Michigan Information Technology Center) on South State Street is a potential site for a collocation facility. At the time of this report, the final details on the build-out are not complete. One event that could expedite the build would be to have an anchor tenant, i.e., the owner of the county's carrier-neutral collocation facility.

- Identify anchor tenants for the POP that have existing service that can contractually be moved to carrier neutral space.

- Identify migration time-table and plan for anchor tenants who contractually cannot move today, but can in the future.

- Identify anchor tenants who desire new service who could use the carrier neutral space once their local access is built out.
- If a cost-effective new site for a colo is not obvious, identify and negotiate with a local business that has an existing data center that might be used.

- If no 3rd party collocation vendor is identified, consider forming a corporation to do it. Secure funding from MBDA that is guaranteed by longer-term commitments from anchor tenants. Anchor tenant commitments will be easier to achieve if long haul carrier contracts are negotiated first. Contract out construction and management.

- Conduct bi-annual business reviews of the collocation facility and success in attracting tenants and carriers. Make adjustments to marketing plans, education plans and council membership to encourage further use of the facility.

- Investigate the tactic of getting Incumbent Local Exchange Carriers (ILECs) to designate part of their existing central offices as "carrier neutral." They have vehemently refused to do this in the past, but if they believe it is going to happen anyway, they may figure the revenue or other benefits from managing the colo are at least some offset to what they view as the negative market share loss. But it will be critical to ensure that there are *no* restrictive policies as to who can build into the facility and how those builders communicate. In addition, there must be "settlement free" communication between providers. That is, the manager of the collocation space should not charge fees for providers and users interconnecting. Lastly, there should be caution in terms of negotiating long-term tenancy without price guarantees and market rate adjustment clauses. The Network Access Points (NAPs) that were sponsored by some telcos during the transition from the NSFNET to the commercial Internet ended up being *very* expensive for providers. The worst scenario would be a neutral colo that many providers and customers connect into becoming very expensive, and yet the cost to move requires a new build.

4.C.3 Technical Subcommittee Tasks

A major role of the Broadband Technical Subcommittee is to provide technical advice and support to the Broadband Council in all their activities. The support required for each of the council's discrete activities is not reiterated in this section. At least one Technical Subcommittee representative should attend all council meetings to ensure that issues are addressed.

The other more specific tasks of the technical subcommittee fall into four main categories: a) Keeping up the inventory; b) General technical support; c) Capacity planning; d) Network deployment. Some tasks do not fall cleanly into a category, or they actually cross category boundaries. For these tasks, a category was chosen where it best fits. These tasks include the following:

4.C.3.a Keeping up the Inventory

- There is a single focus for this task, and that is the technical subcommittee should ensure that the infrastructure that was created does not go out of date when new services and technologies are deployed. Much effort and money went into the gathering of this data. There is a standard vehicle; GIS mapping that makes the data usable information. But effort must be made to continue to update the data. The MEDC has been approached with a proposal for a statewide user interface. The technical subcommittee should be aware of these activities and participate. Ideally, providers would be able to input their own data into the system. The proposed user interface would allow this.

- In the interim, it is recommended that the region continue to update the inventory using the AMI Access Database inventory forms, which are provided on the CD of this final report as well as the GIS system that has been developed. In this way, as a more permanent system is developed, the region will not have any holes in its data, or be required to start over completely.

4.C.3.b General Technical Support

- Identify and prioritize the locations for the free access points and plan and manage the implementation on an agreed upon timetable, as well as the ongoing maintenance. Wherever possible, local service providers should provide this free access.

- Estimate costs, issue an RFP and manage the deployment of the broadband connectivity to the council and subcommittee members' homes and work places.

- Assist in the information models, e.g., cross-link information with other web sites in the region and at the state level; establish appropriate key word and populate popular search engines; direct a quarterly update the web site and evaluate/improve the position on search engines.

- Produce a model RFP that governmental agencies could use to begin to establish their web presence and government functionality.

- Compile a comprehensive contact and service description list of all service providers in the area including IT integrators, consultants, security experts, technical recruiters, and user groups.

- Organize and manage a monthly users' group meeting where support companies listed above are invited as participants as well as guest speakers.

- Develop relationships with remote organizations where there are gaps in need for technical support organizations.

- Have a representative on the State backbone planning effort.

4.C.3.c Capacity Planning

The aggregation of user demand to leverage cost savings and for other reasons is a key assumption of these recommendations. Thus a more structured capacity planning oversight function is required.

- Assess the demand requirements for anchor tenants of the POP to determine impact on existing capacity and contract scale.

- Conduct quarterly capacity planning meetings.

- Complete broadband and technology assessments to accompany any major county development project such as a business park, public works, roads, and highways.

- Provide loop construction cost information to individual businesses that may want to build to the colo themselves. This is not typically the model for "last mile" but if a company has the capital, they may just want to do it. Negotiate bulk construction deals -- it is much cheaper per job when a construction company is constructing four or five loops at one time vs. one at a time.

- Make available a list of professional contacts that work in fiber construction. This includes construction companies as well as 'General Contractors.' For example, the Southfield-based Childs Consulting Associates have been working with K-12 schools for many years in fiber construction projects. They know the routine, the costs and the vendors.

- Document opportunities to share common infrastructure.

- Conduct quarterly capacity planning meetings and issue RFIs/RFPs on an annual or as-needed basis to address incremental capacity increase requirements.

4.C.3.d Network Deployment

- Assist in the expeditious decision on where the POPs should be specifically and then their construction. Work with landlords, property managers and leasing companies to create a list of potential sites for the POP based on criteria of willingness to convert space to carrier-type facility, proximity to longhaul facilities, disaster-resistance, security parameters, proximity to providers such as ISPs and other carriers (CLECs, LECs, Cable, etc.) and the engineering guidelines for the POP in this document.

- Issue an RFI/RFP for 3rd party vendor to build and/or manage space for the POP, including the design specifications. One key site is the new Michigan Information

Technology Center (MITC) on South State Street, with current anchor tenants Merit Network, Inc. and Internet2. Occupation is planned for late 2004.

- Issue an RFI/RFP for the regional backbone, using the network planning guidelines in the *Strategic Models* section as a guide. The RFI/RFP should indicate that the Broadband Council might be the "buyer" but that other private entities are invited to sponsor the deployment and to propose the business arrangements to make this feasible. (For example, a fiber construction company may decide to build the fiber to the colo, and simply be the provider, for subscription fees from users, in operating it.) Appendix II includes an example of an RFI that was issued by several universities for their high-end research requirements. There was pleasant surprise at the quality of responses and the abundance of the resources at an affordable price, as indicated in the attachment.

- Conduct carrier negotiations to get adequate quantity and numbers of backbone carriers to connect to the collocation/POP site.

- Recommend the backhaul for the anchor tenants from the POP using the network technology and business options appropriate to each customer. The *Technology Options* papers in Appendix IV (and described in *Section 2, Key Indicators Assessment* can be used as a reference.

- Oversee the construction and commissioning of the facility in cooperation with ongoing management company.

- Assist in interconnect negotiations and logistics at carrier neutral POP.

- Set policies for peering and other business and networking requirements for POP. Recommend open, settlement-free peering.

- Update inventory and deployment timetable on a quarterly basis.

- Identify a ‘ point person’ (perhaps rotating) who has the responsibility to track new developments in infrastructure technology. For example, just this year, there was an announcement of a Fiber to the Curb (FTTC) initiative by the telcos; the completion of the 802.16 wireless standard that is posed to significantly impact the last mile; the National Rural Telecommunications Cooperative (NRTC) inked an agreement with a company to bring satellite Internet service to rural areas; and there have been developments at the FCC toward opening up the cable television plant for the Internet service competition. (See the *Inventory* section, *Snapshot in Time* subsection for more details on these developments.)

4.D. Summary of Tasks

The tasks listed above are meant to provide general guidance on the steps to be taken to expedite broadband deployment in the region. These tasks will evolve over time as development occurs. Doing them well is highly dependent upon the political situation and commitment in the area to this project. *Section 4.I* below highlights the key tasks to be completed in the next 30-90 days.

4.E. Physical Network Deployment Recommendations - Network Planning Guidelines

The *Strategic Models* section has network planning guidelines for the development of a regional backbone. Sponsorship of this backbone by the Council, in conjunction with the carrier neutral collocation facility and POPs will help expedite the provisioning of Broadband services in the region because it will be more cost-effective for ISPs to deploy service since user traffic is more easily aggregated.

This "sponsorship" by the Broadband Council should take the form of actually paying for the deployment. As with any capital initiative, the funding source(s) for this investment will need to be addressed. But waiting for providers to build to it will take the longest amount of time. The RFPs for the POPs and network may result in vendors willing to do it for the value of the business case. However, the region should not wait for that to materialize, but plan on sponsoring it themselves through the council (which may well be a private corporation as indicated.) The following section on *Policy and Funding* provide some suggestions on approaches to structuring the funding arrangements and public/private partnerships that might evolve for deployment activities.

The fiber for the regional backbone could be constructed, but as stated earlier, there may be available fiber that a provider might be willing to sell. The only way to verify costs of this latter possibility is to issue an RFI/RFP. Given the lack of population density in many areas, wireless options are recommended for several of these areas, and their cost effectiveness is reflected in both the *Network Plan* and the business cases.

4.F. Physical Network Deployment Recommendations - Carrier Neutral POP and Circuit Termination Point Guidelines

Following is a detailed recommendation for a "Carrier Neutral POP and Circuit Termination Point." This POP is a key aspect of the implementation plan. It facilitates the deployment of a regional backbone and the cost-effective deployment of broadband in the region. It is a critical recommendation. The rationale for the POP is explained below. Included are very specific guidelines for how the POP should be constructed.

4.F.1 What is a Carrier Neutral POP and Why is it Important? - Network Background

When network service providers service end users, they must aggregate all of that end user traffic. That traffic is then placed on larger backbone or trunk links to be efficiently carried to another location where it is delivered to another customer, or another service provider. Circuits, fiber links and wireless links from end customer locations are brought to a central facility and connected to equipment (multiplexer, switch or router) which combines that traffic and directs it over the backbone or trunks to the appropriate destination.

Since a large number of customer connections and critical backbone/trunk links are all converging at a single point, a specialized facility is required. This facility is typically called a POP (Point-of-Presence). In order to ensure the highest level of reliability for these facilities, great care and expense is taken to construct the facilities with protection from natural and manmade disasters, as well as high capacity, redundant systems for all critical functions (power, cooling, security, fire detection/suppression).

Historically, each service provider built their own POPs and used them exclusively for services to their own customers and connections to their own backbone. The LECs have many of these facilities and refer to them as Central Offices. AT&T, MCI, Sprint and other long haul carriers also have their own POPs. They interconnected their POPs with the LEC's Central Offices using circuits, usually over fiber. Internet service providers (ISPs) also built their own POPs, and purchased circuits into their POPs from the LECs for customer connections, and long haul carriers for their backbone links.

The Telecommunications Act of 1996 introduced many changes to the industry, opening it to an unprecedented level of entry for new competitors. Two of the key changes were that the LECs were forced to open their Central Offices to competitors' (CLEC) equipment and fiber, and to allow CLECs to resell portions of the LEC network infrastructure. The CLECs also realized that if they allowed customers to place equipment in their POPs, they could reduce their customers' total costs by eliminatingthe extra circuit costs from the CLEC POP to the customer's location, while at the same time, locking in that customer to always use the CLEC's services. Many ISPs took advantage of this cost saving by moving their POPs into the CLEC's POPs. This is whatis known as collocation.

As competition increased and more carriers entered both the local and long haul markets, customers began to demand more and more interconnection between the CLECs themselves in order to leverage the best pricing, coverage, delivery and reliability. Since most CLECs had focused on interconnecting with the LECs (the LECs had most of the existing marketshare and end user infrastructure), it usually was very difficult and costly to get circuits between multiple CLECs. Also, many customers who had collocated with the CLECs, became dissatisfied that they did not have the flexibility to purchase from any carrier they wanted. Most CLECs had policies against this in their own POPs, or they charged large fees in order to do so. The CLECs were in business to sell their own circuits.

Out of these demands, as well ever-increasing costs to interconnect large carriers and ISPs using circuits, came the idea of a Carrier Neutral POP, sometimes also known as a Carrier Neutral Collocation. These facilities are operated by 3rd parties not affiliated with a particular LEC, CLEC or other carrier. They encourage LECs, CLECs and other carriers to bring large capacity fiber infrastructure into the facility. Depending on the business model of the party owning the POP and the perceived demand by the carrier for their services, the owner of the Carrier Neutral POP and the carrier may have one of several cost arrangements:

1) Carrier pays all of its own costs to bring fiber and equipment into the facility but pays no rent to the Carrier Neutral POP
2) Carrier pays all of its own costs to bring fiber and equipment into the facility and pays rent and utilities costs to the Carrier Neutral POP
3) Carrier Neutral POP pays construction costs for the carrier to bring fiber and equipment into the facility and the carrier pays no rent or utilities

Their may be some arrangement on the revenue side as well where the carrier and the Carrier Neutral POP owner share revenue from one or the other' s services, or one party acts as an agent for the other who pays a commission on new sales.

With infrastructure in place from multiple local and long haul carriers, the owners of the Carrier Neutral POPs are able to easily attract a lot of other service providers, especially ISPs and other providers who need large capacity connectivity to multiple local and long haul carriers. The Carrier Neutral POPs are also attractive to the CLECs and competitive long haul carriers since they can easily interconnect their networks with a simple cross-connect within the facility to any other carrier, instead of costly circuits or fiber construction between all facilities. ISPs are now using these facilities as the 3rd step in the peering evolution from public peering at well known exchange points (i.e. MAE-East), to private peering over large circuits between POPs, to cross-connects within these Carrier Neutral sites.

4.F.2 What is a Carrier Neutral POP and Why is it Important? - Regulatory Background

Carrier Neutral POPs represent today' s stage of a continuing evolution of how to best aggregate customer demand and to connect local and long haul infrastructure. They significantly reduce costs, increase reliability and speed time to provision new capacity by providing direct, inexpensive connections to infrastructure from multiple local and long haul carriers, as well as giving economies of scale to the costly construction of all the critical systems to support a POP.

The LECs and the competitive carriers negotiate inter-connection agreements approved by state regulators. In Michigan, the Michigan Public Service Commission (MPSC) is the regulatory agency responsible for approving the inter-connection agreements. LECs are supposed to set reasonable terms, including fees for the inter-connections. These fees

ideally represent fair value of the competitors' use of the infrastructure that was paid for and is maintained by the LEC.

The inter-connection agreements and the setting of reasonable terms and rates have fueled competition in telecommunications by providing competitive access to the monopoly-built infrastructure. However, the interconnection agreements' emphasis is on the older, existing infrastructure that is subject to regulation. To that extent, the LEC-centric inter-connection model has been an impediment to innovation and growth.

When the focus is shifted to a "carrier-neutral" meet point for interconnection, competitive market forces come into play to forge network inter-connection relationships in response to consumer need rather than infrastructure legacy.

Carriers and ISPs have never been compelled to meet *only* in LEC facilities. The LECs, of course, prefer inter-connections at their own facilities. The competitive carriers and other network providers like ISPs can inter-connect with one another freely, and they have done so in many ad hoc arrangements. While these may work well on an individual case basis, there are no economies of scale.

In the carrier-neutral POP or telecom hotel model, a non-carrier third party provides a physical space near to carrier infrastructure. Carriers are responsible for extending their cabling infrastructure into the carrier-neutral POP.

The third party, sometimes called the landlord or *hotelier*, provides floor space to each carrier for equipment racks as well as electrical power, HVAC, and security. These are, by far, the largest expenses involved in operating a POP, so carriers benefit because their operating costs are reduced. Also are provided are the conduits, cable trays and other physical components required for carriers to make the connections between their networks. Through the individual leases with the tenants, the landlord also establishes some basic ground rules for access to the facility, engineering requirements, and tenant-to-tenant interactions.

Carriers themselves are free to negotiate the terms of their inter-connections. Sometimes, those interconnections may be entirely reciprocal and involve no exchange of money. For example, two ISPs with network equipment at the same carrier-neutral POP may agree to interconnect to exchange only traffic destined for end users on the other's network. One ISP may be a cable modem provider connecting mostly homes in the local or regional area, and the other ISP may specialize in providing Internet service to libraries. The two exchange traffic reciprocally because it is in the interest of the cable modem provider to provide its customers with speedy access to their local libraries, and it is in the interest of the library ISP to provide the libraries with a fast and efficient route for its patrons.

In other instances, a smaller carrier may pay a larger carrier for the privilege of inter-connecting to it because access to the larger carrier's network brings value to the smaller carrier's customers. A small local phone provider, for example, must give his customers access not only to one another but also to the regional, national, and international phone

systems. To that extent, the local phone provider will pay to inter-connect to a larger carrier that will provide access to that system.

Establishing the carrier-neutral POP as an aggregation point for local networks solves the "build it and they will come" problem. Long haul carriers, ISPs, and other network providers do not have to build dedicated infrastructure to all of their potential customers in the local area; they need only build into the carrier-neutral POP and gain access to local customers through it. The carrier-neutral POP is flexible because it is not dependent on one large customer or carrier. It provides a level playing field for competition for the business of the locally connected individuals and networks.

A local carrier-neutral POP will also help keep local Internet traffic local. Currently, a stream of Internet traffic to and from two organizations in the same city can travel hundreds and even thousands of miles across the Internet backbone. This absurd phenomenon is actually the product of seemingly rational business practices by the ISPs involved.

If organization #1 purchases Internet service from ISP #1 and so does organization #2, then the Internet data that passes between them never leaves ISP #1's network, and it stays local. When a second ISP, ISP #2, provides service to organization #2, the traffic between the organizations must flow "up" to the point on the Internet where those two ISP can exchange traffic. Depending on how the ISPs connect to the greater Internet, it may make more sense to route the traffic to a distant exchange point where commodity Internet access is cheaper than to purchase that commodity interchange locally.

While any single instance of routing local-to-local traffic over great distances on the national infrastructure can be rationalized on a cost basis, the net effect of the aggregation of such practices is greater congestion on the backbone and higher costs for the industry as a whole. And, even though the data travels at the speed of light, the physical length of the route does affect its speed, and speed sensitive communications like those required for interactive content may be noticeably affected.

4.F.3 Introduction to the Guidelines for Building the POP

These guidelines shall serve as a reference to developers, designers, consultants and end users as the requirements for the telecommunications POPs and Circuit Termination Points. While these guidelines will serve as a point of reference, it is important that detailed requirements be established on a project-by-project basis by a qualified professional working closely with the key stakeholders. Also, qualified and licensed architectural, mechanical and electrical engineering professionals and contractors shall be employed for the actual design and construction of these facilities.

The Carrier Neutral POP has several key components that must be considered when constructing this type of facility. These components will be required whether it is a very small facility housing limited carrier and aggregation equipment (Circuit Termination Point), up to very large facilities designed for large carrier infrastructure and service

provider/enterprise customer collocation. The main components of both the Carrier Neutral POP and the Circuit Termination Point fall into the following categories:

- Codes, Standards, and Regulations
- Site Location
- Space / Architectural
- Environmental
- Electrical / UPS / Generator
- Copper & Fiber Entrance and Cross-connects
- Fire Detection & Suppression
- Security, Monitoring & Alarms

4.F.3.a Codes, Standards, and Regulations

Each project must adhere to all local, state and federal codes. All components and installations must adhere to applicable construction industry standards and bear an Underwriters' Laboratories (UL) listing and must conform to the latest edition or revision of the applicable codes, standards, and guidelines.

The code or standard establishing the more stringent requirements must be followed where any area of conflict occurs between codes and standards or between codes and standards and drawings and specifications.

4.F.3.b Site Location

The single most important consideration when picking a site for a Carrier Neutral POP or a Circuit Termination Point is proximity to existing and future carrier infrastructure. The ideal location will fit all of the minimum requirements described below in the Architectural section, and be in a facility that has existing fiber services from multiple local and long haul carriers.

A Carrier Hotel would be the best fit, but these typically only exist in very large metropolitan areas. A second choice would be within or directly adjacent to a building that is already being used by the local and long haul carriers. In many cities and towns, the LEC has a dedicated facility that cannot be used for a Carrier Neutral POP or a Circuit Termination Point. But, CLECs and long haul carriers usually place their POPs in multi-tenant buildings in the downtown area in close proximity to, or with excellent fiber connectivity to the LEC Central Office. Another alternative would be to search for sites, which house businesses or institutions with large telecommunications requirements. Examples are universities, district offices for schools, hospitals, cable TV or broadcast TV headends or studios, businesses with data centers (banks, insurance, call centers, manufacturer headquarters, ..). These businesses or institutions may even be willing to lease a portion of their existing data center space, meeting many of the other requirements for a Carrier Neutral POP or Circuit Termination Point, and avoiding many of the construction costs.

If a facility with existing carrier infrastructure cannot be located, then another alternative is to look at sites in close proximity to known fiber routes and right of ways. An existing building that meets the architectural requirements below is ideal in order to keep costs down, but new construction can also be used.

Other considerations include avoiding sites that are prone or at-risk to natural or manmade disasters. Especially of concern are flood zones, areas susceptible to severe storm damage (falling trees), and sites in close proximity to high fire risk or noxious activities (fuel farm, chemical manufacturing, etc).

4.F.3.c Space / Architectural

Several decisions will need to take place before an overall square footage requirement can be developed:

1) **How many carriers will locate their equipment in the facility and what are their requirements for number of racks or cabinets?** The minimum recommended number of racks to allocate per carrier is 2 if they are using electronics, 1 if they are just handing off dark fiber. If significant circuit growth is expected, the number of racks will need to be increased accordingly. Most carriers will provide specs for their minimum and growth requirements.
2) **Is it a Carrier Neutral POP or a Circuit Termination Point?**

	Carrier Neutral POP	**Circuit Termination Point**
Section 2 - Dark / Private Fiber Termination	YES	YES
Carrier Circuit & Fiber Services	YES	YES
Cross-connects	YES	YES
Circuit Grooming and Emulation	YES	YES
Customer Aggregation	YES	Limited
Backbone Node	YES	NO
Customer Collocation	YES	NO

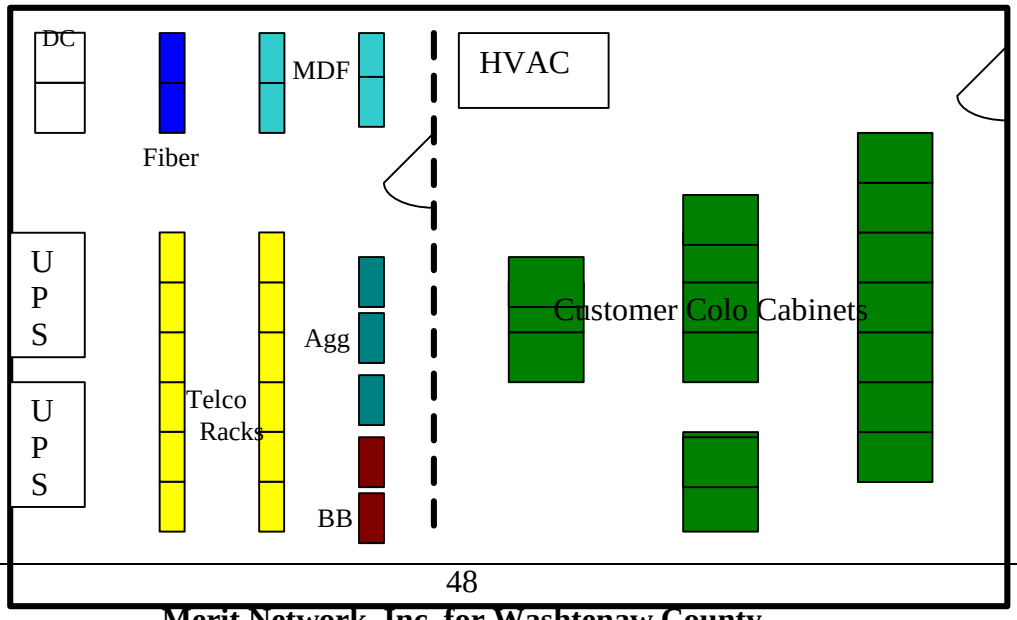
3) **Is this POP ("POP" used alone refers to both a Carrier Neutral POP and a Circuit Termination Point) strictly for carrier interconnect and aggregation, or will this also be used as a backbone node?** The latest aggregation technology can service several thousand end users from a single rack. The entry cost for this equipment is very high though and only makes sense if there is a very high growth rate. Most organizations opt for lower density, modular or stackable aggregation equipment. Even going this route, you can service 50 to several hundred end users from a single rack depending on the equipment chosen and the last mile technology. A good minimum number of racks for aggregation is 3. The same density/cost/growth rate tradeoffs also exist for backbone equipment.

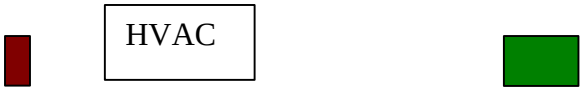
4) **Will other service and content providers be able to collocate equipment in the facility? How many?** ISPs and wireless carriers are usually very interested in locating their equipment close to fiber and carrier infrastructure. In a smaller facility this can easily be accomplished by dividing the carrier area from the collocation area from the carrier area with a fence, and then providing individually locking cabinets for the collocation customers. In larger facilities, dedicated caged areas and even suites can be provided for collocation customers. Selling this space to ISPs, WISPs and other service providers is a great way of quickly recovering the costs for the facility.

5) What level of redundancy is adequate for power and environmental systems? Primary power and cooling systems located in the POP backed up by building systems uses the least amount of space. This is especially true if an on-site generator is available so batteries for the UPS (Uninterruptible Power System) can be kept to a minimum. N+1 or 2N redundancy (discussed later in this document) will require additional floorspace for UPS and HVAC equipment. If a generator is not already available, space in a basement or outside the building will also need to be leased.

6) Will DC power be provided for the carriers, or will each carrier provide their own rectifier? Most carriers require DC power and battery backup for their equipment. If these are provided for them, it will reduce the number of racks. If not provided, each carrier will bring their own rectifier and battery plant, taking up additional rack space.

Once these questions are answered, a rough floor plan can be developed. From this floor plan, an estimated total square footage can be calculated. Each site will have a slightly different space layout and the floor plan will have to be modified accordingly to ensure the space is adequate. This is especially true for spaces that are odd shaped (not rectangular), have columns (interfering with the rack layout) or have inconvenient door or window placement. A sample floor plan for a typical POP is shown below:





As each site is being evaluated, several other factors and minimum requirements need to be taken into account:

- Perimeter walls for the POP space shall extend from the floor to roof deck. Walls between the POP space and other building tenants or common areas shall have the appropriate fire rating and be constructed of a minimum of steel stud, wire mesh and gypsum.
- Entry door shall be a minimum of 36" wide by 80" high and constructed of hollow metal
- Floor to ceiling clear height shall be a minimum of 4'
- If a raised floor is in place, it shall be a minimum of 12" high, preferably 24", with a 300-psf-load rating
- 1st floor, slab on grade location with a 300-psf-load rating is preferred. In a multi-story location, the floor needs a minimum rating of 150-psf and equipment layout and floor plan shall be adjusted to stay within this rating. For the DC power plant, a minimum rating of 600-psf is required. Professional evaluation of the structural details is highly recommended
- POP space and space above shall be free of all non-POP related water or waste pipes, roof drains or other penetrations, If such pipes exist, they shall be relocated outside the POP space. As a last resort, adequate moisture protection (sealed, waterproof chase with drain) shall be provided to ensure no moisture enters the POP space.
- A windowless space is preferred. If windows are present, they shall be tinted with an opaque coating and a wire mesh or other adequate security measure shall be installed. Also, for ground floor locations a new wall shall be constructed between the window and the interior POP space.

4.F.3.d Environmental

Dedicated air conditioning equipment is recommended for the POP. This equipment shall be designed for computer room or telecommunications facility applications. It shall be sized appropriately to maintain a constant POP temperature of 72F and a relative humidity of 50%. Two common vendors for this equipment are Liebert and Data Aire. Additional requirements are as follows:

- +/- 2F temperature control
- +/- 5% relative humidity control
- Downflow type in raised floor POP
- Upflow type with discharge plenum in non-raised floor POP

- Leak detection device
- Humidifier
- Alarm interface
- Roof or ground mounted air cooled condensers
- Condensate drain and cold water piped to each unit, with no routing above the electronic equipment in the POP

N+1 air conditioning redundancy within the POP is recommended.

4.F.3.e Electrical / UPS / Generator

Overall electrical load will need to be calculated based on the number of racks, size and type of the UPS, HVAC and DC systems. In some cases, the existing building service will not be adequate and will need to be upgraded, or a separate service and meter be placed for the POP. The service entrance switchgear will supply the UPSs and other power requirements thru an Automatic Transfer Switch (ATS) and appropriate distribution panelboards with transient voltage surge suppression (TVSS).

The following are recommended power requirements for the various types of racks and cabinets in the POP:

Telco rack = (1) 20 amp 120v
Backbone rack= (2) 20 amp 120v
Agg. Rack = (2) 20 amp 120v
Customer Cabinet= (1) 20 amp 120v

2N redundant UPS systems are recommended in the POP. The UPSs shall be sized to ensure maximum load never exceeds 80%. Where applicable, Power Distribution Units (PDUs) will be used to distribute power from the UPSs out to the individual cabinets using metallic raceway and/or EMT. A separate feed from each UPS, designated "A" and "B" will be delivered to each Backbone and Aggregation rack to ensure full redundancy. Common suppliers of this UPS equipment are APC, Liebert and Powerware.

A 2N redundant DC power system is also recommended for the POP. This system will supply –48v power to all telco equipment racks and is also available for specialized backbone and aggregation router and switchgear. The DC capacity shall be sized in coordination with the manufacturer. This system shall be fed by the redundant UPSs. –48v power shall be distributed as needed by a dedicated overhead ladder/tray and in-rack distribution modules where required for smaller equipment.

A permanent standby packaged engine generator sized to not exceed a 50% load and with the following requirements is recommended:

- Diesel powered
- Outside, pad mounted, as close to the POP as possible
- Emissions compliant with local code and authorities

- Weatherproof enclosure and security fence
- 24-48 hour on-site fuel storage via base mounted integrated tank
- Remote monitoring and alarms for
  - Fuel level
  - Fuel leak
  - Oil pressure
  - Battery
  - Temperature
  - Coolant level
  - Engine speed
- Automatic Transfer Switch (ATS)

A complete grounding system for both the electrical service and the telecommunications systems shall be designed by an electrical engineering professional and installed in accordance with all applicable sections of the NEC, ANSI/NFPA and IEEE standards.

4.F.3.f Copper & Fiber Entrance and Cross-connects

Cable tray or ladder rack and fiber tray shall be installed overhead and be used for all cross-connects between racks. In larger facilities and unmanned facilities, a pre-installed structured cabling system is recommended. This system consists of copper and fiber shelves installed in each rack, with SM/MM fiber cables and CAT5/6 cabling running from each rack and cabinet back to a central Main Distribution Frame (MDF). This allows pre-wiring of cross-connects from each carrier to the backbone and aggregation equipment. With this system in place, new customer or backbone circuit turn-ups do not require a technician to physically visit the site to complete the cross-connect from the backbone or aggregation rack to the telco rack. This system is much easier to manage as well. Fiber and CAT5/6 counts vary depending on the design and application, but it is not uncommon to run 12-24 strands of fiber and 12-24 CAT5/6 cables to each rack.

Ideally, fiber to the POP shall be fed from two physically diverse entrance facilities, manholes, MPOE or NetPOP via multiple 4" Electrical Metallic Tubing (EMT) conduits pre-filled with innerduct and pullstrings. This conduit shall be installed consistent with local and national codes for communications cable use. Entrance fiber from each carrier shall run from the conduit terminating in the POP, in innerduct, in a dedicated overhead cable tray to the appropriate telco rack.

In the POP, it is recommended that all copper based services also terminate in the telco racks and not use a plywood backboard on the wall. This allows for easier management and utilization of the structured cabling system.

Where roof access and rights are available, run (2) 4" EMT conduits from the POP to the roof.

4.F.3.g Fire Detection and Suppression

Local codes and guidelines shall be followed and take priority.

A dry pipe pre-action sprinkler system is recommended in the POP area. Water will not enter the system until the appropriate alarm level is reached. The alarm system shall consist of a central fire alarm panel, connected to the building fire alarm panel. Spot type smoke detectors shall be placed according to code and connected to the central fire alarm panel. For larger facilities, an early warning system can also be installed. This system uses extremely sensitive sensors to detect combustion particles in the air and signal an alarm well in advance of a normal spot type smoke detector.

4.F.3.h Security, Monitoring & Alarms

A number of options are available for site security. The most common security system is a card/badge reader system on the door lock. This system can be programmed remotely to authorize or un-authorize card holders to enter the facility. It also records who enters the POP and when they entered, for audit purposes and in case there is a security incident that needs to be investigated. A remote door unlock mechanism is also recommended in case a vendor or carrier who does not have a card needs emergency access to the facility. A backup entry system shall also be in place in case the card system fails. A key in a secure mechanical cipher lock box is an ideal backup solution.

Other, more sophisticated levels of security are available and make sense depending of the sensitivity of the services provided thru the POP. Biometric scanners which scan a finger print, palm print or retina in combination with a numeric access code are becoming quite common and solve the problem of shared or lost access cards. Also, many larger POP sites employ remote controlled cameras at the entrance and throughout the POP. These cameras can be monitored remotely by security personnel and the images can be recorded and stored offsite.

Like the security systems, there are many levels of sophistication available for monitoring systems and alarms. There are very basic systems, which will monitor alarms on the generator, HVAC, UPS, fire protection and security systems and dial or page a pre-programmed list of numbers to report the alarm. Honeywell and Sensaphone are common suppliers of this equipment. Other, more sophisticated systems will monitor not only alarms, but also set thresholds and continuously monitor fuel level, temperature, humidity, engine speed and other critical parameters. These systems continuously record all of this information to disk and allow real-time viewing over the web, plus also generate trend reports and send alerts to enterprise management systems. DataTrax and Honeywell, among others, supply these systems.

4.F.4 Summary - Carrier Neutral Collocation Recommendation

Planning for construction of and migration to this facility needs to begin immediately. Anchor tenants who have contractual flexibility to move their service the earliest should

be identified, with a schedule for migration of other tenants as they become available. Recommended locations are in the description of the network infrastructure that is recommended in this section.

These recommendations may indicate that the region needs to acquire real estate to build this facility. Although this would probably be ideal, there could be an interim step in the region. Many businesses have data centers for their own business computing systems. The rooms in which these computing resources reside may have the "hardness" that would be adequate for a collocation site, or may be able to be hardened with little cost. One option for the Broadband Council would be to investigate which businesses along key infrastructure routes have data centers, and then approach these businesses with the request to house the collocation site. The advantage to the business would be incredible connectivity at their doorstep. Of course there would be issues to negotiate such as physical security, cost of power and many others. But this option may provide the region with the ability to quickly identify the collocations sites.

4.G. Priority of User Connections

This section refers in various places to the priority of users for whom to target for connection. As a summary it is: The Broadband Council members' homes and work places; government offices; public places; anchor tenants for collocation facilities; lower density population and business areas.

This may appear to replicate the digital divide and/or current problems, but with a secure, doable plan and staff to carry it out, it is hoped that connectivity for all of these users will happen relatively soon, and that this order will expedite connectivity to everyone.

4.H. Broadband Policy Initiatives and Funding Opportunities

In January of 2002 a group of technology CEOs met with high-ranking U.S. government leaders to push for the creation of a national poly on rolling out high-speed Internet access across the country. A laudable goal, and yet little action on a far-reaching, national policy that would make broadband ubiquitous has been taken nearly two years later.

However, some incremental steps have been taken, and in the end, state and local policies may be the most effective since the main bottleneck is local connectivity -- the last mile. One role of the Broadband Council would be to track policy initiatives at the national level as well as in other states and locales as well as international.

For example, one creative approach by the Dutch and Swedes identified in Broadband: Benefits and Policy Challenges from the Quello Center for Telecommunications Management and Law, Michigan State University, was to give *end users* tax deductions and subsidies to connect to a broadband network to find the best business model and speed deployment, respectively (pg. 48). This policy initiative fits consistently with the

goal to get users to use the network, and the knowledge identified in the *Quantitative User Needs* section that 'connectivity and experience make demand grow.'

The Broadband Council should establish a means to track legislative initiatives and policy initiatives in other locales, states and countries. For example, the 47th Congress had no less than ten bills relating to broadband deployment (Bauer, et. al, p. 53).

For the rural communities, tracking the activities of the National Rural Telecommunications Cooperative is recommended. The president of NRTC, Bob Phillips, gave testimony to the U.S. House on July 19, 2003 regarding broadband deployment in rural areas, and announced a program initiative for satellite deployment that would be available to the communities not served by other broadband technologies. The Rural Utilities Service of the US Dept of Agriculture has a $40 million broadband initiative. Eligible rural entities have over subscribed the program this year, but the administration proposes to fund the program again next year at the same level.

The Broadband Council should track reports and publications from entities such as the Quello Center for Telecommunications Management and Law, Michigan State University. In addition to the above-referred paper, they have a working draft on a follow-on entitled, Broadband Deployment: Toward a more fully integrated policy perspective.

In today's economy, grants for networking are scarce. However the National Science Foundation still is providing connectivity grants for some institutional users. Some grants are also available for specific segments such as libraries, through the Gates Foundation. These opportunities change often, and active attention must be given to keep up with the changes. The market segments themselves will often know about opportunities before a networking organization. The Broadband Council will have access to these market segments through their representation on the council as key stakeholders. They council may be able to provide assistance for preparing any grant requests that are known, and also may be able to suggest how planning activities in other areas (e.g., the colo) may make an applicant's grant more attractive to the granting entity.

The Federal Universal Service Fund (USF) program provides subsidies for K-12 schools, libraries and other eligible non-profit entities for Internet connectivity, basic telephone service and some local infrastructure. The funds are collected via a "tax" on every individual's and business' telephone bill. The USF program has been extremely successful in bringing key communications services to entities that might otherwise have difficulty affording them or have to reduce other strategic programs to afford it. Although a long road, the Council should investigate and even lobby for USF eligibility to be extended to an organization like the Council with its specified goal of bringing broadband connectivity to everyone. This, of course, would take policy initiative work in Washington, which is likely not something that would be completed in the short term.

4.H.1 Policy and Funding: Michigan's Landmark Broadband Legislation

In 2003, TechNet, the California-based IT industry organization that promotes the vision of 40 megabytes of bandwidth in every U.S. household by 2008, named Michigan the leading state for policies that promote high-speed Internet and broadband usage. Michigan scored higher than any other state by a factor of two in the TechNet ranking. One of the reasons for this score was the leading-edge legislation passed to encourage broadband development in the State. Three statues comprising the LinkMichigan initiative were passed with bipartisan support from the Michigan House of Representatives and Senate and were signed into law on March 18, 2002.

4.H.2 The Michigan Broadband Development Authority

P.A. 48 is one of three statutes that comprise the LinkMichigan or "MiHiSpeed Internet" initiative. P.A. 48 created a new independent state agency, the Michigan Broadband Development Authority, patterned on the Michigan State Housing Development Authority (MSHDA). Through this legislation, the MBDA is authorized to issue bonds and make loans based on the State of Michigan's moral authority to repay. Instead of financing low-cost housing (MSHDA's mission), the MBDA is expected to finance high-speed Internet and telecommunications infrastructure particularly in underserved areas of the state.

In addition to financing Internet infrastructure -- the *supply* side -- the MBDA is also empowered to finance new Internet applications that stimulate *demand* for high-speed infrastructure.

Not surprisingly, there was strong resistance on the part of established industry groups to the idea of a new state agency being empowered to make loans to private-sector competitors or public entities for broadband infrastructure. The industry fear was that new competition would emerge, or that the public sector would use tax-exempt financing to compete unfairly with the private sector. The precedent that the industry wanted to avoid was Coldwater, Michigan. In the Coldwater instance, the public sector did indeed offer services that could have competed with the private sector. However, since there was a total absence of private-sector competition and affordable service at the time of the Coldwater development, this argument was generally invalid.

Industry lobbied for and won a clear delineation of public and private uses of MBDA funding, as outlined in the following section of the MBDA statute:

> (2) Notwithstanding any other provision of this act, the authority shall not make loans to, or enter into any joint venture and partnership arrangements or participation with, any governmental entity or nonprofit organization except in connection with the financing or refinancing of development costs for that allocable portion of the broadband infrastructure used or to be used exclusively by governmental entities or nonprofit organizations, including, but not limited to, universities,

> colleges, hospitals, school districts, public safety agencies, judicial organizations, libraries, cities, townships, and counties. No allocable portion of the broadband infrastructure financed by a loan to a governmental entity or a nonprofit organization shall be used to serve residential, business, or other commercial customers.

Note the specific reference to "governmental entities" including "school districts, public safety agencies…cities, townships and counties," to which the MBDA can now make loans. Any public entity is eligible to receive MBDA financing. The statute encourages financing of public-sector entities by the MBDA, and public-private partnerships. However, for any public-sector loans the MBDA makes, the public entity is restricted from providing service to "residential, business, or commercial customers," for the "allocable portion of the broadband infrastructure."

4.H.3 How to work with the MBDA

Although it is a new organization, the MBDA has proved very easy to work with. It functions essentially like a bank. Companies or organizations that need financing for broadband projects can approach the MBDA for a loan for both capital and operating expenses, within certain guidelines. The MBDA has $50 million in initial startup financing from MSHDA and is authorized to issue bonds backed by the State of Michigan, to finance projects.

To qualify for a loan, an organization needs to complete a preliminary application to the MBDA, including a credible business plan. Like a bank, the MBDA is in business to make loans. However, like a bank, it needs collateral in the form of a predictable revenue stream or customer guarantee. That is one of the reasons why public sector entities are an attractive "customer base" for the MBDA. Public entities tend to be creditworthy, and need broadband infrastructure and services.

4.H.3.a Funding Scenarios

The simplest scenario for an MBDA loan is for a *private business* to develop a strong business plan for supply-side or demand-side products that will expedite broadband deployment and reach in the state.

However there are other scenarios:

1) *Customer ownership approach.* Here the any entity, including a public sector entity, rather than buying service from a for-profit ISP, elects to construct or acquire network infrastructure directly using an MBDA loan. Many K-12 school districts in Michigan and around the country have adopted this approach. Instead of paying the private-sector provider for service, the customer can use the dollars it has already budgeted for broadband to pay down the capital MBDA loan. A payback period of 5 years or less is usually sufficient to justify a customer ownership approach. If the customer in this scenario were a public sector entity,

they may well have their own bonding authority, however. In this scenario, the MBDA is just one of several possible sources of financing.

2) *"Anchor tenant" approach.* Here any entity, including a public entity, becomes the customer of the for-profit ISP and adds its buying power to ISP's MBDA financing proposal. The predictable revenue stream from the anchor tenant is a form of guarantee that collateralizes the MBDA loan. In addition to providing service to the anchor tenant entity itself, the ISP provides services to residential, business and commercial customers in the same area, hopefully at a more cost-effective rate.

3) *Joint ownership approach.* Here the public and the private entity team build or acquire broadband infrastructure and share the ownership. For example, in a "new fiber build" the public entity may own 24 strands and the private entity own 24 strands. This is a combination of the customer ownership approach and the anchor tenant approach. Each party uses the infrastructure for its own purposes, and the cost to each party is lowered by the amount of money the other party is contributing to the deal and economies of scale in construction. An example of this approach is the pending MBDA-financed deal between Merit Network and Charter Communications.

The MBDA has shown that it can be very pro-active and flexible in brokering deals between public and private entities along all of these lines. The long-term goal of the MBDA is to spur economic development in Michigan, in the form of new jobs, by creating a broadband environment that is healthy for companies and workers. Public-sector growth is not the primary focus of the MBDA.

Working with the MEDC, the MBDA has shown that the State can use a combination of MBDA funds and federal or state funds to bring broadband to underserved areas where the economics of the project do not work otherwise. For example, in the Merit-Charter deal, a portion of the overall cost of the project is to be paid through a Community Development Block Grant (CDBG) from the Department of Housing and Urban Development. To qualify for the CDBG grant, a number of HUD criteria must be met. For further information, please contact the MBDA directly.

The MBDA has a mandate to provide financing for projects in under-served areas of Michigan and may well find creative ways to reach this goal. For example, the MBDA can justify making a loan to a private company, that has no direct public benefit -- for example, using State-backed bonds to refinance a portion of the company's long-term debt at a better interest rate than the company can obtain in the commercial market -- if the company agrees to dedicate a portion of the savings to a project that benefits the public.

4.H.3.b MBDA Paradox Today

The paradox that the MBDA currently faces in working with private entities is that the list of companies that need MBDA financing mainly consists of organizations that are not

creditworthy or cannot obtain financing elsewhere. Companies with a strong balance sheet typically do not need the MBDA: they can finance their capital needs from internal funds or can obtain low-cost financing from other sources.

In the short term, willingness of public sector organizations to work with the MBDA either directly or in partnership with private companies is essential to the success of this new state agency.

P.A. 48 and the companion LinkMichigan statutes are unique in the U.S. Other states are watching Michigan closely to see if this multi-pronged approach succeeds.

4.I. Action Plan Priorities

This list of activities/tasks summarizes the key, *near term* tasks that should be undertaken. Tasks are on this list because they have clear priority over other tasks, and/or because they are enablers of other key priority tasks, and must be done first. It is recommended that these actions take place within 30 to 90 days. The descriptions below are a brief statement of the activity. The detail is in the respective section noted.

However, in addition to these time-critical tasks, there are several key actions which are, in Merit's view, required in order for broadband to be deployed as the county envisions. These are described in *Section 1H,* and are drawn from the items above.

4.I.1 Broadband Council Tasks

1. Form a Broadband Council
    a. Obtain legal advice on structure (Corporation, LLC, Authority)
    b. Assess probability of funding one full-time staff member to manage
2. Form a subgroup to the Council, the Broadband Technical Subcommittee
3. Have a major PR presentation of the final report with the clear message that the *Network Plan* in Subsection F *will* be built. If possible, have the RFPs for the collocation facility and the network itself ready to be distributed
4. Ensure that all council and subcommittee representatives broadband access at work and at home
5. Obtain local recognition for the council
6. Secure ability to be seated on business/industrial park development organizations, zoning and permitting boards, public works commissions and other infrastructure planning activities, especially those involving rights-of-way
7. Begin a policy planning initiative
    a. Set up mechanism/staff to begin to track broadband legislative initiatives and policy actions in other locales, states and countries and to keep up with reports such as those from MSU's Quello Center for Telecom Management and Law
    b. Invite a strong, respected, local legislative representative to chair a policy task force, with its first goal to investigate the extension of USF funding to an

organization like the Broadband Council (see Subsection G for a description of USF) as well as how to extend that model of subsidizing end users to all end users (Ongoing task.)

c. Draft the broadband policies that the MTA and other permitting organizations may require to expedite permit approval

8. Organize an effort to make sure all entities opt in to the METRO Act. At a minimum, a meeting with all the of contacts within the Right-of-Way table should be organized before the end of October 2003, with representation from the Broadband Authority, as well as legal counsel. This will give each entity time to enact the appropriate ordinance/resolution amendments and submit their opt in to the METRO Authority

4.I.2 Technical Subcommittee Tasks

1. Recommend the specific POP locations
2. Issue the RFP for the POPs
3. Issue the RFP for the network recommendations
4. Support the council in drafting the permitting policies to present to permitting organizations
5. Begin assessment of the demand requirements for anchor tenants of the POP to determine impact on existing capacity and contract scale (This is an ongoing task.)
6. Produce a model RFP that governmental agencies could use to begin to establish their web presence and eGovernment functionality

Section 5 - Strategic Models

5.A. Overview

This section includes several topic areas that will assist planners in assessing the technology readiness of their communities, understanding network planning and deployment guidelines, and the value of aggregating user demand. This aggregation planning is presented in the form of business case models that ISPs could use to assess the viability of offering services in various geographies.

5.B Assessment Instruments

Community assessment for broadband can take many forms, but the basic components of most assessment tools commonly include:

Component	**Sample issues of component**
Inventory or Access	What is the level of services available?
Learning	Are there computers in the schools and colleges, are they networked, and are the teachers integrating technology into the curriculum?
Society or Users	How many users are on-line? Is there local, relevant content? What services do users want?
Economy	What is the level of the trained technical workforce? E-Commerce?
Policy	Is Public Policy a hindrance to a networked community?

The Washtenaw LinkMichigan planning effort addressed two of these components. Section 3 of this report describes in detail the inventory assessment. The steering committee also hired an Ordinance Consultant to address the Policy issues in detail, and the *Strategic Plan* section of this report address policy planning tasks more broadly.

Merit believes that there is significant information in the county on the "Learning" component identified above, as well as the "Economy". However, "Society or Users" information may be still developing, and Merit provides the following commentary on the value of surveying users for definitive information on their broadband needs.

5.B.1 Society/Users

Most of the Assessment Tools Merit found included surveys of the user community to collect statistical data on the services they buy, their willingness to pay, their technical expertise, etc.

Although information resulting from these types of surveys may be of some interest in planning, Merit Network, Inc. believes that surveys sent to individuals and businesses

will not provide information that is accurate or far-reaching enough to do infrastructure planning, particularly if the planning horizon is greater than two years.

5.B.2 Bandwidth Projections by Market Segment

An ideal scenario for a network planning engineer would be to have definitive market research on the amount of bandwidth that users will require in two, five and ten years. This ideal scenario does not exist. Further, even the use today of broadband by market segments is no clearer. "Distribution of Broadband access among various sectors of the business community is unclear at this time. Data differentiated by business character and size are not available." (BJK Associates 1). Two key reasons for this are discussed in the following section, i.e., the complexity of application environments and the complementary technologies they require in various market segments which are not easily "translated" into network capacity requirements; the difficulty of users to foresee long term technological requirements.

5.B.3 Complexity of Market Segment Applications

Few researchers have translated market application scenarios into concrete network requirement projections. It is a complex task to do so because of the many interdependencies of the software and hardware applications as well as policies and practices within the business itself. These complexities must then be set against the quickly evolving realm of network technologies, and thus the researcher must be an expert in both the market segment and the network technologies. As such, this type of market research is significantly costly if done well.

For example, it is received wisdom that medical imagery, X-rays, CT scans, MRIs, etc. will be exchanged over data networks for the purposes of remote consultation, archiving, and so on. An open standard for image exchange, Digital Imaging and Communications in Medicine (DICOM) has been available since 1996 for software and hardware producers to use in their medical imaging products. Further, it is well known that the average file size of a DICOM-compliant image is on the order of one Gigabit.

While the raw data on applications is apparent, translating it into a clear set of network requirements is complex, perhaps more so in the healthcare market segment than others. Some typical questions that a network planner would have would be, how many of these one-Gigabit images will be sent in an hour, day, week; who will need access to them; will the readers always be in one spot (i.e., always at some expensive machine) or will the reader be able to view it anywhere; can it be a compressed image or would there be malpractice ramifications in that some (humanly imperceptible) amount of data could be lost through compression; what security/access requirements must be in place in the network; and may others. In addition, regulatory and competitive issues make this sort of data collection particularly difficult in this market segment.

This complex task is the same for other market segments. For example, farming is another potential growth area for networking relevant to many places in the State of

Michigan. But projecting bandwidth requirements for "smart farming" requires an in-depth knowledge of the crop cycles, soil management, the ways farmers manage their finances, planting schedules, what ties to securities exchange entities such as the commodities futures are required, what are requirements for reporting chemical and pesticide usage to regulators, how do farmers work with agronomy and seed advisers, how much do they interface with extension universities, what are their ties to chemical and equipment manufacturers, lenders, and many other areas. Again, to project bandwidth demand by market segment requires a very in-depth understanding of the market segment.

Another factor in the complexity of projecting bandwidth requirements per market segment is that market segments are not homogeneous in their demand for bandwidth. There are advanced businesses and non-technology driven businesses, and these exist even in the same geography where network supply would be relatively equal. Therefore, generalizations are difficult to make. For example, using healthcare again, the implementation of network-based applications and networks is uneven across healthcare systems of similar size. In Michigan, three hospitals of roughly equal staff and number of beds in the same urban area currently utilize widely different levels of Internet access. Of the two largest hospitals, one consistently uses 15 Mbps per while the other uses only 4.5 Mbps. The third, a bit smaller than the others but a self-proclaimed leader in technology uses 7.5 Mbps.

As another example, a small automotive supplier tucked away in the woods of northern Michigan uses only the Internet for the exchange of engineering data with auto manufacturers and with its contract-engineering firms. Designs are exchanged quickly and make their way into production sometimes in only a matter of hours.

Another larger automotive supplier located nearer to the auto companies in Southeast Michigan still relies on courier-delivered bundles of engineering output in its interactions with the manufacturers. The annual revenues of the large company are 10-20 times that of the smaller one, and its failure to implement advanced communications technology is a puzzle that serves as an illustration of the unevenness of technology implementation in a market segment.

Because market segments are not homogeneous in their use of technology, no clear consensus has emerged as to the network requirements for individual market segments.

It seems a safe assumption that all market segments will eventually make use of advanced networking and telecommunications in the same way that all businesses eventually came to have voice telephones. It is anticipated that the network may well differentiate businesses within market segments, though, in the near term.

5.B.4 User Difficulty in Predicting Demand Accurately

As stated above, one reason for the difficulty in predicting demand by market segment is the requirement for a market research to have a very in-depth understanding of the market

segment. A solution might be, then, to simply *ask the users* in the market segment what they need. One would assume they would have this in-depth knowledge of how their segment is anticipated to operate over the years relative to the network. However, this typically is not the case -- users of course understand their business, but they typically 1) do not have the detailed knowledge of network evolution potential that is available; 2) are not able to envision significant business transformations that might be available due to network evolution.

Most business users have difficulty projecting their future networking requirements more than about two years out. Often times, users indicate incremental increases in bandwidth requirements when asked, and suggest tactical business uses. But statements that would indicate greatly increased network capacity are not typically obtained from user studies, although this is the data that network planners would like to have. Yet actual network usage does indeed grow at exponential vs. incremental steps. So why do users typically not foresee what actually happens? Part of the reason users have a relatively short-term view of bandwidth needs may be an education/awareness issue, but it is not solely a matter of education.

Rather, it is difficult for users to articulate their demand for the business transforming services that will be available with widespread Broadband deployment *precisely because* the services will transform their business in ways they cannot anticipate. In 1990, few businesses would have anticipated that within five years a position called "Webmaster" would be required on their staff, and part of the advertising budget would be allocated to on-line information.

In addition, users may indeed see strategic changes for their business, but they may not recognize the network implications of these changes. For example, many medical practitioners say it is highly desirable to have dictated medical notes be automatically transcribed, *accurately*, into a patient record. Of course this requires application development and significant advancement in voice recognition technology. But a network planner would see that for efficient and broad deployment of the capability, the voice recognition technology would likely reside on servers on a high-speed network. When answering a question of how much bandwidth their offices may need in the future, a doctor may well not think of the dictation application as a networking requirement.

A college professor trying to get her students to understand the unforeseeable role of technology in economics tells the story of the Swedish scientist who in 1860 surveyed local farmers to ask them how science could best help them to remove the large glacial boulders that dotted their fields. The most common response was that he should concentrate on animal husbandry to develop a stronger breed of horses so as to be able to pull the rocks away. Not one suggested that he should work in chemistry to identify a way to nitrate toluene to be able to produce a safe yet powerful explosive. Another Swedish scientist, Alfred Nobel, would do that, and by 1870, the farmers were using 2,4,6-Trinitrotoluene (TNT) to obliterate the boulders, increasing their arable land and raising their yields.

That story may be a parable, but the story of the Tennessee Valley Authority (TVA) is real as well as more contemporary, and it too conveys the paradoxical issues involved with attempting to forecast demand for new technology with traditional demand assumptions.

The TVA was a Depression-era dam project that promised to make the Tennessee River navigable all the way from the Mississippi River to Nashville *and* to bring electricity to a portion of the South that hadn't seen significant investment since the fall of the Confederacy. It was the largest economic development project ever proposed, and developers predicted it would raise the fortunes of everyone it touched.

Those to be touched were something less than receptive. The flooding of the valley would dislocate thousands and disrupt the agricultural economy that was already reeling from the Depression. In the context and scale of their 19th century agricultural economy, potential users did not see that electrical power could potentially improve crop yields, productivity, or quality of life. The dizzying array of electrical devices that would eventually find its way into American homes, businesses and farms was impossible to conceive. They fought TVA in state legislatures, in Washington, and in the valleys where surveyors for the project were chased away and their equipment destroyed. But the visionaries carried the day, the project became reality, and the transformations happened.

Users' lack of ability to envision a transformed future through technology is not unique. Even leaders in a technological field sometimes dismally fail to see the shape of things to come:

- "This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us." - Western Union internal memo, 1876;
- "I think there is a world market for maybe five computers." - Thomas Watson, President of IBM, 1943;
- "There is no reason anyone would want a computer in their home." - Ken Olson, president, chairman and founder of Digital Equipment Corp., 1977.

In summary, simple surveys of users asking what bandwidth requirements they will have in the future will likely fail to identify accurately how the business will evolve in terms of their networking requirements. Focus groups, which are more cost effective, can help to identify strategic changes that have networking implications, although they are not *quantitative* studies. Detailed studies of applications and business evolution in market segments would be the most accurate predictor of bandwidth demand. But these are most likely cost-prohibitive. Sometimes even industry leaders do not see the future accurately. So how do network planners anticipate demand for broadband networking? The following discussion addresses this challenge.

5.B.5 Deployment and Speed Increases Use and Demand

While even leaders in their a fields have, in hindsight, missed some pretty obvious transformational shifts in technology, individuals who are exposed to Broadband are quick to explore and use the Internet more and in ways they did not expect (Pew "The Broadband Difference" 2). It is likely that the experience will be the same for businesses as they respond to offer Broadband-enabled services to consumers (Crandall 16).

5.B.6 Deployment

Dial-up Internet access users represented 80% of all home Internet users in 2001 (A Nation Online 35). These users express the most dissatisfaction with their Internet experience, with the most common complaint being slow access times. Maximum dial-up speed is 56 kbps. Satisfaction rates rose from 57% to 92% when those same users switched to DSL, which has a typical range of speed between 200 - 500 kbps (SBC).

With faster access speeds, one would expect that Broadband users would have to spend *less* time online to complete Internet tasks. However, the opposite is true. Broadband users report spending more time online because they can do more online once they have Broadband. They spend more time online compared to dial-in users, 95 minutes versus 83 minutes, and they are more than twice as likely to have several online sessions per day than dial-up users (Pew "The Broadband Difference" 4).

Broadband users report higher rates of almost every Internet activity: email, information searching, online transactions, and watching video. This last activity is pursued by 28% of Broadband users on a daily basis while the number of dial-up users who do so is so small as to be immeasurable (Pew, "The Broadband Difference" 13).

Online transactions are much more common among Broadband users than dial-up: 43% of Broadband users will make a purchase or do online banking on any given day compared to only 18% of dial-up users. One factor may be that the increased speed of Broadband makes browsing online merchandise faster, but Broadband, by virtue of its "always-on" connection, is more accessible, and users think to use it more often for a variety of tasks (Pew "The Broadband Difference" 6).

There is much research on connectivity in the home, and those planning for business expansion may feel this is somewhat irrelevant to their goals. However, telecommuting is a key, growing application, and broadband access in the home is a requirement. Twenty percent of IBM Canada's workforce telecommutes, and their surveys and pilot studies indicate that employees can be as much as 50% more productive when they work in telework environments. American Express telecommuters handled 26% more calls and produced 43% more business than their office-based counterparts. IBM US says there is a 40-60% reduction in real estate costs per site due to telecommuting. IBM summarizes the experience by saying, "For the first time ever, productivity, customer satisfaction and employee satisfaction all increased." Retaining qualified and talented staff is a goal in every organization. In one study, fifty-three percent of teleworkers said

the ability to work at home was important to their employment choice, and an overwhelming majority (nearly 80%) feel a greater commitment to their organization and most say they plan to stay with their current employer (Bauer 28).

Experts understand that the use and sophistication of Internet technologies increases exponentially when individuals have access to Broadband technologies (ECom-Ohio 6)
Internet Use and Deployment

By all measures, across many studies, Internet use continues to grow, and the rate of growth is accelerating. The following statistics refer to Internet growth in general, not necessarily broadband usage, but indicate that the historical growth in Internet access and utilization has not slowed despite the economic downturn of the last three years:

18.6% of U.S. households had Internet access in 1997; by 2002 that number was 50.5% and climbing (A Nation Online 3);

- Since 1997, growth in Internet use among people living in rural households has been increasing at an annual average rate of 24%, and the percentage of Internet users in rural areas, 53%, is now almost even with the national average, 54% (A Nation Online 2);
- The Internet use rate grew 25% for low income households from 1998 to 2001, and accelerated from August 2000 to September 2001 while higher income households saw only an 11% growth rate with no evidence of acceleration (A Nation Online 12);
- While the under 25 age group continues to have a higher Internet use rate than those over 25, this gap has not widened since 1997, and the growth rate for all age groups is the same from the 1997 baseline; millions of Americans across all age groups have begun to use the Internet since 1997 (A Nation Online 14);
- Males were more likely than females to be Internet users in 1997, but since August 2000, males and females have had virtually identical rates of Internet use (A Nation Online 15);
- Internet use for adults with a Bachelor' s degree or higher grew at annual rates of about 12% from 1997 to September 2001 while Internet use for those only with a high school diploma grew at an annual rate of 30% over the same period (A Nation Online 17);
- From 1997 to 2001, growth in Internet use rates was faster for Blacks and Hispanics, 31%, than for Whites and Asian American and Pacific Islanders, and there was a significant acceleration between August 200 and September 2001 (A Nation Online 19).

Thus, Internet deployment and usage is generally growing. After initial deployment and use of dial-up services, users typically desire faster and faster speeds. Historical figures on demand in general show a steep increase in the requirement for bandwidth after users connect.

5.B.7 Historical Growth in Traffic

Historical patterns of Internet utilization and growth are the most likely predictors of future growth and demand. Those patterns are well documented in the many studies that have sought to understand the phenomenal emergence of the Internet. There is some variance in experts' assessment of growth rates because of differences in the methodology for assessment, but there is consistency in the overall conclusion that growth has been steep and is anticipated to continue.

Measurements by Dr. Lawrence Roberts, who led the team that designed and developed ARPANET in the 1960s which was the precursor to the NSFNET and commercial Internet, suggest traffic on the Internet increased as much as an unprecedented four times annually through the first quarter of 2001.

Roberts' data shows traffic (which in this case means data traveling the Internet's "network of networks", not just traffic to Web sites) has been doubling every six months on average across core IP (Internet Protocol) service providers' networks, or in other words, growing by four times annually. (Pastore, "Traffic Grows"). The research is based on special access Roberts received to top scientists at the leading data carriers. Beginning in 2000, he and his team obtained nondisclosure agreements with the top 19 data carriers and began the process of polling them for their network topologies, trunk utilization and traffic. Network traffic was sampled in April 2000, October 2000, and April 2001.

Peter Sevcik, another ARPANET alumnus, finds that Internet bandwidth growth figures are often hyped to make a case for investment, but even his less optimistic assessments suggest that Internet data traffic doubled every eight months from 1997 to 1999, then slowed somewhat so that it was doubling only every 11 months from 1999 through 2000 (Sevcik 1). The Internet industry may see this as a slowdown, but other industries would relish that level of growth and demand for its services.

Using another measure, Insight Research in October 2001 estimated total U.S. Internet traffic at 20,000 terabits per day, and they projected that by 2006 that number would rise to 1.5 million terabits (Pastore, "Bandwidth Expands").

While there is dispute on the means of measurement and the exact rate of growth, all agree that the Internet continues to grow. Even the most pessimistic growth rate exceeds that for other industries. Some consternation resulted from a 2003 JPMorgan Securities report that said IP traffic growth has passed a peak. But a recent analysis in *Broadband World* (Hold 2003) presented a systematic analysis of both the historical assumptions that "Internet traffic is doubling every three or four months (or a factor of 8-16 every year)" and suggested a framework for projecting traffic demand for the future. Some key individuals, "leading wisemen of the industry," were interviewed: Scott Bradner, Vint Cerf, Larry Roberts, David Farber and Ross Callon. In the end, the experts said at worst the Internet is not quite doubling every year, and at best it is doubling every six months. The opinions were supported by various quantitative assessments. Of course the key to

the future is not so much this projection, but the development of businesses cases to determine how businesses will make use of -- and providers will make money off of -- the tremendous bandwidth that is and will be in place.

More common than studies on growth rates are studies on Internet utilization. However, large-scale publicly available studies on Internet utilization have tended to focus on the usage habits of *individuals* and the macro socio-economic impacts of the Internet rather than on utilization and economic impact in specific market segments. Leading studies such as *A Nation Online* from the U.S. Department of Commerce, *Surveying the Digital Future* (the UCLA Internet Report), and *The Pew Internet Project* tend to focus on the demographics of Internet users, the Internet habits and styles of utilization for individuals, and societal impacts.

We do know that as of 2002, 50% of U.S. businesses had only dial-up Internet access; 19% had dedicated connections of T1 or greater, and 27% had cable modem or DSL. However, there was no correlated detail at the national level on the size and type of neither these businesses nor their location. For the state of Ohio, more detail was available in regards to business size: only 29% of firms of 25 employees or less had Broadband, but there was little more refinement with regard to market segment (ECom-Ohio 6).

Missing from much of this research are numerical estimates of expected benefits of the impact of the Internet on business practices and operations. The MSU Policy report (Bauer, et al) points out that one approximation of the benefits of broadband is the change in social surplus (consumer plus producer surplus). The report notes, however, that Crandall and Jackson (2001) is the only study that uses an estimate of consumer and producer surplus to assess broadband. Using two different estimation procedures to calculate the benefit, the total annual benefits from all forms of broadband range from $272 billion to $520 billion. "However, the vast literature on broadband typically does not use such a stringent, operational notion," (Bauer, et al 2002; p.69). In other words, strict, mathematical economic measures of the benefits of the Internet are still to be devised.

5.B.8 Broadband Bandwidth Demand

Bandwidth demand among what are typically broadband users has had a steep trajectory and continues to grow. Some key highlights are:

Academic and research backbone bandwidth has grown at 60% per year – doubling every 18 months – for the past two and a half decades, and forecasts are that it will continue to grow at that rate. (Bruce 23).

The traditional measure of the "size" of the Internet was the number of hosts "visible," (i.e., machines that have a discrete Internet address. By that measure, the growth may be slowing. However, it fails to take into account the growth of bandwidth not through the addition of more hosts, but greater bandwidth to each host (Metcalf). In other words, the

number of machines being connected to the Internet may be slowing, but they may be more capable and may have more bandwidth among them.

Overall network bandwidth (voice and data lines) increased in 2002 and broadband deployment led this growth. In the U.S., high-speed lines connecting homes and businesses to the Internet increased by 55% in 2002. When that data is narrowed down to account for just homes and small businesses, high-speed lines increased by 58%; clearly the focus of growth is moving from large corporate customers to a wider diffusion of high-speed connectivity. While these percentages may seem phenomenal, the actual broadband coverage is somewhat dismal with DSL serving 6.5 million users and cable modem serving11.4 million (FCC). Total Broadband penetration is 27% of all U.S. homes.

Roughly 24 million Americans (21% of all Internet users) have high-speed connections at home. From June 2000 to February 2002, Broadband penetration increased four-fold. Internet users in rural areas are less likely to use a Broadband connection: only 11% or rural Internet users have a Broadband connection compared to 29% for urban Internet users (Pew The Broadband Difference 9,10). Cable modem providers and companies offering DSL are more likely to deploy those services in densely-populated areas where the capital investment in equipment is seen to have a higher potential for return when it is leveraged over a larger potential user base (Pinkham 3).

Strategic Analysts predicts that the 2002 27% penetration rate for Broadband in U.S. homes will increase to 38% by the end of 2003 and to 70+% penetration by 2008.

Broadband penetration, while generally regarded as disappointingly slow, is actually extremely fast by most standards, faster than cell phone diffusion at a comparable stage (Odlyzko).

More anecdotally, a major ISP in the State of Michigan recently reduced pricing in response to competitive pressure. It was anticipated that users would order more bandwidth for the same price. However, by a significant percentage, users tended to not only order a small incremental increase to match their previous spending, but to make a more significant increase in total bandwidth even though their monthly bill would increase.

A key challenge continues to be deployment in rural America. The National Rural Telecommunications Cooperative supports more than 1000 rural utilities and affiliates in 46 states in delivering telecommunications and information technology solutions to their communities. The NRTC members serve more than 35 million customers. In testimony before the U.S. House in July 2003, the NRTC president commented that most rural areas still lack access to the same telecom infrastructure or technologies enjoyed by those living in urban areas, and that the statement can easily apply to most any state in the Union. The testimony references significant demand in these areas, and technology and funding initiatives to answer the demand.

No research indicates less demand in rural areas as a reason for less deployment. Clearly the business case for the rural areas is the key challenge in getting services deployed cost effectively for a population that is not concentrated. Concentrated groups of users are simply more profitable for providers. However, this same testimony quotes an Iowa study concluding that, "Small rural telephone companies have done a better job of providing universal telephone service than large companies serving rural areas." In rural areas served by large telephone companies (e.g., units of the Regional Bell Operating Companies), DSL deployment has been very slow, while small, independent telephone companies serving those areas have been much more successful in speed of deployment as well as penetration (Pinkham 4). Smaller rural providers are committed to serving their communities. Policy initiatives can encourage this service deployment.

5.B.9. Deployment Drives Deployment -- Who Goes First?

The available research indicates that Broadband availability promotes more intensive use of Broadband and leads to discovery of new applications. The problem is that, in the absence of having Broadband, users can' t fully know the potential of Broadband. This presents a chicken-and-egg problem with regard to investment. The Pew Internet Project reports:

> A problem facing providers of high-speed home connections—public or private, before the Web or after its development—is the "chicken and egg" dilemma with respect to consumer demand. Companies or towns considering the sizable investment in high-speed infrastructure for homes have reason to pause, since it is hard to predict how many consumers would want such connections and what information services they would demand once they had them. Consumers, for their part, might be willing to pay for innovative online services, such as video-on-demand, online shopping, or home health care. But potential providers of such expensive online content do not want to incur the cost of creating those applications without assurance that the high-speed networks are built out and ready to serve customers." (Pew, The Broadband Difference 8)

Further, BJK Associates reports:

> Small business' need for Broadband Internet service remains latent at least partially because of the lack of available Broadband access. Although demand for services is usually the driving force for supplying services in a market economy, for new technology-based services, demand may not appear until the service demonstrates apparent value to the user. Thus, demand arises only after the service becomes available and the user recognizes its value. So, unless a supplier believes that an untapped market exists and is willing to raise its awareness sufficiently to generate demand, the market will not provide services that may in fact have a latent demand (BJK).

Even suppliers who believe that untapped markets exist are reluctant to build in the belief that demand will come. Investment capital is too scarce and the dot-com bust too recent in memory for most suppliers to be able to convince their investors. This is an instance similar to the TVA where leadership must transcend individual suppliers and businesses and look to the needs of the larger community.

5.B.10 Trends that Cross Market Segments

There are two key trends in business development that cross market segments and that have a significant implication for network planning: application serving and network convergence.

5.B.10.a Application Serving

Currently, software applications are installed and run on servers or workstations at the office or home of the user.

The management and upkeep of the applications and the operating systems is the responsibility of the individual or the business. Because the key software applications are, by definition, fully integrated into the operations of businesses, they must be regarded as critical business assets. Businesses therefore spend millions annually in technical support, software updates and patches, and maintenance of recovery and data backup systems.

Individuals and small businesses may make a financial decision to forego software upgrades and backup systems, and systems do not perform optimally and/or become outdated quickly.

Application Service Providers (ASPs) are entities that will place key business software applications on servers, connected by high-speed networks, so that any business anywhere can subscribe to the application vs. buying one that would be locally resident. Many applications have been discussed for this purpose, but the ones most likely to touch all businesses and have the greatest financial impact on users are those that are required in most every business: customer relationship management (CRM) software, financial/accounting software, customer billing software, supplier and supply chain management (e-procurement) software, and sale forces automation software.

Application Serving is not a new idea. In the mainframe computer era, software applications did all their processing and storage on the mainframe computer, and remote users networked to it operated only with "dumb" terminal, little more than a keyboard and monitor.

The emergence of the personal desktop computer (PC) in the early 1980's put unheard-of-for-its-day processing power in the hands of individuals, and applications moved from the mainframe to the desktop. Processing power was located near the user, and, because networks were few and not interconnected, software was delivered on diskette or CD and

had to be installed on a per workstation basis. Likewise software patches and updates were delivered by disk and had to be installed on a per workstation basis.

For organizations with many computers, the burden of desktop software support was enormous. Technical staff were required to "touch" every workstation in order to support the software and the end user.

The de-centralized storage of PCs, with data on hard disks scattered across an organization, made it difficult for organizations to establish and maintain *authoritative* records for key business information. If two users start with the same document or spreadsheet and work independently, modifying data or even application settings, the data records diverge, and the productive value of that information to the organization as a whole decreases.

Organizations that faced these problems in the beginning of the PC era modified existing mainframe-centered Local Area Networks (LANs), or they built PC-based LANs to manage applications and data and maintain authoritative data centrally.

Because PCs were often as powerful as any of the centralized servers, the software application and data were stored on the server. When a user started the application from his or her desktop PC, the copy of the software application instruction set was transferredfrom the central server over the network to the PC and then loaded onto the PC operating system. The instructions were executed on the PC *not* on the server, and when the user was finished, the modified data was copied over the network to the centralized authoritative storage area.

Typical LAN speed was 10 Mbps, more than fast enough to make the Application Server process just as fast as if the software loaded from the PCs hard drive. In many LANs, the 10 Mbps bandwidth was shared by all users, making actual per user speeds much lower depending on how many were on the same network, and in those instances Application Serving impeded performance.

Despite any shortcomings, Application Serving solves these problems:

- **Software maintenance** - software can be maintained as a 'single copy' for all users, and updates and maintenance of the software can be done at one computer rather than many, greatly reducing tech support expense and improving performance and robustness;
- **Authoritative data records** - key business information/records reside as a single copy in a central location for all users;
- **Data integrity** - backup/storage systems for data records can be more doneefficiently and reliably at a single point;
- **Software licensing** - organizations that pay software license fees per installed desktop or per simultaneous user can manage the number of licenses in use;
- **Security, privacy, and confidentiality** - access to data can be managed on a per user basis from a single point ensuring only authorized access and modification.

Until recently, Application Serving was rarely done over the Internet because Internet bandwidth was usually far below the 10 Mbps bandwidth available on a LAN.

The limitation of Internet speeds bred a new model for software processes that became know as *client-server*. In client-server network computing, applications run on both the central server and the desktop PC, and data files are delivered from the server and also created locally on the desktop PC.

Using the World Wide Web (WWW) is the archetypal client-server computing experience. The web browser software running on the desktop PC connects to a webserver on the Internet requesting the data on the server. The data files are delivered over the Internet to the web browser software on the desktop PC, which displays the information, text, images, streaming video, etc. on the PC monitor. As the WWW user continues to 'surf' through the webpages, information is transmitted back and forth between the server and the client and processing occurs on both server and client. Most of the time, the exchange is asymmetrical with the server sending a greater volume of data to the client.

LAN bandwidth rates have increased and shared bandwidth issues have been addressed with 'switched' networks. Internet bandwidth rates are increasing as Broadband becomes more widely available. This creates an environment ripe for taking advantage of the benefits of application serving. With Application Serving over the Internet, the benefit will be distributed (potentially) over the vast number of Internet-connected computers. The scale of Application Serving will be so large as to provide more powerful and reliable software applications at lower unit cost. Further, businesses will no longer have the bother and expense of maintaining local servers, only desktop PCs.

Application Service Providers (ASPs) will maintain Internet servers that provide software applications to hundreds and thousands of users. As stated earlier, the most important applications that underlie every business are likely to be:

- Customer Relationship Management (CRM) software
- Financial/accounting software
- Customer billing software
- Supplier and supply chain management (e-procurement) software
- Sale forces automation software

Rather than purchase a license or licenses in a one-time purchase of software, the ASP model will be more of a service subscription model like phone service, providing constantly updated software with the latest productivity enhancements to keep businesses competitive.

Application Serving will provide more powerful, reliable, and robust software to businesses at a lower cost than they can obtain under the current software sales model. These software applications would be available on a shared subscription or transaction basis. Small and medium sized businesses will have powerful software previously available only to the largest corporations who could afford the staffing, hardware and

other infrastructure necessary to run such software. Application Serving will accomplish this with centralized servers located on the Internet that will leverage the connectivity-power of Broadband to deliver fundamental applications required by all businesses

LAN-based Application Serving has seen a renaissance in the past few years with application servers like Citrix, and Internet ASPs began to launch services in 2000.

The business model for Application Serving is still developing. It presents a conflict with the current paradigm for software sales, where typically a per-user fee is charged. The large software companies are wrestling with a paradigm shift in that they see a potential loss in revenue if ASPs provide applications from a centralized point to a wide customer base vs. their individual sales of licenses to those customers. Thus, the software companies are not aggressively pursuing the business model of third-party ASPs. However, it appears that there has yet to be a thorough business case of the opportunity by these software companies. For example, many of these software products are simply out of reach of a typical small business. A business may very much desire an Oracle-based Customer Relationship Management system integrated with sales reporting and financial reporting. But the cost of acquiring it, customizing it, and maintaining it is most likely cost-prohibitive to a small to medium-sized business. At present, they simply are not customers for the product. However, in an ASP-provided scenario, the software company will tap into a customer base that was previously unreachable.

Very large companies may likely still purchase their own licenses, but with ASPs, the smaller business can also avail themselves of it. It is anticipated that this shift in software "sales" will be an impetus to broadband deployment in all locales. In addition, from a business development perspective, small to medium sized businesses could then achieve the operational efficiencies the software products afford to their larger competitors.

5.B.10.b Network Convergence

In the high-speed telecommunications industry, "convergence" means the merging of the traditional voice and data networks into one shared infrastructure. The value of this convergence is in efficiency and cost savings. A major long distance carrier representative stated at a major conference the implication of convergence in large networks. He said that if there were actually a single network in their company for all voice, data and other applications -- a truly 'pie-in-the-sky' view since it probably cannot every be 100% true -- he estimated that a converged network for all services would save in the neighborhood of 70% on administration (far fewer boxes to manage) and 40-50% on maintenance and operations. So if providers and users could even achieve *half this efficiency* it results in tremendous savings on these primary operating expenses.

This impact is reflected in typical customer premises scenarios. For example in many buildings there is cabling, PBX or Centrex equipment, telephones, equipment rooms, and staff to engineer, maintain, plan budgets, plan strategy, manage change, etc., to support the voice infrastructure. Then there is cabling, routers, switches, computers, equipment rooms and staff to engineer, maintain, plan budgets, plan strategy, manage change, etc., to support the data infrastructure. If these two environments -- voice and data -- could be

provided over the same infrastructure, the savings would be immense. These two worlds are historically separate for many reasons including technology, political-economic development and social dynamics. In addition, the requirements for quality provisioning of constant-bit-rate services such as voice, as well as the expectations of the end user, are very different from those of bursty data applications. Both are respectively complex.

But service providers envision this 'one world' and strive to be the single provider. For example, regulated voice phone companies have talked about and attempted to do data for decades. ISPs have toyed with voice. Cable companies are one entity that has come close to being a ubiquitous provider of both services well, but most of their offerings are still in the trial stages. Migrating current infrastructures to a single technology is a great challenge. But what that single technology *should be* is becoming less and less a topic of discussion.

Data networks have become critical to business, and some would say perhaps more important than the voice network. Many businesses could do without their dial tone for half an hour, but if their servers or routers went down, it would be a disaster. Home users use "data" with each email or web browse. The *de facto* protocol for data networks is TCP/IP, the protocol of the Internet.

Vint Cerf, one of the fathers of the Internet, believes that the Internet is the vehicle for convergence:

"What is the future of the Internet? It will become the 21st Century's telecommunications infrastructure. It will become our medium of commerce and education, of research and medicine. It will become a repository of the knowledge, wisdom and creativity of the human spirit. Internet will be there, for everyone" (Cerf).

Much work in the standards arena, in trial environments and emerging products support voice over the Internet Protocol, or "VoIP". The "data over voice" standards of several decades ago are virtually forgotten. It is anticipated that the protocol for both voice and data networks -- and for any converged network -- will be highly dependent upon, and perhaps even totally reliant upon the TCP/IP protocol. Thus, expanding broadband data networking today sets the stage for the ability to provide converged services tomorrow.

But convergence is not just for businesses. These same providers want to be *the single* provider for residential voice, data and video applications. Thus broadband data services to the home are as important a driver of convergence as to the business.

The trend toward convergence will continue because the cost savings of one network for data, voice, and all applications is significantly attractive from the standpoint of building, maintaining and operating this key business infrastructure component.

5.C. Assessment Instrument Review

These listed resources are guides and assessment instruments for local communities. These resources have been collected from wide variety of sources both within the United States and globally. Our research in the area revealed that the *CSPP Readiness Guide* seems to be the template for a majority of communities as well as other assessment resources.

The first five resources are available as printable documents and are included with the report in the Appendixes. The other resources are web-based only. Website addresses are provided for all the resources.

(1) *The CSPP Readiness Guide For Living in the Networked World – A Self-Assessment Tool For Communities*

www.cspp.org

This is a very popular assessment tool that has been used as a base for various community networking projects throughout the country. The CPSS Readiness Guide was a template used by Merit and MEDC to propose planning action plans when the statewide LinkMichigan project first started in 2002. The components of the guide are very applicable to Washtenaw County.

A key value of this guide is the stages defined in the guide dealing with communication, best practices, and development of action plans. The Guide is very thin, only eight pages, and has been around for several years, so there might be a concern that broadband applications might have surpassed this guide's value. That does not seem to be the case here. Merit rates this guide is the second best of the entire group.

(2) *Readiness for the Networked World -- A Guide for Developing Countries*

www.readinessguide.org

This IBM and Harvard University supported project is not strictly from a global perspective. It is actually a guide that is "targeted at *communities* in developing countries seeking to define a strategy to participate in the Networked World" as stated in the Getting Started section in the beginning of the report.

The Guide describes itself as both an educational resource that describes the determinants of a community's Readiness for the Networked World, and a diagnostic tool that systematically examines those factors to assess a community's Readiness. This Guide uses the broadest definition of a community to be a village or town, or encompassing an entire country.

There is a web-based assessment tool whereby a user, representing a community, can answer questions regarding various aspects of the community and be scored on that community' s network readiness.

Due to the Guide' s focus on developing countries, this would not be the first tool of choice for Washtenaw County. Nevertheless, the Guide' s assessment components are common to all regions and communities.

(3) *Net Plan – A Community planning guide for advanced telecommunications services*

www.mnplan.stste.mn.us
www.mnplan.state.mn.us/pdf/2000/planning/netplan.pdf

Designed by the state of Minnesota, this is another widely used toolkit with great visuals and examples for networking communities. This Net Plan was created to "assist communities in acquiring the telecommunication services to meet current and future needs" (Net Plan pg. 1).

Merit rates this guide as the most valuable in the group. There is good detail on planning meetings, when and how to hire a good consultant, samples of an RFP format, and an actual User Needs Assessment Survey for both individual users and for not-for-profit organizations.

(4) *Blacksburg Electronic Village – Community Network Development Guidelines*
Technical Report 2001-01 April, 2001:
An outreach effort of Virginia Tech

www.bev.net
www.bev.net/about/research/digital_library/technical.php

An outreach effort of Virginia Tech, this telecommunications-planning project is specific to the state of Virginia. The technical report is dated 2001, which makes it 3 years old, and guide is only six pages. The content really only an outline, weak in depth and doesn' t discuss Blacksburg Electronic Village at all.

(5) *Wiring Rural Vermont – A Tool Kit For Community Telecommunications Planning*
A Joint Project of: Vermont Council on Rural Development
Telecommunications Committee

www.thinkvermont.com
www.thinkvermont.com/technology/pdf/toolkit.pdf

This planning project is specific to the state of Vermont. It provides various steps/guidelines to developing new and bettering existing community networks.
A good component of this guide is the focus on the "digital divide" issue. Otherwise there is nothing new on this guide that isn' t included elsewhere.

Web-based Resources:

(6) *Smart Communities* (A California Project)

www.smartcommunities.org/guide/html/b.html

An implementation guidebook for turning communities into "smart communities." A smart community is defined as a community in which members of local government, business, education, healthcare institutions and the general public understand the potential of information technology, and form successful alliances to work together to use technology to transform their community in significant and positive ways" (Section A: Introduction, What is a "smart community?").

This guide does have a good deal of depth and focus on all the key components of community networking. The guidebook is all on-line so it's very difficult to print, but the content is very comprehensive. For example, there are 4 pages of discussion on User Needs Assessment, with descriptions of all the various techniques to collect user data and insight on issues and tendencies to avoid in the process.

(7) *The Good Neighbor's Guide to Community Networking*

www.lone-eagles.com/cnguide.htm

Developed by the Lone Eagles Consulting Group and Big Sky Telegraph in Montana, the Good Neighbor's Guide to Community Networking is an informative "handson" web guide filled with resources to aid in the successful networking of communities. The guide includes chapters on networking applications for education, healthcare and community development; rural community e-business strategies; grant writing tips and funding sources and much more. The guide would be most valuable to very rural areas, not so valuable to Washtenaw County.

(8) New Connections Toolkit (An Australia Project)

www.newconnections.gov.au

Created for regional Australia, this toolkit is a reference "for regional, rural and remote communities providing information about how to develop local telecommunications projects". The toolkit includes various case studies, projects and many useful resources.

The case studies are the best sections of this guide with examples of commercial-based models, government-initiated models, and community owned models. The guide also includes examples of networked communities in the United States.

5.D. Network Planning Guidelines

Appendix III includes detail on general network planning guidelines, and applies these guidelines to an architecture for the Washtenaw County regional backbone network described in detail in the *Strategic Plan* section. These guidelines include descriptions of fiber and wireless technology implementations as well as estimated costs.

5.E. Aggregation Services -- Business Case Models

Introduction

The goal of this work effort was to develop generic business case models that can be used to identify the capital and operating expenses, and user demand elements for consideration when a provider was assessing expanding services in the county. Aggregating user traffic in various areas to develop the most promising business case is the goal.

There are almost an infinite number of permutations for the construction of business cases and models for a communications and ISP business. The following business cases represent one attempt of many possibilities to create a business financial model for providing broadband services in the county. Since the Washtenaw County project scope does not include a physical network plan recommendation, rough cost estimates are used for most cost components in the model. Assumptions, e.g., take rate for the demographics gathered, are described in the narrative below for each section of the model. The actual financial model itself is attached in electronic format (Excel) to this report.

The reason for providing the model in electronic format (Excel) to the county is so that values and assumptions throughout the model can be changed in order to see the effect on revenue and costs. In addition, these models can be used to build business cases for specific geographies within the county, and the electronic format allows flexibility.

Using actual U.S. Census statistics and by making some assumptions around a generic network plan, a financial model has been constructed showing subscriber revenue and cost estimates for several different service area types in Washtenaw County. Most of the business cases are positive, but prior to making any investment or business decisions, the County should complete a more detailed network plan with a more detailed cost analysis.

The 1st generic model presented is a large market with a surrounding township. The assumption is that this large market has a circuit termination point connected via fiber to a central POP location for the County. This model shows that by having fairly aggressive wireless take rates by occupation, a large number of households and businesses can be served out of a single hub location in downtown. By including additional dedicated circuit ISP customers, as well as a couple of business park or other business customers served over fiber, this model more than covers its costs, including depreciation.

The 2nd area modeled is a medium size market with portions of two surrounding townships. This model assumes a Circuit Termination Point with fiber backhaul to the central POP location for the County. With a medium size wireless subscriber base, and with only a couple of wireless business and dedicated ISP customers, this model also has positive results before interest and tax expenses.

The 3rd area modeled is a small market also with portions of two surrounding townships. This model assumes a Circuit Termination Point, but with fiber backhaul to another Circuit Termination Point in the County, not the central POP. Even with a small base of residential wireless customers and a couple of business customers, this model is also able to cover its costs including depreciation expense.

The 4th area modeled is exactly the same as the 3rd, except wireless is used for backhaul instead of fiber. The wireless alternative is more attractive for this particular market in the short term because of the lower cost. But, if additional bandwidth will be required in the future, fiber is the preferred backhaul method.

Several options exist that could be used to improve the financials further, including:

- Raise subscriber rates for more rural applications
- Utilize existing infrastructure or subsidize some of the costs by using existing government facilities (i.e. Use a 911 tower and space in a fire/police station to eliminate tower and Circuit Termination Point rent).
- Have other entities or institutions utilize the fiber and wireless infrastructure for their own private network links.

The ability to change assumptions and iterate the model, as illustrated above, should allow the model to be applicable in nearly any scenario.

These are high-level financial models to be used for planning purposes only. Before embarking on an actual business venture, a network plan as well as more detailed revenue, cost, cash flow and equipment estimates should be prepared. This is particularly the case for the point-to-multipoint wireless equipment. It is assumed in the business cases that one radio is sufficient to serve the end users in the locality, but given the topography, additional radios may be required. Only a detailed engineering study will provide a definitive answer. Again, the model is included on the CD with this report so that it can be used in future analyses.

5.E.1 Assumptions and Major Impacts

One area that has a significant effect on the overall model is the expense of the end user subscriber units for the wireless service. These units are quite expensive ($300-$800) relative to the monthly cost for the service. In this business model, the end user subscriber units are purchased as a capital expense and are provided as part of the monthly service fee. Alternatively by unbundling these units and selling them as part of the installation fee, the model changes quite a bit, especially in the smaller markets.

However, this unbundling may have a negative effect on the total number of subscribers since many people may not be willing to pay such a large upfront fee.

Lastly, there are several other factors that were not modeled here, but would have an overall positive effect on the financials:

1. Use of this infrastructure for other large customer circuits. For example, if a large college, business or other institution used the dark fiber infrastructure to connect their facilities or connect to other carriers, the allocated cost of the fiber infrastructure would be significantly reduced.
2. A college, school or business used the wireless infrastructure to connect multiple facilities or provide service to a large, concentrated population (i.e. Students)
3. Government entities switched their traffic entirely over to this infrastructure.

The Income Statements in the following major sections indicate profitability. For example, the EBITDA (Earnings Before Interest, Taxes, Depreciating and Amortization) percentage for the Medium Market model is 39%. For an ISP business, an EBITDA percent in the range of 20-40% or higher is considered attractive since this will usually cover the infrastructure depreciation, interest and other costs. The method of financing the infrastructure build will have the most additional bearing on reaching an acceptable percentage for this profitability measurement.

The following sections provide conservative assumptions for Revenue, Operating Expenses and subscriber take rates. Cost of Goods Sold and Capital Expenses are rough estimates and should be further refined with a network plan prior to any financial decisions. Following each table are explanations of the assumptions.

5.E.2 Revenue Assumptions

The following table shows typical charges and over-subscription ratios for various services provided in this business model.

Revenue Assumptions

	Mbs	Over-subscription Ratio	Install Fee	Monthly Fee
Wireless - Residential	1	30	$ 99	$ 39
Wireless - Business	2	7	$ 99	$ 99
T1	1.5	15	$ 200	$ 399
T3	45	5	$ 500	$ 4,500
10Mb Ethernet	10	10	$ 250	$ 1,500

Mbs represents the speed the end customer is purchasing.

Note that research indicates a very wide range of price for the wireless monthly fees, particularly for residential customers. A state-wide range of $20-$120 was found, with an average of about $40. Thus the $39 fee for residential and $99 fee for business wireless is within the state averages.

Over-subscription ratio is used to calculate total bandwidth required by all customers in aggregate once their traffic is aggregated onto backbone links. "Oversubscription" is a common engineering principle applied to the design of backbone networks. It assumes that, 1) not all users will need the network at the same time; and 2) none of the users will send traffic over their connection constantly. With these two reasonable assumptions, the backbone circuits do not have to be a sum of the access circuits. For example, with 10 customers having an access rate of 1 Mb, an engineer might design a backbone to handle 5 Mb. This would be a 50% oversubscription ratio (quite large).

Install Fee is what the customer pays as a one-time start up cost. As noted in section *A.1*, the install fee charged in this model for the Wireless Install does not cover the cost of the subscriber units. The cost is recovered in the Monthly Fee. Also, it is assumed that the end user is setting up the radio equipment at their site. A second "Premium" installation service may be offered that includes on-site installation of the radio equipment at the customer' s location for an additional fee.

5.E.3 Cost of Goods Sold Assumptions

The table below shows various estimates for the components required to calculate the cost of goods sold to provide the wireless, ISP and fiber services. Note: MRC = Monthly Recurring Charge.:

Cost Of Goods Sold Assumptions

	MRC/Mb
ISP BW Charge 0-1.5Mb	$ 300
ISP BW Charge 1.5-45Mb	$ 150
ISP BW Charge 45-155Mb	$ 100
ISP BW Charge 155-622Mb	$ 75

	LEC (5yr) MRC (ie. Ann Arbor to Southfield)	MRC/Mb
ISP Loop 1.5Mb	$ 653	$ 435
ISP Loop 45Mb	$ 3,265	$ 73
ISP Loop 155Mb	$ 8,650	$ 56
ISP Loop 622Mb	$ 17,920	$ 29

Tower Lease	$ 883
Annual Equipment Maintenance Rate	8%
POP Rent & Utilities	$ 1,000
Circuit Termination Point Rent & Utilities	$ 250
Annual Fiber Maintenance Rate	5%

MRC – Monthly Recurring Charge
LEC – Local Exchange Carrier

The ISP Bandwidth (BW) charge represents estimates of current market rates for transit connectivity to the Internet. This is the connectivity that a local ISP purchases from a national or long-haul ISP to whom they deliver customer traffic destined for elsewhere than the local network. As more bandwidth is purchased, the price per Mb decreases substantially. This is why it is important to aggregate as much user traffic as possible before connecting to the Internet backbone. The ISP Loop charge is the cost for a circuit from a POP or Circuit Termination Point (see *Recommendations* section for a detailed description) to the nearest city with large ISP bandwidth available. Estimated costs for LEC services is on a 5-year contract. There are several other options for this connectivity, including dark fiber.

This model also assumes the wireless services will lease space on existing towers or other structures as opposed to construction of an entire new tower. The equipment maintenance is a percentage rate applied to the total cost of the infrastructure equipment to cover equipment repairs, software upgrades and vendor support. It does not include subscriber units. POP and Circuit Termination Point rent and utilities show the allocated costs for these facilities.

5.E.4 Operating Expense Assumptions

The following table shows various operating expense assumptions as a percentage of revenue for a typical communications/Internet service provider:

Operating Expense Assumptions

	Percent of Revenue	Minimum Headcount	Fully Loaded Monthly Cost per Headcount	Effect	Comment
Sales	10%	1	$ 3,333	$ 3,500	MRR new revenue sold
Commissions	5%		$ 3,500		% of new MRR
Marketing	5%				
Engineering	10%	2	$ 5,000		
Customer Support	10%	5	$ 3,333		minimum 24hr rotation
General & Administrative	10%	1	$ 3,333		
Totals	50%		$ 18,500		

The growth assumption in this model is 5% per month for the wireless services, and a negligible growth for the ISP dedicated services. For the most part, the percentage of revenue figures are used in the financial model. The minimum headcount numbers and costs are used for the main POP site if the revenue is very small.

5.E.5 Capital Expense Assumptions

Below are rough estimates for major capital expense items. A network plan is required in order to firm up these estimates and model actual business scenarios in the County. These costs are per POP or Circuit Termination Point and are used later in the model to calculate maintenance expenses and depreciation.

Capital Expense Assumptions

Hub Costs - point To multi-point for end user service	
20 Mb x6 Base Station	$ 22,372
Router Equipment	$ 15,000
Total	$ 37,372
Depreciation Period (months)	60
Customer connection costs	
20Mb Wireless Subscriber Unit	$ 350
100Mb Fiber customer port	$ 950
Gig-E Fiber customer port	$ 7,000
T1 customer port	$ 575
T3 customer port	$ 8,000
Depreciation Period (months)	60
Main Wireless Trunks	
WIRELESS - Small Market Backhaul	$ 33,600
Depreciation Period (months)	60
Main Fiber Trunks	
FIBER - Small Market Backhaul	$ 300,000
FIBER - Medium Market Backhaul	$ 400,000
FIBER - Large Market Backhaul	$ 150,000
Depreciation Period (months)	240
Facility Costs	
POP	$ 250,000
Circuit Termination Point	$ 50,000
Depreciation Period (months)	120

The hub costs are for setting up the wireless radio and aggregation equipment as well as connections to the Internet backbone and dark fiber to the other Circuit Termination Points. The router equipment cost assumes limited deployment of dedicated T1, T3 and fiber business customer. If those figures are revised higher significantly, a more expensive router with additional capacity will need to be included in the model. Customer connection costs are the per port capital cost to add interface cards to the aggregation switch. It also includes the per customer cost for the wireless subscriber units (assuming a large discount for bulk purchase contract).

The main fiber trunk costs are the costs to construct the fiber optic infrastructure between the POP and the Circuit Termination Points. Point-to-point wireless backhaul is used when a circuit termination point is not served with fiber. The hub costs are also reduced in this case since the fiber interfaces are no longer needed.

5.E.6 Population, Occupation and Income Statistics and Subscribers by Occupation

		Subscribers by Occupation						
		Mgmt, Prof.	Service	Sales, Office	Farming, Fishing, Forestry	Construct., Extraction, Maint.	Production, Transportation	
Broadband take rate based on occupation		40%	20%	30%	10%	20%	30%	
=Take Rate * Distribution by Occupation * Housing Units								**Total**
Ann Arbor city	Washtenaw County	27822	2828	6739	23	616	1368	**39395**
Ann Arbor township	Washtenaw County	1408	48	212	0	18	48	**1735**
Augusta township	Washtenaw County	581	117	344	2	116	308	**1468**
Barton Hills village	Washtenaw County	107	4	8	0	1	6	**125**
Bridgewater township	Washtenaw County	197	42	108	1	45	102	**496**
Chelsea village	Washtenaw County	853	124	274	0	76	104	**1432**
Dexter township	Washtenaw County	934	111	378	4	101	168	**1696**
Dexter village	Washtenaw County	392	74	175	1	39	60	**741**
Freedom township	Washtenaw County	219	31	83	21	30	67	**451**
Lima township	Washtenaw County	547	92	226	0	70	88	**1023**
Lodi township	Washtenaw County	1197	93	418	1	61	166	**1935**
Lyndon township	Washtenaw County	406	68	203	1	68	103	**849**
Manchester township	Washtenaw County	556	111	270	4	111	201	**1252**
Manchester village	Washtenaw County	248	67	181	1	48	107	**651**
Northfield township	Washtenaw County	1145	206	659	2	185	366	**2563**
Pittsfield charter township	Washtenaw County	6335	772	2054	3	229	742	**10136**
Salem township	Washtenaw County	861	110	454	0	129	212	**1766**
Saline city	Washtenaw County	1398	198	641	2	104	260	**2603**
Saline township	Washtenaw County	202	28	78	1	35	66	**409**
Scio township	Washtenaw County	3498	306	1026	2	154	378	**5364**
Sharon township	Washtenaw County	240	39	99	5	51	74	**508**
Superior township	Washtenaw County	1822	279	760	4	127	474	**3466**
Sylvan township	Washtenaw County	1192	159	391	1	130	204	**2078**
Webster township	Washtenaw County	1158	74	357	0	85	97	**1771**
York charter township	Washtenaw County	1325	157	519	0	127	277	**2405**
Ypsilanti city	Washtenaw County	2666	1020	2174	4	206	684	**6753**
Ypsilanti township	Washtenaw County	6335	1584	3497	5	807	2892	**15119**
Milan city	Washtenaw County (par	330	146	196	1	69	151	**892**
Whitmore Lake CDP	Washtenaw County (par	607	138	383	1	105	249	**1483**

The Population, Occupation and Income Statistics tables are referenced in the section of this report titled, *Needs Assessment: Region and User Profiles; Mapping Demand.*

Population, Occupation and Income Statistics are critical to decisions regarding residential subscriber take rates. Using U.S. Census 2000 data, which includes population, housing units, city/township area and occupation distribution by area, it was possible to apply take rates per household based on occupation. The occupation percentages from the population census information were applied to the total number of households so that the model would not "multiple count" households in which several people in different occupations were employed.

The overall result is an estimate of subscriber households since the occupation statistics are for population numbers, not households. These numbers were calculated for each city and township. The take rate percentages by occupation can be adjusted in the financial model in order to see effects on revenue and costs. Within the example below, a take rate was assumed based upon industry experience. Business take rates are represented in each of the following Income Statements for the specific areas. The assumptions are again conservative and can be adjusted. With education and other efforts described in the *Recommendations* section of this report, these numbers would likely increase.

5.E.7. Large Market & Surrounding Townships

The following income statement shows a high level overview of the financials of a standalone WISP/ISP operating in a Large Market and Surrounding Township. The Residential subscriber numbers are driven from the U.S. Census data and the take rate assumptions per occupation. The Business subscriber numbers are assumptions based on existing ISP clients in similar sized markets. The local loop cost for an OC12 Internet ISP connection is proportionally allocated to this model based on peak usage.

Large Market & Surrounding Twp WISP/ISP Sample Income Statement
(Circuit Termination Point w/ Fiber Backhaul)

(ie. Ypsilanti and Ypsilanti Township)

	Placement	Radius (mi)	Coverage (sq mi)
Tower #1	Central Downtown	3	28.3
Tower #2	N/A		
Tower #3	N/A		

	Residential Wireless			Business			
	Take Rate Subscribers	Tower coverage	Subscribers	Wireless	T1	T3	10Mb Ethernet
Large Market	6753	100%	6753	5	0	0	2
Surrounding Township	15119	60%	9071	1	0		
Totals			15824	6	0	0	2

		per month	
Revenue		$ 699,108	
peak usage Mbs	531.2		
COGs		$ 75,821	
Gross Margin		$ 623,287	
Operating Expenses		$ 349,554	
EBIDTA		$ 273,733	39%
Depreciation		$ 94,041	

5.E.8. Medium Market & Surrounding Townships

The following income statement shows a high level overview of the financials of a standalone WISP/ISP operating in a Medium Market and two Surrounding Townships. The Residential subscriber numbers are driven from the U.S. Census data and the take rate assumptions per occupation. The Business subscriber numbers are assumptions based on existing ISP clients in similar sized markets. The local loop cost for an OC12 Internet ISP connection is proportionally allocated to this model based on peak usage.

Medium Market & Surrounding Twp WISP/ISP Sample Income Statement
(Circuit Termination Point w/ Fiber Backhaul)

(ie. Chelsea with Sylvan and Lima Townships)

	Placement	Radius (mi)	Coverage (sq mi)
Tower #1	Central Downtown	3	28.3
Tower #2	N/A		
Tower #3	N/A		

	Residential Wireless			Business			
	Take Rate Subscribers	Tower coverage	Subscribers	Wireless	T1	T3	10Mb Ethernet
Medium Market	1432	100%	1432	2	0	0	2
Surrounding Township	496	40%	198	1	0		
Surrounding Township	1023	40%	409				
Totals			2039	3	0	0	2

		per month	
Revenue		$ 92,928	
peak usage Mbs	70.8		
COGs		$ 10,402	
Gross Margin		$ 82,527	
Operating Expenses		$ 46,464	
EBIDTA		$ 36,062	39%
Depreciation		$ 14,650	

5.E.9. Small Market & Surrounding Townships – Fiber Backhaul

The following income statement shows a high level overview of the financials of a WISP/ISP operating in Small Market and Surrounding Townships. Fiber is used to backhaul service to an adjacent market's Circuit Termination Point. The Residential subscriber numbers are driven from the U.S. Census data and the take rate assumptions per occupation. The Business subscriber numbers are assumptions based on existing ISP clients in similar sized markets. The local loop cost for an OC12 Internet ISP connection is proportionally allocated to this model based on peak usage.

Small Market & Surrounding Twp WISP/ISP Sample Income Statement
(Circuit Termination Point w/ Fiber Backhaul)

(ie. Manchester Village with Manchester and Bridgewater Townships)

	Placement	Radius (mi)	Coverage (sq mi)
Tower #1	**Central Downtown**	3	28.3
Tower #2	**N/A**		
Tower #3	**N/A**		

	Residential Wireless			Business			
	Take Rate Subscribers	Tower coverage	Subscribers	Wireless	T1	T3	10Mb Ethernet
Small Market	651	100%	651	2	0	0	0
Surrounding Township	1252	40%	501	1	0		
Surrounding Township	496	40%	198				
Totals			**1350**	**3**	**0**	**0**	**0**

		per month	
Revenue		$ 59,661	
peak usage Mbs	45.9		
COGs		$ 7,394	
Gross Margin		$ 52,267	
Operating Expenses		$ 29,830	
EBIDTA		$ 22,436	38%
Depreciation		$ 10,184	

5.E.10 Small Market & Surrounding Townships – Wireless Backhaul

The following income statement shows a high level overview of the financials of a WISP/ISP operating in Small Market and Surrounding Townships. Wireless is used to backhaul service to an adjacent market' s Circuit Termination Point. The Residential subscriber numbers are driven from the U.S. Census data and the take rate assumptions per occupation. The Business subscriber numbers are assumptions based on existing ISP clients in similar sized markets. The local loop cost for an OC12 Internet ISP connection is proportionally allocated to this model based on peak usage.

Small Market & Surrounding Twp WISP/ISP Sample Income Statement
(Circuit Termination Point w/ Wireless Backhaul)

(ie. Manchester Village with Manchester and Bridgewater Townships)

	Placement	Radius (mi)	Coverage (sq mi)
Tower #1	**Central Downtown**	3	28.3
Tower #2	**N/A**		
Tower #3	**N/A**		

	Residential Wireless			Business			
	Take Rate Subscribers	Tower coverage	Subscribers	Wireless	T1	T3	10Mb Ethernet
Small Market	651	100%	651	2	0	0	0
Surrounding Township	1252	40%	501	1	0		
Surrounding Township	496	40%	198				
Totals			**1350**	**3**	**0**	**0**	**0**

		per month	
Revenue		$ 59,661	
peak usage Mbs	45.9		
COGs		$ 6,368	
Gross Margin		$ 53,293	
Operating Expenses		$ 29,830	
EBIDTA		$ 23,462	39%
Depreciation		$ 9,494	

5.E.11 Summary

The above generic financial models indicate that Internet connectivity services can be profitable in these areas. Further network planning as well as more detailed cost estimates should be completed before this information is "shopped" with local ISPs and entrepreneurs who may be willing to be new entrants into the service provider market in the county. These are just a few examples of possible provider business scenarios.

The above are only some business cases and some assumptions. This financial modeling tool can be used elsewhere, and assumptions can be changed to view the results.

5.F. Section Summary

This section addressed key models that can be used to assess the broadband capabilities in a community. It discussed actual assessment/survey tools, network planning guidelines and model business cases.

Section 6: Summary

The LinkMichigan planning effort was complex, lengthy, and exciting. Deploying this new, but increasingly fundamental infrastructure to all citizens is a massive undertaking. The LinkMichigan goals are transformational for the region and its constituents. The results can have long-term implications that will have our children' s children discussing the pioneering vision of their forebears. But the key challenge that has been understood from the very first day of this planning effort is to ensure that the plan is implemented. And implementation is another phase of complexity, time commitment and excitement. Regional leadership will determine the speed in which it happens.

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