Preface

This series of reports, entitled *Strategic Technology Infrastructure for Regional Competitiveness in the Network Economy* and packaged in eleven Volumes, is the culmination of a dedicated effort of the following individuals and organizations. Each Volume can be viewed as a stand-alone publication; however, it should be noted that each Volume was written in the context of the overall project. The project utilized the Southside and Southwest Virginia regions as a model for a low-cost Geodesic Mesh network design and viable financial model that could be replicated in any region of the U.S.

Volumes

1) Rationale, Environment, and Strategic Considerations
2) Connecting the Regional Infrastructure to National and International Networks
3) A Fiber Optic Infrastructure Design for Southside and Southwest Virginia
4) Fiber Optic Infrastructure Design Guide
5) Financial Feasibility and Investment Rationale
6) Leveraging Advanced Optical and Ethernet Technologies
7) Speculative and Alternative Technologies
8) Community, Applications and Services
9) Demographics for Southside and Southwest Virginia
10) Health Information Technology and Infrastructure
11) Education in the 21st Century
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Dominion Telecom
Economic Development Assistance Center, VA Tech
EngHouse Systems
Enterasys
Extreme Networks
Economic Development Assistance Center, VA Tech
Floyd County High School
Floydva.com
Force 10 Foundry
Future of the Piedmont Foundation
Gamewood, Inc.
GeoTel
Grant County Public Utility District
Hatteras
Hewlett-Packard
IBM
Institute for Advanced Learning and Research, VA Tech
Institute for Connecting Science Research to the Classroom, VA Tech
ION Consulting
KMI Corporation
LENOWISCO
Level 3 Communications, Inc.
MapInfo
Manticom
Marketing Dept., VA Tech
Micrologic, Inc.
Nexans
Nortel
Old Dominion Electric Coop
Pirelli
Prince Edward County Office of Economic Development
Progress Telecom
Qwest
RACO, Inc.
Rinderva.com
Riverstone
Salira
Sprint
Terabeam
Urban Affairs and Planning Dept., VA Tech
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Verizon
Wiltel
Worldcom
Worldwide Packets
Table of Contents

Rationale .............................................................................................................................................. 1
Approach ............................................................................................................................................. 3
  Construction and Ownership ............................................................................................................ 4
  Fiber Lease/IRU ............................................................................................................................... 5
    Managed Transport Services ........................................................................................................... 6
  High Tech Economic Development: A Virginia Region Grid ......................................................... 7
  Providers with Existing Long Haul Facilities .................................................................................. 11
Summary Conclusion ......................................................................................................................... 19
Quick Reference to Frequently Asked Questions ........................................................................... 20
Rationale

Robert M. Metcalfe, who invented Ethernet in 1973, said, "The power of the network increases exponentially by the number of computers connected to it. Therefore, every computer added to the network both uses it as a resource while adding resources in a spiral of increasing value and choice." Later, George Gilder modified Metcalfe’s observation attributing as “Metcalfe’s Law” the statement that “the community value of a network grows as the square of the number of its users increase.” Metcalfe’s Law is often cited in discussion about the explosive value transformation posed by the rapid shift to a global information economy.

This report primarily addresses development of intra-regional advanced network infrastructure within and between communities located in the tobacco growing regions of the Commonwealth (Tobacco Region). In order to maximize the potential value of this investment for competitive advantage, it will be necessary to connect regional and local infrastructure to facilities and services concentrated in large metropolitan areas strategic to the region to reach national and international networks. In addition, the Tobacco Region should connect surrounding research universities to create a virtual hub throughout the region for high tech economic development.

The existing national fiber optic network infrastructure is comprised of relatively few nodes located primarily in major, “tier one” cities interconnected by high capacity, long haul fiber optic cables. The so-called “fiber glut” often alluded to in the communications industry refers to these inter-city links that follow common, narrow paths. This inter-city fiber traverses a relatively small proportion of the geographic area of the country. In most cases it is largely inaccessible even within the communities through which it passes. This national infrastructure, much like the air travel system, can be accessed only at the major nodes it interconnects. In the mid-Atlantic region, such nodes exist in the Washington D.C., Philadelphia, and Atlanta metropolitan areas and, to a lesser

1 “Metcalfe’s Law”, searchnetworking.com definitions, TechTarget, http://searchnetworking.techtarget.com
degree, in the Richmond, Norfolk, Raleigh, Greensboro, and Pittsburgh areas. For more on the so-called “fiber glut” see Volume 1: Rationale, Environment, and Strategic Considerations.

Providing a means to link intra-regional infrastructure to these major markets yields benefits which are self-evident. The availability of multiple service and application providers within the tier one locations provides opportunity for access to a wide range of information services with competitive pricing and terms. Multiple transport providers maintain major access facilities in these areas providing opportunity to leverage flexible network technologies to connect with enterprise networks, vertical partners, service providers, international facilities, and others.
Approach

Ideally, links to tier one access points should offer the same degrees of flexibility, performance, and robustness of the community infrastructure described elsewhere in this report. In practice, this may be difficult to accomplish using existing fiber facilities due to several factors.

- As previously described, long haul fiber already in place is inaccessible except for a very few locations.
- Owners of existing fiber typically offer only limited, “legacy” services and do not readily promote direct access to fiber.
- Fiber in place varies greatly in condition, specifications, reliability, and capability.
- Where fiber is available for lease it may be difficult to negotiate access at favorable terms.

Thus, while the regional infrastructure will be capable of supporting a variety of needs and approaches ranging from dedicated fiber to the enterprise to high performance service provisioning, it may be difficult or impossible to leverage those capabilities for access to major network access points outside the region using existing, long haul facilities. Ultimately, this may argue for acquisition or construction of high capacity, multiple fiber links to connect the region to tier one markets.

In the near term, the recent downturn in the telecom sector following a period of incredible expansion of facilities interconnecting large cities may present significant opportunities to acquire fiber, related materials, or even completed fiber systems at low cost. Some inter-city fiber already constructed along overbuilt north-south routes through Virginia may be available at sharply reduced cost compared to prices of just six months ago. We do not expect these opportunities to exist for long; these resources are already being subsumed into inventories of the remaining industry players and speculators. Acquisition of such assets will require aggressive action but attention to expert due diligence must be carefully applied.
There are several options for gaining access to long haul facilities including construction, leasing/IRU, and buying managed transport services.

**Construction and Ownership**

The greatest degree of control and flexibility would be achieved through ownership of facilities. Construction methods, techniques, standards, and considerations for long haul facilities are similar to those described elsewhere in this report with a few special considerations. The type of optical fiber typically recommended for long distance links is ITU G.655 compatible or “non-zero dispersion shifted” fiber. Corning LEAF, Pirelli FreeLight, and OFS Truewave are a few examples of such products. High fiber counts are typically applied to long haul builds in order to accommodate multiple uses and future expansion.

Right-of-way challenges are significant, particularly within urban areas where the cost of construction can soar to several hundred thousand dollars per mile due to obstacles posed by urban development. Along with the control and flexibility of ownership comes substantial responsibilities and cost in the forms of ongoing management, administration, maintenance, etc. Recurring costs for right-of-way, pole attachments, and other fees may be substantial. In order to make use of the installed fiber, network optronics and electronics must be installed and managed. This applies also to leased fiber described below. It should be noted that the cost of designing and building the network, lighting the fiber, and managing the system can be many times the cost of the fiber itself.

An attractive approach may be to partner for a joint build with an entity positioned to take on these responsibilities. Also, several providers, including many of those listed below, offer customized managed services packages that may include design, engineering, construction, and facilities management. A typical approach is similar to condominium development with multiple tenants of the fiber sharing costs (the term “condominium fiber” is in common use).
Fiber Lease/IRU

A common approach to securing access to fiber is to lease it from the owner of an existing or planned route. This is typically accomplished through an Indefeasible Right to Use (IRU) agreement. An IRU is a right to use a specified amount of capacity for a specified time period. The "indefeasible right" is one that cannot be revoked or voided. An acquirer of an IRU may use the capacity, leave it idle, or allow third parties to use some or all of it in return for payments or other consideration subject to the terms of the IRU agreement. IRUs usually involve a one time payment for a long term lease of the fiber spanning 10, 20, or 30 years. Short term leases for fiber are also common and may contain provisions for rollover to IRU status.

The cost for fiber leases varies widely depending upon availability, business strategy of the owner, and other factors. IRUs for fiber along overbuilt routes between major cities, for example, are currently priced typically from $300 to $800 per fiber mile. IRUs for fiber along paths where fiber is scarce may be priced up to $2,000 per fiber mile or more. Owners of long haul facilities typically are reluctant to lease only a portion of a fiber between two major points of presence since that will effectively “strand”, or isolate, the remaining fiber along that path. For example, an attractive IRU for fiber from the Tobacco Region to Raleigh may be accompanied by a requirement to also pay for the portion from the region to Washington DC, presuming the route runs from Washington to Raleigh. (Depending upon the circumstances, this example could be argued to demonstrate a positive design outcome since owning routes north and south would help achieve route diversity.)

In the case of lease via IRU, in addition to the one time cost and an agreement for the IRU itself, a maintenance agreement is typically required with annually recurring maintenance fees payable to the owner of the fiber. In return, the owner will agree to perform prescribed regular maintenance and repairs. Also, depending upon the distances, characteristics of the available fiber, and planned network design, it may be necessary to include a collocation agreement for amplification and regeneration facilities which increases the annually recurring costs. The collocation agreement may include terms for collocating within the owners’ major node facilities at the link endpoints for interconnection to other carriers and services.
Managed Transport Services

Most owners of existing optical facilities will prefer to offer some form of managed service to provide the required long haul links. The provider will light the fiber and offer a turnkey facility that may be interfaced to the customer’s network. Typical transport services offered include private line service using ATM, Frame Relay, and/or SONET services ranging from DS1 (1.5 Mbps) to OC-192 (~10 Gbps) links with intermediate services typically at 45 Mbps, 155 Mbps, 622 Mbps, and 2.5 Gbps.

Increasingly, providers are offering optical wavelengths as a managed service typically configured with 2.5 Gbps or 10 Gbps capacity.

Managed services provide the least control and flexibility but may offer a cost effective solution depending upon pricing. A challenge to reasonable pricing for high capacity services, particularly new optical wave services, is that for most providers serving the region, capability to offer such services requires new construction with significant capital expenditure and there are relatively few initial customers. Thus, pricing for a single wavelength for the first customer may reflect nearly the entire capital cost to construct a system capable of offering many wavelengths.

A viable approach may be to partner with one or more providers to implement high capacity optical services by serving as the anchor tenant for such services and sharing financial risks. Wave Division Multiplexing (WDM) systems needed to deliver optical wavelength services typically can deliver forty or more 10 Gbps channels. One scenario may be for the Tobacco Commission to offset the capital expenditure required for a qualified provider to deploy WDM long haul systems connecting the region to tier one markets in exchange for zero or low cost access to a subset of system channels for use by education/government. The Commission may negotiate for additional channels to be available at relatively attractive prices for businesses within the region.

Regardless of transport approach, a few common concepts should be taken into consideration:
• Target metropolitan areas now contain “carrier hotels” which are common exchange points constructed to house communications and computing facilities and designed to facilitate interconnection among multiple carriers and service providers. Fiber or transport services should terminate within the urban area at such an exchange facility rather than at a point of presence providing access to only a few carriers or services. It will be necessary to negotiate a collocation agreement for space within the facility which may be part of the agreement for transport services.

• Route diversity is important for reliability for long haul routes just as it is with regional network infrastructure described elsewhere in the report. At a minimum, any local or regional system should have connections along two separate paths preferably on facilities owned and operated by at least two separate entities to two tier one markets. Many permutations are possible to satisfy and strengthen this objective. One example would be to lease fiber along a “glut” path from Washington DC to Raleigh intersecting the tobacco region in at least two points. This could provide paths in two directions, north and south, and should be relatively easy to secure since the entire segment from DC to Raleigh would be paid for without “stranding” any portion. Another example would be to negotiate attractive prices for optical waves from an entity capable of connecting to several tier one markets then add waves as demand and engineering requirements dictate.

• Scalability, meaning the ability to increase capacity and capability over time, is a crucial factor for future-proofing any solution. Construction and ownership of a multi-pair fiber path offers the best scalability. Partnering for implementation of a multi-channel WDM system with options to use additional channels over time is another good scaling strategy. Entering a long term contract to purchase “legacy” private line services may offer poor scalability.

High Tech Economic Development: A Virginia Region Grid

According to a Milken Institute report entitled America’s High-Tech Economy: Growth, Development, and Risks for Metropolitan Areas, “Research centers and institutions are undisputedly the most important factor in incubating high-tech industries. A side effect of the technical capability and scientific research activities of these institutions is the
training and education of the skilled labor that will be critical to the expansion and reinforcement of regional high-tech industries.²

Twenty-nine of the top thirty fastest-growing, high-technology metropolitan areas in the United States are home to, or very near, a research university (DeVol 1999). In Virginia 83.7% of the high technology jobs are found in metropolitan areas in close proximity to research institutions.³ Furthermore, proximity to research institutions was the only one of a dozen high-tech development factors listed in the Milken Institute report considered to be a critical success factor at all stages of a region's technology development.

Worldwide, leading institutions of research are now focused on creating optical “grid” network systems similar to the geodesic mesh architecture described in this report. The grid will support dramatic increases in computational research capability and collaboration by enabling distributed supercomputing and resource sharing on a massive scale. Access to this grid will be absolutely essential for the competitiveness of Virginia’s research institutions and also for high tech economic development. The Tobacco Region has an opportunity to leverage the proposed fiber infrastructure to distribute grid capability throughout the region.

The Tobacco Region of Virginia is fortunate to be surrounded in close proximity by multiple, world class research institutions. By extending high capacity fiber optic communications links to connect these institutions, the region can establish itself as the hub of a virtual, high tech community with opportunities for biotech, engineering, nanotechnology, material science, and other scientific areas ripe for commercial development.

² Ross C. DeVol, America’s High-Tech Economy: Growth, Development, and Risks for Metropolitan Areas, Milken Institute, 1999
Virginia Tech (VT) is the state’s largest research university and is a nationally recognized leader in advanced, optical network initiatives. VT is located in close proximity to the northwest of the Tobacco Region only one county removed. The university has already made an initial commitment to the effort described here through the Institute for Advanced Learning & Research (IALR). IALR is envisioned to revitalize and diversify the economy of the Southside Virginia Region by developing an innovative, high tech, network-based economy that provides opportunities for the upward mobility of this region’s citizens. Through advanced network connectivity, the resources of the university could be virtually established within every community throughout the region providing high tech companies with real time, collaborative access to the expertise, knowledge, and facilities of the institution.

To the east, Old Dominion University (ODU) is a tier one research university well positioned to facilitate access to high tech and defense industry players in the burgeoning Hampton Roads area of the state. ODU has a strong track record for distance learning and collaboration for advanced network initiatives serving the Commonwealth.

The University of Virginia (UVa) is located within easy reach of the Tobacco Region right up the US 29 corridor. UVa is a world class research institution with strong programs in telemedicine and many areas of science and engineering. UVa also has a strong track record for leadership in IT initiatives of the Commonwealth.
Oak Ridge National Laboratory (ORNL) is a multi-program science and technology laboratory managed for the U.S. Department of Energy by UT-Battelle, LLC. (Both Virginia Tech and the University of Virginia are partner universities in the managing LLC.) Scientists and engineers at ORNL conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation’s leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security.

Virginia Commonwealth University is located in Richmond which is a strategic metropolitan area network access point accessible to many long haul fiber routes and providers. Other higher education institutions including Longwood College, Saint Paul’s College, Averett University, the Virginia Community College System, and others located within or near to the Tobacco Region can be incorporated into a virtual community to attract high tech development and to promote workforce development.

Many communities within the Southside portion of the region are strategically located close to research institutions and high tech companies located in the Research Triangle Park (RTP) area of North Carolina. MCNC (previously the Microelectronic Center of North Carolina) is a non-profit corporation located within RTP that aggregates high performance network access for North Carolina universities and research institutions. MCNC operates an exchange facility within the park providing a strategic connection point to reach those institutions and high tech enterprises located there. MCNC also houses the North Carolina Supercomputing Center and the North Carolina Bioinformatics Grid.

The Virginia Tobacco Region could effectively provide a regional "Grid" infrastructure to facilitate collaboration among these respective institutions while establishing an advantage to entities within the tobacco area for high tech development opportunities and workforce training.

Virginia Tech, together with a few of the research institutions mentioned in this section, is very active in development of national optical network initiatives. These efforts are playing important roles in the emergence of the national infrastructure and in the flow of
resources for research and all types of development. An effective approach may be for one or more entities in the Tobacco Region to become a partner in these efforts. Such a partnership could yield significant influence and opportunity by providing early access and a measure of control nationally.

Upon request, Virginia Tech will assist in brokering discussion for connection to any of the research institution connection points listed or will provide institutional contacts. Virginia Tech could also serve to coordinate an optical grid network initiative involving the entire research and higher education community in and around the region together with economic development interests to realize a Virginia Grid.

Major Research University/Lab Connection Points:

- Virginia Tech, 1700 Pratt Drive, Blacksburg VA 24060
- University of Virginia, ITC-Carruthers Hall, 1001 N. Emmet St., Charlottesville, VA 22901
- Old Dominion University, 4608 Hampton Blvd., Norfolk, VA 23529
- Virginia Commonwealth University, 900 E. Main Street, Richmond, 23219
- MCNC, 3021 Cornwallis Rd, Research Triangle Park, NC
- ORNL, 1 Bethel Valley Road, Oak Ridge TN

**Providers with Existing Long Haul Facilities**

This section identifies some providers with existing fiber optic facilities that may be available to provide links from the Tobacco Regions to tier one network access points. This is not an exhaustive list of providers serving the region. The list is limited to providers appearing on a report from KMI Corporation depicting long haul fiber routes in Virginia. Fiber path information is based on data from KMI Corporation last updated September, 2001 and reflects only approximate routes. Thanks to KMI Corporation,

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www.kmicorp.com, for permission to use this information in this report. The “offering” section displayed for each provider is, where quoted, as stated by the provider contact.
AEP Communications, LLC
Address: 1 Riverside Plaza
11th Floor
Columbus, OH 43215-2373
Telephone: 614-716-1389
Contact Person: Scindra Kolecki
Title: Account Manager, Asset and Bandwidth Services
e-mail: sscolecki@aep.com
Internet URL: www.aep.com
Offering: “fiber leasing, construction, engineering services, network design, collocation, project management”

AT&T
Address: 13630 Solstice Street
Midlothian VA 23113
Telephone: 804-897-1734
Contact Person: Chester Porter
Title: Client Business Manager for VA
e-mail: cporter@at.com
Internet URL: www.att.com
Offering: “Full range of voice and data services, IT and professional services”

Dominion Telecom
Address: 4355 Innslake Drive
Glen Allen, VA 23060
Telephone: 804-565-7584
Contact Person: Thomas M. Hogg
Title: Manager for Regulatory Affairs
e-mail: tom.hogg@dom.com
Internet URL: www.dominiontel.com
Offering: “Private Line (DS-1, DS-3, OC-N), WDM Waves, Ethernet. Fiber leasing and collocation are ICB.”
Volume 2: Connecting the Regional Infrastructure to National and International Networks

**Level 3**
Address: 8270 Greensboro Drive
         Suite 900
         McLean VA 22102
Telephone: 571-382-7427
Contact Person: Laura Spining
Title: Account Director
e-mail: Laura.spining@level3.com
Internet URL: www.level3.com
Offering: “Private line transport services, optical waves, managed services for construction, engineering, fiber leasing, collocation, MPLS transport product”

**Progress Telecom**
Address: 100 2nd Avenue South,
         Suite 500
         St. Petersburg, FL 33701
Telephone: 727-820-5961
Contact Person: Steece A. Hayes
Title: Senior Account Manager
e-mail: shayes@progresstelecom.com
Internet URL: www.progresstelecom.com
Offering: Wholesale capacity, private line, optical wavelength

**Qwest**
Address: 1306 Concourse Drive
         Suite 400
         Linthicum MD 21090
Telephone: 410-694-4848
Contact Person: Joel Prescott
Title: National Account Manager
e-mail: Joel.prescott@qwest.com
Internet URL: www.qwest.com
Offering: “Private line services, Internet, collocation, fiber leasing, engineering, construction, hosting, VPNs”

NOTE: Company website map shows planned route completed as of Jan. 2003
Sprint
Address: 7202 Glen Forest Drive
          Suite 100
          Richmond VA 23226
Telephone: 804-285-5928
Contact Person: Mike MacDowell
Title: Account Executive
e-mail: mike.macdowell@mail.sprint.com
Internet URL: www.sprint.com
Offering: “Full range of data network services”, engineering, construction, fiber leasing, collocation, managed solutions

Valleynet
Address: 401 Spring Lane
          Waynesboro VA 22980
Telephone: 540-946-3525
Contact Person: Gene Sandridge
Title: General Manager
e-mail: genes@valleynet.com
Internet URL: www.valleynet.com
Offering: “Wholesale bandwidth (DS1, DS3, OC-n, optical wavelength) member of DDR Broadband with capability to extend services to NC, SC, GA, FL, KY, in addition to Valleynet coverage in PA, MD, WV, TN”

Wiltel (formerly Williams Communications)
Address: 58 Camden Road NE
          Atlanta, GA 30309
Telephone: 678-296-4802
Contact Person: Rob Armstrong
Title: Regional Director, Sales
e-mail: Rob.armstrong@wcg.com
Internet URL: www.wiltel.net
Offering: “Wholesale private line, ATM, frame relay, optical wave, fiber leasing, managed services”
In addition to the providers listed above that were included in the fiber path report from KMI Corporation, there are several service providers who have indicated an interest in providing inter-regional services.

- Adelphia has long haul fiber within Virginia in addition to local fiber facilities in several communities. They offer typical private line services and have indicated on multiple occasions willingness to work innovatively to develop partnerships and new approaches. A contact is Tom Thompson, 24 West Main Street, Charlottesville, VA 22903, telephone 434-817-8132.

- Cox also has both long haul and community area fiber optic facilities in the region and has indicated interest in working with developers in the Tobacco Region. A contact is Wes Neal, Director of New Business Development, telephone 757-369-4528.

- Verizon has recently received regulatory relief in Virginia and may be able to address inter-regional connectivity requirements. Verizon has indicated a strong interest in working with the Tobacco Commission.

- Old Dominion Electric Cooperative (ODEC) does not currently operate fiber optic facilities but has indicated willingness to work with the Tobacco Commission and partners to develop fiber optic infrastructure serving the region. ODEC has been highly engaged with the e-58 effort of the Commission since its inception and has made several significant contributions to the discussion to date.
Figure 2 displays national long haul fiber routes in place and planned as of May 2000. This map is copyrighted by KMI Corporation, http://www.kmicorp.com, and is reprinted by permission. The routes shown do not depict the precise location of fiber but rather indicate connections between nodes. This picture reinforces the point that long haul fiber is generally deployed along a relatively few paths nationwide interconnecting major urban areas. The pathways resemble large ribbon cables of fiber linking city to city with relatively few endpoints. The map in Figure 2 identifies the major nodes on the national fiber infrastructure. As previously indicated, important locations with proximity to Virginia include Washington D.C., Atlanta, Richmond, Norfolk, Raleigh, Greensboro, Charlotte, Philadelphia, and Pittsburgh.
Figure 2
Summary Conclusion

In order to maximize the value and opportunity created through investment in fiber optic infrastructure within the Tobacco Region, it will be necessary to establish optical links from the region to multiple major nodes of the national long haul fiber optic system which are primarily located in major metropolitan areas described herein. This may be accomplished by partnering with or leasing capacity from owners of existing fiber passing through the region or by constructing new long haul fiber routes to strategic locations. Current market conditions may offer unusual opportunities to gain existing facilities on overbuilt, inter-city routes at attractive terms.

In order to leverage the infrastructure to promote high tech economic development, fiber optic links should be extended to major research universities and institutions surrounding the region to establish a virtual, high tech crossroads throughout the Tobacco Region. Key institutions, including Virginia Tech, the University of Virginia, Old Dominion University, MCNC (aggregating access all North Carolina research facilities), Oak Ridge National Laboratories, and other area institutions could leverage the fiber infrastructure to create a regional optical Grid for education and research. Access to this Grid throughout the region would create significant opportunities for high tech business development, education, and workforce development.
Quick Reference to Frequently Asked Questions

1) Why is it difficult for an established telecommunications company to make this investment? (Volume 1, Volume 5)

2) There is already too much fiber in the ground. Why not use what’s there? (Volume 1, Volume 2, Volume 6)

3) The principal design criterion driving the development of this infrastructure is that every user has the potential to be a “producer” in the network economy. Is this the same as “broadband”, as it is currently hyped in the industry? (Volume 1)

4) Can we quantify the potential jobs that will be created if a region invests in building advanced telecommunications infrastructure? (Volume 1)

5) What should be the Tobacco Commission’s role in the deployment of first mile technologies? (Volume 1, Volume 3, Volume 5, Volume 7, Volume 8)

6) How can localities ensure that they get early access to the network? (Volume 1, Volume 5, Volume 8)

7) What kind of success have other regions had with the development of network infrastructure for economic development? (Volume 1)

8) What regulatory factors should be considered when investing in wireless technologies? (Volume 1, Volume 7)

9) Why do we need to connect to network points outside of the tobacco regions? (Volume 2)

10) Once the network is in place, what do we do with it? (Volume 2, Volume 8)

11) Since the business model for inter-regional and inter-county infrastructure did not include the use of conduit facilitating blown fiber strands, what are the circumstances in which this technology is appropriate and financially feasible? (Volume 3, Volume 7)

12) How do existing community networks fit into the overall design? (Volume 3, Volume 5, Volume 6)

13) What are some examples for deployment in the first/last mile? (Volume 3, Volume 7)

14) What type of fiber is recommended? (Volume 3)

15) What would a network design for my county look like? (Volume 3)
16) How much would all this cost? (Volume 3, Volume 5)

17) What is the appropriate organization model for managing and sustaining the Tobacco Commission’s investment in critical technology infrastructure? (Volume 5)

18) Tobacco region communities are underserved because the private sector does not see a profitable business case. What makes this feasible from a business perspective? (Volume 5)

19) If the traditional investment model for developing critical technology infrastructure has failed, what is the alternative? (Volume 5)

20) How much would it cost for consumers in the region to use the network? (Volume 5)

21) What technologies enable use of the fiber? (Volume 6)

22) How does the choice of technology to light the fiber impact the cost? (Volume 6)

23) How do wireless technologies fit into this framework? (Volume 7)

24) What is meant by the term “open access”? (Volume 8)

25) What is the difference between the broadband hype and the “next generation” networks? (Volume 8)

26) What are some next generation Internet (NGI) applications? (Volume 8)