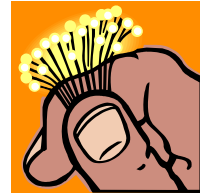


## NRV Proposed Fiber-Optic Network

Given the needs present and future identified in the NRV, creating an expansive, open-access, regional community fiber-optic network is critical to future economic health in the region. A basic three-tier network (inter-county, intra-county and local access) fiber design is included here as the essential “community network.” There are many other shorter-term options for increasing local access to higher-speed connectivity, and these are not seen as “bad.” However, to the extent possible, fiber is preferred as it is the only long-term solution (others will become obsolete in a few years, as many wireless or other last-mile solutions may.) This fiber network design is a “20-year solution” (John Nichols) that would create a New River Valley economic engine, interconnecting higher education institutions, major industrial parks and commercial centers, schools, and local governments, including fire and rescue. These 127 sites are all considered to be anchor tenants. The proposed network will also interlink the towns, most major employers and core commercial areas. (See Figure 8 for a map of business in the New River Valley by sector and number of employees.) This section details the proposed design and cost estimates, assesses feasibility and implementation strategies.



### Design Overview

We propose to create a regional fiber-optic network for the New River Valley. The system is designed to deliver Open Access TCP/IP transport services. Such a system is capable of delivering a full range of telecommunications services to the end-user, such as Internet, VoIP, digital video, and other services. Each end-user of this network will negotiate separate arrangements for the delivery of these services from third party service providers, who may compete for the end-users’ business, resulting in lower costs.

The first phase of the proposed network would serve most industrial parks and several commercial centers, major government facilities (including fire and rescue), all schools, and major health care facilities within the New River Valley. All of these are considered to be anchor tenants. Each site would be provided with 10/100/1000 BaseT Ethernet transport across a fiber-optic cable run to the premise. Some of these sites have been designated as “distribution” sites, from which fiber is run to serve other end-user sites.

The current design of the network affords us the flexibility and scalability to expand it to serve businesses and residential users later on. However, there are legal and regulatory complications in Virginia that must be addressed before this can take place. As a first step, it is our intention in the near term to conduct research regarding the nature of the entity in charge of the operation of this network. In the interim, the network will only serve public facilities.

### System Architecture

The architecture of the proposed network has two components: the fiber-optic cabling infrastructure that will be constructed or leased to interconnect the sites, and the network equipment (“electronics”) that will “light” the fiber. As was mentioned previously, the “sites” are primarily government facilities and schools, with a few hospitals and business parks. All

fiber runs are point-to-point, from one facility to another. Thus far, we have not built any outdoor splice/junction points into the design, nor have we encountered the need to acquire any land upon which to place our equipment.

The fiber-optic infrastructure has been designed in a hierarchical manner. It consists of three layers: the Inter-County Backbone, the Intra-County Backbone, and the Local Access Layer.

The Inter-County Backbone is characterized by long, high-capacity fiber runs connecting the region's major towns. It connects the main distribution hubs (usually major government facilities) in each town to the "Core" sites that connect the system to higher-tier carriers. By design, the number of access points in this layer of the network has been kept to a minimum, since the equipment required to operate these sites is more expensive than that required to operate a small distribution or end-user site. Initially, the inter-county backbone made only one stop in each incorporated town and independent city in the region; however, a limited number of exceptions were made to this rule during subsequent revisions of the design.

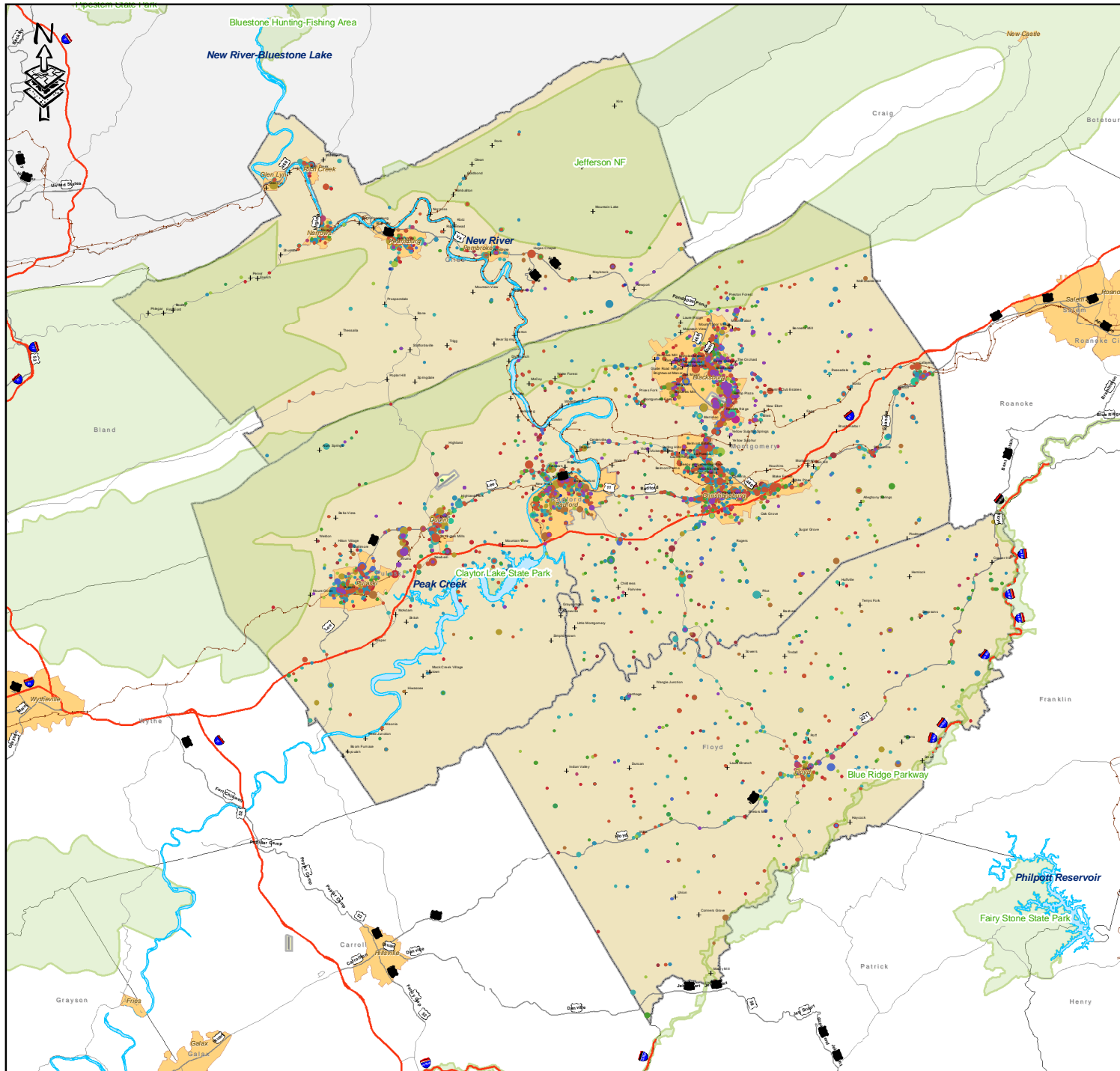
The Intra-County Backbone, or Distribution Layer, consists of medium-capacity fiber runs within a county or large town interconnecting the local distribution sites. Since it was envisioned that the K-12 schools would function as the local distribution sites, this layer of the network was initially designed to connect all the schools. Where practical, however, other sites such as industrial parks were added in as local distribution sites – though most of the other sites were connected to the distribution sites in the Local Access layer.

The Local Access Layer consists of short, lower capacity fiber runs connecting network end-users to the local distribution sites. Anything that was not a core site and not a distribution site was by default an end-user site, and was connected to the network using local access fiber. In the current phase of the design, the local access fiber parallels Inter-County or Intra-County fiber in several places. It was assumed that installing local access fiber along the same path as backbone fiber would actually be less expensive than terminating the backbone fiber at a site that did not have a distribution role.

The fiber-optic infrastructure we are proposing allows for route diversity, as the inter-county backbone forms a "ring" around the region, and several smaller rings are formed in the lower layers of the network. In addition, the core sites are redundant (RU and RAAP), and secure (RAAP is a restricted-access facility).

Nearly all of the fiber routes in the accompanying map follow public roads. It is acknowledged that this may not always be the most desirable path to follow when connecting two sites. However, in the absence of more detailed information regarding the location of other infrastructure, such as power lines and utility poles, following the highways was a necessary assumption. For the purposes of cost estimation in this initial phase of the design, it is an acceptable assumption. We are currently in the process of refining the routes, as we have assembled a design team, knowledgeable about the geography of the area, the existing infrastructure, and the technical issues to be considered, to review the proposed routes and comment on alternate paths. ***See Figure 9 to NRV Proposed Fiber-Optic Network. See detailed descriptions in Appendix D.***

# New River Valley Businesses



## Legend

### Industry Sectors

- Dot color indicates SIC category
- Accounting, Architecture and Engineering
  - Agriculture, Forestry and Mining
  - Business and Personal Services
  - Contractor or Construction
  - Education
  - Finance, Insurance, Real Estate
  - Government
  - Health
  - Household and Miscellaneous Services
  - Legal
  - Manufacturing
  - Membership Organizations
  - Non-Classified Establishments
  - Retail
  - Transportation, Communication and Public Utilities
  - Wholesale

### Firm Size

Dot size indicates number of employees

- 1-5
- 6-10
- 11-20
- 21-50
- >50

### Highways

- Limited Access Freeway
- Highway
- Secondary Roads
- Railroads

### \*Populated Places (GNIS)

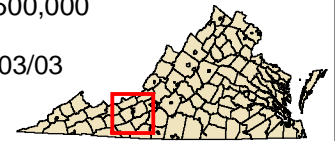
- Towns and Cities
- Parks
- New River Valley (PDC 4)
- Other Virginia Counties
- Surrounding States

Scale: 1:500,000

Date: 3/03/03

Author:

Seth Peery  
Virginia Tech eCorridors Group  
sspeery@vt.edu



Data Source:

MapInfo/GeoResults Business Points  
Data Version: December 2003



# New River Valley Proposed Fiber-Optic Network

## Overview - Entire Project

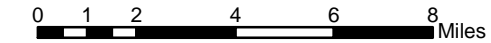
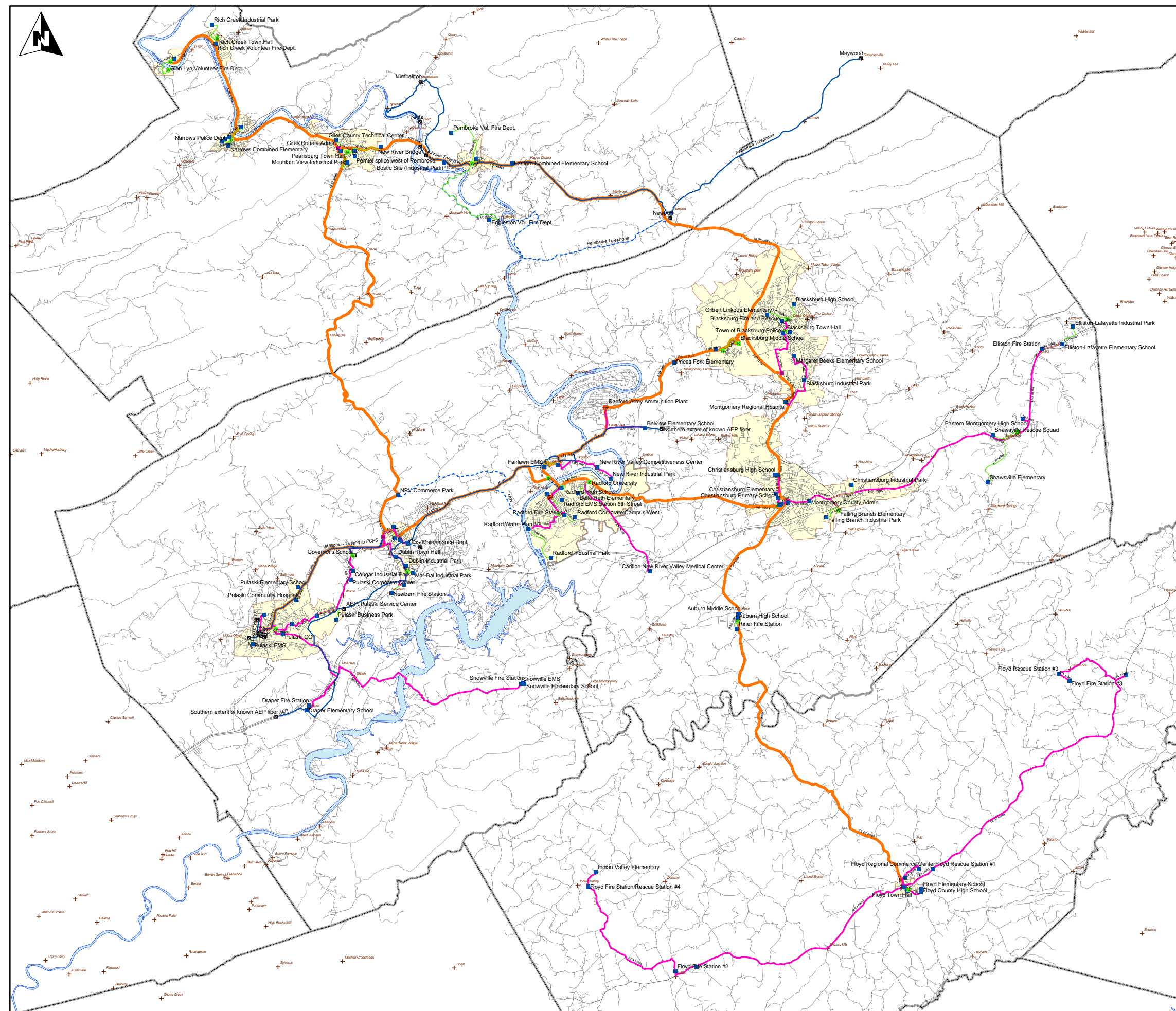
Drawn By:	Seth Peery, Virginia Tech eCorridors
Scale:	1:246,493
Date:	June 15, 2004



## Legend

- NRV Fiber Junctions**
- Already Connected
  - Core
  - End User
  - Large Distribution
  - Small Distribution
- Inter-County Backbone**  
— Inter-County Backbone
- Intra-County Backbone**  
— Intra-County Backbone
- Local Access**  
— Local Access
- Other Fiber - Existing**  
— Other Fiber - Existing
- Other Fiber - Proposed**  
— Other Fiber - Proposed
- Non-Metro Populated Places**  
 + Non-Metro Populated Places
- Highways**
- <all other values>
  - Limited Access Freeway
  - Highway
  - Secondary Roads
  - Local Roads
  - Railroads
- Major Water Features**  
— Major Water Features
- Towns and Cities**  
 Towns and Cities
- Counties**  
 Counties

## Spatial Extent



## Construction Costs

The cost estimate for the New River Valley Fiber-Optic Network, as a starting point, assumes that every component of the network will have to be bought and installed. The cost for 283 miles of fiber and electronics for 120 sites, as well as rights-of-way, all labor and administration, is estimated to be nearly \$10.5 million (Table 9; detail products and costs in Appendix D). While major shake-outs in the telecommunications industry in recent years have brought dramatically improving technology and major price reductions, it is expected that prices have now leveled for the foreseeable future.

**TABLE 9**  
**Estimated Construction Costs for Proposed NRV Fiber-Optic Network**

Components	units	unit costs	total costs
Fiber (in miles; costs for labor and materials)	283.29	\$30,000	\$8,498,700.00
Electronics (user sites)	120	vary	\$927,592.25
Installation			\$235,500.00
<b>Total Construction</b>			<b>\$9,661,792.25</b>
Administration (8%)			\$772,943.38
<b>Grand Total</b>			<b>\$10,434,735.63</b>

While this construction cost estimate for the NRV Community Network seems large at first, several factors must be considered:

- ⇒ A substantial amount of fiber has been or will be installed in the near term by local telephone cooperatives in Floyd County and parts of Giles County; as well as the City of Radford (meaning the actual costs of the total network will be less.)
- ⇒ Millions of dollars in telecommunications expenditures leave the New River Valley every year—to pay for phones, Internet, and wireless communications. One local school division alone pays over \$8,000/month in telecom costs—even though they get a free T-1 line through New River Community College.
- ⇒ Grant funding may lower the local out-of-pocket costs.
- ⇒ The project may be done in phases.

## Operating Costs

Based on industry estimates, operations and maintenance contracts cost as much as 20% (of initial capital outlay) annually. Additionally, administration and management including contractual oversight, marketing, and accounting will likely add another 10% in operational costs annually. It is unlikely that grant funding will substantially reduce these costs in the long run. Marketing will focus on the 127 anchor tenants identified and the voice, data and video services listed in Table 8.

## Financial Feasibility

The critical question then becomes: could more speed and bandwidth be provided at reasonable costs if there were a regionally-owned, open-access community fiber-optic network? Could capital costs to build this network be reduced through regional collaboration and partnerships with federal funding agencies, local cooperatives, and/or private providers?

Studies, such as eCorridors, have suggested that the full value of community networks cannot be assessed using the traditional cost-benefit analysis. Rather, since broadband is so essential and critical for long-term community well-being, it should be considered, valued as, and invested in by local governments as a necessary public good, i.e. so critical and indivisible that availability is essential for health, safety and welfare of the community<sup>12</sup>.

This plan cannot provide a final answer regarding the cost-benefit of a community network. Rather an analytical framework is presented below that will encourage and guide closer assessment and better understanding.

## **New River Valley Community Fiber-Optic Network**

### **Financial Analysis Framework**

#### COSTS of a new Broadband Community Network:

- ⇒ Planning, Construction and Implementation (estimated above)
- ⇒ Operations, including service and maintenance
- ⇒ Opportunities for cost-sharing (and grants), depending on the type of regional entity formed, and the use of “in-kind” resources in the region

#### VALUES of a new Broadband Community Network in doing the following:

- ⇒ Insuring the continuing strength and growth of higher education in the region (including teaching, research, technology transfer and outreach)
- ⇒ Employer retention and attraction, including entrepreneurship in the region (jobs created and retained)
- ⇒ Providing current level of services to local governments and schools
- ⇒ Expanding applications for new educational and e-government services, including emergency services
- ⇒ Expanding medical access and services
- ⇒ Reaping maximum economic benefit of existing assets in the region, including industrial parks, educational assets, and natural, heritage and recreational amenities

Some key variables of the financial feasibility of this network are:

- ❖ The availability of grant funding, which is also dependent on the type of organization formed (to be discussed next)
- ❖ Availability of local skills, assets and entities that might help lower costs (to be discussed later)
- ❖ The estimated dollar amounts of the general value statements in the above framework.

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<sup>12</sup> Brenda van Gelder. ““The Case for the Municipal Provision of Competitive Broadband Infrastructure,” *EDUCAUSE Review*, vol. 39, no. 3 (May/June 2004): 62–63.

## Organization

Given the flux of recent rulings and legislation, the best framework for a regional entity to own and operate a regional community fiber-optic network is not readily apparent. There are a few options that need to be explored in detail with potential participants:

- ❖ The formation of a new regional non-profit, as LENOWISCO did.
- ❖ The use of an existing regional non-profit, the NRV Development Corporation.
- ❖ The use of Virginia's First Regional Industrial Facilities' Authority, a 15-member entity that enables public-private partnerships for the provision of infrastructure facilities.
- ❖ A new regional authority, based on other existing regional authorities, such as the wastewater authority.

This process is proposed as part of the next planning phase. Consideration will need to be given to the eligibility for various funding types.

## Capital Funding and Resource Opportunities

There are several state and federal initiatives encouraging the development of broadband networks at this time. The Appalachian Regional Commission, for which all of the NRV is eligible, has competitive planning and design funding and a modest amount of implementation funding. USDA's Rural Development and Rural Utility Service has broadband loan funds available to local governments, cooperatives and utilities. Other Virginia communities have also received Technology Opportunity Grant funds and Economic Development Administration funds from the US Department of Commerce. Unfortunately, the NRV (except for Floyd County) is not eligible for Virginia Tobacco Indemnification Funds, which has been a major benefactor of Southwest and Southside broadband initiatives.

State and federal operating assistance programs are less prevalent. Yet the NRV enjoys substantial assets and expertise related to operational expertise. Virginia Tech is a leading research university and is out-front on the effort to create a national tetra-bit research network. Moreover, Virginia Tech has operated their own campus network for two decades. The Virginia Tech e-Corridors group has voluntarily supported this planning effort through the provision of high-level design and cost estimates and other technical guidance. Additionally, New River Community College and the New River Valley Technology Magnet School have many important resources, included training programs for hardware and software development.

## Conclusion

Clearly, there are many opportunities for funding and regional collaboration to help make the New River Valley Community Fiber-Optic Network a reality. Moreover, there is compelling evidence that only this network will provide for the needs of higher and k-12 education, the next-generation companies and jobs, and the high quality services required to sustain and improve the lives of all residents of the New River Valley.

## Implementation Strategies

### **New River Valley Vision:**

*Greater bandwidth and services will be provided to meet current demands and future needs, enabling affordable access to 100-megabit service for everyone in the New River Valley.*

### **New River Valley Goal:**

*An open-access service network with three levels will be established--inter-county, intra-county and local access—through regional coordination and collaboration.*

Given the Vision and Goal stated above, the following are the basic implementation strategies:

- ⇒ Form a viable, regional legal community network entity.
- ⇒ Encourage cooperation, collaboration and partnership to ensure the greatest impact with limited resources.
- ⇒ Invite broader participation by local government officials and staff into the process, including public service authority board members, planners and building officials.
- ⇒ Complete a financial feasibility analysis to determine viable construction and services.
- ⇒ Pursue funding for implementation of the community network:
  - Inter-county network
  - Intra-county network, and
  - Community Access.
- ⇒ Pursue telemedicine links, especially for medically-underserved areas such as Floyd County.
- ⇒ Consider all viable last mile strategies, as geographies and infrastructures of NRV communities vary widely.
- ⇒ Encourage “any open-ditch policy” (water, wastewater and streetwork) to insure that fiber or conduit is put in at every opportunity at lowest cost.
- ⇒ Expand the network by amending subdivision requirements, building codes, and street maintenance policies.
- ⇒ Continue developing technology skills locally and jobs to retain and attract highly-skilled graduates.

## Priorities

Three projects are critical to the formation of a regional, secure, and redundant optical network. Priority linkages include: Blacksburg-Radford Army Ammunition Plant, Radford-Dublin-Pulaski, and Dublin-Giles connections. Small demonstration projects, including wireless, are also needed. One wireless project is actively being sought to serve the south side of Claytor Lake in Pulaski County.

## Next Steps

The critical next steps in this planning and development process will be the work of establishing the regional, legal entity to develop, construct, house and manage the NRV community network. This process will also further refine the design hopefully including use of local government sites for electronics. These two steps will enable feasibility analysis and operational planning. A proposal to achieve these steps has been submitted to the Appalachian Regional Commission for funding consideration (proposed scope of work included below).

### Next Phase: Proposed Scope of Work

#### **I. Invite and Organize Collaborative Partners**

- Local Governments
- Higher Educational Institutions
- Private providers, including local cooperatives
- Other Right-of-way owners
- Potential anchor customers (including hospitals, manufacturers, governments)

#### **II. Review and Update of NRV Community Network Design** (based on input from partners)

- On-the-ground detail of location decisions, including electronics
- Updated Capital Cost estimates

#### **III. Analysis of Organizational Alternatives in light of changing Federal and State Laws and Rulings**

- Lead regional organization: public-private partnership, non-profit, or community cooperative?
- Installation: local options?
- Operation and Maintenance options

#### **IV. Financial Feasibility Analysis**

- Analysis of Current Telecom Costs for Localities
- Operations and Maintenance Cost Estimates
- Likely major anchor tenants (and updated prioritization of project areas)
- Major economic externalities and benefits
- Funding Opportunities
- Break-even analysis

#### Products Would Include:

- ✓ Identified Collaborative Partners
- ✓ Draft Organizational Documents
- ✓ Revised and Enhanced Network Design and Costs
- ✓ Funding Plan
- ✓ Operations and Maintenance Plan

#### Project Measurements:

- At least 5 local governments and two local phone cooperatives will participate in organizational conversations; major employers, including higher education institutions, together serving more than 8,000 employees, will also participate in the conversation.
- Completion of products listed above.