

Bland County, VA - Wireless Broadband Deployment Project

Executive Summary:

Quite simplistically, the County of Bland, with a population of approximately 7,000, is boldly taking broadband where broadband has never gone before... In fact, Bland County is the first community in Southwest Virginia, and one of only three in the Commonwealth, to launch a major wireless internet access project free to its citizens and visitors using the latest in broadband deployment technology. Bland County is the initiator and rural test bed for this new technology called Mesh Networking, as it is considered to be the industry's most sophisticated and intelligent Wi-Fi system.

Phase I of the County's Mesh Network System is deployed throughout downtown Bland; Exit 52 on the I-77 Interchange; 0.5 miles of Rt. 42/52; the Bland County High School Campus; and Fairview Subdivision (residential neighborhoods) being made available free to citizens, business patrons, visitors, emergency services and the general public. The County feels the offering will be a valuable tool to increase traffic to local downtown businesses and create more exciting opportunities for new enterprises. Bland residents, individuals enjoying the community park, patrons at downtown eateries, Appalachian Trail hikers, Interstate travelers passing through, the Volunteer Fire and Rescue Squads, as well as professionals in Bland on business, will have the ability to utilize the free service in hopes of finding even greater reason to spend more time in Bland.

The County is depending on this next-generation technology to provide the community with more than just a public and residential wireless application, will, in the near future, have police and public safety roles as well as public utility and expanded business functions.

The external equipment installed to make this system work are rugged, weatherized modules (antenna routers) that communicate wirelessly. The five (5) modules used in

Phase I have been strategically placed throughout the downtown Bland area, and are slated to be installed in other strategic locations throughout the county. The County felt that one of the greatest benefits of this system is its expansion capabilities. Because the system is completely wireless, it can be expanded anywhere in the county where power is available. All that is required to enlarge the system is the location of point-to-multipoint routers on existing communication or cell towers that will communicate to the mesh routers that are easily installed on light or telephone polls, water tanks, or tall buildings within the respective communities.

Beyond providing broadband wirelessly, the local government leadership has planned to take it to parts of the county where broadband is not available. Bastian, Virginia has been identified as Phase II of the County's broadband deployment efforts. Bastian is one of the many areas within Bland that does not have access to broadband internet access.

Phase II is underway with the establishment of the Bland Wireless Service Authority and the construction of a commercial and carrier class deployment plan. This phase of the project will be the answer to broadband deficiencies in the center of the county known as Bastian, where the Bland County Industrial Park is located along with where the County's newly designed Commerce Park is slated to be developed.

January 5, 2007

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Community Profile:

Bland County, named for the prominent Virginia patriot, Richard Bland, is situated on the edge of the southwest portion of the Great Valley of Virginia. Formed from parts of Giles, Wythe, and Tazewell Counties in 1861, the county's area is 369 square miles; it has approximately 7,000 residents with an average population density of approximately 20 persons per square mile. About 45 percent of the current population is concentrated in Rocky Gap, Bastian, and Bland.

The Problem:

The local government leadership of Bland County, comprised of the Bland County Board of Supervisors and the Economic Development Authority, were faced with a county-wide challenge of limited broadband accessibility for its businesses, visitors and its citizens. Even in the few areas where private sector broadband service exists, the cost is prohibitive to many of the county residents and small business owners.

Like most, if not all of the communities in southwestern Virginia, "last mile" broadband connectivity does not readily exist nor is it affordable. Due to Bland County's rurality, low critical mass, and challenging topography, private sector investments in communication technology are not scheduled to take place nor will they be likely in the future. From the private sector perspective, the economic model does not currently yield

a return on investment, thus the County of Bland can not expect advancements from the private industry in such technologies. This leaves only the local government leadership to provide an innovative solution to the problem.

The Challenges:

1. Being the First:

The first major challenge the County faced is the fact that no Virginia locality has ever been 'successful' in providing broadband access where it previously had not existed. There is no existing model to emulate or guidebook to follow.

Resolution - The County had to conceive a vision, set priorities, locate the needed technology, develop a scope, devise a plan, carefully budget, and then pursue implementation.

2. Identifying Capable Technology:

The second major challenge was identifying the technology that would work to complete the last mile connection. The County discovered, researched and sought the latest in Wi-Fi communications.

Resolution - The system the County is using is known as Mesh Networking and is considered to be the industry's most sophisticated and intelligent Wi-Fi system.

3. Providing a Backbone:

The third major challenge was identifying a backbone with adequate capacity for hosting the county's new wireless broadband system. Since the County is offering a variety of access to the system, including free open-source, secure commercial and residential and

potentially carrier class service, use is expected to be great; thus, a suitable backbone would need to be in place to accommodate the demand.

Resolution - The County used a pragmatic approach and utilized a business class DSL connection to suffice until Bristol Virginia Utility (BVU) Fiber Project reaches Bland County and provides the backhaul for the system.

4. Funding:

Funding the initial capital costs for equipment and installation, along with ongoing expenses to host the project, was the County's largest challenge.

Resolution – The Board set priorities and had identified deployment of broadband service as one of great importance. The Board made a long-term commitment to invest in this project and did so with general fund dollars as the source of money to get the project underway. No state or federal dollars were put into this project, as Bland County would not have been a front runner to receive such funding. The Board continues to be proactive and is budgeting for Phase II and Phase III.

The Solution:

Bland County has pragmatically and resourcefully solved the conundrum of “last mile” connectivity in rural America. Technology exists, and has now been tested and proven to work in one of the most topographically challenged, rural communities in Virginia. Bland County has successfully created the model for rural communities who wish to offer broadband internet services to its citizens and business community. The County of Bland has publicly offered our intellectual capital, expertise, and experience to germane counties in southwest and central Virginia. We are committed to not only

advance the County of Bland, but advancing the entire region further into the information age.

Project Scope:

Objectives (Phase I) – Establish a backbone, install infrastructure, deploy free wireless broadband throughout the identified service area, identify new applications for the system, and to establish and record demand

Service Area(s) – All of Downtown Bland; All of Exit 52 on I-77 Interchange; 0.5 miles of Rt. 42/52; Bland County High School Campus, contiguous subdivision, community park, fair grounds, Bland County Volunteer Fire Department, Bland County Volunteer Rescue Squad, downtown churches, Bland County Courthouse, Bland County Library, and all downtown businesses.

Technology Used – Tropos Metro-Scale Wi-Fi Mesh Network

Cost – Under \$35,000.00 for Phase I

Major Equipment Used – Five (5) 5210 Outdoor MetroMesh Routers, Business Class DSL as temporary backbone.

Bland County, VA – Wireless Broadband Deployment Project – Phase III

Executive Summary:

The community of Mechanicsburg is located in the beautiful Blue Ridge Mountains of Virginia within the County of Bland. The essence of this project is to take broadband deployment where broadband has never gone before. The County of Bland, with a population of approximately 7,000, must take it upon themselves to provide last mile connectivity to its citizenry. The incumbent providers have no plans of providing these necessary services to Mechanicsburg because it does not fit their business model. The rural area of Mechanicsburg does not possess the critical population mass to generate an acceptable rate of return on their investment.

As a result of connectivity deficiency, there has been no expansion of much needed governmental facilities or business within this segment of the County. We all know that in today's knowledge-driven economy, cottage industries, home-based employment, and entrepreneurial enterprises can not thrive without the most basic of infrastructure. Additionally, we can not effectively offer educational support for our students and workforce without access to broadband. Sadly enough, 90% of the remaining portion of the County has no internet connectivity other than dial-up or cost prohibitive T1 connection. DSL offers only limited availability in the immediate areas of Bland and Ceres.

The impact of this project will be far reaching beyond just the 170 residents of Mechanicsburg. The wireless system will provide service to the Hollybrook-Mechanicsburg Volunteer Fire Department and both community centers. In addition, the system may benefit a community cannery operation in Mechanicsburg, as well as an election polling place. Bland County intends to provide a free wireless hot spot at the community center so anyone with a laptop and wireless technology can access the internet at this site. Today, many are driving 30-50 minutes to Bland to connect to an existing hotspot there.

Bland County has an acute focus on Economic and Community Development. Its main objective is to supply parts of Bland County with affordable and reliable, high-speed internet access where such services do not currently exist. Our continual requests for the incumbent providers to expand broadband services have been met with little or no response.

Since the private sector failed to address the need for broadband, Bland County installed one mesh router at the Bland County Courthouse to offer high-speed Internet to anyone in range. This beta-test immediately identified the great demand in Bland to expand high speed services as quickly as possible. The County's next step was to install additional mesh routers to expand the coverage area. This allowed connectivity from the Courthouse to the Interstate (77 exit 58) in Bland. Locals as

play host to police and public safety capabilities as well as public utilities and expanded business functions.

The local government leadership has planned to take their Broadband Deployment Project to an even greater depth by incorporating parts of the County where broadband, most likely, will never be available. Mechanicsburg, Virginia has been identified as such a community and is integrated into Phase III of the County's Broadband deployment efforts. It is and will continue to be one of the many areas within Bland that will not have access to broadband internet services unless it is resourcefully provided by the County. By expanding the infrastructure employed in Phase II, Mechanicsburg can access the County's high-speed backbone and can distribute that connectivity to all the facilities and residents, as well as the community center, in Mechanicsburg.

well as visitors could exit off I-77 and connect to the Internet. The response to expand the service in Bland was even more overwhelming than expected.

To that end, we are now in the process of funding the build-out of the wireless infrastructure needed to provide Internet services to a large geographical part of the County. When completed, this project (Phase II) will provide coverage from the Big Walker Mountain area in the southern part of the County to South Gap at the northern end of the I-77 corridor. We established the Bland Wireless Service Authority and we are proceeding with the construction of a commercial- and carrier-class deployment plan. This phase of the project will help to relieve some broadband deficiencies in the far eastern part of the County. When, and only when, Phase II is completed, will the County be able to make it feasible for the residents and businesses to remain in Mechanicsburg by providing services that will not require a at least a 25 minute commute to access a broadband connection. Additionally, the Public Safety providers can connect directly to the Internet and then back to the dispatch center or other informational sites without tying up essential personnel to provide critical information.

The areas that will be served from the scope of Phase II are respective communities of Bland, Bastian and Rocky Gap, VA. These communities are Bland County's three largest residential, commercial, and industrial congregations. The immediate benefactors are those small businesses and industries located within the Bland County Industrial Park (Quarter Tyme, Inc.; Melvin Enterprises, Inc.; Skyway Outdoors, Inc.; and Virginia Steel & Fabrication, Inc.) who currently do not possess access to any form of high speed connectivity. Others who will directly benefit from the expanded services will be the County's largest existing industries such as ABB Inc., Pascor Atlantic, Inc., and GIV Inc., who will be able to utilize the project's services as an added layer of redundancy or as an alternate ISP to lower operational costs. In addition to business assistance, the expanded system could provide service to the Bland County Medical Clinic, the Virginia Welcome Center, the Wolf Creek Indian Village, the Rocky Gap Elementary School, the Rocky Gap High School, the Bland Elementary School, the Bland High School, the small businesses within the newly-planned Bland County Commerce Park, the various volunteer fire & rescue departments, the Bland County Public Library, the Bland County Governmental Offices, and the multiple commercial establishments along the I-77 corridor.

Quantifying jobs as a result of this project is a challenge; however, one could be certain that this new/improved service would open the door for business expansions, new enterprises and increase stability of existing industries. Jobs retained and/or impacted by Phase II could total more than 1,250, as the project has potential to touch a majority of the Bland County business community.

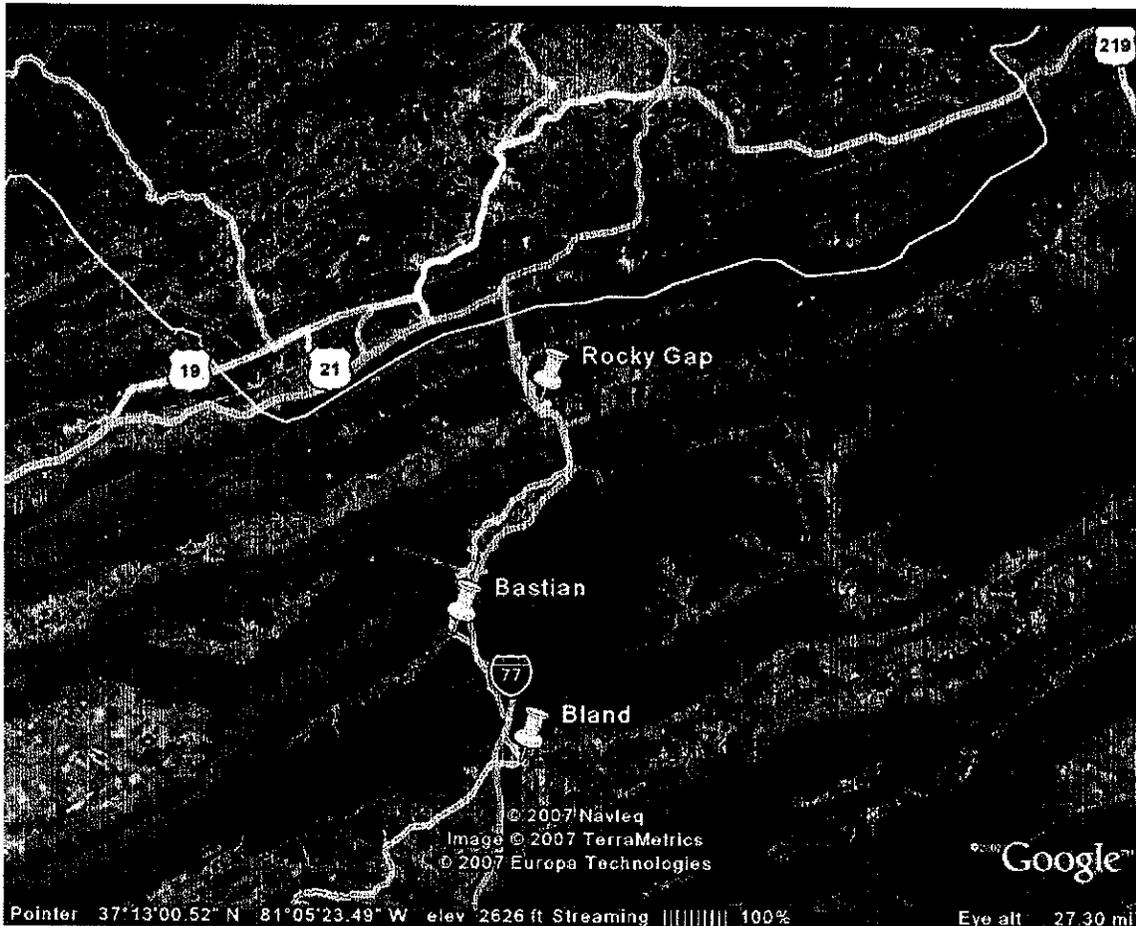
The County is depending on this next-generation technology to provide the community with more than just a public and residential wireless application, as it will

Bland County, Virginia

Existing Facilities

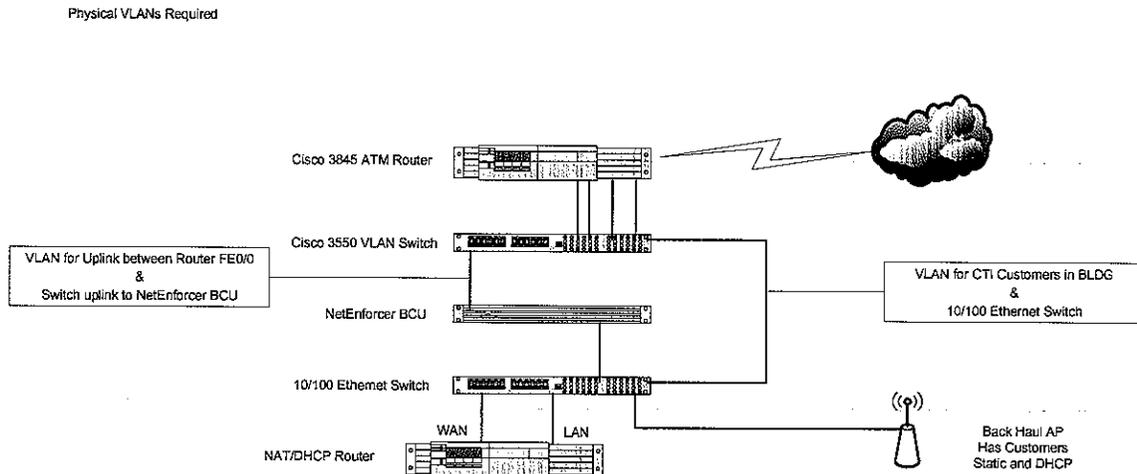
- Tropos Wireless Network – 5 nodes
- Switch
- Router
- DSL Broadband connection

The proposed build out consists of two different but connected phases. Phase I will build a high speed wireless backhaul system from the southern end of Bland County to the Northern end and will geographically follow I-77. Phase II will provide user connectivity in Bastian, Rocky Gap and Bland. This will provide resources to connect residents and businesses in selected areas. Mesh networking technology will be used to allow users to connect to the network with standard Wi-Fi equipment, reducing the cost for the users as well as the County. The mesh network must be connected with Access Points to the high speed connectivity and ultimately back to Bland to link to the Internet. The desired coverage is shown below.

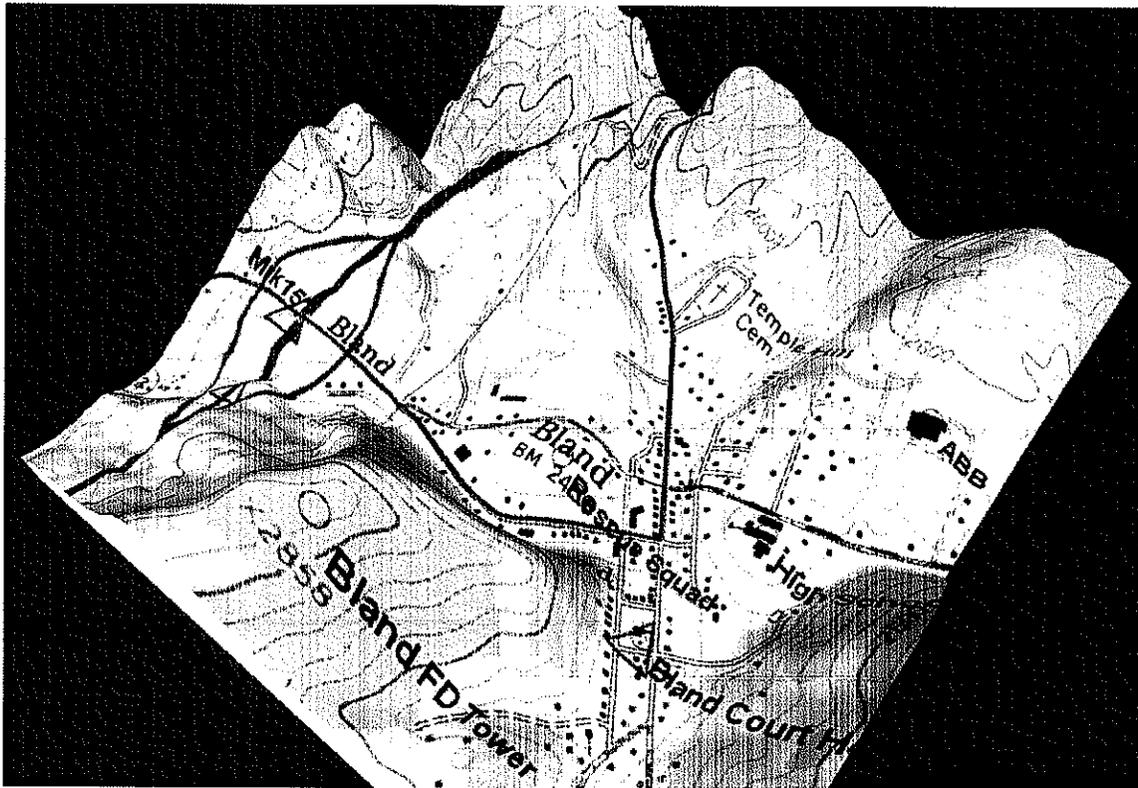


Phase II of the build out can also provide mobile connections to Public Safety/Law Enforcement vehicles for the county. Once their vehicles are equipped for mobile connectivity to their private network and ultimately allow the officers to link to their Network Operations Center as if they were sitting at their desks. The vehicles equipment includes a laptop computer, client Virtual Private Network (VPN) software for secure communications. Any other applications can be added as needed.

The planned deployments will require networking schemas such as Virtual Local Area Networks (VLAN) similar to:

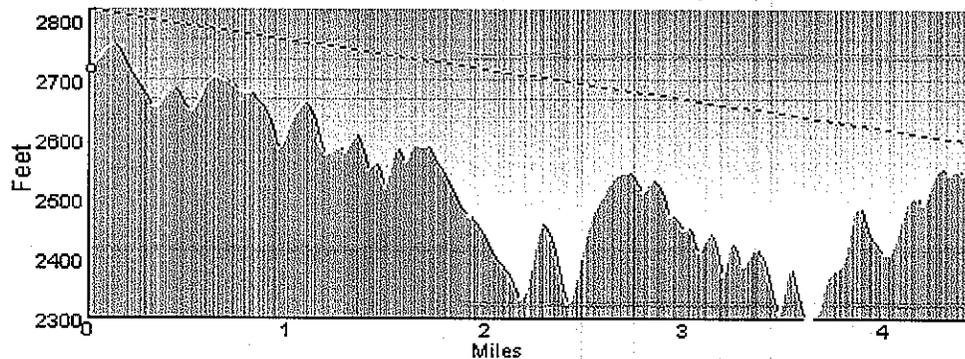


While terrain mapping provides for some contingencies, it does not allow for new buildings added since the maps were created, growth of foliage and other potential barriers to clear line of sight for the Point-to-Point connections. Typical mappings to determine connectivity are similar to:



The mappings are further enhanced to show the actual topography.

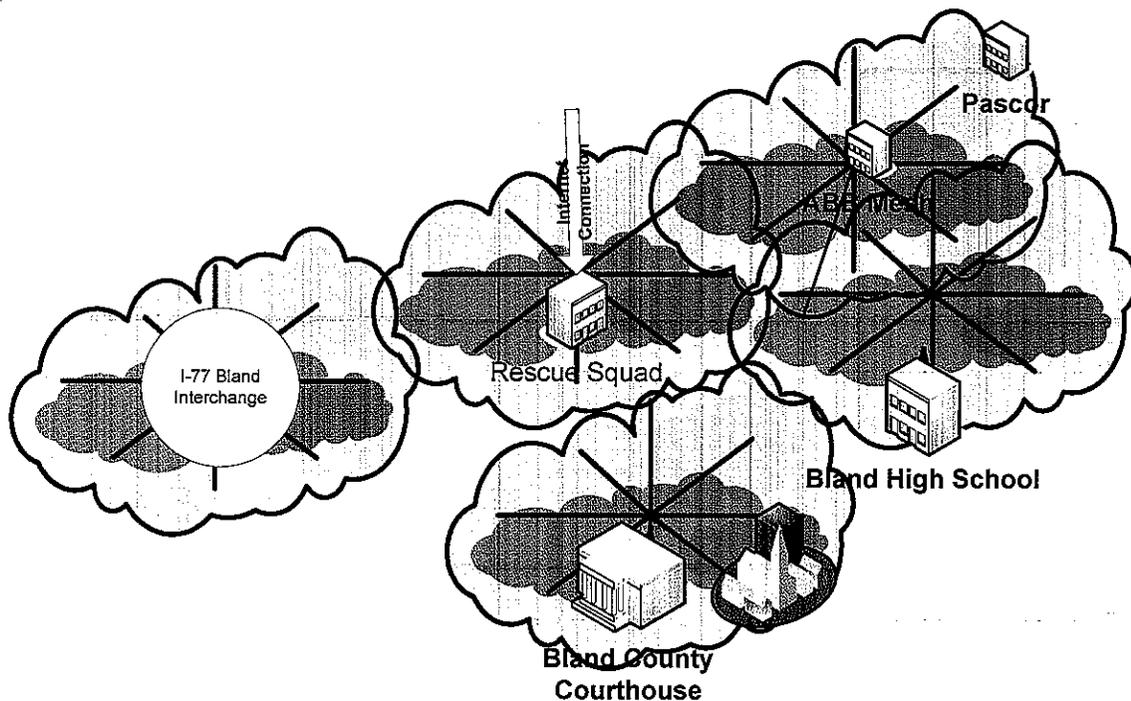
Initial line of sight can be determine using the same software. Line of sight has been determined by performing a site survey of each deployment sight. We took GPS readings for each location, determined the height at which the transmission antennas can be mounted, determined the distance between the sites to be connected and then actually calculate the line of sight. An example line of site diagram is:



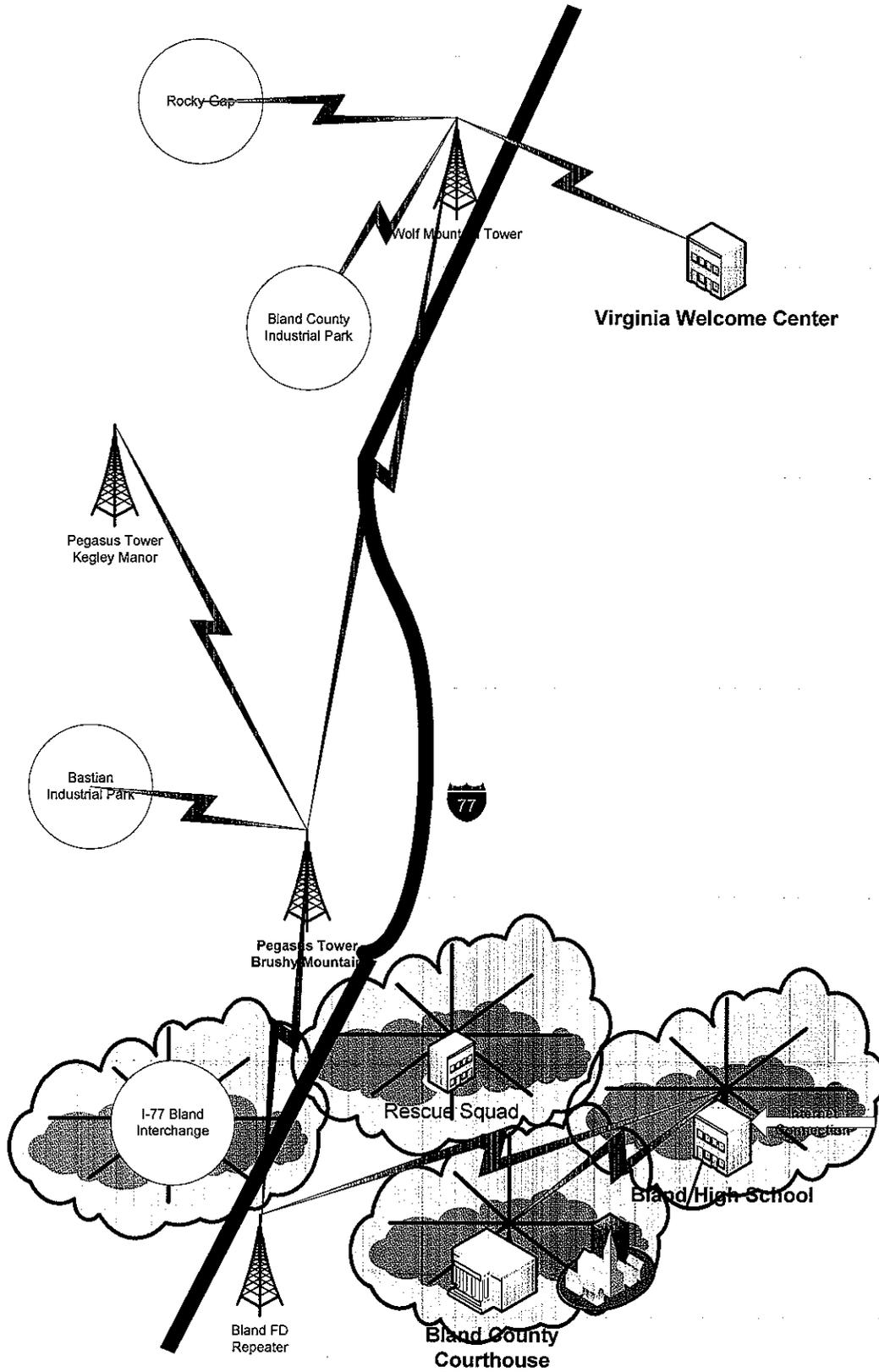
Construction of a deployment site demands a lot of information such as, electrical power, type of tower (telecommunications, water, building, light post, etc.) The types of telecommunications towers require different mounting hardware for the antennas. The equipment must be placed in a weather and dust protective enclosure or in a environmentally controlled building. The wiring from the ground to the antennas on the tower require use of outdoor rated cabling and conduit to house the runs of cable. The conduit must be secured against rain, wind, snow, ice and other such elements. Power must be supplied via Universal Power Supplies for short electrical outages and by temporary generators for longer times. The access rights must be granted by the tower owners and must be negotiated for a long term. The sites must have enclosed areas to prevent vandalism of equipment. The network must be monitored to identify any problems before they occur or to determine causes of downtime in the event of any equipment failure.

Water towers offer a different challenge for antennas and other equipment. If the water tower has a railing and platform circling the entire tower, the mounting is very simple. If not such railing and platform is available, welding may be necessary to create mounting structures for the antennas. Again, the site survey determines what the installation team must do to create the transmission point for the network.

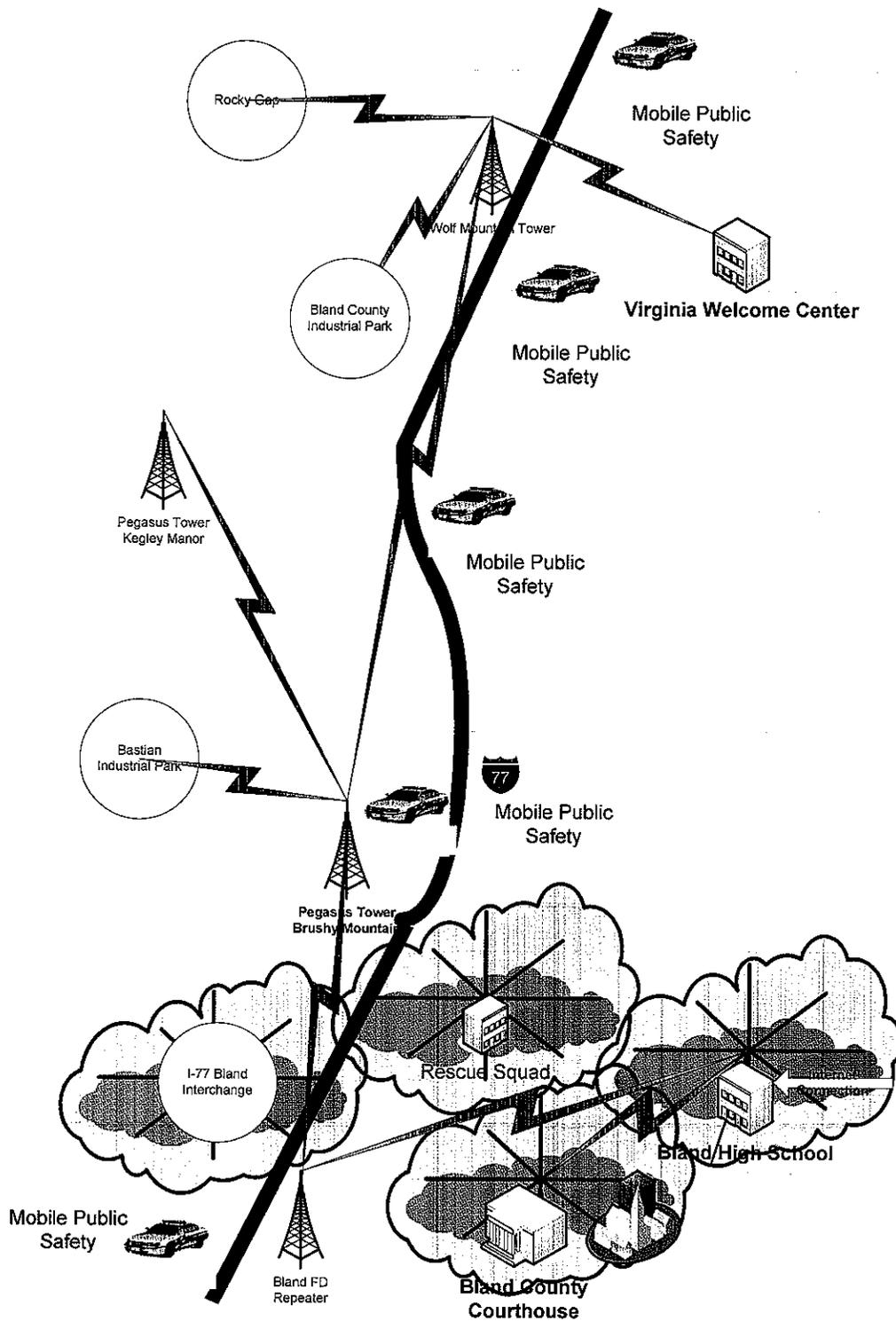
The current wireless mesh network, started by Bland County is:



The Rural Business Enterprise Grant will be used to create an infrastructure shown below.



Additional needs for Public Safety could be met by adding mobile connectivity, using the infrastructure from the first two phases.



From this point, there is an infrastructure to connect businesses and residents to the Internet provided by Bland County. The network can now be expanded to include more business, residents and city, county and regional government groups.

Cost estimates and suggestions for building out the wireless network as described are:

Bland County Mobile Network Costs Estimates

Network Operations Center:

Universal Power Supply(UPS)	
Monitoring Software	
Monitoring Computer	
Bandwidth Management System	
Patch Panel	
Network Rack	
Power Distribution Center	
Managed Switch	
Total NOC	\$29,100

Wireless Infrastructure:

<u>County Radio Tower</u>	
(1) BS-SH Chassis	
(2) BS-PS-AV-VL Power Supply	
(3) VL-AU-5.8 (with 120° Sector Antennas)	
UPS	
Switch	
Outdoor CAT-5 Cable	
Tower Mounting Arms	
CAT-5 Clamps	
Lightning Arrestors	
Mounts/Masts	
Rack	
Miscellaneous Installation Items	
Labor	
Total	\$28,000

High School

(1) VL-SU-5.8
Outdoor CAT-5 Cable
CAT-5 Clamps
Lightning Arrestors
Mounts/Masts
NEMA Outdoor Cabinet
Miscellaneous Installation Items
Labor
Total **\$ 4,000**

Court House

(1) VL-SU-5.8
Outdoor CAT-5 Cable
CAT-5 Clamps
Lightning Arrestors
Mounts/Masts
NEMA Outdoor Cabinet
Miscellaneous Installation Items
Labor
Total **\$ 4,000**

Pegasus Tower Company(Brushy Mountain)

(1) BS-SH Chassis
(2) BS-PS-AV-VL Power Supply
(2) VL-AU-5.8 (with 120° Sector Antennas)
(1) VL-SU-5.8
UPS
Switch
Outdoor CAT-5 Cable
Tower Mounting Arms
CAT-5 Clamps
Lightning Arrestors
Mounts/Masts
Rack
Miscellaneous Installation Items
Labor
Total **\$31,000**

Pegasus Tower Company(Kegley Manor)

(1) BS-SH Chassis	
(1) BS-PS-AV-VL Power Supply	
(1) VL-AU-5.8 (with 120° Sector Antennas)	
(1) VL-SU-5.8	
UPS	
Switch	
Outdoor CAT-5 Cable	
Tower Mounting Arms	
CAT-5 Clamps	
Lightning Arrestors	
Mounts/Masts	
Rack	
Miscellaneous Installation Items	
Labor	
Total	\$23,000

Pegasus Tower Company(Wolf Mountain)

(1) BS-SH Chassis	
(2) BS-PS-AV-VL Power Supply	
(2) VL-AU-5.8 (with 120° Sector Antennas)	
(1) VL-SU-5.8	
UPS	
Switch	
Outdoor CAT-5 Cable	
Tower Mounting Arms	
CAT-5 Clamps	
Lightning Arrestors	
Mounts/Masts	
Rack	
Miscellaneous Installation Items	
Labor	
Total	\$31,000

Customer Premise/Mesh Feed

(5)VL-SU-5.8	
Equipment, Setup and Installation)	
• Bastian Industrial Park	
• Bland County Industrial Park	

- Rocky Gap
- Kegley Manor Tower
- Additional Location

Total **\$20,000**

Grand Total – Infrastructure and NOC **\$170,100**

Equipment Specifications

Alvarion

BreezeACCESS™ Highlights

A family of products addressing point-to-point, point-to-multipoint, fixed access, backhaul and mobile wireless applications

- Complete Spectrum solution leveraging multiple frequency bands to enable connection of all subscriber types and capacity needs across any terrain:
 - BreezeAccess VL – 5GHz band : OFDM ;
 - BreezeAccess 4900 MHz; OFDM
 - BreezeAccess II - 2.4 & 900MHz : GFSK; Mobile solution
- Multi Serviced
 - xDSL like services; VoIP; Video; Surveillance cameras Hotspots feeding; Wireless leased lines; Secured VPN
- High Interoperability
 - BreezeACCESS family was tested with a wide range of complementary products such as voice gateways, routers, billing and performance monitoring and more, ensuring best functionality especially suited to the customer needs
- Flexible BST Architecture
 - Chassis based Macro BST
 - Chassis hosts all BreezeACCESS Family – VL, 4900,2400, 900
 - Distributed architecture
 - Standalone Micro BST
- CPE Portfolio
 - Bridge w/ an integrated or detached antenna
 - Voice Gateway; Networking Gateway
- Extended NLOS coverage, top performance, high capacity, and robustness
 - OFDM and GFSK
 - Adaptive Modulation - selecting between 8 modulation rates facilitating link robustness
 - ATPC (Automatic Transmit Power Control) – Ease of installation and optimized cell's transmission
 - Automatic distance measuring for optimized cell performances
- Management Tools & Maintenance
 - AlvariSTAR NMS (SNMP); BreezeCONFIG (free windows application) & telnet
 - Over the air SW upgrade for easy, cost saving maintenance
 - Over the air configuration upload/download