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Connecting Danville, Virginia, to the Future

By Joe King

DEPLOYMENT OF A MUNICIPAL BROADBAND NETWORK

Some communities cannot wait for national telecommunications companies to build advanced local broadband networks. That may never happen in small, isolated cities. Localities in that situation find they must develop their own systems. The economic development rewards for doing so can be significant, but entering the broadband business is neither for the faint of heart nor for the uninformed. Danville, Virginia's approach should not be simply replicated, but it makes sense to follow its five-step process to:

- Determine the community's real need for broadband;
- Define the local government's role in meeting that need;
- Select a suitable broadband business model;
- Develop and strategically implement a plan of action; and
- Leverage success.

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connecting danville,

VIRGINIA, TO THE FUTURE

By Joe King

Danville, Virginia, is one of a growing number of American cities that operates its own advanced fiber-optic broadband telecommunications network. Launched over a decade ago primarily to stimulate economic growth and development, "nDanville" (network Danville) has positioned Danville as a digitally connected community capable of supporting any high-tech or telecommunications business needing gigabit-plus broadband service. Providing the "last mile" link to a large, robust regional fiber network operated by the nonprofit Mid-Atlantic Broadband Communities Corporation, nDanville not only provides blazing fast internet service, but also directly connects businesses to practically any point in the world at multi-gigabit speeds.

Economic development professionals in communities that have state-of-the-art broadband delivered by private sector cable TV and telephone companies can consider themselves lucky. Cities like Danville located in "broadband deserts" have found it necessary to develop their own broadband utilities to make commercial grade broadband available to their businesses. Broadband Communities Magazine estimates there are at least 135 public sector fiber networks operating in America. Many like Danville are aggressively using broadband to promote economic development.

The Dan River flows through the center of Danville.

Municipal broadband networks use different technologies and come in all shapes and sizes. Because there is no single deployment model, Danville does not recommend that other communities simply copy its municipal broadband program approach. However, a strategic process similar to that undertaken by Danville should be followed by any community considering a large scale broadband deployment. This article shares the nDanville story and lessons learned with hopes that local governments will actively exchange information and collectively develop best practices on broadband deployments.

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DEPLOYMENT OF A MUNICIPAL BROADBAND NETWORK

Some communities cannot wait for national telecommunications companies to build advanced local broadband networks. That may never happen in small, isolated cities. Localities in that situation find they must develop their own systems. The economic development rewards for doing so can be significant, but entering the broadband business is neither for the faint of heart nor for the uninformed. Danville, Virginia's approach should not be simply replicated, but it makes sense to follow its five-step process to:

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- *Define the local government's role in meeting that need;*
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- *Develop and strategically implement a plan of action; and*
- *Leverage success.*

DANVILLE'S BROADBAND DILEMMA

Danville sits right on the North Carolina border in the middle of Virginia. Cities and towns in this Virginia-North Carolina region grew prosperous during the 19th and 20th centuries through their tobacco processing, textile, and furniture industries. Since its inception nearly 200 years ago, Danville served as a tobacco market hub and a century later also as a major textile manufacturing center. Market changes and globalization brought on the gradual demise of these legacy industries.

After experiencing 20 years of decline, Danville's tobacco and textile plants were closed by the turn of the 21st century and nearly 12,000 jobs and 20 percent of the city's population were lost, mostly because displaced middle-income workers left to find jobs elsewhere. Danville had become a mill town without its mills, a community with an emaciated middle class, high poverty and unemployment rates, and low educational attainment, and falling to the bottom of "best places" ratings.

Danville is located in southern Virginia on the Virginia-North Carolina border.

Legacy industries were textiles and tobacco.

Population: City: 43,000 Metropolitan area: 106,000

Size: City: 44 sq. mi. Electric service area: 500 sq. mi.

History: Founded in 1793 and incorporated in 1830; tobacco and textile manufacturing center

Government Structure: Council-Manager

Municipal Employment: 1,134 full-time employees

Services: Basic municipal services, plus water, sewer, natural gas, electricity, and telecommunications utilities

The community saw it coming. With Danville's old industries declining around them, community leaders reached a consensus 15 years ago that the region must shift from its traditional manufacturing and agricultural economy to a more diversified knowledge-based economy capable of creating and sustaining family-wage jobs. Economic developers at that time lost a recruitment competition for a large data center. Recognizing that the area lacked the infrastructure necessary to support commercial information technology development, building a broadband communication network became a high priority.

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Virginia was then suffering a serious digital divide. It ranked among the top ten states in America for broadband deployment, with some of the world's highest concentrations of information technology, telecommunications, data centers, and internet companies in Northern Virginia. But areas outside these concentrations ranked among the nation's lowest in broadband availability.

Economic developers serving bustling Virginia and North Carolina communities an hour or two from Danville could rely on private sector telecommunications companies to provide cutting-edge services. While telephone and cable companies in Danville did a good job providing basic residential services within reach of their networks, those in rural areas had nothing but dial-up internet service. More critical to Danville's economic development ambitions, business-grade connections were limited and expensive. Adelphia (now Comcast) provided TV and basic internet services over its coaxial cable network in Danville, and Verizon offered limited-area digital subscriber line (DSL) internet and commercial T-1 service over its copper wire telephone network. A local internet service provider offered wireless Wi-Fi within range of its copper wire-connected antenna

network. This was, and for the most part still is, the kind of desolate broadband environment typical of small, isolated cities and rural areas.

With availability of robust broadband becoming an increasingly essential part of community infrastructure, the city of Danville adopted the following statement of principle in 2003:

> Danville's businesses, institutions, and households should have affordable broadband services on par with those available elsewhere in Virginia in order to ensure access to entertainment, cultural, health, and especially to educational and economic opportunities. This will require a variety of both wireless and wired services and applications.

nDanville was launched to help achieve this goal. Keeping with its conservative philosophy, the city's preference was that the private sector take the lead in providing broadband services. Its local private sector providers – Comcast and Verizon – were beginning to deploy fiber elsewhere and offer increased bandwidth and expanded services. But they promised no such system investments anytime soon in Danville.

City leaders recognized that Danville's geographic isolation and weak economic and demographic profile did not offer attractive business growth opportunities for the incumbents. As a municipal electricity distributor serving a 500-square-mile territory, Danville had the opportunity to make use of its power poles and utility right-of-ways to deploy fiber cable. nDanville and the Mid-Atlantic Broadband Communities Corporation took up the challenge and built local and regional advanced multi-gigabit fiber optic networks to serve Danville and southern Virginia.

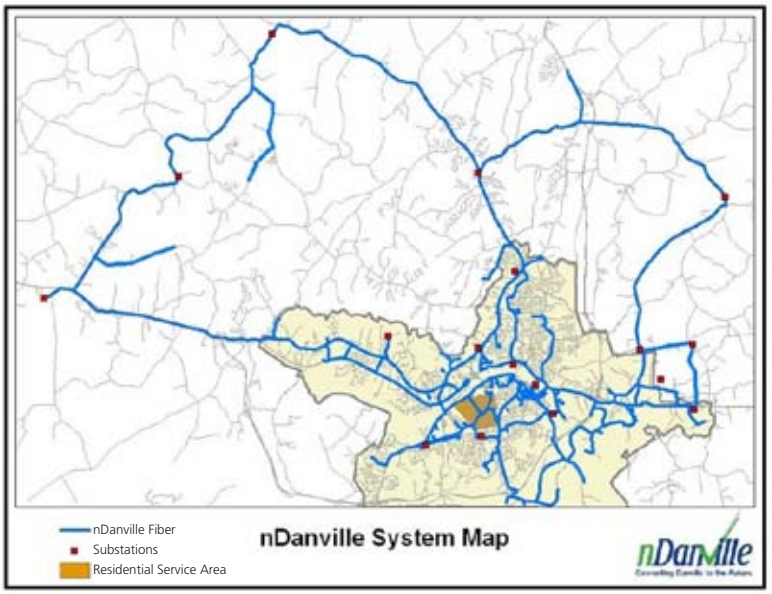
BROADBAND TECHNOLOGIES

Most of us have at least a general understanding that the internet is a huge, worldwide collection of individual computers and computer networks in homes, businesses, governments, and institutions that are linked together by a variety of cable types and radio waves through network layers. Information, whether in the form of text, graphics, music, or video, is digitized, broken down into packets, independently routed along paths of least resistance (although potentially halfway across the world through several different network nodes), and reassembled at the destination computer.

Packets that can make it to the highest internet tiers with the fewest bounces between network elements travel the fastest. How much digitized data can be transported across the internet in a given amount of time depends on how much data you're sending, how your computer is connected, and over how many network elements and layers your data packets must travel.

Measured in kilobits, megabits, or gigabits per second (Kbps, Mbps, or Gbps, respectively), "bandwidth" is the product of the speed at which the digital information is traveling and the size of the conduit in which it is traveling. While demand for bandwidth seems to grow exponentially, not every user needs the same amount.

Someone sending and receiving basic e-mails and accessing basic internet websites can get by with a 750 Kbps to 1.5 Mbps connection. Sharing high-resolution photographs or video clips and viewing highly graphical websites might require 3-6 Mbps. High quality, two-way video conferencing and remote educational applications could take 10-25 Mbps. Interactive medical applications like those involved in remote operation of imaging and diagnostic equipment could easily require 50 Mbps. Since most users require more



Danville's fiber optic cables extend outside the city limits to electric substations.

The Mid-Atlantic Broadband Communities' regional fiber network provides nDanville direct, lightning fast national and international connections.

bandwidth to receive data than to send data out, most services are configured disproportionately to and from their computers.

When Danville was deciding what to do about its broadband dilemma, some municipal telecommunications networks used coaxial cable (the type used by most cable TV companies), some used fiber-optic cable networks, others used Wi-Fi deployed over hot spot antennas or antenna networks, one or two were experimenting with broadband over power lines, and a few were contemplating the exciting newly developing WiMAX (Worldwide Interoperability for Microwave Access) technology that deployed Wi-Fi more powerfully and required fewer antennas. There was a growing variety of combinations and variations of each network technology. Proponents of different broadband solutions took on almost ideological zeal in depicting theirs as the Holy Grail. The hyperbolic noise generated by vendors and enthusiastic users made it hard to think clearly.

nDanville fiber optic cable installer

This phenomenon continues today. And broadband decision making is further complicated by what the Gartner Research Group, a leading information technology research and advisory company, has termed "technology hype cycles." Many broadband stratagems that attract enthusiastic early adopters fail to meet inflated expectations. Some completely sputter out. Others achieve only marginal success. Several communities wasted significant time and money after betting on the wrong technologies. Danville determined from the outset that it would avoid the latest fads, take a technology agnostic approach, and design a system that best met municipal and economic development needs over the long term.

In the Danville of 15 years ago, wireless, DSL, and coaxial cable service could provide no more than 1.5 Mbps of bandwidth. While some municipal or business applications can function satisfactorily within these limits, nDanville placed its bets on an advanced fiber-optic network. Only fiber could promise a highly reliable network and almost unlimited bandwidth and flexibility to meet widely different user needs. It's essentially future-proof. The fiber itself could be expected to function for decades. Change out or upgrade the electronic equipment and operating software and you're good to go for the next generation uses.

Part of a decision to deploy fiber is to determine how far out to do so. Like so many other broadband elements, this network feature offers a bewildering array of design choices ranging from the gold standard fiber-to-the-premises (FTTP), often referred to fiber-to-the-home (FTTH), to the less speedy fiber-to-the-node (FTTN), neighborhood, or last-amplifier, where the customer location is connected by copper wire to fiber terminated at some point as far as a mile or more away. Danville recognized that some businesses would need very high-speed internet access, others would need direct point-to-point connectivity between multiple business locations, and some would need both. Only fiber to the premises can support this range of requirements. So, Danville decided to deploy its fiber all the way to the customer premises.

BUSINESS MODELS

The next important question was what business model to employ, retail or wholesale open access. A municipality following the retail model functions like an internet service provider that directly provides services to each customer. The open access approach entails municipal construction and operation of a network over which private sector telecommunications businesses provide services to the customers and then pay fees to the municipality for use of its network. An open access network can offer fiber that is "lit" by communications electronics and fully functional, "dark" until the customer lights it using his or her own electronics, or both lit and dark fiber options.

The retail vs. open access dispute has lasted for decades. Similar to geeky debates over broadband technologies, advocates of each business model are zealously convinced of the superiority of their approaches. The Fiber-to-the-Home Council trade association reports that retail based municipal networks outnumber open access operations by four to one and enjoy twice the new customer "take rate." Unfortunately, Virginia and at least 18 other states have passed legislation limiting the role local governments can play in the broadband marketplace.

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nDanville servers and routers

Sticking to its economic development mission, nDanville was launched using an open access business model. nDanville provides direct internet services to municipal and public school users, but business and residential customers are served by one of two private companies operating on nDanville that share revenue with the city.

Bristol Virginia Utilities has run one of the nation's flagship municipal retail operations since 2001, providing "triple-play" internet, television, and telephone services. Danville considered following suit. However, the Commonwealth of Virginia enacted a law in 2002 allowing the state's 15 municipal electric utilities to directly offer triple-play telecommunications services, provided that they neither subsidize those services nor charge rates lower than the incumbents. In other words, forget about using the retail model. In practical terms, grandfathered in by the new law, Bristol would be the only municipality in Virginia that could do so.

The state-imposed barriers proved to be of little consequence to Danville. Its businesses were not well served with advanced network and internet services, but at the time Danville was deciding which broadband model to use, its residents were generally satisfied with their telephone, DSL, cable, and satellite TV services. Broadband speeds provided to residents would not support sophisticated home-based businesses, but there were very few of those in Danville.

The city decided it would not only be inappropriate to compete with the private sector in providing TV based entertainment, but also too expensive. Projected debt service and operating costs were too high to allow for competitive monthly fees. And the experience of other municipalities getting into the retail TV business told Danville that the incumbent providers would likely employ predatory pricing to drive the city out of the business.

Sticking to its economic development mission, nDanville was launched using an open access business model. nDanville provides direct internet services to municipal and public school users, but business and residential customers are served by one of two private companies operating on nDanville that share revenue with the city. The first has been with nDanville from the outset. The second joined just this year and nDanville is working to recruit more. Providers offer an array of services, including internet access, VOIP (Voice Over Internet Protocol) telephone service, and IPTV (Internet Protocol Television) service, which convert sound, video, radio signals into digital packets and send them over computer networks.

SUCCESSFUL DEPLOYMENT

With initial loan financing of $2.5 million from the city's electric fund (quickly repaid with interest) and without state or federal grants or taxpayer or utility ratepayer subsidies, the city deployed its current 175-mile fiber optic network in three phases at a deliberate pace and on a *pay-as-you-go* basis. *The First Phase*, completed in 18 months in 2004 with the $2.5 million loan, connected all utilities and public works infrastructure facilities, including electric substations, water pumps, reservoirs, wastewater pump stations, and traffic control signal lights, and municipal and school buildings.

nDanville is helping make Danville's historic River District a center of economic development revitalization.

Fiber-connected Wi-Fi antennas provide free internet in municipal parks.

Fiber cables are now also connected to antennas in municipal parks and in the city's River District to provide free public Wi-Fi services in those areas. The city reads and controls utility meters and electric grid elements by radio signals over a reliable network of fiber-connected antenna towers. This was a better fit for Danville Utilities' 500-square-mile territory than installing fiber to every meter at a much greater expense. Even the most advanced smart meter and smart grid electric systems require only small bursts of data.

nDanville now provides connectivity to public and private K-12 schools, the Danville Community College, Averett University, and city and county libraries. School connections enable on-line access to teaching resources such as videos, distance instruction between school campuses, robust internet access, on-line testing, automation of back office functions, and information exchanges between student households and the schools.

An important part of nDanville's financial success ever since has been its ability to compete with the investor-owned telecommunications firms as an "E-Rate" provider. The Federal Communications Commission's E-Rate program provides grants to schools and libraries to help pay for telecommunications services and internet access. E-Rate enabled payments to nDanville by the city, and

county school systems have provided the means to sustain and expand the city's broadband network.

Since mid-2007, nDanville's *Second Phase* has been extending fiber connections to businesses within reach of the network and to all parcels in the city's industrial parks. The city also established the "nDanville Medical Network" and connected the local hospital, clinics, and other health care facilities. One hundred forty five business and medical service locations are currently served. Customers include:

- Internet service providers
- Banks and credit unions
- Accounting firms
- Law offices
- Engineering consultants
- Insurance agencies
- Radio stations
- Hospital, medical, and dental clinics
- Funeral homes
- Atlanta Braves minor league team's stadium office
- Retail stores
- Restaurants
- Car dealers
- Motels
- Churches
- Museums
- Welding shops
- Manufacturing plants

Undertaken in 2011, the *Third Phase* is incrementally deploying fiber through neighborhoods as capital funding is available. Over 100 households spread across 40 city blocks are now connected with most of them receiving more than one service – internet, television, and/or telephone – from private sector providers operating on nDanville. Fiber optic cable has been installed in several newly constructed apartments in beautiful old brick tobacco warehouses in Danville's historic River District.

PROVIDING INTERNET & POINT-TO-POINT CONNECTIVITY

In addition to nearly unlimited access to the internet, the city government, public school districts, and several business customers with multiple locations use nDanville to create their own wide area networks. For example, nDanville connects the Danville Regional Medical Center to its five clinics scattered around the community at speeds ranging from 5 to 250 Mbps over its own network. The hospital additionally has a 25 Mbps internet connection and its clinics have internet connections ranging from 5 to 10 Mbps. A local dental practice likewise directly connects its four clinics with fiber at 5 to 10 Mbps and provides each with 2.5 Mbps internet connections.

nDanville's connection with the Mid-Atlantic Broadband Communities Corporation's regional network allows similar direct fiber reach to offices and data centers in northern Virginia; Charlotte, North Carolina; Atlanta, Georgia; and nearly anywhere else. This expansive connectivity made it possible for Danville to recruit the Noblis Center for Applied High Performance Computing

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with its Cray XMT supercomputer, the first to be sited outside a federal laboratory or university. Noblis helps customers solve big data problems in areas ranging from molecular science, to cyber security, power grid analysis, and homeland security. Located in Danville's historic River District, the Noblis Center is directly connected by fiber commercially by a company named "Level 3" and redundantly by nDanville and Mid-Atlantic Broadband Communities Corporation networks to the firm's headquarters in Falls Church, Virginia.

BROADBAND DRIVEN DEVELOPMENT

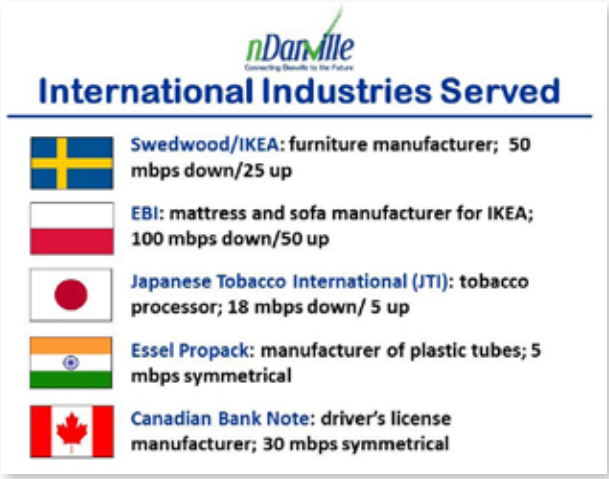
Direct fiber connectivity to remote locations gives today's Danville a huge broadband advantage compared to the plight it suffered a decade ago. Businesses located in Danville can now experience faster data transmission connections with Northern Virginia sites than they could were they physically located in that area. As the vast majority of the world's internet traffic flows through network tiers and data centers located there, this positions Danville well to attract information technology companies needing connectivity to Northern Virginia. A former textile mill site served by high volume electricity infrastructure and broadband assets is currently being marketed by Danville as a data center site.

nDanville provides connectivity to the Cray supercomputer in the city's River District.

Internationally-based businesses recruited to Danville since its devastating loss of legacy industries are also well served by nDanville's fast internet connections. Taking advantage of nDanville's customized service symmetry, the local IKEA furniture plant is provided 50 Mbps upstream / 25 Mbps downstream internet connectivity to communicate with its headquarters in Sweden and its plants and stores around the world. EBI, a Polish mattress and sofa manufacturer and IKEA supplier, makes use of a 100 Mbps up / 50 Mbps down internet service. The Japanese Tobacco International plant uses an 18 Mbps up / 5 Mbps down internet connection. India-based Essel Propack uses a symmetrical 5 Mbps connection and the Canadian Bank Notes printing plant uses a symmetrical 30 Mbps internet service.

As currently configured, nDanville offers symmetrical business fiber connectivity of up to 10 Gbps and residential service of 78 Mbps down / 39 Mbps up. Residential connections can be upgraded to business service levels if needed. Danville can consequently make the same claims as any other "Gigabit City" about blazing speeds available on its fiber network. However, its experience to date suggests that local business need for nationally adored gigabit service has yet to materialize. The hospital, its biggest user, only needs 250 Mbps to send medical scan images between its clinic locations. It will likely be a much longer time coming for residential users to demand gigabit speeds. nDanville will be ready when its customers are.

nDanville has never been viewed as the city's economic development cure-all. Broadband is strategically integrated into the city's economic development program that also includes aggressive marketing, having shovel-ready industrial sites and buildings ready and utilities and transportation infrastructure in place, having a capable workforce and training programs, and having access to project financing and necessary incentives. Broadband is also integrated into the city's renaissance of its historic River District, currently the most active locale for entrepreneurial start-up business development and attraction of young, upwardly mobile professionals to Danville. Availability of robust broadband services from nDanville and commercial providers, coupled with high voltage electric service, is making it possible for the city to redevelop a 90-acre textile manufacturing complex and market it as a data center location.



SUCCESS & LESSONS LEARNED

nDanville has succeeded on all fronts and has positioned Danville as a digitally connected community capable of supporting any high-tech or telecommunications business needing gigabit-plus broadband service. As of mid-2014, the city had invested $15 million in nDanville. The broadband network has grown more slowly than had the city adopted a retail service model, but nDanville has managed to operate as a self-sufficient standalone enterprise fully funded through user fees without taxpayer or utility ratepayer subsidies, is entirely debt-free, and contributes $300,000 annually to the city's General Fund.

So, what can economic developers learn from nDanville's experience? At least five important points should be addressed. *First, determine the community's need for broadband.* A community lacking anything but dial-up internet service might choose to directly address the needs of residents. In Danville's case, private sector telephone and television providers were serving residential customers satisfactorily, but not adequately serving the city, the public schools, or the community's businesses. In choosing to install a fiber optic network, Danville focused its broadband efforts squarely serving its own needs and using broadband to promote its economic development. Another community might find a wireless network more suitable in meeting its needs.

Second, define the local government's role in meeting the community's need for broadband. The city or county's role might be severely restricted by state law. Some local governments permitted to get into the business, choose not to do so as a matter of philosophy. Cities like Danville with their own electric utilities have an advantage in deploying municipal broadband networks in having access to power poles and easements, right-of-ways, workforce resources, and equipment.

Third, select a suitable broadband business model. When allowed by law to do so, some communities choose to directly provide retail internet, telephone, and television services. Others adopt the open access business model and encourage private sector service providers to use the public broadband network, much as businesses use public streets to conduct commerce.

The "field of dreams" approach that assumes new businesses will flock to a community that has a broadband network is wishful thinking. Broadband is critically important but not the only tool in the economic developer's tool box.

Fourth, develop and strategically implement a plan of action. As with any other major endeavor, deploying a broadband network takes considerable time and money. It cannot be accomplished quickly. Danville chose to implement nDanville in a pay-as-you-go basis in three phases over more than a decade. Municipal and public school needs were addressed first and economic development needs led subsequent deployments.

Finally, leverage success. The "field of dreams" approach that assumes new businesses will flock to a community that has a broadband network is wishful thinking. Broadband is critically important but not the only tool in the economic developer's tool box. A fiber optic network like nDanville can also be used to serve municipal government and public school needs. nDanville enables connectivity to Danville's municipal office buildings and utility infrastructure, traffic signals, WiFi antennas, and smart meter/smart grid system.

nDanville has succeeded on all fronts in closing the digital divide. Danville is now a gigabit city connected to a bright new future over nDanville fiber. Not bad for an old mill town!

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