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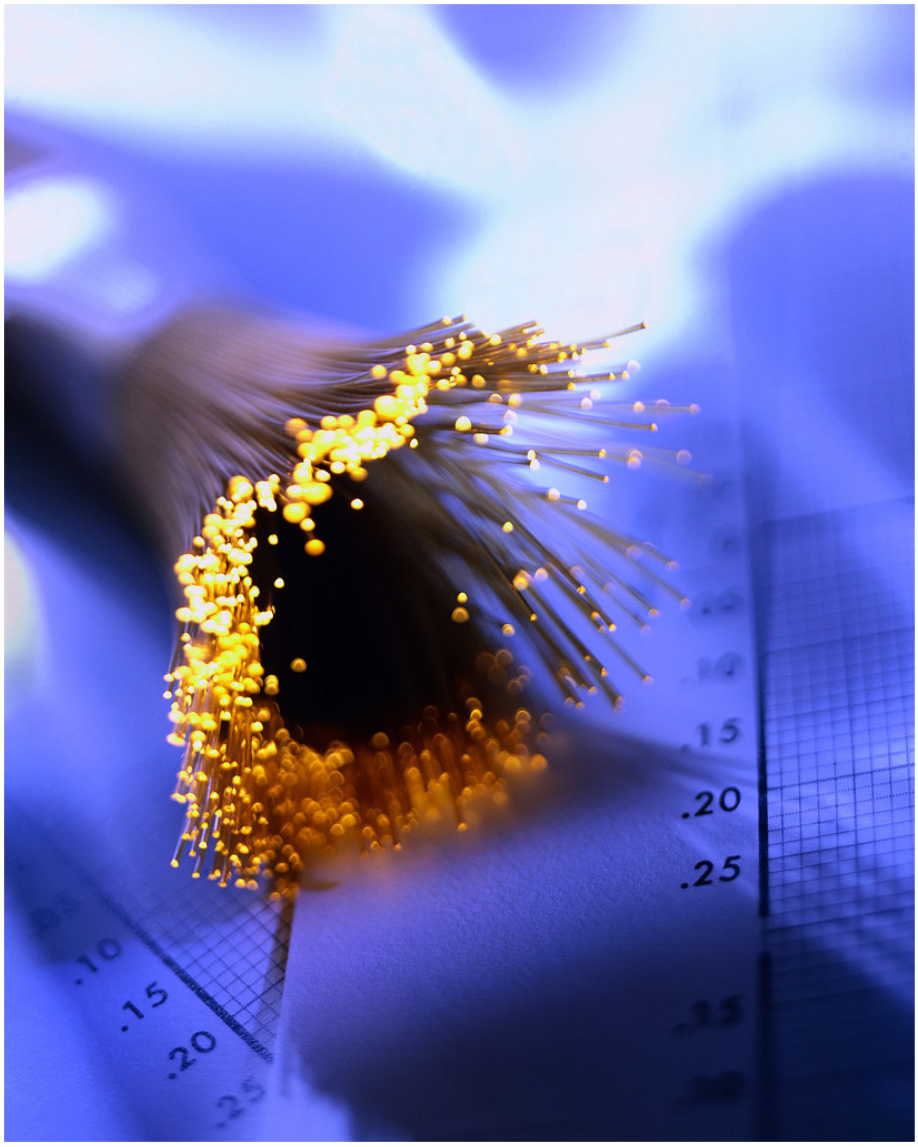

BROADBAND TECHNOLOGY FOR RESIDENTS OF ACCOMACK AND NORTHAMPTON COUNTY

A study commissioned by the Eastern Shore of Virginia Broadband Authority

Contents

1. Summary

Construction of fiber lines throughout Accomack and Northampton County is expected to begin within the next two years. With that in mind, both counties need to quickly decide on architecture for their community's broadband system. With a fiber backbone running through the county in the near future, we need to build a broadband structure to local communities. Expanding on the backbone with fiber cables is clearly more expensive than all other options, but the extra expense is counterbalanced by the long term effectiveness of fiber. At best, coaxial cable and copper wire can perform at half the speeds of fiber, so they will have to be replaced with fiber or any new technology in the near future. Fiber is clearly the fastest and most timeless option available in broadband technology.

Since both counties prefer fiber, my study focuses on following federal and local goals and guidelines in constructing a fiber system. The two fiber architectures I discuss on my study are passive optical networks and point to point networks. Passive optical networks are a better option for less densely populated communities while point to point networks, which are clearly more expensive, are the best option for more robust communities that are interested in drawing in major businesses. Although residents in more rural areas will not get broadband access as quickly as those in villages and towns, Accomack and Northampton County need to first focus on hospitals, schools, government, and businesses. All of these premises need very high speed broadband provided by fiber.

Both passive optical networks and point to point networks are necessary to develop Accomack and Northampton County. Once the structures are built in the next few years, I am confident that several internet service providers will be interested in buying and maintaining the fiber lines.

2. Introduction

a. Federal Goals

Broadband, according to The Federal Communications Commission, FCC, is high-speed Internet access that is always on and faster than traditional dial-up access (broadband.gov). In an effort to keep Americans better informed and economically competitive, the FCC recently released the National Broadband Plan. This plan calls for 100 million U.S. homes to have access to affordable download speeds of 100 Mbps (megabits per second) and upload speeds of 50 Mbps. Dial-up internet has an overhead speed 56 Kbps (kilobits per second), which is about 1785 times slower than the national goal. The National Broadband Plan also calls for every American community to have access to at least 1 Gbps (gigabits per second) broadband service to anchor schools, hospitals, and government buildings.

b. Broadband in Rural America

Affordable broadband access is easy to find in and around cities, but rural communities are left in the dust. Considering America's vast size, building broadband connections to rural areas comes with a cumbersome price tag (Bringing Broadband to Rural America). Although private broadband companies, e.g. Comcast and Cox, are always looking to expand, they do not build in locations that seem unprofitable. Constructing wired broadband lines to remote locations costs more money than a company is likely to earn back in subscribers. This is when the federal and local government steps in and offers incentives to private companies or constructs wired broadband connections independently.

c. Eastern Shore of Virginia Broadband Authority

The Eastern Shore of Virginia Broadband Authority (ESVBA), a public not for profit company created under the Virginia Wireless Service Authorities Act, is taking the lead in bringing broadband to Northampton and Accomack County. The main goal of the first project conducted by ESVBA within their broadband initiative "is to plan, design and construct a fiber backbone from Norfolk in the South to Cape Charles across the Chesapeake Bay Bridge Tunnel. This project is funded by NASA and will be installed by Mid Atlantic Broadband," a privately owned company (www.esvabroadband.net). The fiber backbone is an open access network allowing public companies to provide services to the businesses and residents of the Eastern Shore of Virginia. With the soon to be built fiber backbone running though Accomack and Northampton County, the next step is to build broadband technology that pulls broadband from the fiber backbone and brings it to the rural villages in these two counties while adhering to FCC guidelines on broadband speeds and availability.

d. The Report

In this report, I weigh two fiber broadband architectures that possible options for Accomack and Northampton County's government, hospital, schools, businesses, libraries, and residences for a project known as "The Last Mile". Both Accomack and Northampton County agree that fiber is the only broadband technology capable of handling present and future high speed internet demands. They also understand that fiber will help them gain the ability to draw businesses to the area and reach the FCC's guidelines. The two fiber architectures are Passive Optical Networks (PONs) and

Point to Point networks (POP) both fiber architectures are necessary to bring broadband to the communities in Accomack and Northampton County.

Gathering data for this study on broadband has proven to be a difficult task as little information is readily available on the actually speeds, latency, cost, and long term effectiveness of broadband technology. The FCC is presently collecting this necessary data, but results of their study are not expected to be released soon enough for ESVBA to make decisions regarding broadband service to residents. I empathize with that ESVBA's desire to bring much needed broadband availability to Accomack and Northampton County via the "Last Mile" project, and thus I agree to conduct this study with limited available information from sources dating back no farther than 2005. I would like to that recommend a new study be conducted as more information on broadband technology becomes available.

3. What is Fiber?

Fiber is short for optical fiber cable, also known as fiber optic cable. Fiber optic technology converts electrical signals carrying data to light and sends the light through transparent glass fibers about the diameter of a human hair (www.broadband.gov). Fiber transmits data at speeds far exceeding current DSL or cable modem speeds, typically by tens or even hundreds of Mbps (see Table 1). Fiber is the only commercial method available to bring 1 Gbps broadband to hospitals, government, and schools and it is the most commonly used method to bring 100 Mpbs broadband to homes. However, the actual speed of broadband available to buildings is determined by how close fiber cables are brought to the premises.

Hospitals need fiber to connect to the premises, while residential areas can have fiber supplied to the curb or to a street cabinet. Fiber that is not built directly to a premises needs private internet service providers to connect the fiber in the street cabinets to VDSL (very fast digital subscriber lines) that use cheaper copper cables instead of more expensive fiber. Another option would be to bring fiber to the premises, such as a library or large business, and then offer wireless connections for all subscribers. There are several methods to bring fiber quality broadband to buildings, but this can be accomplished by private internet service providers who are willing to buy, distribute, and maintain fiber lines.

Technology	Speed	Physical Medium	Common Application
Dial-Up	Up to 56 Kbps	Copper twisted pair	Home and small business access
Digital Subscriber Line (DSL)	512 Kbps to 8 Mbps	Copper twisted pair	Home and small business access
Cable Modem	512 Kbps to 52 Mbps	Coaxial cable, usually uses Ethernet	Home, business, and school access
Very fast Digital Subscriber Line (VDSL)	~10 Mbps to 52 Mbps	Fiber and copper twisted pair	Home, business, and school access
Fiber to the Home/Curb/Premises	100 Mbps	Fiber	Home, business, and school access
Optical Carrier	~150 Mbps to ~13 Gbps	Fiber	Business, hospital, and internet backbone

Table 1 : Broadband Mediums and Speeds
source: http://whatis.techtarget.com/definition/0,,sid9_gci214198,00.html and "Broadband Technology Overview"

4. Passive Optical Network (PON)

A passive optical network, PON, brings optical fiber cable from a source, or head end, all of most of the way to the end user (Figure 1). The head end is connected to a fiber backbone. The optical signal given from the fiber backbone is distributed via passive splitters. Since fiber optic technology is made of high quality glass, passive splitters use glass to distribute the broadband signal. Fiber splitters are passive because optical transmission has no power requirements or active electronic parts once the signal is going through the fiber network (searchtelecom.techtarget.com). PONs are sometimes called point to multipoint networks.

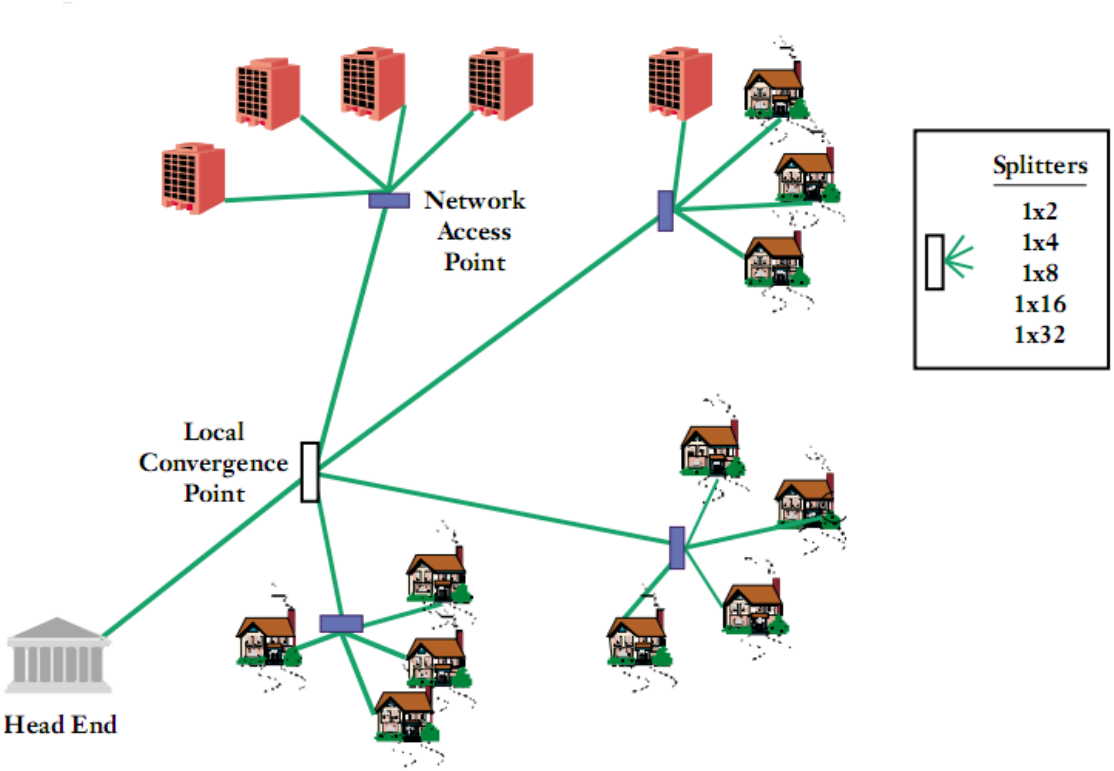

Figure 1: Passive Optical Network
source: "Broadband Technology Overview"

5. Point to Point (P2P) Network

A point to point, P2P, network brings individual optical fiber cables from a source, or head end, to the user. Unlike PON, P2P does not utilize splitters; instead it dedicates a separate fiber from the head end to a subscriber. This requires far more fiber cable than PON, but offers faster broadband service in exchange. For residential areas and closely distributed small businesses, P2P architecture allows for fiber connections from the head end to connect to a street cabinet owned by an internet service provider. From there, internet service providers can build smaller fiber connections directly to subscribers or utilize the speed of fiber to more cheaply connect homes with VDSL, very fast DSL, that uses twisted pairs of copper.

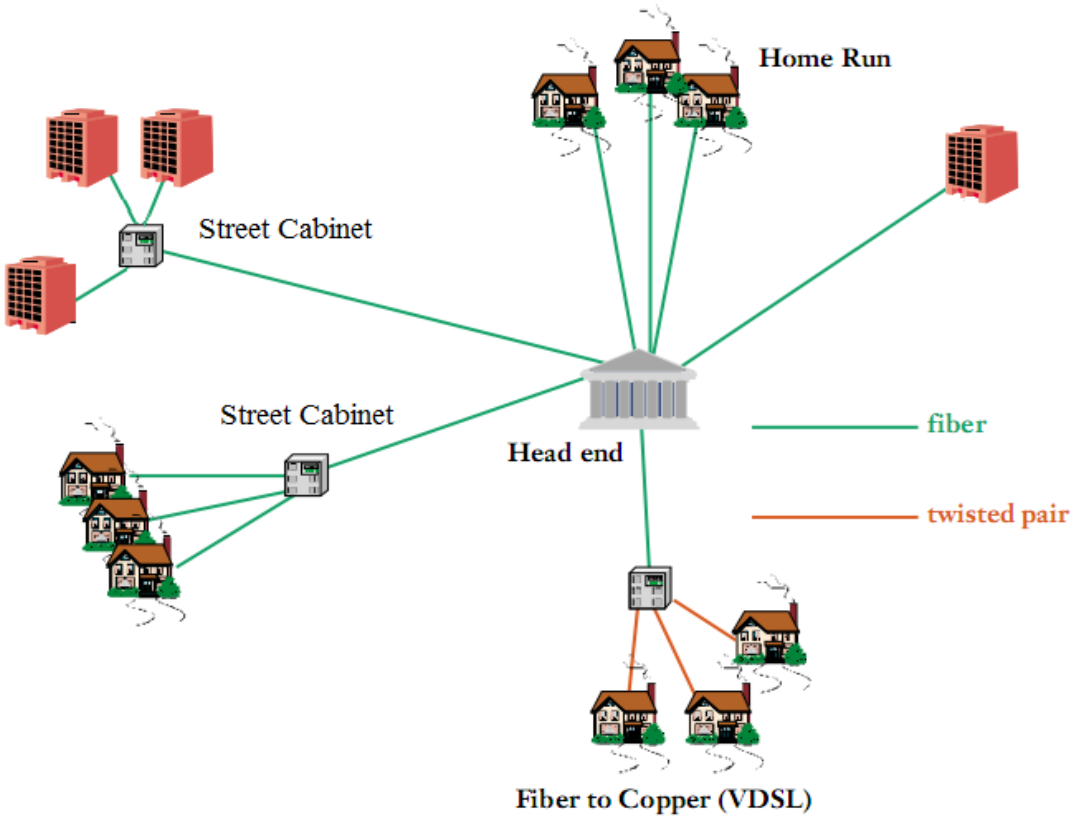

Figure 2: Point to Point Network
source: "Broadband Technology Overview"

6. Comparison

Notice on Figure 3 that the distinguishing feature between PON and P2P architecture is the number of fiber lines connecting from the broadband source to the subscribers. PON uses passive splitters symbolized as triangles below left. P2P networks use street boxes or similar stations symbolized as squares below right.

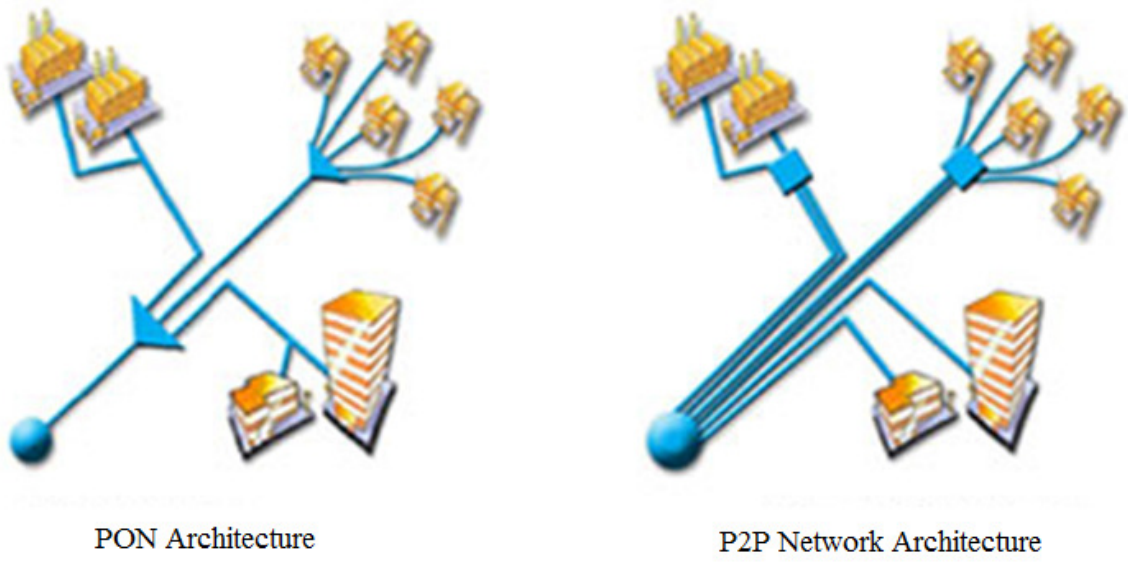

Figure 3: PON and P2P Architecture
http://www.bpoffice.ro/solutii/images/ftth2.jpg

Accomack and Northampton County structure their broadband goals similar to that of the federal government building highways: the government owns the roads, but the private sector businesses use those roads to sell goods and services directly to the public. Hence, the responsibility of building fiber

infrastructure is the job of Accomack and Northampton County. Since neither of the two counties have any intention of selling broadband to their constituents, the broadband structure built in these counties need to be as marketable as possible to internet service providers.

P2P network architecture is particularly friendly to internet service providers because of the dedicated fiber lines. Internet service providers have the option of setting up a street cabinet (Figure 2) and expanding on the broadband lines as they see fit. DSL providers can use the street cabinet to supply subscribers, particularly residences, with VDSL which runs at about half the speed of fiber, but is cheaper to install than fiber. There are several well established VDSL providers in Virginia, so P2P will bring in more bids by these companies to utilize the fiber lines built by Accomack and Northampton County.

Although exact pricing is not available, it is clear from looking at the architecture of P2P networks that PONs are significantly less costly since they use less far less fiber lines (Figure 3). The budget of Accomack and Northampton County is not limitless, so some locations need to be constructed with PON architecture. This architecture is cost effective and efficient for towns and villages with lower populations. Internet service providers cannot easily share ownership of PONs because there is only one connection to the broadband source. In communities with PON architecture, internet service providers can bid for control of the whole PON. The ability to own lines to an individual community is a huge draw for internet service providers who do not want to compete heavily for customers in the next few years.

P2P architecture is necessary for schools, hospitals, libraries, government buildings, and large businesses. Hospitals and government buildings in particular need broadband to function and communicate internally and externally. A dedicated fiber line must be built to hospitals. Schools need broadband to keep their students and teachers well informed and to teach valuable computer skills.

Since Accomack and Northampton County presently have approximately 30 Kbps speed internet service, most residents do not own computers or they do not have strong computer skills. Once broadband is available at libraries, there will be an influx of people using the library for internet access, so libraries will need a dedicated fiber line to handle the growing number of patrons ("Broadband Adoption in Low-Income Communities").

Both Accomack and Northampton County expressed interest in drawing in large businesses to the area. With Washington DC only a 4 hour drive away, government agencies, government contractors, and large businesses may be drawn towards these two coastal counties if they had supply the broadband necessary to keep large businesses running. Large businesses will require a dedicated fiber line to their premises which is best offered by P2P networks. Smaller businesses can easily manage with the broadband speeds offered by PONs if the broadband does not pass through too many splitters.

7. Recommendation

Accomack and Northampton County plan on building infrastructure for their “Last Mile” project and then selling it to the highest bidding internet service provider. I recommend P2P architecture because it is easiest to split into smaller regions. Although it costs more, both counties should build P2P network structures in every village that has a hospital, library, and/or county government buildings. P2P is more cost effective in the long run because it offers higher speed broadband than PON, meaning less money spent on future installation of fiber.

Smaller communities in Accomack and Northampton County should consider PON architecture, especially if they believe an internet service provider is willing to buy and maintain the infrastructure. Internet service providers are more willing to consider buying fiber lines in rural areas if they have less a costly structure to maintain like PON.

8. Conclusion

Broadband availability is vital to the success of Accomack and Northampton County. Although there are many residents without computer skills, most Americans clearly understand the need to have these skills ("Broadband Adoption in Low Income Communities"). The goal of the "Last Mile" project is connect those who need broadband the most. Careful budgetary planning may allow those in the islands of Accomack and Northampton County to find broadband in their backyard as well. Construction on the "Last Mile" will take approximately a year or two to begin, which leaves room for more research on the community members and their interest in bringing broadband to the area. This also leaves room to recruit new businesses and cater to their needs if there is a guarantee that they will move to Accomack or Northampton County.

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