A Backgrounder on Open Access Networks

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This report is a backgrounder on Open Access Networks (OAN), and is designed to give the reader an understanding of what OANs are, how they work, and how to avoid the pitfalls.

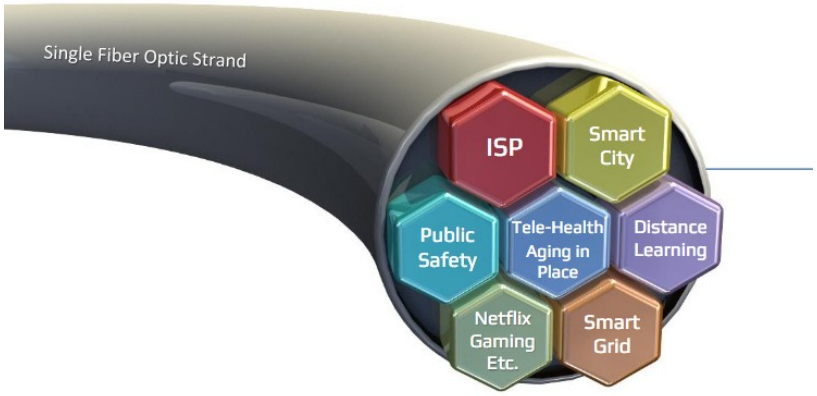
Introduction

The New Kent County Broadband Advisory Committee (NKBBAC) recently saw a presentation that included information on an innovative company (EntryPoint Networks) and its case study on Ammon, Idaho. This is a good example of an OAN, but it is only one example of what one company is offering. Below we will delve into the background and details of OANs, which have been deployed successfully in Europe, Japan and even Virginia for over ten years.

A key problem in improving Internet access has been ensuring residents and local businesses have high quality services. One means of ensuring high quality is via competition – if people can switch away from their Internet Service Provider, the ISP has an incentive to provide better services. However, the high cost of building networks is a barrier for new ISPs to enter the market, limiting the number of options for communities. Open access provides a solution: multiple providers sharing the same physical network.

Publicly owned, open access networks can create a vibrant and innovative market for telecommunications services. Municipalities build the physical infrastructure (fiber-optic lines, wireless access points, etc.) and independent Internet Service Providers (ISPs) operate in a competitive market using the same physical network. In this competitive marketplace, ISPs compete for customers and have incentives to innovate rather than simply locking out competitors with a de facto monopoly.[i]

Open Access Network Defined



Unlike more common network arrangements (where one company, owns, operates, and provides services on the network), an open-access network (OAN) refers to a horizontally layered network architecture, and the business model that separates the physical access to the network from the delivery of services. In an OAN, the owner or manager of the network does not supply services for the network; these services must be supplied by separate retail service providers.

"Open Access" refers to a specialized and focused business model, in which a network infrastructure provider limits its activities to a fixed set of value layers in order to avoid conflicts of interest. The network infrastructure provider creates an open market and a platform for internet service providers (ISPs) to add value. The Open Access provider remains neutral and independent and offers standard and transparent pricing to ISPs on its network. It never competes with the ISPs.

An Open Access FTTH network is open to be used by multiple service providers **simultaneously** and on **equal terms**, providing a real choice for the end customer. This makes the network more attractive and delivers higher take-up, which is the number one value driver.

More services mean greater take-up of fiber, making the fiber owners more money and bringing greater overall economic benefit to the area. From experience in Sweden, as well as from various studies, it is clear that Open Access is the way real estate owners make the most money from providing broadband infrastructure.

It can result in a **5% premium on home prices**, while also maximizing the satisfaction of residents in the area, with both consumers and business users getting the best possible choice and prices for broadband services.[ii]

In contrast to traditional municipal networks where the municipality owns the network and there is only one service provider, the open access model allows multiple service providers to compete over the same network at wholesale prices. This allows service providers to make money in the short-term, and the municipality or cooperative to recoup its costs over the long-term. The build-out and infrastructure is typically financed through low-cost bonds.

In the US, open access networks like municipality owned The Wired Road in Virginia have been able to attract both local and regional service providers quickly. This has resulted in the cost of Internet access and telephone service for business users in The Wired Road service area to decline by fifty to seventy percent due to the increased competition between providers.[iii]

There are two different open-access network models: the two- and three-layer models.

Open Access can drive greater take-up and revenues for both property and fiber owners but is normally outside their domain or experience. Choosing the right equipment, systems and especially the right configuration for a large complex network is a challenging task. It can be technically very difficult to get right and can be daunting for many fiber owners to take this step.[iv] This points to the value of the three layer model.

Two Layer Model

In this model there is one entity being both the network owner and the operator, and multiple retail service providers that deliver services over the network. In Sweden, larger cities with municipal networks have often also chosen to operate their own networks.

Three Layer Model

In the three-layer model the network infrastructure (the fiber) is owned by one entity (a company or sometimes the city/municipality), the operations and maintenance of the network and the provision of services is run by a second company, and the retail service providers provide the third layer marketing and selling their services to the subscribers.

An Example

Below is an example of an open access arrangement. The network owner funds the construction; the operator oversees construction and maintenance. The retailers provide the Internet service required by us, the end users, who likely just want to get online to get informed, play games, and do work.

A Comparison to Roads

The open access model is often compared to road systems. Roads are built and maintained through both public funds and taxes on vehicles, but do not themselves fill the coffers of municipalities. They are then used by everyone: trucking companies, UPS, taxi cabs, pizza delivery people, etc. - to deliver services or get around. For the municipality, the net gain of building robust road systems comes in economic development successes, improvements in quality of life, and other indirect benefits rather than direct profits.

Building open access broadband networks along the same principles has proven immensely successful at fostering competition and producing economic gains in some U.S. communities, but also more extensively in Sweden, France, and Japan. In the United States, this model has been used less frequently, in part because of differences in national regulation and the power of the largest corporations to shape policy.[v]

If we managed roads the way we manage telecom, we would not get package delivery at our homes and businesses until Fedex or UPS decided to build a private paved road for their trucks to our house. Most of us would never get package delivery with that model because we would not send or receive enough packages to justify the expense of building a Fedex-only road to our home. But that is exactly how we manage telecom. We can get a package delivered to our door for a few dollars because all shipping companies share a single common road system. And UPS and Fedex are doing very well financially because the shared model makes the marketplace for shipping bigger, not smaller.[vi]

U.S. Open Access Networks (Three in Virginia)

ILSR is currently tracking more than 30 open access networks across the United States, including three in Virginia.[vii]

nDanville

nDanville is the **first municipally owned open-access, open-services network** in the United States. The project was initiated in 2004 to provide the City of Danville, as well as three surrounding counties, with powerful, high-capacity broadband services.

At its inception, the nDanville project was divided into three phases to systematically begin serving the City of Danville. The first phase was to connect area schools, providing better resources for students and teachers. The second phase, Fiber to the Business, offers greater bandwidth, speeds and accessibility to area businesses and those that locate in Danville. Service to schools and businesses is provided directly from nDanville. The third, final and current phase is Fiber to the Home, which provides infrastructure for third-party providers to offer super fast Internet connections, fiber optic television and digital VoIP telephone service.[viii]

Eastern Shore of Virginia Broadband Authority

The Eastern Shore of Virginia Broadband Authority is a public authority, formed by the Counties of Northampton and Accomack, to provide broadband services on the Eastern Shore of Virginia. The ESVBA is a public not for profit company created under the Virginia Wireless Service Authorities Act, Chapter 54.1 §15.2-543.1.1 et seq. and by a resolution of the Counties of Northampton and Accomack.

The ESVBA provides connectivity and dedicated internet services to all customers. However, the ESVBA's network is an ***"Open Access" network***, which allows for any certified provider to utilize the ESVBA's network to provide services to end customers.[ix]

The ESVBA was formed ten years ago (2009) and has 9 retail service providers competing to provide Internet and telephone services. Their fiber-to-the-home network is being built to demand, and currently serves select communities.

The Wired Road

The Wired Road Authority is a collaborative effort between private sector service providers, the local governments of Grayson County, Carroll County, and the City of Galax, and the Carroll-Grayson-Galax Regional Industrial Facilities Authority (dba Blue Ridge Crossroads Economic Development Authority).

The Wired Road network has been in operation for over ten years (since 2007) and is a true public/private partnership with 2 service providers offering last mile services on the network. The Wired Road is an ***open access, fully integrated fiber and wireless regional broadband network*** offering "big broadband" 100 megabit and Gigabit fiber connections and multi-megabit wireless connections in Carroll, Grayson, and Galax.[x]

What Open Access Should Be

In a fiber access network, Open Access should mean the ability for an end customer to receive and choose from **multiple types of services** delivered by multiple different operators **simultaneously**. The customer should be able to buy broadband from one company and TV from another, as they wish.

Changing service provider should be easy, at the click of a mouse.

For service providers, **the ability to add their services to the network should be completely open** and on equivalent terms for all operators; no advantages for one, no blocking of another. The essence is to have an open market on the network that makes that network much more attractive to the customer and hence better for the fiber owner.

A long definition is needed because of confusion among municipalities and developers and also a trend with operators trying to hijack the term Open Access for marketing purposes (in the same way that lots of customers connected to a copper or coax connection in the last mile are being told they have "fiber broadband").[xi]

What Open Access Isn't

So if an operator is offering Open Access but you can only get their services on their network, then it isn't Open Access! One incumbent is claiming that this is actually open because you can switch to another provider, but the cost is so high that customers are essentially trapped with the incumbent. That is not truly open either.

If an operator is sharing its network using "bitstream" (a wholesale access capacity product) then that is not Open Access -- customers can't see a menu of services from which to choose. Yes, a customer could change to another provider but the pricing can be prohibitive for them and even if a customer does change, then they're stuck with a single provider for all services.[xii]

Financing Open Access Networks

Some, like Rio Blanco County have taken advantage of **state grants** to subsidize their network build-out. Rio Blanco received $2 million in matched funds from the Colorado Department of Local Affairs. It then committed another $7 million of its own funds to the project, made up of $2 million in federal mineral lease revenues and $5 million from the county's general fund.[xiii] But for NKC, I have been informed that VATI makes no awards to municipal entities including authorities.[xiv]

Another approach is to use **Tax Increment Financing (TIF)**, a tool that allows specified districts to borrow funds for redevelopment that are to be paid back in future taxes, to subsidize infrastructural costs. TIF has aided in Bozeman, Montana's effort to bring next-generation technology to their community.[xv] NKC is likely to see a considerable increase in real estate tax revenue due to the increased property value, and increased business tax revenue because more and better businesses will be attracted to FTTP Internet access. By quantifying and projecting these increases, a case could be made for TIF in NKC.

Tax-exempt **revenue bonds** are bonds that are tied to a specific source of income. Revenue bonds are typically used to finance projects such as roadways, transit systems, utilities, airports, power plants, and broadband Internet systems.

Some networks place more of the financial responsibility on the network subscribers. In the **utility fee model**, subscribers (or all community members, depending on the arrangement) pay a monthly surcharge, which helps to fund the construction and maintenance of the network. A version of this approach is being used in Ammon, Idaho, which has two fees. The first is for the fixed cost of building it, and the second is for operation and maintenance. This last fee varies based on the total number of network subscribers: the more subscribers to the network, the less the individual cost.

Other networks use a **wholesale model**, selling bandwidth in bulk to ISPs, which can then be bundled, often in a triple-play (phone, TV, Internet) arrangement, and sold to customers. ISPs pay for the ability to provide services over the shared network. For example, Mount Vernon, Washington receives 15 percent of the gross income of each ISP that uses its network. In other cases, ISPs pay a one-time connectivity fee to be able to use wholesale services.

In some cases, communities have built their networks with the assistance of **federal loans/grants** along with **community and private sector contributions**. Fast Roads in New Hampshire is one example of

this. Fed up with poor service in western New Hampshire, a coalition of municipalities built the Fast Roads network using a combination of stimulus funds from the American Recovery and Reinvestment Act (ARRA), community contributions, and private donations.

Even with these many options for financing, building a citywide network immediately is challenging. Many community networks start out incrementally. The revenue or savings from one section pays for the construction of the next section. Most begin by connecting community anchor institutions before moving on to connect businesses and residents. The public savings from ending contracts with incumbent ISPs enables communities to fund the expansion of the network, such as with Santa Monica, California's City Net. Incremental financing works, especially in cities without a public power utility.[xvi]

Supporting Technology

Many of the communities that start off enthusiastic about open access ultimately decide to have a single service provider (themselves or a contractor) to have more certainty over the revenues needed to pay operating expenses and debt. We believe this will change as the technology matures and more communities embrace software-defined networks (SDN).[xvii]

Operating an Open Access network is way more complex than being the single provider on their own infrastructure. An operator has to keep track of:

- Every single subscriber in the network, their physical address, their "technical address" (switch, switch port, etc.).
- Which services they are buying from which provider/s.
- The total number of customers and/or services bought if operating in a three-layer model where you have to report back to the network owners how their network is utilized.

Getting this correct is tricky, but the real complexity comes over time, when customers move, cancel services, buy new services, change service providers, new providers enter the network and adds new services, etc. It's simply not possible to do this without the support of a BSS/OSS (Business and Operations Support System) tailor-made for keeping track of all these moving parts.[xviii]

Fortunately, This is not a new or untested technology. OANs have been operating since at least 2001[xix] and their use in expanding. With the advent of software-defined-networking, it is much easier to operate and manage an OAN. There are several companies that offer this kind of software; some also offer specialized hardware. They include:

- COS Systems (https://www.cossystems.com/)
- EntryPoint Networks (https://www.entpnt.com/)

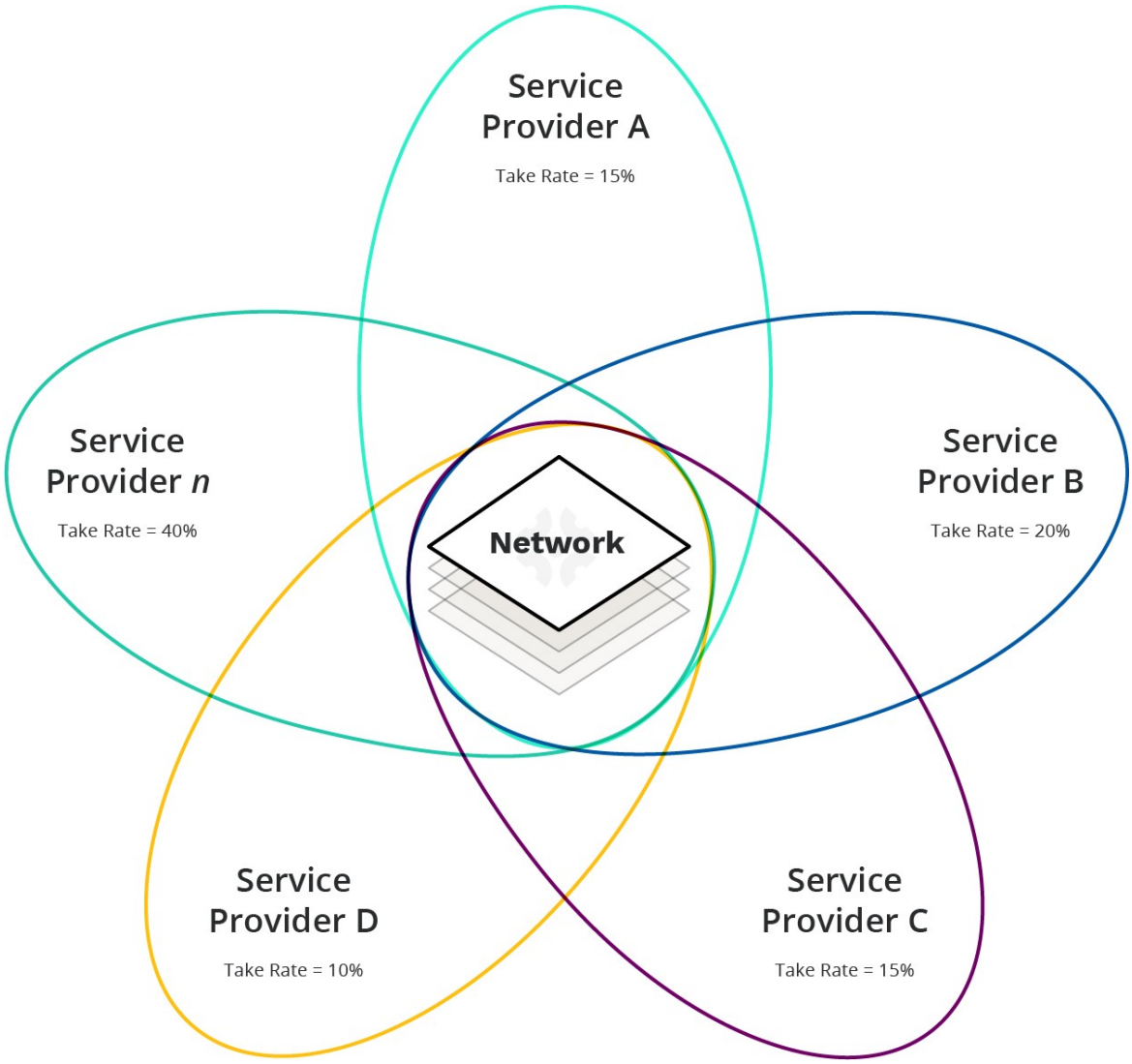
And there are Design/Build/Operate firms that specialize in community-owned open-access networks:

- Neighborly (https://neighborly.com/)
- Greywale Advisors (http://greywale.com/)
- WideOpen Networks (http://www.wideopennetworks.us/)
- Forsite Group (http://www.fg-inc.net/services/network-design/)

Network Take Rate

Open access fiber broadband networks require new and distinct business math compared to the incumbent closed network model in the U.S. This includes a reframing of the way we understand network “take rates”.
In the open access model, multiple providers operate on shared network infrastructure that supports a marketplace for service providers of all types (XSPs) to jointly increase the overall take rate of the network. The take rate is cumulative — across service providers and service types e.g. internet, tv, phone, health.

Cumulative take rate is an important new data point for consideration: we cannot judge new open access networks within the framework of the old system. On open access networks, it is important to remember that while one service provider might have a low take rate — perhaps due to price and quality of service — that does not reflect the viability of the network as a whole.



With this model, network investors can think about the take rate through three metrics.

How many potential residents have subscribed?
How many service providers are on the network?
How many services has each subscriber signed up for?

A true open access network creates a marketplace for the future of network-based services such as tele-health, smart home applications, data security, autonomous vehicles, and 5G small cell deployments. An open network empowers providers of these services to deploy their applications in a direct and private format to the end consumer. A truly successful open access network will have take rates that exceed 100% as customers consume multiple services from a variety of providers.[xx]

Appendix A - Practical questions for potential Open Access providers

Here are some simple questions that municipalities, property and fiber owners can put to any potential Open Access provider to understand their offering more fully and avoid potential errors in selection. I've added comments after some of the questions to explain why the answers are important.

1. Can multiple different service providers deliver services at the same time over the network?

2. Can end users see these services and select freely from them?

3. Can service providers create new services and easily add them to the offers presented in the online services supermarket to end users without the need for assistance? (In an Open Access network, an ISP should be able to create and add a new service, such as a 100Mbit/s package, to their list of offers and this be presented to end users automatically without software development or help from any third party.)

4. Can the real estate developer add their own IP-based services to the system, such as CCTV cameras? This is important, as some operators just want to put their own services on and not help the developer with security, access control and other applications. True Open Access makes adding these things easy.

5. Is the supporting software already developed, stable and proven at scale? If not, this opens up the risk of the classic IT problem in telecoms of long delays, high costs and lots of problems. That won't make a Residents Association very happy.

6. Is it possible to see a demonstration of an existing commercial deployment with multiple service providers and services? A simple request and it's much better to see a live demonstration of a working system than mere promises in a proposal.

7. Is it possible to talk to some existing customers? A good Open Access partner will be happy to let you talk to customers.

8. Do different service providers pay the same price for accessing the network? It is all too easy for a big telco to cross-subsidize services to disadvantage competitors. For example, an incumbent could charge a rental for the fiber to other operators that is 90% of the retail price, making it impossible for any other operator to compete.

9. Can your provider explain what hardware choices they have made and how these help deliver high performance and up-times? Some components last 75 years between failures while 50% of some components will fail in three years. It is better to know that your provider has thought of this and is choosing wisely.

10. Is the network equipment based on a truly interchangeable technology? If not, the risk is the network may be tied to one hardware vendor -- such lock-in can lead to higher prices over time or lead to problems if the vendor experiences difficulties.

11. Will the system be capable in the future of offering delivering multiple HD (and one day UHD) TV services to end users? Be careful as this can be a trap. If the technology selected is GPON then quite simply the system will not be capable of delivering such services in the future. In Sweden, the home of Open Access, there is not one Open Access operator using GPON -- they all use Active Ethernet.

12. How will the network be maintained?

13. Does the business model mean the provider is committed to the development in the long term or can they run away early (for instance, if you paid for everything up front)?

14. What track record does the provider have? It's better to work with someone that has seen and done it all before.

If the provider can't deliver against the above, then you're risking having lower penetration and unhappy customers that don't have the control or range of services they desire.[xxi]

GPON vs Active Ethernet

GPON uses passive optical splitters to connect up to 32 fibers to a single fiber which is then connected to an OLT in a roadside cabinet which provides the service. This is a shared medium where all 32 customers receive the same transmission from the OLT and send back their separate transmissions on effectively the same fiber. It is pretty similar to the way Cable network operates - just using fiber instead of copper.

Active Ethernet runs as you would expect for an ordinary Ethernet network. Each customer has their own fiber which runs back to a switch in a roadside cabinet. The type of switch used determines the speed of the connection to the customer and the bandwidth of the uplinks of the switch determines whether there is any contention on the network.[xxii]

Appendix B - Challenges for Open Access Networks

While many municipal networks face challenges from incumbent providers and state laws, open access networks encounter a unique set of problems. The most obvious being, how to attract service providers to the network? After that, it then becomes a matter of maintaining the reputation of the network. In the long term, however, there may develop concern over price competition and consolidation. This section aims to provide solutions and advice for these open access problems.

Challenge 1: Getting Service Providers

There's not much use in an open access network without service providers offering a variety of competitive services. In order to ensure the network's success, there should be at least one core provider at the start. Some community networks begin with an operator who also acts as an ISP. For a set period of time, the operator will be the sole ISP before opening up the network to other ISPs. Westminster, Maryland, pioneered this model when they built a community network with the ISP Ting.

It may take time for ISPs to join the network. While incumbent ISPs do not often want to do business on the public open access infrastructure, other smaller, local ISPs may join. Some communities hire a specific person, such as the network director, to recruit service providers. Others wait for the reputation of the network's speed and reliability to entice ISPS to the new market.

Challenge 2: Reputation

After securing service providers, the community faces a new challenge, building and maintaining the reputation of the open access network. In extreme cases where an ISP acts in bad faith, a network's reputation will become so maligned that it struggles to rebuild its brand and attract new, better ISPs.

For example, Provo, Utah is often cited as proof of the failure of municipal networks. The network's wholesale model (mandated by the state) relied on private ISPs that overpromised, under-delivered, and bowed out of the market too quickly. Provo's network reputation was severely compromised.

Challenge 3: Price Competition and Consolidation

Some fear that in the long term ISPs will consolidate, leaving us once again with a duopoly or monopoly. These fears have yet to be realized, but it has become more of a topic in Sweden where open access networks have been in existence longer.

Over time, if the only differentiation between service providers is price, then eventually those profits will be competed away. Eventually people will choose the cheapest plan that suits their needs, and the ISPs will have to consolidate. This will diminish the number of options for the consumer – leading to the situation that open access meant to avoid all along. ISPs will have to take care to differentiate their services, preferably by competing for providing the most friendly customer support, in order to stay competitive and in business.[xxiii]

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