Before the

FEDERAL COMMUNICATIONS COMMISSION

In the Matter of	)	
	)	
International Comparison and Survey Requirements	)	GN Docket No. 09-47
In the Broadband Data Improvement Act	)	
	)	
Inquiry Concerning the Deployment of Advanced	)	GN Docket No. 09-137
Telecommunications Capability to All Americans	)	
In a Reasonable and Timely Fashion, and	)	
Possible Steps to Accelerate Such Deployment	)	
Pursuant to Section 706 of the Telecommunications	)	
Act of 1996, as Amended by the Broadband Data	)	
Improvement Act	)	
	)	
A National Broadband Plan for Our Future	)	GN Docket No. 09-51

NBP PUBLIC NOTICE #12
COST ESTIMATES FOR CONNECTING ANCHOR INSTITUTIONS TO FIBER

COMMENTS OF THE SCHOOLS, HEALTH AND LIBRARIES BROADBAND COALITION

I. Introduction

The Schools, Health and Libraries Broadband (SHLB) Coalition is very pleased that the Federal Communications Commission (FCC or Commission) has initiated this inquiry into the costs of providing fiber connections to community anchor institutions (CAI). CAI need very high-bandwidth broadband connections to provide essential services, including remote medical care, distance learning, job training, access to e-government benefits, and many more. Because of the increasing prevalence of high-definition video and other bandwidth-intensive uses, these institutions need to upgrade their connections simply to maintain their current level of service, and they need even greater levels of bandwidth to plan for the future. They often need capacity of 100 Megabits per second (Mbps) or even 1 Gigabit per second (Gbps), which is far greater than the bandwidth needed by individual households. CAI use these high-capacity broadband capabilities to provide essential services to rural, low-income, disabled, the elderly, students, immigrants and many other underprivileged and vulnerable segments of the population. These reasons alone warrant treating community anchor institutions as significant cornerstones of the FCC's National Broadband Plan.

Yet, there is another, equally important reason that community anchor institutions should be considered as essential building blocks of the National Broadband Plan – open fiber connections to CAI can benefit the surrounding community. Community anchor institutions often serve as economic and social "hubs" of their regions; both residential and commercial development often clusters around the school, hospital and library. Building open, high-bandwidth facilities makes it easier to provide broadband services to these homes and businesses. These high-capacity fiber facilities can be used as "jumping off" points (or "stepping stones") to which Last Mile broadband providers can interconnect and from which they can provide wired and wireless broadband services to homes, businesses and non-profit entities in the area.

II. Community Anchor Institutions' Need for Fiber Optic Connections.

Some may question why the FCC is focusing on the costs of providing fiber optic connections to community anchor institutions rather than considering all broadband technologies. The SHLB Coalition appreciates the concept of technological neutrality, and we recognize that there are many technologies that can provide "always-on" access to the

Internet, including DSL, cable modem, broadband over power lines, satellite and other wireless technologies. Each of these technologies can play a valuable role for certain users, in certain environments and locations.

Nonetheless, fiber optic cables offer certain advantages that are often best-suited to the needs of CAI. Fiber is often described as "future-proof" because it provides almost unlimited bandwidth. The capacity of fiber is limited only by the speed of light, which is to say that the actual capacity of the fiber is limited only by the electronics placed at either end of the cable. As a result, fiber is a long-term asset (20+ years) that can be used to provide increasing transmission rates without replacing the fiber itself. No other technology can match this transmission capacity and this longevity of use.

Second, CAI generally occupy a fixed location for many years. Part of the value of these "anchor" institutions is that they seldom move from one location to another. And even though there may be certain wireless applications within the building, these local wireless connections (such as Wi-Fi) are often limited to a few hundred feet and even these wireless connections ultimately need a fiber connection to the Internet. Constructing a long-term, landline fiber connection is often the most appropriate technology for these stable and longstanding community institutions.

Third, the costs of maintaining and operating a fiber network are often less than other technologies.[1] For example, long distance telephone call rates have declined to almost zero in

[1] In making this statement, we are not referring to the "price" of bandwidth provided over a fiber connection charged by commercial providers. Incumbent commercial companies often charge higher prices for bandwidth provided over fiber-based facilities that are unrelated to the actual costs to the provider.

part because of the universal deployment of fiber in long distance and backbone transmission networks. While the up-front, initial costs of installing fiber cables can be significant in some cases, fiber is often the most efficient investment in the long run because its lower operational and maintenance costs will more than offset the one-time deployment costs. The lower operating costs can be true for several reasons, such as:

- Fiber optic lines require fewer repeaters that need to be replaced or upgraded because the light signals travel farther than traditional signals;
- Fiber cables are designed not to break (they are lashed to a strong steel cable that is designed not to break even if the telephone pole breaks);
- Fiber cables do not need to be replaced, just the electronics need replacing.

Fourth, fiber networks can achieve even greater efficiencies through demand aggregation. As evidenced by our country's regional and state research and education networks, connecting community anchor institutions through a single network allows these institutions to share initial and on-going network costs among a larger number of participants. Average costs are lower to the institution and savings accrue sooner than if each institution has to acquire data services independently. Once the need of anchor institutions for higher bandwidth is included, the savings of demand aggregation on a fiber network are even more striking.

III. The costs of deploying fiber to anchor institutions vary greatly from location to location.

The SHLB Coalition has solicited feedback from a variety of network engineers, fiber construction companies, broadband providers and community anchor institutions to evaluate the cost model developed by the Bill & Melinda Gates Foundation. Almost every commenter has responded that it is extremely difficult to generalize about the costs of providing fiber to anchor institutions because the actual costs will vary tremendously from location to location. Some of these cost factors are predictable in advance (such as terrain, geography, weather, size and scale of the project, density) while other factors cannot be predicted until a field study is conducted (such as existing fiber availability, existing conduit, labor costs, management expertise, etc.)

To ensure that the Commission appreciates the diversity of factors that can affect the costs of fiber deployment, we list below some of the most important determinants of the cost of providing fiber to an anchor institution:

- The distance of the fiber connection. If there is fiber already running down the street, the cost of deploying a fiber cable connecting the CAI to the fiber in the street (the "drop") may be minor. If the fiber must be run from the CAI all the way to a central office, or to an Internet access point several miles away, the cost could be prohibitively high.

- The number and proximity of the anchor institutions to be served. The closer together that the institutions are clustered, the more they can share the costs of joint facilities, which lowers the costs per entity.

- On the other hand, the density of area to be served can also increase the cost. For instance, if several wires already share the use of telephone poles so that existing lines must be moved to create space for the fiber wires, the costs will increase. If urban area is so dense that there are many other cables using the same conduit under a city street, the costs of engineering around the other cables will also be higher.

- The type of deployment has an enormous affect on the cost. In general, aerial deployment is the least expensive, trenching (digging into the earth) is the most expensive, while "direct bury" is somewhere in between. However, the aerial costs will be influenced by the "make-ready" process of preparing the poles to carry the fiber, and the pole attachment fees charged by the pole owner.

- The geography and terrain. Mountains, large bodies of water, rocky terrain will tend to increase the deployment costs.

- The type of electronics at the hub. Some central offices or head-ends may already have adequate electronics to accommodate the increased traffic from the fiber connection, but most hubs will need to be upgraded.

- The availability of adequate backhaul (middle mile) capacity from the hub to the Internet to handle the increase in traffic from fiber connections will also affect the total cost of the project. In some locations, there are multiple, competitive providers of backhaul capacity; in other locations, however, there is less competition and the broadband provider must purchase higher-priced "special access" services from the local telephone company to connect to the Internet.

- Fiber connections will usually require new equipment at the premises, including inside wire, power, routers, etc.

- The amount of network security and intelligence required will also affect the overall cost. This can vary depending on the needs of the particular CAI.

- The availability of adequately trained and experienced network personnel and staffing can help to reduce problems and costs, but this staff is not always available, especially in rural areas.

- One of the biggest factors affecting deployment is the cost of labor. In general, rural areas will have lower labor costs than urban areas.

- Overall program management experience can also be a large cost factor. Experienced management can avoid mistakes and plan wisely.

- The cost of gaining access to rights-of-way is often a problematic for fiber builders. City managers must balance the needs of the fiber builder to dig under the city streets with the needs of commuters and other construction projects. Pole fees, municipal and state fees for use of the rights-of-way, and other conduit fees can have a significant effect on the deployment costs.

IV. Despite the variety of circumstances, there are certain common factors that can be used to provide a general estimate of the costs.

The costs of deploying fiber to community anchor institutions can be categorized as either **one-time** or **ongoing** costs:

A. One-Time Costs

One-Time Costs can be grouped into five categories. Before examining these categories in detail, it will be helpful to refer to a version of the FCC's network diagram (P. 37 of its presentation to the Commission on September 29, 2009) shown in Attachment A. The community anchor institution occupies a position equivalent to the position of the DSLAM in this diagram. The Second Mile fiber connects from the CAI to the Central office. The term Middle Mile describes the connection from the Central Office to the Internet (the Tier 1 interconnection point). The CAI can also serve as a local hub from which to serve the surrounding residential and business subscribers (represented in the network diagram as a home on the far left).[2] From this diagram, it is easy to see that the one-time costs of providing fiber to the school/library/hospital can be broken down as follows:

i. Premises Costs within the CAI (including labor charges for installation, constructing conduit in the building, electronics inside the building, inside wire, routers, LAN Connection and engineering)

ii. Second Mile Deployment Costs (including fiber material, labor deployment, trenching, boring, direct-bury and/or make-ready costs of poles).

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[2] Although the link between the DSLAM/CAI to the home is shown as a copper loop, the technology could be fiber, wireless, cable, or any other technology. But regardless of the technology, it is not necessary to include the costs of this Last Mile link between the DSLAM/CAI and the home/business in the cost of providing fiber to the community anchor institution.

iii. Head-End or Central Office Costs (including additional electronics, additional switch capacity if necessary)[3]

iv. Middle Mile Costs (including the one-time cost of obtaining additional backhaul capacity, although most of this cost will consist of ongoing, monthly lease costs, rather than upfront deployment costs)

v. Overall Project Management Costs (including the costs of staff and management to integrate these technologies into a functioning service)

Of all these cost categories, the biggest category of costs lies in ii. the Second Mile Deployment Costs. Even within this category, the costs of the actual material (the physical fiber cable and the electronics) are small in comparison to the labor cost.[4]

Contrary to popular belief, the costs **per-mile** are generally much higher in urban areas than in rural areas. This is partly because the urban areas are much more densely packed with other cables (electric, telephone, cable TV) that the fiber must be engineered around. The costs per-mile are less in rural areas because there are not as many wires, real estate is less expensive, labor costs can be cheaper, etc. However, the total costs of deployment in rural areas are often higher than in suburban and urban areas because of the length of the distance between the CAI and the Head-end/Central Office and the costs of the Middle Mile connection to the Internet.[5]

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[3] The Head-End/Central Office costs can sometimes be avoided by directly connecting a CAI to the Internet Core. In most circumstances, however, a community anchor institution network will use a "hub-and-spoke" approach that will aggregate the traffic of several CAIs to a central hub or head-end and route the aggregated traffic over a single high-capacity connection to the Internet.

[4] Several studies (CTC Engineering, New Zealand, and the OECD estimate that the Second Mile Deployment cost (sometimes called "support structures" or "passive infrastructure") is between 50-80% of the total cost of fiber deployment. But these estimates may not include all the other categories of costs (Premises Costs, Central Office Costs, Middle Mile Costs) in their estimate of "total costs".

[5] See Footnote 1136 of the FCC's UNE Remand Order, citing comments from Norlight and WorldCom that deploying fiber in urban and suburban areas is costlier than in rural areas because trenching requires digging up

Aerial (stringing cables over telephone poles) is generally considered the least expensive method of deployment. The cost of aerial construction can vary from $25,000 per mile to $100,000 per mile. Aerial construction may be more expensive when poles are crowded or when the utility pole owner charges high rates for access.

Trenching is usually much more costly than aerial deployment. Trenching involves digging and pushing the dirt to the sides. Then after the conduit is placed in the trench, the dirt is pushed back into the trench. Afterward, the fiber is “blown” into the conduit. In short, trenching requires four steps (digging the trench and moving the soil to the side, laying the conduit, refilling the trench, and then "blowing" the fiber through the conduit after the conduit is laid.

A third deployment method is called “direct-bury.” Direct-bury eliminates two expensive requirements of trenching, i.e., the excavation and refilling of a continuous trench, and the insertion of a continuous duct or conduit in the trench. Direct-bury involves plowing the fiber or conduit(s) directly into the ground. In areas where restoration is not important and long continuous runs are possible (e.g., rural areas, in dirt, on the side of interstate roads), “plowing” the fiber into the ground is an inexpensive option. The cost of “direct-bury” is about 30-60% of the cost of trenching and can be approximately $70,000 per mile.

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and then repairing streets and sidewalks. WorldCom also noted that fiber can be deployed in a buried manner in rural areas at a rate of several miles per day, in suburban areas, at a rate of up to a half a mile per day, while in urban areas, daily construction averages only a few hundred feet. In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, Report and Order and Order on Remand and Further Notice of Proposed Rulemaking, CC Docket No. 01-338, released August 21, 2003.

In more built-up areas, a fourth method called directional boring ("drilling") may be necessary, because it is less destructive to the right-of-way and requires less restoration. Boring is more expensive, approximately $90,000 to $400,000 per mile. Boring also limits the amount of cable and conduit that can be built. (Two 2-inch conduit is a typical limit, corresponding to four medium-sized fiber optic cables.) Boring is also necessary if the terrain includes rock or water passage.

B. Ongoing Costs

It is more difficult to separate the Ongoing Costs into separate and distinct categories, because the types of ongoing costs incurred vary substantially. Ongoing Costs can include items such as the following:

i. Fiber costs (maintenance and repair of fiber, ongoing pole attachment fees, rights-of-way charges, etc.)
ii. Monthly backhaul fees
iii. Monthly Internet Access fees
iv. Cost of upgrading and maintaining electronics (equipment replaced every 5-7 years can be amortized as monthly/yearly costs)
v. Network Monitoring and Support
vi. Hub Costs (Collocation, space and power)
vii. Real estate (costs of an installing a repeater/amplifier/electronics on a piece of land may be separate from the rights-of-way fees)

These costs can vary depending on how the fiber is deployed and who deploys it. For instance, commercial providers often charge a lower up-front installation fee and charge a higher monthly fee to recoup the costs of the deployment over a longer period of time. Non-profit networks, however, may charge a higher up-front fee to cover the actual deployment costs, and may then limit their ongoing fees to covering their actual monthly operational and maintenance expenses.

V. Actual Fiber Deployment Cost Examples

In the Public Notice, the Commission posed several questions concerning the assumptions and conclusions in the Gates Foundation Cost Model. In an effort to test the accuracy of the Cost Model, the SHLB Coalition surveyed its membership in an effort to gather as much “real-world” information as possible. Because of the wide variety of circumstances explained above, the SHLB Coalition was unable to gather enough information to “prove” or “disprove” the accuracy of the Gates Foundation Cost Model.

Nonetheless, based on the examples we have encountered and provided below, we believe that an estimate of $50,000 to $75,000 per anchor institution to be reasonable, which is consistent with the conclusions of the Gates Foundation Cost Model. Many of the specific examples we obtained fall below that range. It is possible, however, that the more specific estimates we provide below are less than the actual average cost because institutions in high-cost areas may not even pursue a cost study if it is obvious that deploying fiber is cost-prohibitive. In other words, the actual, real-world average is likely to be higher than the average of the examples below. Nonetheless, we provide these examples to demonstrate that the Gates Foundation Cost Model is reasonable.

A. Peninsula Library System

The Peninsula Library System (PLS) is a consortium of eight public library systems and one community college library district serving 33 libraries spread across the entire county of

San Mateo in California. PLS recently upgraded its network to provide each of its libraries with a fiber connection. Though the planning, design and installation took about 18 months, every PLS library now has a fiber connection that can provide scalable bandwidth capacity as the demand for usage grows. PLS estimated that it would incur the following costs in bringing fiber to these libraries:

1. Total fiber to each of the 33 libraries = (This figure includes the cost of deploying fiber and the additional electronics at the head-end)	$495,000[6]	($15,000 average)
2. Total Equipment to each library = (This equipment is for the Local Area Network)	$202,000	($6,121 average)
3. Installation support/Project management =	$145,000	($4,394 average)
Total One-Time Deployment Cost =	**$842,000**	**($25,515 average)**
4. Maintenance on equipment =	$60,000	($1,818 annual average)

B. Santa Clara Library System

Just last week, the Santa Clara Library System approved a plan to deploy fiber to eight libraries in its system (see Attachment B). The Santa Clara Library System consists of 7 large libraries and one small branch library with approximately 350 public access computers. The System encountered severe congestion in its network and determined that it needed to transition all of its 8 libraries to fiber to accommodate existing and future demand. Since 7 of the 8 libraries already had fiber nearby, AT&T has proposed to charge the Library System for installing only one new fiber connection for an up-front cost of $53,000. However, an additional $404,000 will be needed to cover

[6] AT&T initially provided this estimate of the cost of providing fiber to these 33 libraries, but, after the plan was confirmed, AT&T waived these charges and deployed the fiber to these locations at no additional charge.

hardware, routers, network engineering time, bandwidth shaping, and some applications for the 8 libraries (an average of $50,500 per library, which does not include the costs of deploying fiber to the one library).

C. Wisconsin BTOP Application

Wisconsin filed a BTOP application to provide fiber to 467 schools and libraries. The average cost of bringing fiber is $57,707 per location. (additional information on this application is being filed by the Wisconsin Department of Public Instruction in separate comments in this proceeding).

D. ACCESS (Ohio)

All the libraries in Mahoning County, Ohio were connected with fiber by a non-profit consortium of schools called ACCESS. The Library system worked with the schools at the planning stage of mapping so that the fiber would run close to each library. The Library system entered into a 10 year flat rate contract with the non-profit that provided a dedicated fiber strand for library purposes. ACCESS covered the cost to bring fiber to the building. The Library only pays from the termination point into the building.

ACCESS recently added two additional library branches to the fiber network. ACCESS charged based upon the length of the fiber run from the library to their network. The cost for connecting East was $5,200 (which is about ½ mile from the nearest fiber at East High School) and the cost for connecting Newport was $8,500.

E. West Virginia BTOP Application

In August, the State of West Virginia filed a Middle Mile BTOP Application with the National Telecommunications and Information Administration (NTIA). The West Virginia

Statewide Broadband Infrastructure Project proposes to build a middle mile network over Microwave and Fiber technology. The proposed network will provide a fiber backbone to community anchors, including schools, libraries, hospitals, public safety agencies and jails. This middle mile solution is intended to push fiber into parts of the state where there is none, thus creating the opportunity for the build-out of broadband to homes, businesses, and other public institutions currently without access.

The West Virginia application provides specific estimates of the cost of building out fiber to 471 schools, 184 health care locations, 176 libraries, and 233 other anchor institutions (public safety answering points, courthouses, jails). The application proposes to deploy fiber to a total of 1054 sites at an average cost of $80,191 per location. (see Attachment C)[7] While this figure is somewhat higher than the costs in other states, West Virginia's mountainous terrain is likely to mean that its costs are higher than the national average.

F. Tennessee

The State of Tennessee recently engaged with AT&T to provide fiber connections to several libraries across the State under the State's NetTN Contract. AT&T's proposed "special construction" charges to cover its costs of deployment range from a low of $2,600 to a high of $83,000 per location. The total of all special construction charges will come to $1,172,750 for 30 sites, an average of $39,092 per site. Tennessee will be seeking negotiate with AT&T in the hope that at least some of these charges will be waived. In addition, each library will pay a one-time charge of $950 under the State's NetTN contract with AT&T to cover the library's costs of a

[7] The West Virginia BTOP application is available at http://www.recovery.wv.gov/Documents/BTOPSubmission.pdf.

new router, LAN interface and connection to a 10 Mbps circuit over the fiber cable. The libraries will not incur any additional upfront costs for this connection. However, the libraries will pay a monthly recurring fee of $1495 for the 10 Mbps circuit.[8]

VI. Models for Fiber Deployment to Anchor Institutions.

While the Public Notice did not ask about the methods of deploying fiber to anchor institutions, it is worth noting that there are several models for doing so:

A. State Research and Education Networks (such as MERIT in Michigan) often build and own their own fiber backbone networks and then extend additional fiber off the backbone network to reach anchor institutions. Because they are non-profit entities, they may only charge the anchor institutions for their actual costs of providing service and thus they can flow through the cost efficiencies (and lower monthly rates) of fiber technology directly to the anchor institution.[9]

B. Rather than building their own networks, some state or municipal entities will contract with a commercial provider. The Ohio Public Library Information Network (OPLIN) is an example of a statewide provider that leases and manages a physical network connecting libraries to the Internet. OPLIN has already transitioned its main libraries (not branch libraries) to fiber-based "Ethernet" circuits. OPLIN obtains most of its broadband connections from AT&T and other commercial providers who are under contract with the State. Because the State aggregates the traffic and the provision of service, the commercial providers are able to offer lower rates for the fiber connections than if the libraries pursued their own individual fiber connections.[10]

C. Another model is a public-private partnership. Although there are many examples of this model, one such example involves MCNC in North Carolina. MCNC is a broadband provider that has operated the North Carolina Research and Education

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[8] Information about Tennessee's Broadband efforts can be found at www.nettn.org.

[9] See, www.merit.edu.

[10] See, www.oplin.org.

(NCREN) for over 25 years. MCNC has submitted a BTOP application in which it proposes to share use and ownership of the fiber build between anchor institutions and the private sector. The "public" portion of the network will connect community anchor institutions (schools, community colleges, other institutions of higher education, and community support organizations) in rural North Carolina to the existing NCREN. The second portion of the network will be leased to private-sector middle-mile operators and wholesalers who will provide wholesale-priced access to middle-mile bandwidth to ILECs, CLECs, MSOs, wireless ISPs, energy cooperatives, and independent and cooperative telecom companies.[11]

D. A fourth approach can involve a local government that contracts with a private sector company to deploy fiber to the anchor institutions. Again, there are several examples. In one, a group of community institutions in Beaver County, Pennsylvania formed the Beaver County Fiber Network Consortium, which contracted with a private fiber builder (Sunesys, LLC) to design, build and maintain a gigabit fiber optic network connecting all twenty School Districts, eleven libraries, thirteen county government buildings and multiple enterprise businesses throughout the county with over 125 miles of fiber.[12] In another case, Scott County, Tennessee (an Appalachian County in Eastern Tennessee) worked with Education Networks of America (ENA) to acquire a fiber-based wide area network providing 10 Mbps to 100 Mbps connectivity to 7 schools in the Scott County Schools System.[13]

E. Finally, the Government of New Zealand has taken a more creative approach that is worth considering – creating a new national government-owned investment corporation to partner with commercial providers to deploy "dark fiber" to anchor institutions. The New Zealand communications ministry has proposed a NZD 1.5 billion broadband investment initiative to roll out ultra-fast broadband to 75 percent of New Zealanders over ten years, concentrating in the first six years on businesses, schools and health services. The government plans to establish a Crown-owned investment company, Crown Fibre Holdings, to carry out a partner selection process and manage the investment in fiber networks. Crown Fibre Holdings will establish a commercial vehicle, a Local Fibre Company (LFC), with each partner to deploy fiber

[11] See, www.mcnc.org.

[12] See, www.sunesys.com.

[13] See, www.ena.com.

network infrastructure and provide access to dark fiber products and, optionally, certain active wholesale Layer 2 services.[14]

VII. Conclusion

The SHLB Coalition appreciates the FCC's interest in promoting the deployment of fiber to anchor institutions and is ready and eager to work with the Commission in pursuing this goal in its national broadband plan.

Respectfully Submitted,

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[14] See, http://www.beehive.govt.nz/release/ultra-fast+broadband+investment+proposal+finalised.

ATTACHMENT A

FCC NETWORK DIAGRAM

ATTACHMENT B

SANTA CLARA LIBRARY SYSTEM

ATTACHMENT C

EXCERPTS FROM THE WEST VIRGINIA BTOP APPLICATION