Maximizing K-12 Fiber Connectivity Through E-Rate: An Overview

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An evaluation of self-construction, dark fiber, and lit fiber options for school districts following recent enhancements to E-rate

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CONTENTS

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An evaluation of self-construction, dark fiber, and lit fiber options for school districts following recent enhancements to E-rate

"E-rate is the nation's largest education technology program, and it has helped to ensure that almost every school and library in America has basic Internet connectivity. In the 18 years since E-rate was established, technology has evolved, the needs of students and teachers have changed, and basic connectivity has become insufficient. That's why, last year, the FCC took steps to reboot and modernize how we connect our schools, libraries – and most importantly, our students – to 21st century educational opportunity. We improved the program's cost-effectiveness, set specific, ambitious goals for the broadband capacity delivered to schools and libraries – a short term target of 100 Mbps per 1,000 students, and a longer term target of 1 Gbps per 1,000 students – and re-purposed funding for Wi-Fi and robust broadband connections capable of supporting cutting-edge, one-to-one digital learning. These reforms will only have their intended impact if schools and libraries step up to take advantage of new opportunities."

—FCC Chairman Tom Wheeler, May 2015

Executive Summary

Schools across the country are feeling the bandwidth crunch. Demand for bandwidth is increasing rapidly, and many schools are faced with the dilemma of choosing between insufficient bandwidth and prohibitively expensive rate increases to meet their bandwidth needs. In 2014, the Federal Communications Commission (FCC) sought to help schools facing the connectivity dilemma by overhauling its subsidy program designed to help schools and libraries acquire high-speed Internet access (commonly known as "E-rate").

Many facets of the program were modified, including an increase in the amount of yearly funding from $2.4 billion to $3.9 billion and expanded funding eligibility for different types of fiber services. Beginning in 2016, E-rate applicants are able to seek E-rate discounts for dark fiber and self-provisioned fiber (lit fiber services remain eligible), giving schools greater flexibility in how they are able to meet their connectivity needs.

Fiber is generally accepted to be the only communications medium that can meet the bandwidth needs for all but the smallest school systems, but how schools acquire fiber connectivity in the most cost-effective manner will depend on the unique circumstances of each district.

The FCC's expansion of the E-rate program to include support for different fiber network architectures gives schools the opportunity to decide for themselves how to best meet their connectivity needs, whether through lit, dark, or self-provisioned fiber services. Deciding what is best for each school system will depend on a broad range of considerations and an array of factors that must be balanced. This toolkit is intended to help simplify the E-rate program for school administrators and clearly lay out how school systems should evaluate what opportunities are available.

Introduction

The growth of digital tools available to K-12 educators has created new ways for students to learn. Many of these tools require a robust high-speed Internet access network. Simply put, having high-quality Internet access is fast becoming a necessity for schools to educate their students and prepare them for college and the 21st-century economy.

Unfortunately, schools are feeling a bandwidth crunch. Due primarily to the increases in bandwidth needed and the costs to increase bandwidth, many schools are stuck between insufficient connectivity and prohibitively expensive rate increases. A recent survey of school district technology officers conducted by CoSN reported that 68% of participants felt that their districts did not have the bandwidth to meet their district's needs through the next 18 months.[1] Of the many reasons that administrators did not think their districts could meet those needs, the high cost of connectivity was the most common.[2] The FCC's 2015 *Broadband Progress Report* found that 35% of public K-12 schools did not have access to fiber optic networks (commonly referred to as "fiber"):[3] "K-12 bandwidth demand is currently growing at a rate of more than 50% per year, with the highest growth rates occurring in districts that have deployed 1:1 device programs, Bring Your Own Device strategies and robust Wi-Fi networks. This significantly outpaces the natural rate of price deflation in the broadband market."[4]

The potential educational benefits[5] and cost savings fiber can provide are tremendous. For many school systems, fiber is the only cost-effective way to provide the bandwidth that can deliver the type of high-speed connectivity that these educational tools require. Fiber's bandwidth scalability is unparalleled.

The recent E-rate rule changes give schools even greater flexibility in choosing how to acquire fiber connectivity. Lit fiber services were already E-rate eligible, but the expanded funding eligibility to dark fiber and self-provisioned fiber gives schools the chance to explore a broader array of options, which can lead to large cost savings. Depending on the characteristics of the school district, schools could be eligible for E-rate subsidies for up to 90% of the cost to bring high-speed Internet access into a school system.[6]

If schools do not plan carefully, administrators may face extraordinary connectivity costs in order to meet their bandwidth demands.[7] Additionally, cost

With diligence, schools can maximize the connectivity benefits and cost-savings of fiber and prepare for any situations that may arise.

run-ups due to construction delays or unexpected network maintenance[8] can hit an unprepared school system with significant expenses.

With diligence, schools can maximize the connectivity benefits and cost-savings of fiber and prepare for any situations that may arise. Acquiring considerable amounts of subsidized funding is an attainable goal for even smaller-size districts.

However, it is important to understand and adhere to E-rate rules in order to ensure an application for reimbursement is not delayed or denied. Thus, it behooves administrators to carefully consider the factors that may affect the cost, feasibility, and suitability of a proposed plan.

Determining the optimal solution is largely dependent on the individual circumstances of each school system. What makes economic sense for one district may not be a cost-effective option for a different district. Thus, this toolkit will not be able to provide definitive answers; instead, it will provide a comprehensive overview of the many important factors that go into a decision whether to pursue lit, dark, and/or self-provisioned fiber services. As school districts embark on their individual applications, the advice and expertise of third-party consultants may be necessary or advisable.

This toolkit is organized into three parts. Part One gives an overview of the E-rate program and the types of E-rate eligible fiber, including corresponding case studies detailing particular districts' circumstances, highlights, and results. Part Two provides an overview of considerations that need to be taken into account as schools assess their options, including an additional case study depicting how E-rate reimbursements for a school district fiber "self-build" could aid a wider fiber buildout. Part Three concludes with a call to action for school leaders who wish to leverage the billions of dollars available for their districts.

A final flowchart categorizes and describes key resources that may be useful for administrators. These resources range from topics such as network design and bandwidth estimations, to E-rate application information and examples of requests for proposals. Some resources will be helpful for answering questions in Part Two, while others will provide greater detail about the E-rate program and later stages of the application process.

In 2014, the FCC overhauled its E-rate subsidy program designed to address increasing growth in schools' demand for bandwidth and the high cost of meeting this growing demand.

Understanding the Basics: The E-Rate Program & Eligible Fiber

E-Rate Overview

E-rate is the commonly used name for the Schools and Libraries Program, one of four programs of the Universal Service Fund. Initially adopted by the FCC in 1997, E-rate is designed to expand and improve broadband Internet access for schools and libraries.[9] At its most basic level, the E-rate program provides subsidies to help schools afford Internet access, provided the schools meet application requirements (which are intended to ensure that funds are used in a cost-effective manner). The Universal Service Administrative Company (USAC) administers the applications and funding on behalf of the FCC (under the FCC's guidance).

In 2014, the FCC overhauled its E-rate subsidy program to address increasing growth in schools' demand for bandwidth and the high cost of meeting the growing demand. The FCC's E-rate modernization orders[10] changed many elements of the E-rate program, and included an increase in the annual funding cap from $2.4 billion to $3.9 billion.[11]

There are two principal components to a fiber network that are relevant for E-rate purposes:

- **Internet access** – the network connection between a school and an Internet Service Provider. Individual schools may each have a separate Internet connection, or a whole school system may connect to the Internet through a single Internet access point (also known as a "hub").

- **Wide Area Network (WAN)** – the network connections *between* the buildings of a school system. Both internal network data *and* Internet connectivity can pass through a school system's WAN (such as when a district hub is used to distribute Internet connectivity).

The E-rate modernization orders serve a few different purposes. First, they update the bandwidth targets both for Internet access and WAN. The "short term" target for Internet access is 100 Mbps[12] per 1,000 students, and the "long term" is 1 Gbps[13] per 1,000 students.[14] The WAN bandwidth target is currently 1 Gbps scalable to 10 Gbps per 1,000 students. For multi-school districts, the targets represent averages of all district schools so districts have flexibility to allocate bandwidth where it is needed (such as a high school needing more bandwidth than an elementary school).[15]

Beginning in 2016, E-rate applicants will have the opportunity to receive funding for dark fiber if it is shown to be cost effective when compared against the price of available lit fiber.

The second goal was to readjust funding priorities and increase the total funding available. As such, funding for certain legacy and voice services shifted towards high-speed broadband and wireless networks, and the total funding available for E-rate increased to $3.9 billion (indexed for inflation). This funding is split between two services eligible under the E-rate program: Category One or Two Services. "[Category One Services are] the services needed to support broadband connectivity *to* schools and libraries… and those needed for broadband connectivity *within* schools and libraries [are category two services]..." (emphasis added).[16]

In short, Category One includes the services and equipment needed to bring Internet access to schools and to create a WAN, along with reduced levels of funding for some voice services.[17] Category Two includes the services and equipment necessary to create a local area network (LAN) or wireless LAN (WLAN), along with equipment needed for caching.[18]

Of the $3.9 billion available, $1 billion is allocated for Category Two services, but if demand for funding for Category One services exceed expectations, Category Two funding will be reallocated for Category One funding.[19] Category One services also includes a subdivision of eligible costs, collectively known as "special construction." "Special construction" is defined as "the one-time costs of physically deploying new or upgraded network facilities and the services required to complete the deployment..."[20] It is limited to the "construction of network facilities, design and engineering, and project management."[21] Special construction is applicable to lit fiber, dark fiber, and self-construction.

The third goal was to create parity in funding between lit fiber and dark fiber, while also allowing schools and libraries to engage in self-construction projects when they are the most cost-effective option. Beginning in 2016, E-rate applicants will have the opportunity to receive funding for dark fiber if it is shown to be cost effective when compared against the price of available lit fiber services. To demonstrate cost-effectiveness of a dark fiber proposal, applicants must account for equipment and maintenance costs when comparing the proposal with lit fiber bids. Dark fiber applicants and self-construction applicants must seek bids for lit fiber services, but lit fiber applicants are not required to seek bids for dark fiber services or self-construction.

Lit, dark, and self-provisioned fiber

Fundamental to the new E-rate rules are the FCC's distinctions among lit fiber, dark fiber, and self-provisioned networks. Each of these terms refers

to a different way that schools are able to access the Internet.

- **Lit fiber**, at its most basic level, refers to a service model where the school neither controls the fiber network nor is responsible for the operations and maintenance (O&M) of the network.

- **Dark fiber** refers to a service agreement where the school leases unused fiber from a provider, constructs a fiber line that connects the leased fiber to the school, and attaches the equipment needed to use the fiber to communicate. Depending on the contract with the provider, schools may be responsible for the O&M of the leased fiber, but schools are generally responsible for the O&M costs for the fiber they own.

- **Self-provisioned networks** (which is also referred to as "**self-construction**") refers to those situations when a school builds a new fiber network without the use of existing fiber optic cables. The school owns the network, and thus it is responsible for the O&M costs.

A district may utilize a mix of lit, dark, and self-provisioned services to connect its schools.

The touchstone for E-rate applications is *cost-effectiveness.* How schools allocate costs depends on the type of fiber service being used. The up-front costs ("capital expenditures") associated with dark fiber and self-construction projects can be far greater than for lit fiber due to construction costs. On the other hand, lit fiber services generally have higher recurring costs ("operating expenditures") over time than dark fiber or self-construction because providers build O&M costs into the recurring fees charged to provide service. Self-construction of a fiber network likely will require the largest up-front capital expenditure compared to similar lit and dark fiber services. O&M costs of a fiber network can be very expensive if a fiber line is cut or needs to be relocated. Schools can mitigate this risk through agreements with third-party contractors to maintain fiber networks.[22] The cost of scaling up the bandwidth of a network can vary dramatically based on the type of service provided. Increasing the bandwidth for a dark fiber or self-constructed network may trigger little to no extra cost, whereas an increase in bandwidth from a lit fiber service provider may be expensive or infeasible (such as if the network is already at capacity).

In addition to differences in cost, fiber services vary in their complexity. Lit fiber services are typically the simplest projects, dark fiber builds are more

complex, and self-provisioned builds are generally the most complex. Applying for E-rate funding for dark fiber and self-construction is also more complex. Schools must provide greater amounts of information to receive funding.

Lit fiber

Schools most typically utilize fiber through lit fiber services. Under this model, schools connect to a provider owned and operated fiber optic network and the provider manages the operations and maintenance of the network. Schools pay a recurring fee (typically monthly, biannually, or annually) for Internet services and network transport costs. Providers may be willing to foot the cost (or a portion of the cost) of connecting the school to the fiber network (this is referred to as "special construction" in the E-rate program). The connection costs necessary to connect the school to a lit fiber network are eligible for E-rate funding. The per megabit cost of Internet access and Wide Area Networks (WANs) (described in the next subsection) can vary widely depending on the market, the capacity of the network, and the amount of bandwidth desired. Generally, per megabit costs will decrease as the bandwidth increases, but as schools' high-quality Internet access and WAN needs increase, the per megabit cost increase may not scale accordingly.

:: CASE STUDY

Bartholomew Consolidated School Corporation and competing lit fiber services

In 2002, economic leaders in Columbus, Indiana identified a need for a robust fiber backbone that could serve the various technology needs of the community. Identified users of this fiber backbone included the various manufacturing and process industries located in the city, technology-based enterprises, the community's health care system, governmental services, and the K-12 and post-secondary education communities.

Ultimately, the community settled on a model that involved created a network of conduit through the city and leasing this to a communications company that then populated the conduits and sold both lit and dark fiber to subscribers. This fiber network became active in 2008. The competition created by this service resulted in significantly lower costs to the community with a much lower level of risk.

Bartholomew Consolidated School Corporation (BCSC) operates 19 instructional facilities and three administrative buildings in Bartholomew County. The district's footprint is over 330 square miles with some schools as far as 16 miles from the center of the district. In 2005, the district connected all of its buildings using a 100 Mbps managed Ethernet service. When BCSC re-bid the fiber network in

The use of managed lit fiber resulted in an effective solution requiring very little commitment of human resources to manage the network.

2010, the competition created by the city network resulted in a lit service being available that *was 10 times faster at costs that were 5% below the 2005 prices.* For BCSC, in this competitive context the use of managed lit fiber resulted in an effective solution requiring very little commitment of human resources to manage the network. This solution avoided the cost and financial burden that would have been required had BCSC chosen to construct its own fiber network.

Dark fiber

Beginning in 2016, E-rate funding is available for schools to acquire dark fiber for Internet access and WAN connectivity. Dark fiber's general definition is fiber optic cable that is not currently being used. Schools can lease dark fiber through a contract called an *indefeasible right of use agreement* (IRU). An IRU basically gives a school the right to use fiber optic cable and/or the fiber conduit owned by a provider. Schools must furnish the necessary equipment to "light" the fiber and connect it to the school network. IRU terms are generally for twenty years. IRUs may place the responsibility for operations and maintenance of the fiber on the owner or on the purchaser. E-rate funding is eligible for O&M service contracts for schools that do not wish to operate or maintain the fiber themselves.

Schools will likely need to build a fiber connection between the dark fiber and the school building. IRU agreements may include a significant up-front payment, along with recurring payments over the life of the IRU. Both the up-front costs and recurring costs are E-rate eligible. Over the life of an IRU agreement, the total cost of using dark fiber *may* be less expensive than an equivalent lit fiber service.[23] When schools apply for E-rate funding for a dark fiber project, applications must consider the cost of the IRU, an O&M agreement, the necessary equipment, and any construction costs.

Dark fiber provides some distinct advantages over using a lit service. The cost of scaling the WAN bandwidth will typically be much lower with dark fiber because districts can increase the WAN's bandwidth from 1 Gbps to 10 Gbps for only the cost of upgrading the modulating equipment on the ends of the fiber optic cables. The equipment cost for a ten-fold increase in bandwidth can be offset in a relatively short period of time when compared to a similar increase in bandwidth for lit services. Moreover, fiber optics equipment is continually improving, so even higher data rates can be expected in the future (while using the same fiber optic cables).

Dark fiber presents some disadvantages as well. The technical issues of setting up and managing a fiber optic network can be both difficult and costly. Lit fiber service providers can manage these tasks for the school so that administrators can focus on education. Depending on the type of IRU, however, schools may be responsible for operations and maintenance costs, which can be both unexpected and very large. While lit fiber may be more expensive in the long run, its cost may be more predictable, provided a competitive market for lit fiber exists where the school is launched.

:: CASE STUDY

Township High School District 214's leased fiber WAN

Located twenty-five miles from Chicago, Township High School District 214 (District 214) is the second-largest high school district in Illinois, serving approximately 12,000 students.

As District 214 was scaling up their 1:1 deployment of mobile devices, they were pushing the limit of their network. In order to accommodate the additional bandwidth needed to support 13,000 mobile devices, the district knew it had to expand its capacity from 1 Gbps to 10 Gbps.

District 214 increased its capacity by installing a 10 Gbps leased fiber optic WAN. The fiber WAN was made affordable through E-rate subsidies. The cost of the new fiber WAN is less than what District 214 was paying for its 1 Gbps WAN from a Network Service Provider.

The leased fiber WAN gives District 214 the ability to make configuration changes without having to wade through red tape with a Network Service Provider, which at times would take many weeks. The leased fiber WAN has the ability to scale to 100 Gbps and beyond in the future by adding different optics to the network.

In addition to the new fiber optic WAN, a leased fiber optic link to an Internet Exchange Point was provisioned. This provided a 10 Gbps Internet connection at a very cost-effective price. Being connected to an Internet Exchange Point gives the district the ability to choose among hundreds of Internet Service Providers in the future that reside at the exchange. They now have the capacity and flexibility to provide their staff and students with a reliable network to support digital-age learning.

Self-provisioned fiber

The final available type of service eligible for E-rate funding is self-construction. As the name would imply, the fiber network is built and run by the school. There are a few principal differences between self-provisioned and dark fiber. Dark fiber IRUs typically have 20-year terms, and so while a district will retain the right to use the fiber for an extensive period of time, control will eventually

The FCC is looking for a demonstration that building a fiber network is going to show a return on investment within about ten years.

revert back to the owner of the fiber. If the school must build extensively to connect its buildings to the dark fiber network, the 20-year term may not be long enough to justify the expense. Also, while dark fiber generally includes a yearly maintenance fee, self-provisioning requires schools to seek out a contractor to perform this maintenance (if the school chooses to do so). Lastly, unlike dark fiber, additional fiber strands can be added to the self-provisioned network when it is built, which can be owned by the school or another party (such as the district's city).[24]

Self-construction involves the highest amount of initial capital expenditures. Lit and dark fiber options likely involve some construction, but not to the extent that a self-provisioned network would. The logistics of self-construction are likely the most complicated, and failing to account for every important consideration could delay construction, cost the school district large sums of money, or cause the application to be denied. When E-rate applications are evaluated, cost-effectiveness is the principal concern (but not the only one). The FCC is looking for a demonstration that building a fiber network is going to show a return on investment within about ten years (there is no brightline rule), but various affiliates with the program have indicated anywhere between 8-12 years is the range that needs to be considered. Like both other fiber services, construction costs related to bringing fiber to a school building are E-rate eligible. O&M contracts are covered as well. E-rate funding is not available for schools hiring staff to manage the O&M of the fiber network.

Self-provisioning gives schools the most flexibility in operating and maintaining their networks. Like dark fiber, self-provisioned fiber offers the scalability, reliability, and security benefits that come with controlling a network. Self-construction has the added benefit of giving a school the opportunity to allow other entities to add their own fiber strands and build additional fiber connections off of the school-owned fiber network. The inclusion of additional entities help schools mitigate the high up-front expenses and complexities.

:: CASE STUDY

Albemarle County Public Schools' Self-Provisioned Fiber Buildout

The digital transformation of education has put extreme pressure on the bandwidth needs of schools across America. Albemarle County Public Schools (ACPS) certainly felt the squeeze, with both internal network and Internet bandwidth demands exceeding its capacity to meet those demands. Located in the Piedmont region of

One of the principal reasons for the shift in the E-rate rules towards fiber is that only fiber networks can provide the bandwidth needed at a feasible $/Mbps ratio.

Virginia, ACPS spans 726 square miles and 30 school buildings, with a mix of primarily rural but also suburban and urban settings.

When ACPS approached its service provider with a proposal to increase its Internet connection bandwidth from 100 Mbps to 1 Gbps and its WAN bandwidth from 1 Gbps to 10 Gbps, *its annual cost was estimated to increase from $208,000 to $1.2 million.* ACPS began to investigate other possible alternatives to not only meet its current demands but potentially future-proof the network. Based on the cost structures of lit service providers and its anticipated bandwidth demands, ACPS concluded that it was a prudent business decision to begin construction of a 100-mile, school-owned fiber optic network.

The recent changes in the E-rate program have allowed ACPS to accelerate its construction process, bringing broadband connectivity to all 30 locations within the 726-square-mile school district. This increased network bandwidth, coupled with its low cost, has allowed the district to bolster Internet access from 200 Mbps to 2 Gbps.

Important Considerations

Cost Comparisons, Scalability, and Aggregation

When comparing different options for increasing connectivity, a useful ratio to use is the dollar cost per megabit of service. For example, spending $100 per month for 20 megabits per second Internet service has a ratio of $5/1 Mbps. This ratio is also useful for comparing costs over time based on anticipated increases in bandwidth needs.

That said, as Internet and WAN bandwidth increase, the $/Mbps ratio will typically decrease – sometimes dramatically. In one study performed by CoSN and Education SuperHighway, it was estimated that 100 Mbps of Internet access costs $15.41/Mbps per month, $4.37/Mbps per month for 1 Gbps, and $2.32/Mbps per month for 10 Gbps. It is anticipated that the FCC's bandwidth goals for schools can be met once districts reach an average price of $3/Mbps. One of the principal reasons for shift in the E-rate rules towards fiber is that only fiber networks can provide the bandwidth needed at a feasible $/Mbps ratio.

For districts exploring different fiber options and providers, it is important to consider the scalability of the network. Scalability refers both to the cost of increasing the bandwidth of the network and to the

availability of bandwidth. In CoSN's annual survey of district leaders, nearly half (46%) felt that the monthly recurring cost for Internet access prevented the district from increasing its bandwidth. 14% of rural respondents reported that their ISPs were at capacity.

School bandwidth demands are growing at a rate of over 50% per year, with the highest growth rates seen at schools implementing 1:1 and BYOD initiatives. An assessment of which fiber service will best serve the needs of a school district should account for this growth in demand. Additionally, USAC's evaluation of a school's E-rate application may look to neighboring, similarly-situated districts to see how an applicant's $/Mbps ratio compares.

Just as fiber typically yields the most cost-effective $/Mbps ratio for a district, aggregating demand can further drive down the cost for Internet access. One method for a single district to accomplish this is by connecting all buildings to a district hub (via the district WAN) and connecting the hub to an aggregation point, such as a Point of Presence (PoP) or Research and Education Network (REN).
By connecting to a PoP, the district will be able to access multiple Internet service providers, which typically results in a lower $/Mbps than by utilizing a dedicated service provider. Similarly, a REN functions like a PoP, but is dedicated to research and education communities.

Whether a school system should pursue lit, dark, or self-provisioned fiber will depend on the unique circumstances of each district. The most cost-effective method for connecting a school system's individual buildings to each other and to the Internet will vary depending on the characteristics of the district. Some districts may use a single building as a hub to an Internet PoP, whereas others may create a ring, and others may not connect directly to one another.

For many districts a REN, an intergovernmental cooperative network, or a PoP, can provide access to many Internet service providers as well as virtualized software, storage, and network services. If schools can connect to the Internet at an aggregation site such as a REN or PoP and then distribute Internet access through a WAN, the cost to connect a school system to the Internet can be decreased. Depending on the types of technologies utilized by the school—for example, whether teachers or students are using high-definition video for instruction purposes, or whether the school uses education applications can be cached locally on school servers—the bandwidth needed for Internet access and the WAN may vary.

As school systems transition to 1:1 and BYOD programs, demand for network bandwidth will likely approach 60% year-over-year growth.

As school systems transition to 1:1 and "Bring Your Own Device" programs, demand for network bandwidth will likely approach 60% year-over-year growth.[25] The E-rate program placed new bandwidth targets of 100 megabits per second (Mbps) per 1,000 users (students and staff) for Internet access, and of 1 gigabit per second (Gbps) per 1,000 users for a district WAN.

Cost-effectiveness

The touchstone of evaluating E-rate is cost-effectiveness. While it does not have to be the only factor considered, applicants must weigh the cost category more heavily than any other single factor. Applicants who seek funding for dark or self-provisioned fiber must also request bids for lit services (even if no lit service providers are currently in the applicant's area). When evaluating the cost of dark or self-provisioned fiber compared to lit services, applicants must consider the total cost of ownership of the fiber buildout. This includes but is not limited to: the costs associated with any fiber construction; the IRU (for dark fiber); Internet access; O&M; and equipment replacement. Only E-rate eligible expenses will be considered in the evaluation of an application. Applicants must request bids for lit services, even if they do not expect any bids.

Applicants have some flexibility when deciding over what time period cost-effectiveness will be evaluated. USAC has stated that it should be "a reasonable, defensible period of time for the comparison, based on the anticipated use of the assets." Applicants should also consider their projected demand for bandwidth over their determined time period and how costs will be affected.

2016 is the first year in which self-provisioned fiber buildouts are E-rate eligible, and so there is very little publicly available information or precedents regarding application outcomes for self-provisioned fiber builds. USAC, the FCC subsidiary that manages E-rate applications and funding, has provided some guidance on cost-allocation for a consortium of E-rate eligible and ineligible entities. The general rule of thumb is that costs that are necessary for the construction and delivery of services to E-rate eligible entities are E-rate eligible costs. "Excess capacity" of a fiber network may not be sold by an E-rate recipient.

Attorneys at the Wireline Competition Bureau have clarified the FCC's stance on cost-allocation for self-provisioned networks. Allocating cost between eligible and ineligible entities is best done by determining the total cost of a fiber build, and then separating the portions that are E-rate eligible from the total cost. The basic cost allocation model divides

the number of E-rate eligible locations by the total number of locations connected to the fiber network – this percentage is the portion of the total cost of the fiber build that is E-rate eligible. Multiply that percentage by the total cost of the build – this is the cost by which an E-rate application will be evaluated.

This cost allocation method assumes that the cost of connecting eligible and ineligible locations is similar. If the cost of connecting eligible locations or ineligible locations is greater (such as when a school district has remote buildings that are farther away than a municipality's buildings), the percentage of the total cost of the fiber network that is E-rate eligible will be greater than in a basic calculation.

Consortia, municipalities, and optimizing cost-effectiveness

The new E-rate rules have made it easier for schools and libraries to bid collectively as a "consortium." Bidding and purchasing as a consortium allows for schools and libraries to drive down the cost of acquiring equipment and services.[26] By applying as a consortium, individual school districts have the opportunity to retain control over their final purchasing decisions while bidding collectively, potentially saving a district both time and money compared to applying separately.[27] Consortia can leverage their constituents' buying power and economies of scale to reduce connectivity costs. State-level consortia can save up to 39% of the cost of Internet access for member districts.[28] Similarly, construction costs for district WANs cost 22% for purchasers of 20 or more circuits when compared to smaller-sized purchasers.[29]

There is no minimum or maximum membership. Consortia can form having only two entities or include schools across a state. While only schools and libraries are eligible for E-rate funding, ineligible entities, such as municipalities and hospitals, may also participate as members of a consortium.

Acquiring services and building out fiber networks are typically less expensive when E-rate applicants participate as part of a consortium. Paired with E-rate's expanded eligibility for different types of fiber services, schools and ineligible entities have the opportunity to aggregate their bandwidth demand and economic resources to acquire fiber connectivity in ways that can create real cost savings for all participants.

The project could provide high-speed connectivity to seven schools and libraries, then potentially save more than $947,000 or eight percent of the cost of public fiber.

:: CASE STUDY

How E-Rate Reimbursements for a School District Fiber "Self-Build" Could Also Aid a Wider Fiber Buildout

Under recent changes to E-rate, school districts may now seek reimbursement for building their own dark fiber networks. With proper planning, such networks can also become a foundation for full municipal or regional buildouts, filling the "Homework Gap" and meeting myriad other municipal needs.

The network maps on the following pages reveal how this might play out for the South Gibson School Corporation, a school district in Indiana. These maps and estimates were generated by a technical consultant. Under a scenario developed by the consultant, the school network, which might be eligible for E-rate reimbursement, could build a network in a way that helps the district's municipalities save more than $947,000—or 8 percent—on a full buildout for residential and commercial Internet access service to more than 5,000 customers.

This potential savings is realized simply by designing the network to serve schools and libraries, then using a higher fiber count strand, thus adding much more fiber along the same network path. The municipalities merely cover the additional cost of the extra fiber strands, which in this case is a relatively inexpensive $41,000.

The district would have to first call for comparative bids for traditional lit service to evaluate against dark fiber and self-construction options. But because the area lacks adequate fiber infrastructure, it is unlikely that private providers would be able to provide "lit" service any cheaper, especially given 20-year planning horizons, according to Raj Singh, CEO of Network Design Decisions, Inc.

In short, E-rate now represents a potentially powerful new tool in planning regional buildouts. Network planners and consultants are already plugging E-rate into financial models and finding it can save significantly on wider buildouts, leveraging public dollars efficiently. Thus, the first step in any school administrator's decision process should be to consult with municipal and county officials—as well as neighboring school districts—to explore how to collaborate and coordinate.

The new subsidy for construction—coupled with E-rate's recent 60 percent expansion, to $3.9 billion from $2.5 billion annually—makes this a significant resource for expanding fiber connectivity nationwide.

This will be especially true in rural areas, which are more likely to lack fiber.[30] Today, 41 percent of U.S. schools have not met short-term goals of

having 100 Mbps bandwidth speeds per 1,000 students, and only nine percent have fiber that can provide 1 Gbps per 1,000 students.

The nonprofit Education Superhighway puts it this way: "Finding and working together with neighboring districts can provide significant benefits. Not only can you share skills and the workload of finding providers, you can also use consortia principles to negotiate better prices for services by purchasing at scale."

To stay most up to date on the E-rate modernization process, visit: http://fcc.gov/E-rate.

IMAGE 1 :: **A SCHOOL DISTRICT IN NEED.** The four towns served by the South Gibson School Corporation in Indiana, have 5,634 homes and businesses. This map shows the location of four schools and three libraries or library branches that are potentially eligible for E-rate subsidies to provide high-speed Internet connectivity.

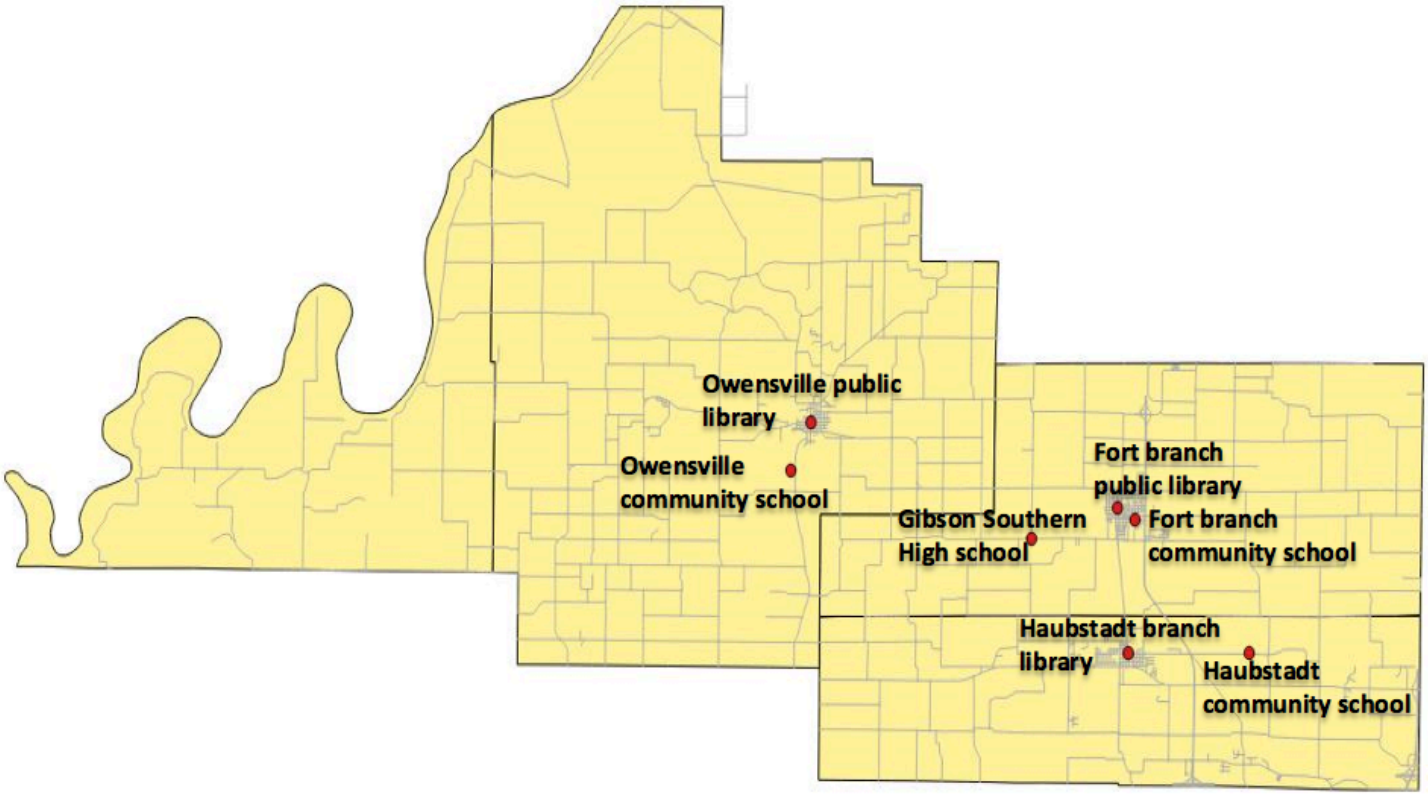


IMAGE 2 :: **A POTENTIAL SCHOOL AND LIBRARY FIBER NETWORK.** Because the rural district has few other options, new E-rate rules might help reimburse the cost of a "self-construction" of 24 miles of fiber to connect these seven buildings. The cost of building eight strands of fiber—enough to serve the schools and libraries—would be $926,000.

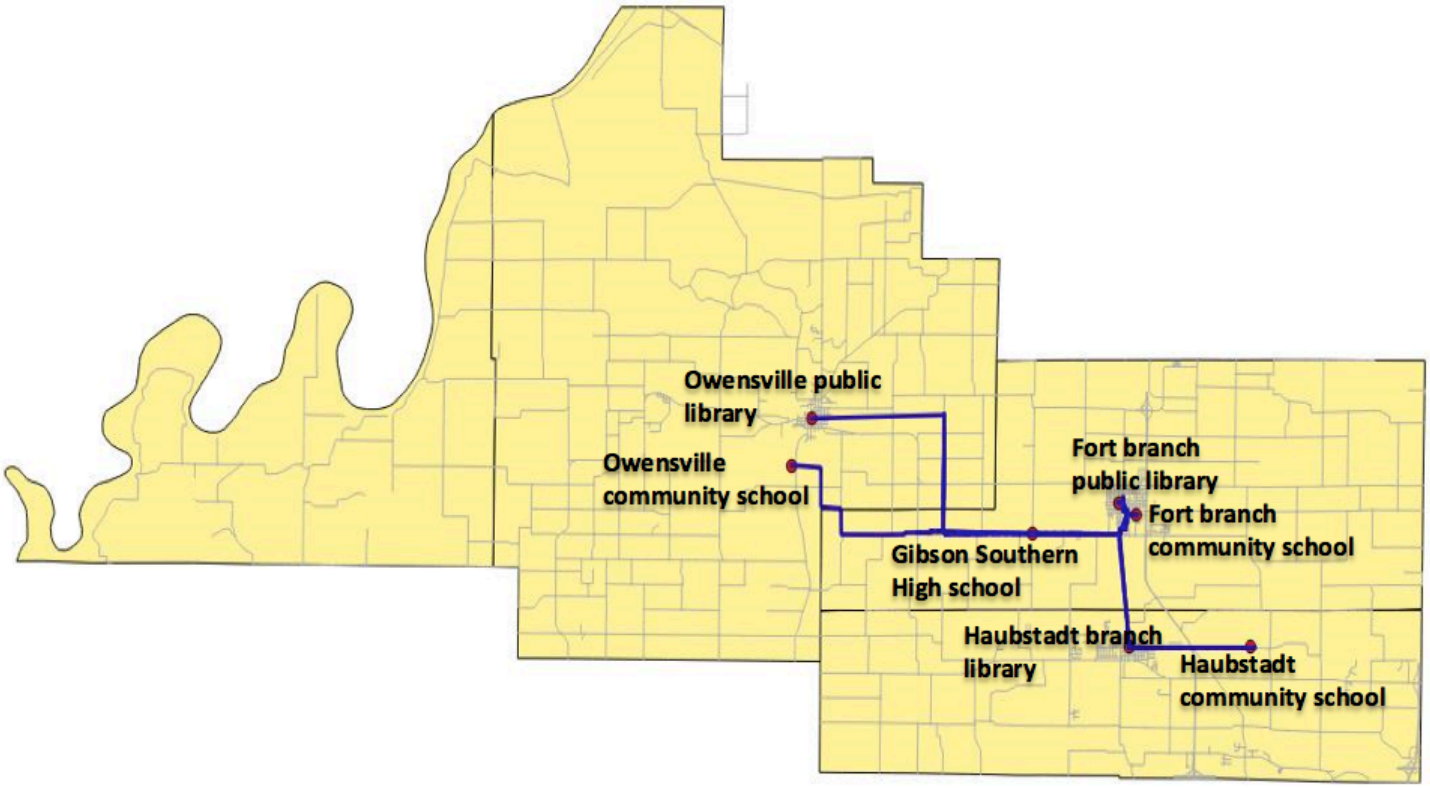


IMAGE 3 :: COORDINATING AND PLANNING AHEAD. Increasing the scope of the project from eight strands to 288 strands (fatter line) would cost only an additional $41,000 in materials, which the municipalities or county could pay to form a portion of a regional public fiber network.

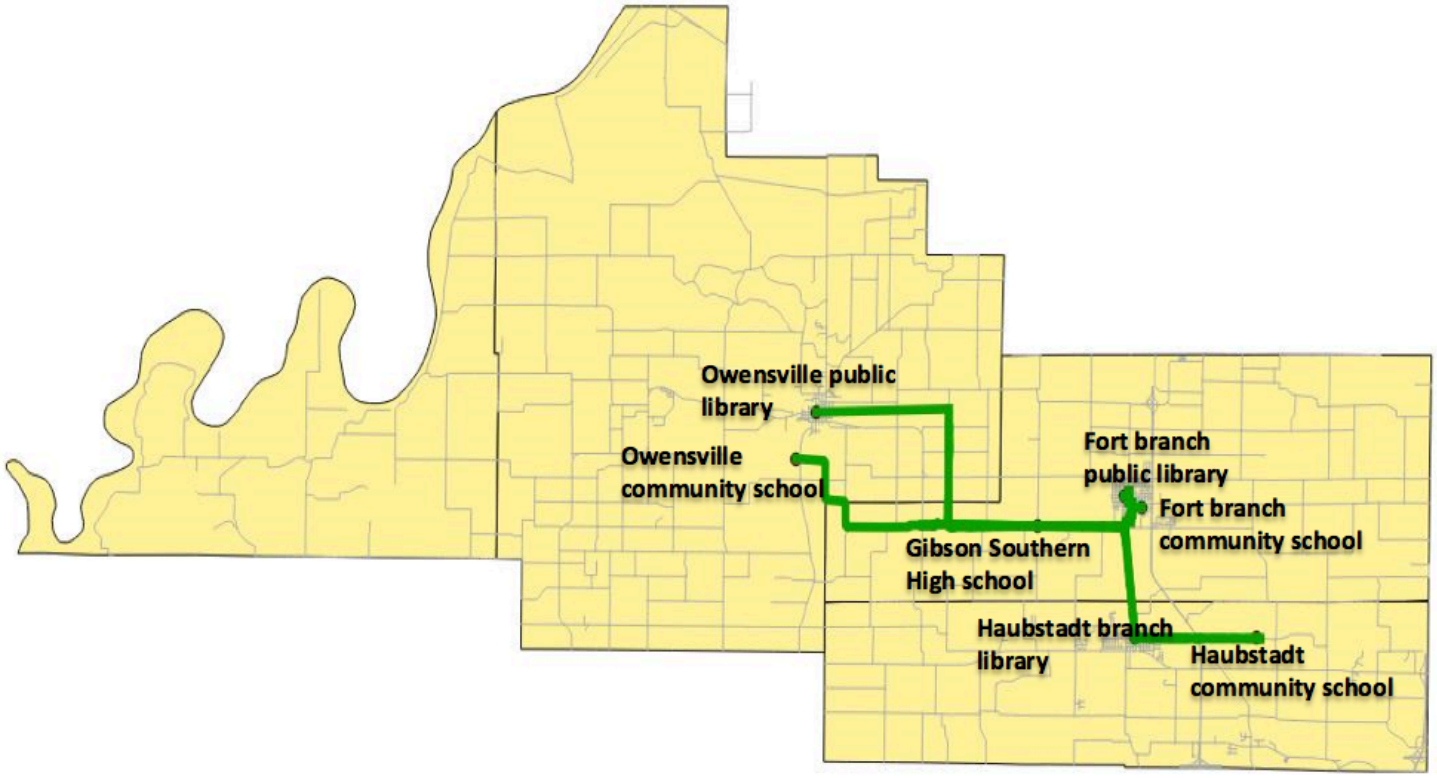
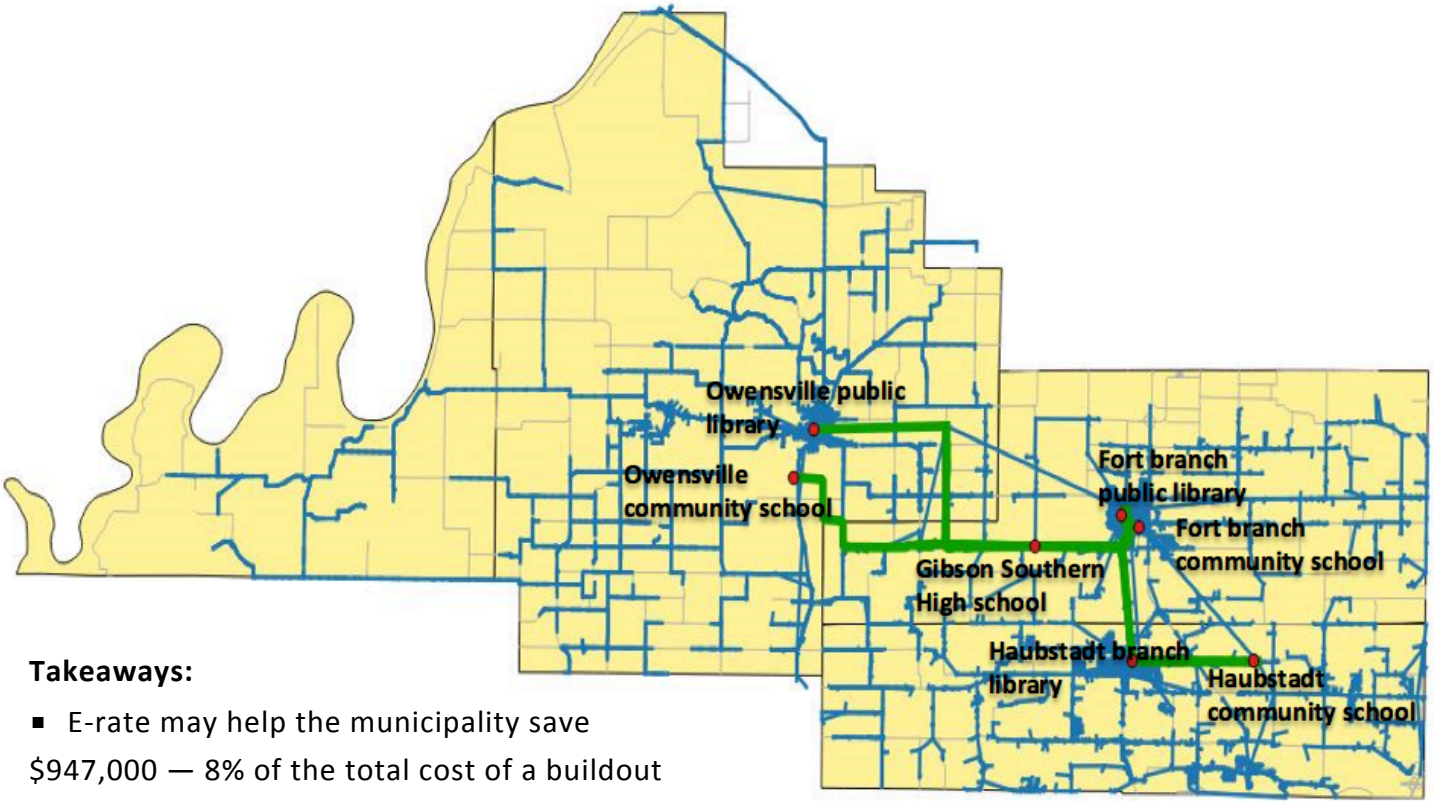


IMAGE 4 :: THE FINAL REGIONAL BUILDOUT. A regional 245-mile network serving 5,634 properties would cost an estimated $11,541,000. With coordinated advance planning between school and municipal officials, the cost of building a 288-strand network throughout the district could be reduced by $947,000—about eight percent of the total cost.



Takeaways:

- E-rate may help the municipality save $947,000 — 8% of the total cost of a buildout
- Current spend on E-rate eligible locations $13,855/mo = 166K/yr
- 20 year business case is allowed for E-rate fiber
- $926,000/20 = 46K/yr. This leaves 120K/yr as budget for bandwidth.

This is a great opportunity for schools that are willing to spend the necessary time investigating what options are available and performing the due diligence before applying.

Conclusion

The FCC's expansion in fiber eligibility has given schools some much-needed flexibility to acquiring high-quality, cost-effective fiber connectivity. Nearly $4 billion in annual funding is available for these expenses. This is a great opportunity for schools that are willing to spend the necessary time investigating what options are available and performing the due diligence before applying.

Acknowledgements

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End Notes

[1] *CoSN's 2015 Annual E-rate and Infrastructure Survey* at 5. *Available at* www.cosn.org/infrastructure2015.

[2] *Id.*

[3] *2015 Broadband Progress Report, 30 FCC Rcd 1375, 1418 at ¶ 57.*

[4] *Bringing Everyone Up to Speed Part A – An Analysis of Costs to Upgrade and Maintain WAN and Internet Access Connections for all K-12 Public Schools*. EducationSuperHighway (In partnership with CoSN) at 4. *Available at* http://www.educationsuperhighway.org/resources/.

[5] *See* J. James Cengiz Gulek and Hakan Demirtas, *Learning with technology: The impact of laptop use on student achievement*, at p. 29, Journal of Technology, Learning, and Assessment, vol. 3, no. 2 (2005), available at http://ejournals.bc.edu/ojs/index.php/jtla/article/view/1655/1501.

[6] http://www.usac.org/_res/documents/sl/pdf/samples/Discount-Matrix.pdf

[7] *See* Albemarle County Case Study at p. 11 for an example of how one district was able to use E-rate funding to avoid a steep cost increase (from $200,000 year to $1.2 million per year) by building out its own fiber network.

[8] For example, due to an unexpected cut fiber line.

[9] https://www.fcc.gov/general/universal-service

[10] *Modernizing the E-Rate Program for Schools and Libraries*, 29 FCC Rcd 8870 (2014) ("*First E-rate Modernization Order*"); *Modernizing the E-rate Program for Schools and* Libraries, FCC 14-189 ("*Second E-rate Modernization Order*").

[11] *Second Modernization Order* at ¶ 6.

[12] "Megabits per second."

[13] "Gigabits per second."

[14] The July order's language explicitly references the SETDA recommendations. The latest SETDA report (from 2012) recommended 100 Mbps per 1,000 students for the 2014-15 school year and 1 Gbps per 1,000 students for 2017-18 school year. While this may be what USAC follows when evaluating applications, these targets are "subject to refinement over time as warranted." (Order 1 FN 76).

[15] *First Modernization Order* at ¶ 39

[16] *Id.* at ¶ 77

[17] 2016 Eligible Services List Order Appendix B P. 5.

[18] 2016 Eligible Services List Order Appendix B P. 5.

[19] *First Modernization Order* at ¶ 78

[20] Eligible Services List Order ¶ 10

[21] *Id*.

[22] These contracts are E-rate eligible.

[23] Second modernization order ¶ 30

[24] Note: fiber strands are not eligible for E-rate funding if they are not used by the school in the same year that it receives funding. Also, schools may not sell excess fiber capacity. *See Second E-Rate Modernization Order* ¶ 37.

[25] *Smart Networks: Comprehensive Design Overview.* At p. 12. CoSN.

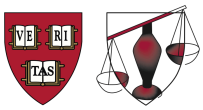
[26] *First Modernization Order* at ¶ 168.

[27] *Id.* at ¶¶ 177-181.

[28] *E-rate Policy Options Analysis* at 2.

[29] *Id*.

[30] *2016 Broadband Progress Report* at ¶ 93.



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