

EBOOK

BUILDING A FUTURE-READY K-12 NETWORK



K-12 education is rapidly evolving. Is your network ready to handle the growing demands?

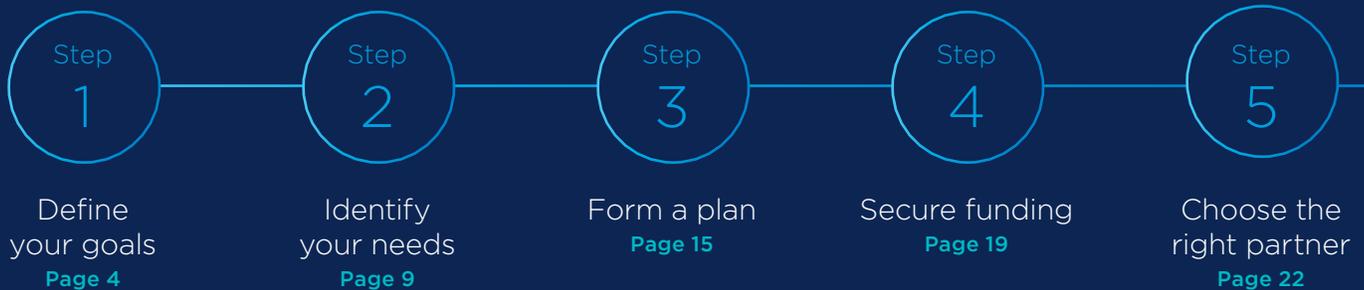
Here's a step-by-step guide to planning a network infrastructure that will help you achieve your learning objectives

A new era of learning

Technology is transforming K-12 education by enabling richer, more personalized and more student-centered learning environments. Aided by technology, students are collaborating with their peers and with subject-matter experts around the world, creating and sharing original ideas.

In this new era of learning, a powerful and scalable network is essential for delivering on technology's promise. This eBook will help you understand how to be prepared to meet evolving network requirements.

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Step 1: Define your goals

Any investment you make in your network infrastructure should be driven by the learning objectives you've set. Creating a plan for your network upgrade begins with understanding how your network will be used over the next three-to-five years to advance teaching, learning and school administration.

Setting goals should be a community-wide process, with input from students, teachers, parents and administrative staff. If you don't already have a forward-looking strategic plan in place or if it needs to be updated, use surveys, focus groups and a strategic planning committee. Be sure to include representation from all stakeholder groups to set your vision and identify your goals.

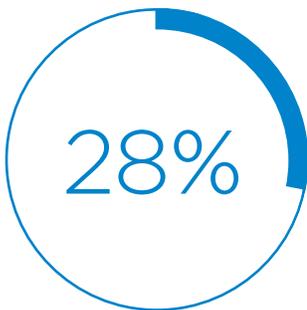
As you work through this process, here are some questions to guide you:

Instruction

How often will students use digital devices for learning? Will every student use his or her own internet-connected device throughout the school day as part of a mobile learning initiative? Or, will students be sharing devices either through a station rotation model or through the use of mobile device carts?

Will students be using more than one device in school? As technology becomes more ubiquitous in students' lives, a growing number of K-12 leaders are planning their networks with the idea that students will be using more than one connected device at a time for learning. An example might be a student who uses a mobile sensor or smartphone app to collect data about his or her environment and transmits this information to a laptop for real-time analysis during science class. In a 2020 Consortium for School Networking survey, 28 percent of K-12 leaders said their students are already using two or more networked devices during school — and 57 percent said they expect this to be the case within the next three years.¹

How often will students use media-rich applications to learn? When planning your needs, consider not only how many devices will be on the network simultaneously, but also what kinds of applications students will be using — and how often. Will students be watching streaming video as part of their daily instruction? Will they be using augmented or virtual reality? Connecting with content experts through video conferencing? Collaborating with their



28% of K-12 leaders said their students are already using two or more networked devices²



peers through shared cloud services? These media-rich applications consume more bandwidth. If students will be using them often, you'll want to make sure your network has the capacity to support this activity. For the optimal learning experience, searching the web requires 1 Mbps of bandwidth, streaming HD video requires at least 5 Mbps and sharing cloud-based documents through Google Apps or Office 365 can use up to 50 Mbps.³

30 to 100 Kbps

per student being tested:
Recommended minimum network requirements from PARCC and the Smarter Balanced Assessment Consortium

Assessment

Will students be taking high-stakes assessments online? If so, you'll need to figure out the demand this will place on your network and plan accordingly. What are the minimum network requirements needed to support uninterrupted testing for an entire school or grade level, while also allowing for regular network usage by staff and students who aren't being tested? Estimates from testing organizations such as PARCC and the Smarter Balanced Assessment Consortium call for anywhere from 30 Kbps to 100 Kbps for each student being tested. If you'll be administering tests online, make sure that your network is designed to ensure a high quality of service (QoS) by allowing you to prioritize the traffic from this activity, so your students don't experience a disruption during testing.

Communication

Will you be using your network to transmit voice communications through a voice over IP (VoIP) or unified communications system? If so, how many concurrent calls will you need to support? Each concurrent voice call will require a minimum of 100-125 Kbps both upstream and downstream.

How else will you use your network to communicate? For instance, will you be using your network to send out automated messages to parents and other community members? An automated notification system is an important driver of family engagement, however, it requires certain network design considerations.

1 to 2 Mbps

bandwidth is used by each
networked camera⁵

Administration and operations management

How will staff use media-rich applications? Don't overlook teachers and administrative staff when identifying how many devices will be connecting to your network and what kinds of applications will be used. Will teachers use streaming video for professional development? Will staff members use web or video conferencing to hold meetings? How much of this activity will take place during normal school hours (that is, peak usage times), as opposed to after school?

How many cloud-based applications will you be using? Shifting your software to the cloud offers many benefits. For example, you don't have to purchase, install and maintain as many servers or support the software yourself, and you always have access to the latest versions of software programs. However, your network will likely need to be redesigned to accommodate additional cloud service requirements to maximize application efficiency between sites and cloud infrastructure.

How many IoT devices will be connected to your network? Another aspect to consider is how many cameras, sensors and other Internet of Things (IoT) devices will be transmitting information over your network. Will you be using your network to monitor and store the images from security cameras? Will you need to control "smart building" features such as door locks, thermostats, lighting and HVAC systems? Data transmitted from sensors and controllers generates minimal network traffic. One report estimates that a typical IoT device may need 2,500 transactions to consume 1 MB of data.⁴ However, even the traffic from sensors and controllers can add up when these devices are deployed across an entire district in large numbers. Images from networked cameras are a different story: You should figure on 1 to 2 Mbps of bandwidth use per camera.

Other uses

How many guests will you have on your network? The number of network users you anticipate should include guests to your buildings as well. It's important to understand how your buildings might be used by the community and how this could affect your network. Will you be holding meetings or hosting community events that require network connectivity? If so, how many users do you anticipate having to support?

Will you be using the network for gaming? eSports, or competitive video gaming, is becoming enormously popular and many K-12 schools have formed eSports clubs and teams. Will you have teams of students using your network for online gaming after school? If so, figure on each player needing at least 4 Mbps during live play, with some games (such as Overwatch) consisting of up to six players per side.

Emerging vs. transformational technology use

Your answers to these questions not only help shape the goals you have for your network; they paint a picture of how sophisticated your use of technology will be. This picture, in turn, helps determine how much capacity your network will need to allow you to reach these goals.

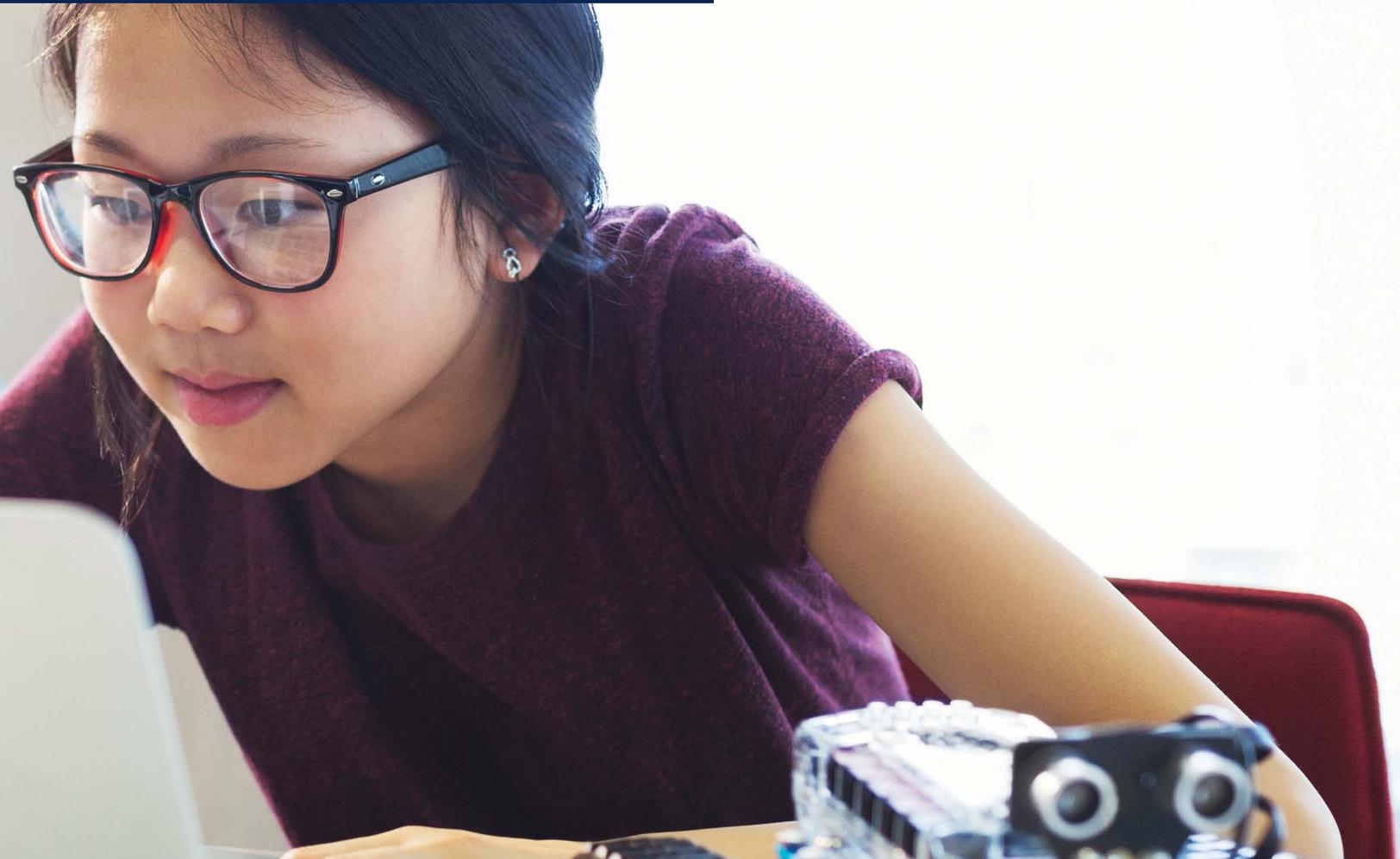
Here’s a simple guide⁶ for how to characterize your network use as either “emerging” or “transformational,” which will help you identify how much bandwidth you’ll need in the next section.

	Emerging use	Transformational use
Number of devices per student	Fewer than one	One or more
Media-rich instruction	Fewer than half of students using media-rich applications simultaneously	More than half of students using media-rich applications simultaneously
Voice infrastructure	No VoIP	VoIP access and possibly unified communications
Cloud-based infrastructure	Premises based equipment and applications	Public and hybrid cloud application enablement



Step 2

Identify your needs



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Step 2: Identify your needs

Once you have a clear sense of how your network will be used in the next three-to-five years, you can determine the type of infrastructure you'll need to support these goals. Aspects to consider include the amount of bandwidth you'll need from your internet service provider (ISP), your wide area network (WAN) infrastructure, your WiFi coverage and the services you'll need to keep your network secure.

Bandwidth

In figuring out how much internet bandwidth you need from your ISP, the broadband recommendations from the State Educational Technology Directors Association (SETDA) are a good place to start.

In SETDA's first [Broadband Imperative report](#), released in 2012, the organization suggested minimum bandwidth goals for school systems at three different levels of technology use: Basic Connectivity for Supplemental Enrichment, Emerging Reliance on Online Tools and Transformation to a Tech-Rich Learning Environment. Four years later, SETDA came out with new targets for school systems to strive for by the 2020-21 school year.⁷



average annual growth in district bandwidth needs⁸

2020-21 targets for...	Emerging use	Transformational use
Small districts (fewer than 1,000 students)	At least 2.5 Mbps per user (minimum 150 Mbps for the district)	At least 4.3 Mbps per user (minimum 300 Mbps for the district)
Medium districts (1,000 to 10,000 students)	At least 1.5 Gbps per 1,000 users	At least 3 Gbps per 1,000 users
Large districts (more than 10,000 students)	At least 1 Gbps per 1,000 users	At least 2 Gbps per 1,000 users

SETDA's recommendations are a good starting point, but you'll want to take a closer look to see if they're right for your needs. As you do, here are some additional aspects to consider.

Understand year-over-year trends in network usage. As you consider how much bandwidth you'll need for at least the next three years, it's important to know that the average school district nationwide has seen its need for bandwidth grow by at least 50 percent year over year.⁹

Don't forget to project student growth. When determining how many users will be connecting to your network, make sure you take into account the projected growth in your student population over the next several years. Otherwise, you might end up with a network that doesn't meet your needs after only a year or two.

10 Gbps

per 1,000 users: Recommended WAN bandwidth, per SETDA

Take action

Know your bandwidth usage

Knowing how much bandwidth you're currently using can help you figure out how much more you'll need to achieve your goals. Here are a few ways to test your current bandwidth and identify your needs:

- Use a network monitoring tool to understand how much of your capacity is being used throughout the school day. Consult the data from usage reports to understand key trends, such as peak usage times, sources of bottlenecks and how much bandwidth individual applications are using.
- Use the [Bandwidth Calculator](#) from Spectrum Enterprise to identify your organization's unique network needs. It's free, fast and easy to use.

Wide area network

For the WAN connections between buildings, SETDA recommends at least 10 Gbps of bandwidth per 1,000 users for school districts of all sizes. As you think about your WAN infrastructure needs, here are two more points to consider.

Plan for future capacity. SETDA advises school systems to plan to support at least 25 percent more capacity than their purchased levels. This enables you to upgrade seamlessly based on increased demands and not diminish the speed of your WAN.

Consider a virtual network infrastructure. In a software-defined network (SDN), the network control functions are decoupled from the physical routers and switches and are virtualized in the cloud. This results in greater scalability, flexibility and control.



Take action

Create a network map

Your network utilization between buildings will differ from your internet bandwidth, but it's just as important to understand. A network map can help you visualize how your school buildings are interconnected and how much traffic from various connected devices flows between them. Look for software that can help you create a network map and analyze the traffic between school sites, so you can plan your needs more effectively.

WiFi

Adequate wireless coverage throughout every building is essential for students, staff and guests to use technology effectively. Here are some things to consider as you determine your wireless needs.

Understand your current technology and what's available. The good news is that WiFi is about to get a significant boost with the release of the 802.11ax standard, or WiFi 6. This is the first major development in WiFi technology since 2013. WiFi 6 should be able to improve the average per-user throughput by at least four times in dense or congested environments, while increasing network efficiency and extending the battery life of networked devices.⁷

Look for technology that's easily scalable. By investing in a modular solution, you can easily add more capacity to your wireless network if your needs should change — such as satellite offices or temporary/portable classrooms — without having to overhaul or build an entirely new network.



Use WiFi management tools. Wireless network management tools can help you track and report on your WiFi coverage, find dead spots in your network, identify and block rogue access points and boost the signal output where needed.



348

cybersecurity incidents
hit public K-12 educational
institutions in 2019¹¹

Take action

Conduct a site survey

Designing a wireless environment can be complex. K-12 leaders have to account for possible signal interference, as well as how walls and building materials affect the range of wireless signals. A site survey done by an experienced provider can help you plan for adequate coverage.

Security

Cybersecurity is a huge issue for K-12 districts. In 2019, 348 cybersecurity incidents hit public K-12 educational institutions.¹⁰ Your network upgrade should include measures to protect the integrity of stakeholder information. As you think about your security needs, here are two points to consider.

Include the latest threat protections. Safeguard your network with technologies such as a firewall and unified threat management (UTM), which creates a single point of defense using multiple security measures; distributed denial of service (DDoS) intrusion detection and prevention; and advanced reporting and visibility into real-time network threats and activity.

Consider segmenting your network. Segmenting your network means you're dividing it into smaller sub-networks that are isolated from each other.

This makes it easier to ensure that users can only access certain types of resources — and if a breach does happen, it's limited only to that segment of your network.

Take action

Perform a security audit

A network security audit can help you understand where your network might be vulnerable to possible security breaches. A security audit identifies all of the assets on your network and whether their operating systems are up to date. It also reviews the configuration of your firewall and assesses the biggest risks to your network security, so you know which potential threats are most important to address.





Step 3

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Step 3: Form a plan

Once you've identified your needs, the next step is to plan your network upgrade. Some key issues to consider include your timeline for upgrading, how the lack of E-rate support for voice services might affect your planning and whether you'd prefer a fully managed solution or would rather own and manage the infrastructure yourself.

Here's some advice on how to create a network upgrade plan that works for you.

Timeline

The timeline for your network upgrade will depend on many factors, such as how many schools and classrooms you need to upgrade, how much budget you have available, equipment refresh cycles and how you'll integrate your plan with the academic calendar.

One factor that could influence your timeline is the amount of E-rate funding available for network upgrades over a five-year period. Currently the FCC limits schools to a pre-discount budget of just over \$150 per student, per school site for category two services, which cover WiFi equipment and other network infrastructure.

You can choose to use this budget all at once or spread it out over five years, which might influence how you decide to move forward with your network upgrade.

If you can't afford to upgrade all of your classrooms or buildings at once, here are some strategies to consider when choosing how to prioritize this work.

Need. Where it makes sense to do so, start with the schools and classrooms that have the greatest need. For instance, you might have some buildings that are much older, or whose network capacity lags behind that of other schools in the district. These facilities should rise to the top of your priority list.

Grade level. Some districts choose to roll out technology in grade-level phases, starting at the high school level and working down to the elementary grades. An advantage to this approach is that it creates equity: When all high schools in the district have the same technological capacity, it doesn't matter which school students attend; they'll receive the same grade-level-based opportunities regardless of where they enroll.



~\$150

per student: Current FCC pre-discount limits for Category 2 services



Readiness for digital transformation. If some schools in the district are more prepared for change than others — for instance, they have strong leadership teams and change management practices in place, or their staff are ready to embrace a digital transformation — then you might consider leading with these schools. In this way, your investment will pay immediate dividends, and these schools can serve as models for others to follow.

The voice budget challenge

With the federal E-rate program no longer offering support for voice-related services, you should consider the implications this will have on your district budget when planning your network upgrade. K-12 leaders will be looking for more cost-effective ways to support voice communication. VoIP might be able to help.

Converging voice and data on a single network allows you to eliminate parallel infrastructures and simplify administration, while possibly saving on the average cost per call as well. If you're already upgrading your network, this might be the perfect opportunity to prepare your network for VoIP deployment. Here are some steps to consider.

Do a cost analysis of what you're currently spending. To figure out whether VoIP makes sense for your schools, take a close look at what you're spending now across all of your communications systems. Consider not only recurring monthly charges, but also how much it costs to support your PBX or other voice-related equipment. Talk with service providers to see how various VoIP options might help you save money.

Upgrade your network with the capacity to add VoIP in the future. Even if you have no immediate plans to move to VoIP, use your network upgrade to prepare for a VoIP migration in the future if and when it makes sense for you. Power-over-Ethernet plus (PoE+) enabled switches and the ability to segment network traffic with a virtual local area network (VLAN) will give you the power and quality of service you'll need for success.

Consider the hidden costs that come with managing your own equipment.

Owned vs. managed services

The network solutions available to schools have evolved rapidly over the last decade. School districts no longer have to own and manage their own routers, switches, firewalls, wireless access points and other network technology; instead, they can choose a solution that is fully owned, installed and managed by a service provider.

Although purchasing and managing network equipment yourself might appear to be cheaper, there are numerous hidden costs you need to be aware of. Here are some key factors to consider when weighing this decision.

Budget model. Would you rather incur a large upfront expense or have monthly recurring charges? Some districts would prefer the single capital outlay that comes from buying and installing their own equipment; for others, being charged a fixed monthly rate for a managed service makes it easier to budget. Keep in mind that if you don't opt for a managed solution, you'll still need to set aside funding for maintenance and upkeep — and these expenses can add up quickly.

Staff expertise. Do you have skilled and experienced network technicians on your IT staff who can maintain and troubleshoot your network? If so, then it might make sense to own your own infrastructure. If not — or if you want your in-house experts spending their time focusing on more strategic projects for your school or district — consider a fully managed solution, in which support teams are available to troubleshoot problems and deploy technicians 24/7/365 if there are any problems.

Flexibility. When you buy your own equipment, you're investing in a specific network infrastructure with a fixed capacity. If your needs change faster than you anticipated, or if you underestimated the demands on your network from the outset you'll be stuck until additional capital is available for enhancements. If flexibility is a priority, a managed solution can add more capacity as needed and the assurance that as technology evolves, you'll always have access to the latest upgrades.

Reliability. When you own your network equipment, you're responsible for all maintenance and repairs. This might require constant tweaking and firmware updates to get things working smoothly. How might this affect the availability of network resources? If you have the ability to keep up with these demands, then owning your network infrastructure might be the best option. But if you're worried this might place too much of a burden on your IT staff — or you consider the network to be mission-critical and don't want to risk downtime — then you might prefer the peace of mind that a managed solution provides. With a managed solution, you have service level agreements (SLAs) in place that guarantee network uptime.

Step 4

Secure funding



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Step 4: Secure funding

The federal E-rate program can help you achieve your network upgrade. But it should only be one piece of your funding plan.

If you've never applied before, E-rate provides discounts of up to 90 percent off the cost of Category 1 services (internet access) and up to 85 percent off the cost of Category 2 services (network infrastructure) to schools and libraries. The actual discount that applicants receive is based on their percentage of students who are eligible for the federal school lunch program.

Applying for E-rate discounts begins with filing a Form 470, which indicates the products and services you intend to purchase. Your Form 470 must be posted to the website of the Universal Service Administrative Co. (USAC), the agency that administers the E-rate program, for at least 28 days. This gives service providers a chance to bid on your intended services.

Once the 28-day posting period is over, you can choose a provider, sign a contract and file a Form 471 indicating the services you're procuring. More information about the E-rate process can be found on the USAC website (usac.org/sl).

Whether you're new to the E-rate program or you've applied before, here are two important pieces of advice.

Know the program deadlines. The E-rate program requires you adhere to deadlines. The window for filing a Form 471 application generally runs from January through March. Keep in mind that the application process requires you to file a Form 470, wait 28 days, then evaluate bids and sign contracts before you can file a Form 471. Make sure you give yourself enough time to complete this process before the filing window closes. (You can file a Form 470 before the filing window opens. USAC generally begins accepting these forms about 12 months before the start of the following E-rate year on July 1.)

Up to 90%

E-rate discount for internet access (Category 1 services)

Up to 85%

E-rate discount for network infrastructure (Category 2 services)

Be prepared for E-rate season with the Spectrum Enterprise "Using E-rate funds to enhance school networks" and "3 planning tools to navigate the E-rate process" guides.

Take advantage of special construction funding

Applicants can apply for funding for special construction charges (defined as upfront, non-recurring installation charges for the deployment of new or upgraded facilities) incurred up to six months prior to the July 1 start of the funding year.

Alternative funding for voice services

Spectrum Enterprise has teamed up with the Poly Grant Assistance Program to help K-12 leaders identify and secure alternative funding sources for their voice communications systems. Learn more by calling 866-850-5136.

Understand the latest eligible services. USAC posts a new Eligible Services List each year that details which network services are eligible for E-rate support. There are often minor changes or adjustments to this list, so make sure you're familiar with the latest rules. If you're buying a service that includes a mix of eligible and ineligible features, you have to factor out the cost of these ineligible features in your application. Your service provider can help you with this.

Budgeting for success

Even if you receive E-rate funding, you'll still be responsible for at least some of the cost of network services yourself. How will you secure the funding necessary to accomplish your goals? Here are three key strategies to guide you.

Get the support of your board. Prepare a report or presentation explaining your vision and goals for using technology to transform instruction, how a network upgrade is essential for achieving these goals and how much an upgrade will cost. Focus on the expected *outcomes* your project will have on student engagement and achievement, 21st century skills, college and career readiness, parent engagement and other factors. Invite students, staff, parents and other stakeholders to speak in support of your initiative.

Build network upgrade costs into your budget. A budget document is a reflection of a school district's priorities. Figure out how much you'll need to contribute beyond what the E-rate will cover and build this figure into your annual budget. Add a little extra to account for unanticipated expenses.

Have a contingency plan. If E-rate funding doesn't come through for some reason, how will you pay for your network upgrade? Think about alternative sources of funding you can tap if necessary, such as grants, rainy day funds, a bond measure or other fundraising efforts.





Step 5

Choose the right partner

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Step 5: Choose the right partner

Your choice of service providers matters. You want a company that is not just a technology vendor, but a partner who is fully invested in your success. The right partner can help you at every step in your project, ensuring the success of your network upgrade.

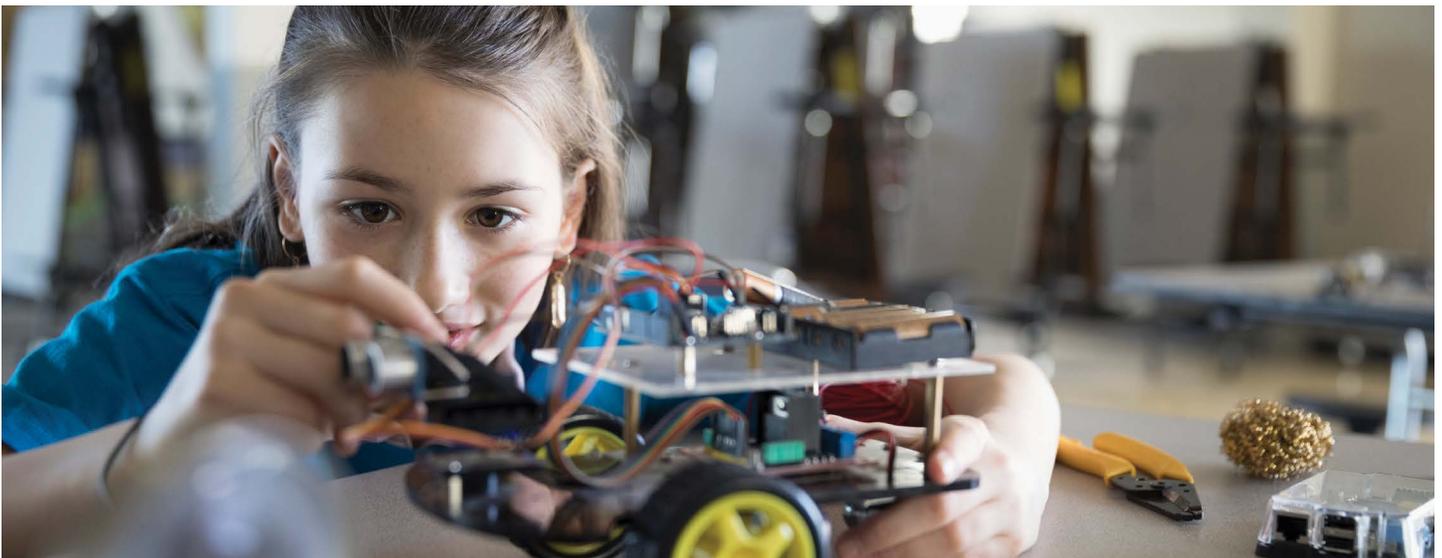
Here are four important qualities to look for in a network service provider.

Advanced technology. Does the provider employ the latest standards and technologies? Do the company's products reflect the latest industry developments?

Industry leadership. Does the provider have the size, capacity and expertise to serve your needs effectively? Is the company stable and reliable, with a strong reputation in the industry?

Experience in the K-12 market. Does the provider understand the unique needs of school systems? Does it have a proven track record of success in serving education?

High-quality service. Does the provider value you as a customer? Will you receive prompt answers to your questions? Is someone available at all hours in the event of an emergency?



Spectrum Enterprise — your partner of choice

Spectrum Enterprise provides a complete range of solutions for the K-12 marketplace, from fiber internet and WAN services to managed WiFi and security.

As a fully compliant E-rate service provider since program initiation in 1998, we take pride in being one of the largest E-rate service providers today. Spectrum Enterprise works with hundreds of school districts nationwide and delivers service to more than 10,000 locations and millions of students.

Our services include:



Fiber Internet Access

Get dedicated, symmetrical connectivity up to 10 Gbps backed by industry-leading SLAs and proactive, 24/7/365 monitoring to ensure network performance and uptime.

The wholly-owned fiber network from Spectrum Enterprise provides reliability and security.



Ethernet Services

Increase the capacity of your network with a managed WAN over Spectrum Enterprise's private fiber network. Expand your network quickly with flat-rate pricing and scalable bandwidth up to 10 Gbps.



Managed SD-WAN

Improve application performance on your network using SD-WAN technology that enhances the end-user experience. With this adaptable solution, your school or district can be more flexible, more responsive and better able to keep pace with growing demands.



Cloud Connect

Extend your network with fast, secure and dependable private connections to cloud service providers — offered with a single or redundant dual paths.



Managed WiFi

Improve your wireless coverage with a complete, turnkey WiFi solution that includes design, installation, management and operation of wireless infrastructure, ensuring high-quality connectivity with no equipment to buy.



Managed Security Service

Protect your connection with a fully managed solution that includes a firewall and UTM, intrusion detection and prevention, anti-malware, anti-virus, event log management and more.



Enterprise Voice

Increase productivity with feature-rich, easy-to-scale PRI and SIP trunking solutions for premise based phone systems. Alternatively, answer communication and collaboration needs for your staff with a fully managed cloud-based Unified Communications (UC) solution. UC includes voice presence, instant messaging, video calling and desktop sharing available anytime — on any device.

10,000+

education locations that
Spectrum Enterprise provides
services to nationwide

The bottom line

A high-performance network is essential for supporting powerful teaching and learning that leads to better student outcomes. Following the five steps discussed in this eBook will help you create a future-ready network that enables you to realize your learning goals — and Spectrum Enterprise is here to help at every step.

To learn more, visit enterprise.spectrum.com/K12ed.

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9. Ibid.
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11. Ibid.

About Spectrum Enterprise

Spectrum Enterprise, a part of Charter Communications, Inc., is a national provider of scalable, fiber technology solutions serving America's largest businesses and communications service providers. The broad Spectrum Enterprise portfolio includes networking and managed services solutions: Internet access, Ethernet access and networks, Voice and TV solutions. Spectrum Enterprise's industry-leading team of experts works closely with clients to achieve greater business success by providing solutions designed to meet their evolving needs. More information about Spectrum Enterprise can be found at enterprise.spectrum.com