JUNIPER NETWORKS® | **Engineering Simplicity**

TRANSFORMING LEARNING WITH SCALABLE BROADBAND FIBER SERVICES

Delivering digital learning-ready networks for schools and libraries

Challenge

Cloud-based instructional, assessment, and administrative applications are creating a critical dependency on reliable high-speed broadband connections, straining traditionally designed networks and pushing them to limits that can have material impact on digital learning.

Solution

Districts and E-Rate applicants trust Juniper to help them build out their digital learning-ready networks. With E-Rate Category One leased dark fiber or self-provisioned fiber options available, Juniper's switching, routing, and security solutions are effectively serving these projects with eligible modulating electronics.

Benefits

- *Scalable, affordable networks that keep pace with digital learning traffic growth*
- *Carrier-grade solutions that create a foundation for a reliable, always-on digital learning experience*
- *Industry-proven E-Rate Category One and Two eligible products and services that satisfy user demands*
- *Centralized management that simplifies and automates network monitoring and control*
- *Juniper Care technical and operational support that keeps networks running*

School districts across the country are transforming learning by making the shift to a digital curriculum. Enabled through greater technology integration, this shift has resulted in the unprecedented adoption of cloud-based applications for instructional and online assessments as well as for the district's administrative and operational use. This move is accompanied by a critical dependency on high-speed broadband connections for Internet access, as well as a need for wide-area networking to aggregate and connect digital learning and online assessment traffic from multiple campuses.

While a vast majority of school districts have made tremendous progress toward achieving the FCC short-term national goal of 100 Mbps per 1,000 students, many are still unprepared for the long-term national goal of 1 Gbps per 1,000 students. To achieve that goal, the underlying network infrastructure requires upgrading[1].

The Challenge

Most school district networks were never designed to support a digital curriculum. Network traffic traditionally moved east to west, serving users with content and applications mainly housed within the district itself. In the new digital curriculum era, this traffic orientation has shifted, taking on a mostly north-south orientation due primarily to the adoption of cloud-based applications and services to support instruction, learning, and assessments. These cloud-based services, combined with the growing number of devices used by students and administrators, are causing network traffic to double every 18 months, pushing district networks to their limits and negatively impacting digital learning initiatives. These conditions expose school districts to a number of risk areas, as detailed in Table 1.

[1]CoSN's Annual Instructure Survey Report **www.cosn.org**

Table 1: School District Vulnerabilities in the Digital Curriculum Era

Risk Areas	Network Issues
Lack of network reliability	• Internet access connection is dependent on a single ISP; any outage interrupts digital learning. • Lack of multipath traffic routing exposes the network to a single point of failure—there is no alternate path if the primary path fails.
Demand for network bandwidth growing 60% year over year	• Legacy lit fiber services can become prohibitively expensive at higher gigabit-per-second rates. • In some locales, higher speed broadband services may not be available from local service providers.
Security threats	• As digital learning traffic grows exponentially, the district's legacy security appliances reach their capacity limits, impairing threat protection effectiveness and creating traffic bottlenecks.
Unsatisfactory end-user experience	• The lack of high-performance, low-latency network connections can lead to poor application responsiveness, resulting in a poor user experience that stifles the successful adoption of cloud-based learning.

Table 2: Fiber Network Options for Schools

Leased Lit Fiber	Leased Dark Fiber, including Indefeasible Right of Use (IRU)	Self-Provisioned Network
A fiber-based broadband service where the service provider owns and manages the network, and the E-Rate applicant pays a recurring fee to transport data over the network.	The E-Rate applicant leases capacity (i.e., a specific number of fiber strands) on a provider-owned and maintained fiber network. The applicant pays separately for modulating equipment to light the fiber in order to transmit data over that fiber.	Complete applicant ownership of a high-speed broadband network. The applicant hires a vendor to construct the network or a portion of the network, and thereafter owns and maintains that network or portion, including all the fiber strands, conduit, and modulating electronics.

Modernizing Broadband Connections, New Fiber Options

For many of these risks areas, school districts are taking a new look at their Internet access and WAN network architecture. At the same time, the FCC Second E-Rate Modernization Order[2] introduced additional flexibility to schools and libraries seeking affordable high-speed broadband connections as part of their E-Rate Category One projects. That flexibility has opened eligibility for additional, potentially lower cost fiber options that now include leased lit fiber services, Leased Dark Fiber, and Self-Provisioned Networks. Table 2 summarizes the eligible options with the corresponding USAC definitions[3]. As these options are all considered E-Rate Category One eligible, funding requires applicants to demonstrate that the desired fiber option provides the lowest possible cost to achieve the required bandwidth capacity, benchmarked against a leased lit fiber service alternative.

The Juniper Networks Solution for E-Rate Category One Fiber Services

Many schools and libraries looking for more scalable, affordable broadband connections have selected either the leased dark fiber or self-provisioned network option for their E-Rate Category One Fiber project, deploying Juniper Networks equipment to efficiently and cost-effectively aggregate and connect WAN and Internet traffic. To maintain control over and visibility into the system, these organizations also deploy Juniper Networks® Junos Space® Network Management Platform, which offers a single-pane-of-glass management solution, along with Juniper Care services to support their respective operations and maintain workflows on their leased dark fiber or self-provisioned networks.

Solution Components

For projects such as these, applicants seeking funding from the federal E-Rate program can deploy a mix of the following Juniper building blocks, summarized in Table 3.

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[2] Second E-Rate Modernization Order summary https://www.fcc.gov/general/summary-second-e-rate-modernization-order

[3] http://www.usac.org/sl/applicants/beforeyoubegin/fiber.aspx

Table 3: Juniper Networks E-Rate Category One Fiber Building Blocks

Solution Components	Summary	Description
EX Series Ethernet Switches	Carrier-grade switches for campus, data center, and WAN applications	Juniper Ethernet core, aggregation, and access switches are widely deployed by school districts to scale broadband connections with carrier-class reliability and capabilities. When equipped with extended or long-reach optics, these platforms cost-effectively integrate switching and optics to support Category One-eligible modulating electronics functions.
QFX Series Data Center Switches	Ultra-high-performance, high-density network switches	QFX Series switches, which improve the efficiency of fiber networks by aggregating traffic for WAN and Internet access transport, are ideally suited for district traffic aggregation points and data centers. The QFX5100 line of scalable Layer 2/3 switches is optimized for application delivery and contains a powerful feature set for virtualized data centers. The QFX10000 line of industry-leading switches offers a highly scalable, high-density network foundation for supporting today's most demanding data center and cloud environments, including midsize to large data centers, private clouds, and public clouds. QFX10000 switches scale from 3 to 96 Tbps of throughput.
BTI7000 Packet Optical Transport Platforms	Massively scalable, carrier-grade networking for metro service networks	The BTI7000 line of packet optical transport platforms delivers highly scalable, carrier-grade networking for metro networks. The systems unify packet and optical service delivery at the metro edge, integrating carrier Ethernet switching, wavelength-division multiplexing (WDM), reconfigurable optical add-drop multiplexing (ROADM), and photonic-layer elements.
Junos Space Network Management Platform	A centralized network management and orchestration platform for managing network devices and services through a single pane of glass	The Junos Space Network Management Platform works with management applications like Network Director and Security Director to simplify and automate the management of Juniper's switching, routing, and security devices. As part of a complete solution, the platform provides broad fault, configuration, accounting, performance, and security management (FCAPS) capabilities, same-day support for new devices and Juniper Networks Junos operating system releases, a task-specific user interface, and northbound APIs for integration with existing network management systems or operations/business support systems. Note that where Junos Space and its associated management applications are an integral part of network operations, they would be considered eligible under E-Rate Category One for the "leased dark fiber" or "self-provisioned networks" fiber option.
Juniper Care Support Services	A family of services and support tools that covers Juniper hardware and software products	Juniper Care combines traditional 24x7 remote technical support, hardware replacement services, online support, and service automation. More than a simple break-fix service, Juniper Care helps school districts meet network demands with technical and operational support designed to keep your network running reliably while protecting your high-performance networking investment. Note that where Juniper Care is an integral part of providing maintenance, it would be considered eligible under E-Rate Category One for the "leased dark fiber" or "self-provisioned networks" fiber option.

Real-World Deployment Scenarios

E-Rate Category One Fiber projects vary in scope and size. The following real-world deployment scenarios illustrate the diversity of projects where E-Rate applicants have successfully designed and deployed Juniper for their Leased Dark Fiber or Self-Provisioned Network projects. The four use cases span school districts, education service agencies, and tribal consortium projects.

Use Case #1: Large School District

Profile: 55,400 students; 35 elementary schools, 11 middle schools, 10 intermediate schools, six high schools, and 15 other locations for a total of 77 sites.

Challenge: Digital learning traffic growth at the district outpaced the legacy network's ability to scale WAN and Internet connectivity. Attempting to scale via the standard approach would impose prohibitively high recurring costs on the district. Instead, re-architecting the Internet access and WAN network was needed to improve reliability, lower TCO, and boost near-term capacity with a provision to easily accommodate growth in the long term.

Requirements:

	Near Term	Long Term
Internet bandwidth	12 Gbps	62 Gbps
WAN bandwidth	62 Gbps	620 Gbps

Solution Selected: The district opted for the leased dark fiber option with modulating electronics consisting of Juniper Networks QFX5100 data center switches with 1/10/40GbE ports at 77 campus locations; two traffic aggregation nodes; and a QFX10008 core switch in the data center. Juniper Care Core and Next-Day Services provide ongoing maintenance.

Use Case #2: Education Service Agency

Profile: 71,131 students across 40 school districts consisting of 183 public schools

Challenge: As the lead agency providing Internet access and WAN to public, private, and charter schools in the county, the agency needed to lift members to a baseline of 1 Gbps WAN connectivity with an upgrade path to 10 Gbps over the life of the project. The agency considered the lit fiber service and leased dark fiber service options.

Requirements:

	Near Term	Long Term
WAN bandwidth	1 Gbps per school	10 Gbps per school

Solution Selected: The agency went with the leased dark fiber option with modulating electronics consisting of Juniper Networks EX4300 and EX4600 Ethernet Switches, and QFX5100 switches. Juniper Care Next-Day Services provide ongoing maintenance.

Use Case #3: Midsize School District

Profile: 8,900 students; nine elementary schools, three middle schools, and five high schools

Challenge: After upgrading the school district's Wi-Fi network, severe bottlenecks on the WAN and Internet connections impaired digital learning. The lack of a viable higher speed broadband connection from local service providers limited the district's options. With the backing of the community and the board of trustees, the district moved forward on a plan to bring all schools to a baseline level of connectivity, with an upgrade path to increase this level tenfold in the future. The district evaluated lit fiber service, leased dark fiber and modulating electronics, and self-provisioned options.

Requirements:

	Near Term	Long Term
WAN bandwidth	1 Gbps per school	10 Gbps per school

Solution Selected: The district went with the self-provisioned option with Juniper modulating electronics consisting of EX4300 Ethernet switches equipped with long-reach optics, QFX5100 data center switches for traffic aggregation, and Juniper Care Services for ongoing maintenance.

Use Case #4: Education Tribal Consortium

Profile: 338 students; one elementary school, one charter school, one day school, one high school, two libraries

Challenge: Tribal consortiums of educational entities serve as critical institutions for providing native Americans with educational opportunities in regions where technology resources and sufficient broadband Internet services are difficult to come by. These community hub sites wanted to upgrade their current T1 and DSL lines to a fiber option and evaluated lit fiber service, leased dark fiber and modulating electronics, and self-provisioned options.

Requirements: The consortium was seeking 10 Gbps fiber connections to the hub site supplying 600 Mbps ISP service allocated across six sites.

Solution Selected: The group selected a hybrid of leased dark fiber and a self-provisioned fiber option with Juniper modulating electronics consisting of BTI7000 Packet Optical Transport Platforms and Juniper Care Services for 24x7x7 maintenance at six eligible locations, as well as the hub site and point of presence (POP) location.

Features and Benefits

Juniper delivers the following benefits to an E-Rate Category One project environment:

- Helps school districts massively scale broadband connections with carrier-class reliability and capabilities
- Improves the efficiency of fiber networks by aggregating school district traffic for WAN and Internet access transport
- Centralizes management to simplify and automate management of Juniper switching, routing, and security solutions
- Offers Juniper Care to help school districts meet network demands with technical and operational support designed to keep networks running reliably

Summary

Improving student achievement and outcomes while preparing students with 21st century skills is key to the industry's digital transformation. Digital curriculums and the associated mobile learning and cloud-based technology integration are driving unprecedented demand for bandwidth—something many school districts are ill-equipped to address.

With new fiber options available for E-Rate project consideration, the timing is right for schools and libraries to reconsider their options and modernize their Internet access and WAN architectures to deliver affordable and scalable high-speed broadband connections. This is what Juniper does best: create an extraordinary learning experience for students and cutting-edge connected classrooms for teachers and staff with networks that offer higher availability, better security, less complexity, and lower costs than the competition.

Next Steps

To learn more about Juniper Networks E-Rate eligible services, please visit the Juniper E-Rate Resource Center at **www.juniper.net/e-rate** or contact your Juniper Networks representative.

About Juniper Networks

Juniper Networks brings simplicity to networking with products, solutions and services that connect the world. Through engineering innovation, we remove the constraints and complexities of networking in the cloud era to solve the toughest challenges our customers and partners face daily. At Juniper Networks, we believe that the network is a resource for sharing knowledge and human advancement that changes the world. We are committed to imagining groundbreaking ways to deliver automated, scalable and secure networks to move at the speed of business

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