Effective planning of next-generation network and security architecture is a complex task that is critical now more than ever for all districts and schools. While most educational institutions have well-qualified IT personnel with good working knowledge of existing operations and technology, many can benefit from help when defining a road map for the future and deciding how to incorporate new technology as we transition away from textbooks to digital curriculum delivered over all manner of devices.

It is for this reason the Learning Counsel is offering this brief. We hope this research and our findings and references can assist as you scale for full technology integration with enhanced network and security environments and digital equality for all your teachers and students.

No district in the land has succeeded with a full-on transformation to digital curriculum without first grappling with its “underbelly”—the network infrastructure that sustains 1-to-1 and bring-your-own device usage in the classroom. Like an athlete adding core workouts to the biking/running/swimming regimen, schools require a solid build-out of their computing networks to ensure reliable network and Internet access.

Currently, a majority of districts or schools have a 1-to-1 program in place. A recent survey by The Learning Counsel found that 77 percent of respondents reported the existence of at least some grades in some schools issuing mobile devices to every student—whether laptops, Chromebooks or tablets.

Often, these are multi-year pilot efforts intended to test out the viability of 1-to-1 and frame effective approaches to professional development for teachers. Expanding 1-to-1 in order to deliver digital curriculum into every single classroom in every grade in every school is another matter. Achieving that level of scale-up takes a thoughtful, strategic approach by the IT organization.

As many districts have found in their conversion to digital learning, the network infrastructure that served the school suitably well under limited usage isn’t the same one that will hold up when it needs full coverage.

As this Learning Counsel report lays out, for digital curriculum and content to be highly in use, there must be the build-out of a robust network easily accessed by students, teachers, administrators, and other school service workers.
**Next-Gen Networking for Full-School Coverage**

Before you expand to 1-to-1 or BYOD to the entire campus, take steps to prepare your network for full impact.

### Breadth of Bandwidth Challenge

- **77%** Districts with 1-to-1
- **68%** Districts that lack “sufficient” bandwidth now
- **60%** Year-over-year growth in network demand in 1-to-1 schools
- **8%** Districts meeting FCC “long-term” broadband goal

### 6 in 10 Districts Testing Flipped & Blended

### 7 in 10 Teachers Using Digital Curriculum at Least 1/4 of the School Day

### How School Bandwidth is Being Consumed

### Network Bottlenecks

### Become Network-ready

1. Choose a network vendor with deep education experience.
2. Map a network plan that leaves ample room for growth.
3. Choose scalable, resilient, open standards-based tech.
4. Secure the entire network to fight outside and inside security threats.
5. Seek network simplification to reduce staff impact.

Sources: CoSN, Juniper Networks, The Learning Counsel
The Classroom is a Different Place Today

The shift to digital in schools is no longer a theoretical proposition. The 2015 IT Leadership Survey from the Consortium for School Networking (CoSN), found that the “vast majority” of IT leaders expect their districts’ instructional materials to be “at least 50 percent digital within the next three years.” “Pro-digital” initiatives in Florida, Texas, and California herald what CoSN researchers called a “major shift in acceptance and expectations” for digital content.

The Learning Counsel research has found that the most prevalent uses of digital curriculum in the classroom are these: formative assessment, video embedding, spell checking, summative assessment and professional development. However, close behind these are the “higher value” more technical capabilities which will cause more network demand as teachers adopt more sophisticated digital materials. Such things as Intelligent Learning Engines, VR and Manipulative-Object Interplay.

Almost half of teachers (48 percent) report that they use digital curriculum and content at least a quarter to half of the time. Another 24 percent have students turn to digital resources more than half the time.

To what degree do you expect print instruction materials to be replaced by digital materials over the next 3 years in your district?

On top of that more students are taking instruction virtually from home or attend class in school but take instruction online. Currently, the count hovers around 44 percent. However, that number is expected to rise. Nearly 64 percent of districts or schools are creating pilot programs to assess alternate forms of instruction, such as the flipped model or blended learning, for at least some of their classes.

What School Leaders Say about Digital Curriculum Growth

Since 2013 Ventura Unified School District in California has seen the district device count grow by 20,000, including iPads, Chromebooks, and PCs. As a result, it’s had to up the bandwidth it acquires from the county. What used to require 170Mbps now takes a full gigabit, and work is underway to bolster that to 2-4Gbps in the short term. But growth there hasn’t led to an increase in staffing size. The district’s technology department has a staff of 12 to support 26 schools, 900 classrooms, and those 20,000-plus devices, as well as “the firewall, content filter, and wireless access points,” says Julie Judd, Chief Technology Officer.

Arlington Heights Elementary District 25 in Illinois has expanded its WAN and LAN links to 10Gbps and its Internet speed to 1Gbps. Says Chris Fahnoe, Director of Technology, “I believe that these speeds will continue to go up as more and more of our devices require connections to cloud-based servers and digital curriculum is adopted.”
The shift to digital transforms the classroom in multiple ways. Let’s look at some of the areas of greatest promise (which also represent the heftiest demand on network resources):

**Digital content.** Forget about the use of monolithic textbooks, whether printed or provided in electronic format. As teachers mature in their use of digital curriculum, they learn how to take back control they had long ago relinquished to traditional publishers. Instead of allowing the textbook to shape their units, they’re discovering the possibilities of “unstructured” content. Open educational resources, for example, available through a myriad of sources, allow teachers to mix and mold the content pieces that precisely fit their needs for any given lesson. Just as people build playlists for specific occasions or create mash-ups for the purposes of discovery, educators and their students are doing the same with learning objects.

**Curation.** As creators of learning objects increasingly adopt interoperability standards, such as those promoted by IMS Global, both teachers and students are learning how to pull together and rate individual pieces of content and compile them into repositories for their own and others’ access. While those objects might be simple worksheets, they could also be hefty video and audio clips, high-resolution images, and portfolios of content and samples that have unique meaning for the users.

**Apps and ebooks.** The extensive adoption of education software-as-a-service, cloud-based applications and ebooks has allowed teachers to customize the education tracks for individual students, introduce collaboration capabilities into the classroom and provide access to text or other learning objects that don’t weigh down knapsacks. In most cases, they also require an always-on Internet connection. So does access to the reporting and analytics teachers use to monitor student engagement and progress through those digital resources.

**Immersive digital courseware and gamification.** STEM courses are proliferating within schools for a good reason. They plunge students into design thinking, real-world problem-solving, and hands-on activities. In many cases the authentic learning opportunities are delivered via virtual interfaces, including the use of online science labs, 3D modeling programs, and virtual reality experiences. Gaming in the classroom serves a similar purpose by pulling the student into challenges with goals, actions, and visible ways to keep track of progress and failure.

**Online testing.** Few changes in education this century have had a greater impact on the adoption of technology in schools than digital assessment. The introduction of online testing based on Common Core and state-specific learning standards by necessity has required districts to update not just devices but also network access in their schools. Whether the testing is delivered with a live connection to the Internet for each student or from cached servers, the networking requirements can be extensive.

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**What School Leaders Say About Network Upgrades**

Ventura Unified has upgraded its metropolitan area network (MAN) switching gear to accommodate 20Gbps, which allows for future growth, says Judd. Although many of the district’s schools are still operating at 10/100Mbps on campus, the district has been updating its site switching gear to a 1 Gbps connection between schools and the district office. “With the new gear,” she notes, “we have positioned ourselves to connect the schools back to the district at 10Gbps. We began this process in 2014 and anticipate that it will take us two more years to completely upgrade the network.” That includes adding access points to every classroom and outdoor wireless arrays “to capture the between-class access.”

Arlington Heights Elementary follows a three-year refresh cycle for its network expansion, devices, and appliances, says Fahnoe. That’s driven by what’s going on in the classrooms. “Luckily for our district, we have always evaluated our network needs based on our curriculum initiatives,” he says. Fahnoe anticipates that eventually the network will transition from a mix of wired and wireless connections to “mostly wireless devices,” which will necessitate additional access points and switches.
Meeting the Network Readiness Challenge

While taken individually, these activities may not be particularly intensive draws on school network or Internet bandwidth, the multiplier effect takes a toll. According a CoSN report issued in November 2015, it isn’t “unusual” for districts to see 60 percent growth year over year in demand for their network capacity when they’ve moved to a 1-to-1 or a BYO environment. As the CoSN researchers pointed out, “Over the lifetime of a 5 year technology plan, that reflects an order of magnitude increase in capacity needs.”

Not only is network growth assumed, but so are the expectations of users. In a 1-to-1 scenario network downtime is akin to a snow day. Except for the classrooms of the most nimble of teachers, learning pretty much stops.

Yet, a gap exists between the kind of Internet and network capacity schools require and what they have. The CoSN “Annual E-rate and Infrastructure Survey” found that more than two-thirds of school systems (68 percent) lack sufficient bandwidth now and into the future. Only 8 percent of respondents said all of their schools “meet the long term FCC national broadband goal of 1Gbps per 1000 students.”

Sizing the network smartly is a challenge for even the most experienced IT professionals. After all, there are so many moving parts to consider:

- First, as that same CoSN report explained, existing hardware, including the wireless access points, switches, and cabling in school facilities “may not support growing levels of Internet capacity and may be incompatible with newer technology.”

- Second, network appliances—firewalls, filters, and other security systems as well as gateway routers—may top out way before user demand does, and replacing that equipment can be a major hit to the district budget. The selection process has to be right the first time around.

- Third, the kind of full-time network expertise that’s common in corporations and institutions of higher education—network architects and certified engineers—is often too pricey for districts. So district I/T leaders need a network strategy that better aligns to the available network talent, a strategy that reduces network complexity and eliminates time consuming, complex, error-prone work flows.

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What School Leaders Say About Being Network-Ready

Judd is committed to making sure her school system’s networks are available “24/7,” including figuring out how to provide Internet access for students who lack it at home. The challenges are continuous network growth and budgeting. “We are managing at this point,” she acknowledges. “However, we constantly find issues as a result of growing pains. Demands increase daily.” On top of that, funding is a constant concern. While the latest upgrade to switching gear was covered by “one-time monies,” the network cabling throughout the district is 15 years old, and that’s just one element. “As the requirements for technology increase in speed and processing, this will require a consistent funding stream,” she says.

Arlington Heights users have come to expect “seamless connectivity and minimal disruptions,” reports Fahnoe. Keeping up without getting too far ahead requires team thinking with input from technology, curriculum, and others within the district. “We need to make sure that we continue to work together to keep a reliable and fast network for our students and staff.”

What’s a school leader to do to make sure the network is ready when teachers and students are? The Learning Counsel advises a four-part action plan:

**Choose a carrier-class company:** Leading districts have long known that vendor selection plays a crucial role in the effectiveness of their subsequent decision-making. Schools that expect to deliver full-coverage digital learning, digital content, and online education applications need to maintain an enterprise-grade perspective. That job is made easier by choosing a company with deep experience in education installations that can serve as a sounding board and advisor through the planning and implementation processes.

**Go strategic with network planning:** Few schools can afford a boundless patchwork of disparate network equipment purchases to react to ever-growing network traffic. Nor is it economical to pre-build more network capacity in anticipation of network capacity demand that may not materialize. The smart ones align the network plan to support the needs of the digital curriculum. If they participate in the FCC Schools and Library Program, also known as E-Rate, they can take on a planning horizon spanning up to five years; that aligns with the short- and long-term SETDA/FCC broadband connection targets and takes into account the E-Rate Category Two five-year budget window. In this way, curriculum drives the network modernization plan, which in turn maps to the optimal use of available E-Rate funding support.

**Choose best-of-breed gear:** The vendor must be prepared to deliver and support high-performance, open, industry standards-based technology across the network to empower schools to build a best-of-breed network to sustain their digital curriculum transformation. These components include the routers for high-speed, resilient broadband Internet access and WAN connections, the switches in the access, distribution and core switching layers;
the security appliances that deliver network protection against cyber threats and data breaches; and the wireless access points inside and outside the classrooms that help deliver broadband connections from learning resources to student devices.

**Reduce complexity and simplify network management:** Network manageability is a critical aspect of the network equipment selection. For example, options exist today to collapse the access, distribution and core switching layers into a single logical network for significant simplification. Having a common operating system across all the network elements offers schools additional operational advantages. And oversight of both the wired and wireless networks in a single, integrated console simplifies the work and takes less time for IT staff to manage.

Building a next-generation network that will support a school’s digital curriculum transformation from one end of campus to the other isn’t a process that will ever be fully finished. However, smart network choices made early can be leveraged more effectively later as the learning demands grow.

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Ventura Unified School District, Education Service Center, Technology Dept (2016)

THE CLASSROOM IS A DIFFERENT PLACE TODAY

**Today** — formative assessment, video embedding, spell checking, summative assessment and professional development

**Emerging** — sophisticated digital materials such as intelligent learning engines, virtual reality and manipulative-object interplay

WHAT'S NEEDED TO BE DIGITAL READY

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- **Improved Agility and Flexibility**
- **Scalability and Capacity**
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