Bandwidth: Education's need for speed

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"The "digital divide" is a term that has been used to characterize a gap between "information haves and have-nots," or in other words, between those Americans who use or have access to telecommunications technologies (e.g., telephones, computers, the Internet) and those who do not. One important subset of the digital divide debate concerns high-speed Internet access and advanced telecommunications services, also known as broadband. Broadband is provided by a series of technologies (e.g., cable, telephone wire, fiber, satellite, wireless) that give users the ability to send and receive data at volumes and speeds far greater than traditional "dial-up" Internet access over telephone lines." (United States Congressional Research Service, 2009)

"The early wiring of schools in the mid- to late 1990s began with 56kbps or 1.5Mbps connections over existing phone lines. After almost a decade and a half of Internet usage and many doublings of Moore's Law, many schools cannot afford to upgrade and must cling to their copper infrastructure rather than moving to high-bandwidth fiber connections. Without high-speed access and transport, however, high-powered desktops don't have the juice to deliver their full educational promise." (Consortium of School Networking [COSN], 2009, p. 2)

Enter the 21st century. New advances in technology are/will have an enormous effect on classroom instruction. One commonality of each of these findings is that they rely more and more on a robust infrastructure that more importantly includes having large amounts of bandwidth. This paper will examine these issues to provide a primer for Minnesota's district leaders to aid in their decision of supporting more bandwidth in their schools.

Issue 1 – Online Learning

In November 2008, Minnesota Governor Tim Pawlenty announced his online learning initiative. Under the Governor's plan, he proposed that all high school students have an online experience prior to graduating. This new requirement would take effect in 2013. (Office of the Governor, Tim Pawlenty, 2008) The announcement parallels research by the Hoover Institute stating that, by 2019, online learning will affect nearly 50 percent of all high schools courses. (Christianson & Horn, 2008). A similar report by the North American Council for Online Learning (NACOL) indicates that online learning will affect nearly 16% of all students by 2011. (International Association for K-12 Online Learning [iNACOL], 2009)

The need of online learning in rural schools is also increasing significantly. Declining enrollments reduces teacher course offerings and online learning allows districts an efficient way to deliver courses. (Piccanio & Seaman, 2007, p. 18) Online learning can provide students with courses that are not normally offered in their schools, can extend learning beyond their face-to-face environments, and can provide students a way to "catch up" by means of credit recovery.

Issue 2 – Virtual Learning Environments and Web 2.0

According to the MIT's new media literacies, "a participatory culture is a culture with relatively low barriers to artistic expression and civic engagement, strong support for creating and sharing one's creations, and some type of informal mentorship whereby what is known by the most experienced is passed along to novices. A participatory culture is also one in which members believe their contributions matter, and feel some degree of social connection with one another." (Jenkins, Purushotma, Clinton, Weigel, & Robison, 2006, p. 3)

Online, as well as brick and mortar classrooms, are starting to utilize virtual environments (video games, Second Life) as well as Web 2.0 tools (blogs, chats, podcasts, video, and wikis). "This technology is providing a platform for on-going and real

communication, collaboration, and assessment among students and teachers with writing, research, publishing, and debating on topics in all subject areas and bandwidth is critical to the success of teachers and students utilizing these new tools." (State Educational Technology Directors Association [SETDA], 2008, p. 8) This new participatory culture means that students are expected to be problem solvers and co-creators of "intellectual and artistic content rather receivers of the curriculum." (Bosco, 2009, p. 12)

The School 2.0 bandwidth calculator was developed by the Department of Education to help district leaders plan for bandwidth in their schools. According to the site, online learning per student requires approximately 100k per student while students creating content could take as much as 150k (with a threshold of 60-75%). The Etoolkit defines online learning is defined as, "interactive environments in which students connect to a web server over the Internet that hosts content (text and animations) for learning". The virtual environment "can include online testing, course management and bulletin boards" tools as well. A lab full of 30 online learners can easily take up half of a district's T1 line. (School 2.0, 2006)

Issue 3 - Video

"Video is also becoming one of the fastest growing applications in the information society…as broadband increases, so does the utilization of video on the web." (Kressel, 2007, p. 80) "YouTube was just the beginning. Online video will experience three waves of growth. Even with a six-fold increase between 2007 and 2012, current Internet video growth is in its initial stages. Internet video to the PC screen will soon be exceeded by a second wave arising from the delivery of Internet video to the TV screen. Beyond 2015, a third wave of video traffic will result from video communications." (Cisco, 2008, p. 2)

Figure 1- Cisco's Global Consumer Internet Traffic Forecast
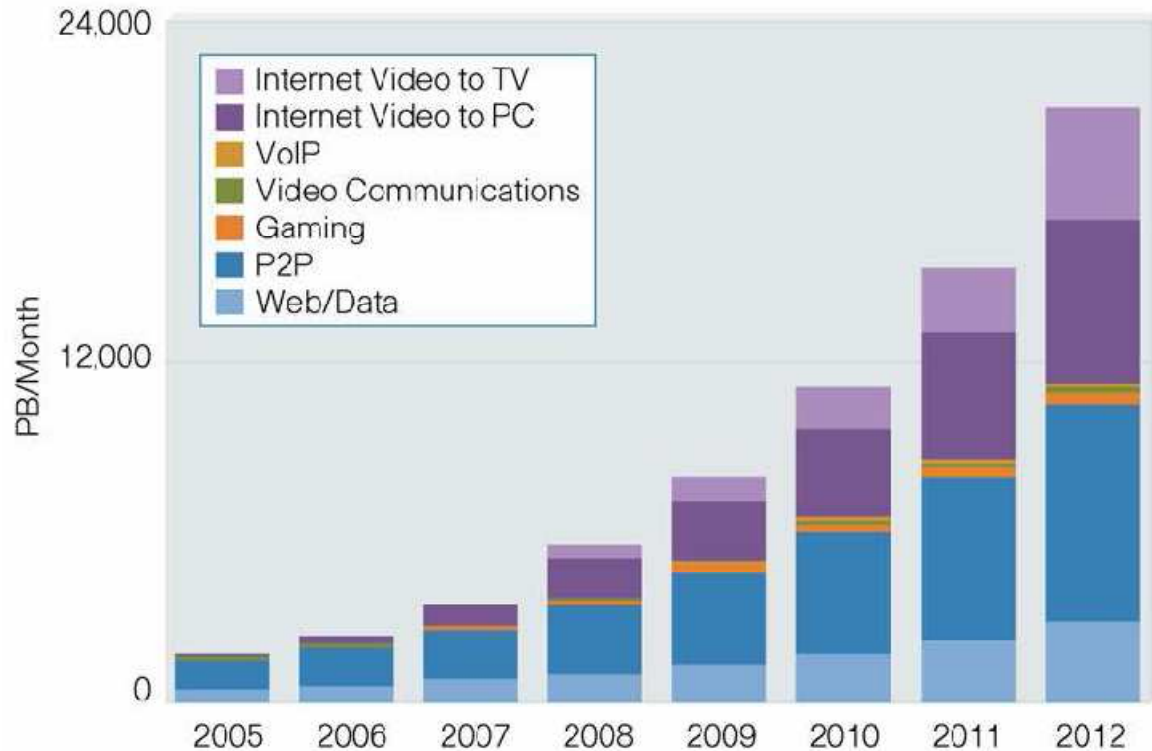
(Cisco, 2008, figure 2)

Internet2 is a non profit advanced networking consortium comprising of universities, government agencies, and international institutions connecting entities with a high capacity fiber optic backbone. The primary focus of Internet2 is to develop and deploy advanced networking technologies and capabilities in service of U.S. research and education. (Internet2, 2009) Some of these advanced technologies include the use of video conferencing.

Video Conferencing is continuing to pave its way into Minnesota school districts. Not only is the technology used to offer or share k12/higher education classes via interactive television, it can also supplement classrooms with virtual field trips, professional development and administrative meetings. All of these areas of video conferencing can be an economical and

time saving advantage for school district across Minnesota, especially in rural areas where

content is not as accessible as urban areas.

Issue 4 – NCLB and Assessment

The No Child Left Behind Act of 2001 brought forth a whole new system of

accountability to school districts across the nation. This rigorous assessment system requires

"states to apply resources to technology-based solutions, because there is no other alternative that

can deliver assessment and accountability reports on time." To get the right data fast, the

Education Department recommends "schools, districts, intermediate units, and state education

agencies be connected for fast and large data exchanges" as well having rock solid "technology

infrastructure built on adequate resources and policy support." (Us Department of Education,

2004, p. 6)

In 2007, the Minnesota Department of Education (MDE) piloted their first online

assessment system called the Science Minnesota Comprehensive Assessment II (MCA II) that

included flash-based objects. Many districts around southeast Minnesota decided to shut down

student computer labs and even limited business use for fear of disrupting the testing system.

The infrastructure guidelines stated, "As a rule of thumb, testing will require a minimum of 6

Kilobits/second of network bandwidth end-to-end for each user. This is the *minimum* bandwidth;

additional bandwidth will speed the test delivery process. Note that this bandwidth requirement

assumes linear (not adaptive) test delivery with traditional test items. Delivery of media files, for

example, significantly increases bandwidth consumption and requires greater network

bandwidth. The 6 Kilobits/second represents the amount of bandwidth available versus leased.

For example, if a school district has a 1.54 Mb/s connection to the Internet, but it is 50% busy

prior to testing, testing should have 512 KB available for the entire district." (Pearson, 2008, p. 19-20)

On February 2009, MDE announced its new Student Educational Record View Submission (SERVS). SERVS is a fully web-based collection system used to collect and eliminate duplication of student/financial data currently submitted by schools. One goal of this new program is to provide real-time data collection through the School Interoperability Framework (SIF). (C. Anderson (personal communication, February 4, 2009) Districts will need to assess their infrastructure and bandwidth to support this effort.

Issue 5 – Computers are everywhere (Kressel, 2007, p. 64)

Computers are shrinking, prices are dropping, and the new devices are more powerful than ever. "Improvements in microprocessor speed and power allow us to use sophisticated software on our cell phones and process loads of multimedia data on our laptops that just a few years ago would have seemed impossible." (Greenemeier, in press) "Products have become smaller, faster, more powerful, easier to use and cheaper - much cheaper." (Kressel, 2007, p. 57) "Mobile learning is changing education in a big way. High school and college students already have mobile access…they come to class with the Internet in their pockets. If educators can tap into that access, then any place…is a place to learn." (Apple, n.d., ¶ 1) These new devices are always on, always connected and will have a considerable affect on school's bandwidth.

Conclusion

Cheap computing and high-speed communications has influenced society far beyond the realms of technology and industry by ubiquitously linking billions of people from around the globe. (Kressel, 2007, p.56-57) "Computers made digital communications possible…but digital communication has turned out to be the more disruptive technology." (Kressel, p. 65)

Districts must have adequate bandwidth to support the new learning landscape that is easily scalable for the future. SETDA recommends that districts implement Internet bandwidth, over the next 2-3 years a 10mb per 1000 students. They predict in 5-7 years, districts will need 100mb of Internet per 1000 students. District WAN connections need to be at least 10 times their Internet connections. (SETDA, 2008, p. 10)

Schools should consider fiber as the building block for their infrastructure. "…there is no substitute for terrestrial or underground fiber, which offers "scalability"—the capacity for fast, easy bandwidth upgrades that improve the return on investment of the original connection costs."(COSN, 2009, p. 3) Fiber has the extraordinary to carry data at high speeds over very long distances and makes high capacity data transmissions, like video, possible. (Kressel, 2007, p. 44)

"Broadband service is no longer a luxury. It has become a basic part of the infrastructure of education and democracy." (Broadening Broadband, 2008) Online learning, virtual learning environments and Web2.0, video, assessments, and increases of computer devices will have a significant impact in our teaching and learning as educational organizations. District leaders not only need to understand the impact these new technologies will have in their classroom instruction, but must also realize the impact these technologies will have on their infrastructure. "Our *pipe* is the bloodline of our schools. We use it to teach, we use it to learn, and we use it to run our school business." (Hegna, 2009)

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