



Projecting Internet Demand

Key Reports

- ***The State of the Internet: 1st Quarter, 2013 Executive Summary, Akamai (2013)***
Akamai offers comprehensive data about the growth of Internet traffic year over year. Akamai observed a 3.1 percent increase in the number of unique IPV4 addresses connected to the Akamai platform in the 1st quarter of 2013. Globally, high speed* broadband adoption grew 10% quarter-over-quarter to 13 percent while broadband (less than 4Mbps) 5.8% to 46 percent.
- ***Visual Networking Index, Cisco (2013)***
CISCO provides growth rate estimates for North American traffic. Its 2013 Visual Networking Index (VIN) indicates that North American IP traffic in 2017 will be equivalent to 122 billion DVDs per year, 10 billion DVDs per month, or 14 million DVDs per hour, and 83% of all Internet traffic will cross content delivery networks, up from 56 percent in 2012. IP video traffic will become an even larger share of all traffic, growing to 80 percent in 2017, up from 75 percent in 2012. North America, mobile data traffic will grow 17-fold from 2012 to 2017, a compound annual growth rate of 76% and there will be 7.8 networked devices per capita in 2017, up from 4.8 per capita in 2012.
- ***Wireless LAN Design Guide for High Density Client Environments in Education, Cisco (2011)***
This design guide, while not specifically for K-12 education, identifies bandwidth requirements by application. Internet 2 is also working to determine this for K12. See here for more: <https://wiki.internet2.edu/confluence/display/k20t/Bandwidth+Requirements+by+Application>

Design Point #1: Establish and Validate a Per-Connection Bandwidth Requirement

How much bandwidth does each user require on average? In Table 1, the nominal throughput requirements for several popular applications and use cases in a higher education setting are shown.

Table 1. Bandwidth Requirements per Application

Application by Use Case	Nominal Throughput
Web - Casual	500 kilobits per second (Kbps)
Web - Instructional	1 Megabit per second (Mbps)
Audio - Casual	100 Kbps
Audio - instructional	1 Mbps
On-demand or Streaming Video - Casual	1 Mbps
On-demand or Streaming Video - Instructional	2-4 Mbps
Printing	1 Mbps
File Sharing - Casual	1 Mbps
File Sharing - Instructional	2-8 Mbps
Online Testing	2-4 Mbps
Device Backups	10-50 Mbps

- ***The Broadband Imperative: Recommendations to Address K-12 Education Infrastructure Needs, State Educational Technology Directors Association (2012)***
This report offers the most comprehensive and definitive recommendations for broadband capacity in public schools to date. It includes case studies for digital learning, policy, funding and broadband capacity recommendations.

Case Studies

Utah Education Network (UEN), Public/private Partnership

The Utah Legislature formally established the public Utah Education Network (UEN) as the statewide content delivery system for education in 1989. It currently serves 1,102 public schools and colleges. UEN provides a robust, reliable fiber-optic backbone network connecting every public school, college, university and library in the state. The Network enriches the lives of thousands of students, educators and citizens by bridging obstacles of time and distance. UEN also provides network services including internet access, storage and filtering, applications and content, professional development and technical support.

Washington State K20 Network, Public/private Partnership

Founded in 1996, the non-profit K-20 Education Network is a visionary solution to a unique convergence of conditions: the advent of the statewide broadband transport network; the diverse needs expressed by all sectors of the educational community; and the state's will to build one shared solution to serve all of them reliably and cost-effectively. The K-20 Education Network leverages a variety of state and federal investments in public education including e-rate to provide equal access to all school districts at the same cost. K-20 offers smart, cost-effective video and data services to over 2,500 schools and colleges throughout the state, enables more efficient use of scarce teacher resources and sought-after programs, making them available to students in communities large and small, urban and rural, across Washington. K20 is also planning and building to meet its needs 10 years into the future. Available services include professional development for educators, network engineering, applications/content and technical support.

Michigan Educational Research Information Triad (Merit), Public/private Partnership

Created in 1966 as the Michigan Educational Research Information Triad (MERIT), Merit began extending "the Internet" throughout Michigan in the 1990s, offering both direct connect and dial-in services, and upgrading the state-wide network from 56 kbit/s to 1.5 Mbit/s, and eventually 1 and 10 gigabits/sec. In 2003 Merit began its transition to a facilities based network, using fiber optic facilities that it shares with its members, purchases or leases under long term agreements, or builds. In addition to network connectivity services, Merit offers Internet2 connectivity, VPN, Network monitoring, Voice over IP (VOIP), Cloud storage, E-mail, Domain Name, Network Time, VMware and Zimbra software licensing, colocation, Michigan Cyber Range cybersecurity courses, and professional development seminars, workshops, classes, conferences, and meetings for member organizations.

Merit is currently expanding through the REACH Michigan Middle Mile Collaborative (REACH-3MC). REACH-3MC will build 2,287 miles of open-access, advanced fiber-optic network through rural and underserved communities in Michigan's Lower and Upper Peninsulas with backhaul to key connection points in Wisconsin and Minnesota. REACH-3MC includes sub-recipients from the private sector to make broadband readily available to households and businesses that lack adequate service options in the 52 counties that make up the project service area and is funded by a two grants (Round I and Round II) from the Broadband Technology Opportunities Program (BTOP) as part of the American Recovery and Reinvestment Act of 2009 (ARRA), commonly referenced as the Stimulus Package.

Microelectronics Center of North Carolina (MCNC), Public/private Partnership

MCNC is a technology non-profit that builds, owns, and operates a leading-edge broadband infrastructure for North Carolina's research, education, non-profit healthcare, and other community institutions. MCNC leverages North Carolina's open access broadband infrastructure to meet the needs of existing and future connectors to our North Carolina Research and Education Network (NCREN). MCNC meets these needs by partnering with service and application providers to develop deploy and sustain solutions. MCNC's plans appear less developed than Washington State, Utah or Massachusetts.

OARnet (Ohio), Public/Private Partnership

In 2012, Ohio announced an effort to increase broadband network speeds tenfold in an effort to benefit research and job-creating assets statewide. Under a recently approved agreement with Cisco and Juniper,

Ohio will invest approximately \$10 million to harness new innovative technology that will, in essence, “open the faucet” of Ohio's current broadband infrastructure, over 1,800 miles of fiber, from its current 10 Gbps capacity to 100 Gbps. At this speed, every one of Ohio's 1.8 million enrolled K-12 students could download an eBook simultaneously in just over two minutes. This expansion leverages the fiber optic network operated by OARnet, a member of the Ohio Board of Regents Ohio Technology Consortium.

The 100 Gbps network will connect Ohio's major metropolitan areas to northern and southern connection points of Internet2, a nationwide advanced networking consortium led by the research and education community, spanning U.S. and international institutions who are leaders in the worlds of research, academia, industry and government. Ohio public and private partners also will invest \$2.3 million in a state-of-the-art innovation center that will enable and test 100 Gbps technologies and promote the development of compelling broadband, software and advanced technology applications. Located at The Ohio State University, the center will operate in research collaboration with Internet2, NSF-Future Internet Infrastructure (GENI), UC-Berkeley and other national laboratories.