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Strong Networks Grow Distance Learning

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Strong Networks Grow Distance Learning

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INTRODUCTION

This article presents a snapshot of one state's experience with connectivity from the early 1980s to the present and illustrates how distance learning has utilized that infrastructure to grow to serve more than 100,000 Ohioans.

In early 1980s, most of Ohio's telecommunications traffic traveled on dial-up connections. Ohio's history of formidable statewide networking began in 1987, when Compuserve and OARnet (Ohio Academic Resources Network) were among few regional networks in existence. Through various mergers and acquisitions, Compuserve became Worldcom, AOL, MCI-Worldcom, and, finally, Verizon. OARnet became the Third Frontier Network (TFN) in 2004 and now is referred to as OSCnet and Broadband Ohio Network (BON).

OARnet was created in 1987 by the Ohio Board of Regents to provide statewide connectivity to resources at the Ohio Supercomputer Center (OSC). In later years, the network extended support to the 89 member institutions of the Ohio Library and Information Network (OhioLINK), and the 83 colleges and universities of the Ohio Learning Network (OLN), a consortium offering blended, online, and distance education. OLN provides faculty development, infrastructure support via Collaborative Learning Environments (CLE), and various student support services and grants.

HISTORICAL UNDERSTANDING OF DISTANCE LEARNING AND NETWORKING IN OHIO

Broadly speaking, there have been three distinct network variations in the state – OSCnet, which caters to education, research and innovation; the State of Ohio's Office of Information Technology network and many of its departmental components; and private sector networks developed by various telecommunications and cable operators.

At OARnet's 1987 inception, Ohio's higher education network backbone consisted of fourteen 56Kbps circuits from various parts of the state connecting back into Columbus. Since 2000, exponential demands for the bandwidth with predictable time-of-provisioning and somewhat predictable cost became an important factor for growth in education and research. These demands drove OARnet to consider the substantial, long-term investment in a statewide, fiber-optic infrastructure that resulted in the November 2004 launch of the Third Frontier Network (now OSCnet). Today, the OSCnet backbone consists of 1,850 miles of optical fiber, with a current capacity of OC-48 (2.5Gbps). Upgrades are underway to increase the backbone capacity to OC-192 (10Gbps) over the next 24 months.

Ohio's colleges and universities, K-12 schools, public broadcasting stations, and university hospitals and their partners are current OSCnet stakeholders. OSCnet provides commodity Internet service to its members, procuring these services at six different points of presence in the state from Tier-1 Internet service providers.

The Ohio Board of Regents created OLN in 1999 to build a catalog of distance education, provide faculty with tools and resources to teach at a distance, and to create efficiencies through shared services, including course management systems. By 2002, 67 degrees and certificates were listed in the *OhioLearns!* catalog, and, today, 211 degrees and certificates appear. Some of that growth was funded by grants from the Ohio Learning Network. Ohio is rich in number and diversity of colleges and universities with 14 state universities with a total of 25 regional campuses, 23 community and technical colleges and 60+ independent institutions. Within the context of its mission, each Ohio institution will continue to choose how, when, where and why to provide e-learning to a clientele increasingly hungry for new and different ways to enhance learning.

OLN has funded 175 Learning Communities of faculty, and staff and students exploring improvements in teaching and learning using various technologies, from hand-held devices to Second Life worlds to topics such as portfolios and the future of distance education.

OLN provides statewide collaborative licenses for CLEs and tutoring, thus saving member institutions thousands of dollars. OLN also supports a statewide Blackboard hosting service provided by the University of Cincinnati.

OHIO'S CONNECTIVITY LEADS THE NATION

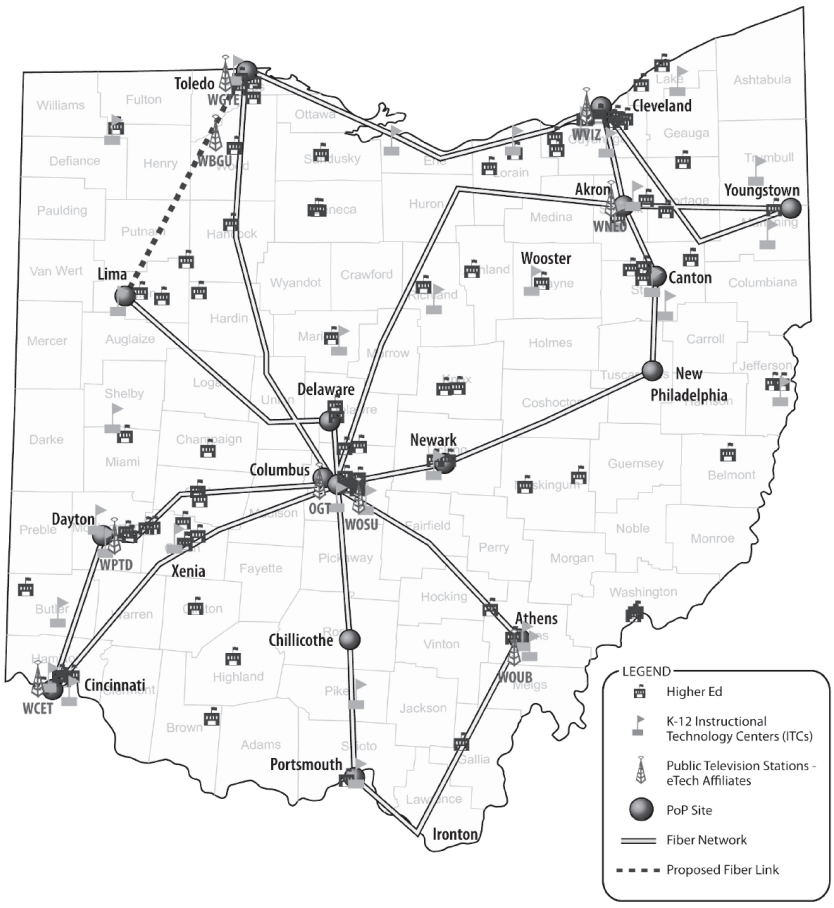
In July 2007, Governor Ted Strickland issued an executive order instructing all state agencies, boards, and commissions to begin migration of their networks to the OSCnet backbone under a consolidated Broadband Ohio plan. Three awards from the Federal Communications Commission's November 2007 Rural Health Care Pilot Program will enable use of the OSCnet backbone for statewide telehealth network initiatives, providing high-speed connections to healthcare facilities in nearly half of Ohio's 88 counties.

OSCnet also acts as a Regional Optical Network (RON) for the state's higher education community. OSCnet's footprint extends into Michigan, Illinois, Pennsylvania and West Virginia through various partnerships, collaborations and peering. Nationally, OSCnet connects to leading research and education networks, such as Internet2. These connections provide all its statewide stakeholders with connections to hundreds of research universities and other K-20 networks across the country.

Multifaceted Networks

End-users (consumers) often perceive voice, video, and data as flowing seamlessly over a pipe between mul-

Figure 1. Ohio's connectivity

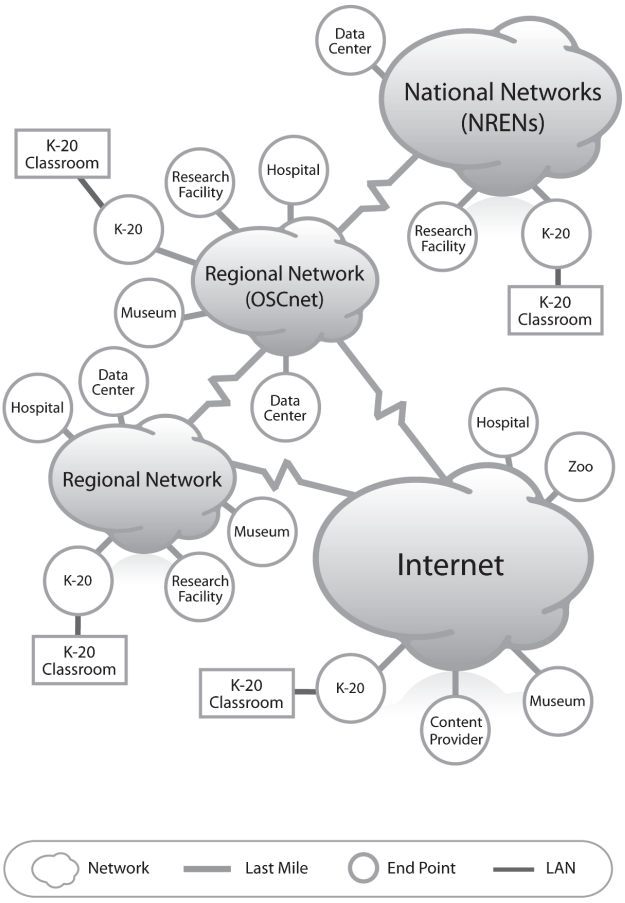


tiple end-points. Today's networks are supposed to be ubiquitous. In reality, networks operate in a hierarchy. Broadly, we can define this hierarchy as follows:

Endpoint (user) ↔ LAN ↔ RON/ISP ↔ Internet/NREN ↔ RON/ISP ↔ LAN ↔ Endpoint (user)/Content Provider

There may be slight variations of path in the above hierarchy, but most data traverses one or more sections of the hierarchy. With the TCP-IP protocol as a de-facto industry standard, most asynchronous applications such as e-mail, file transfers, collaboration tools, and on-demand services run seamlessly across these networks

Figure 2. An example of a multifaceted network



OHIO'S INFRASTRUCTURE SUPPORTS 100,000 E-LEARNERS

The verdict is in – Ohioans like e-learning. For the past five years, enrollments increased as Ohio's colleges and universities expanded their delivery of e-learning. In 2006, nearly 100,000 students enrolled in courses in Ohio's public and independent colleges and universities.

With a campus within 30 miles of nearly every Ohioan, Ohio has a tradition of reaching out to its citizens through its 118 public and private colleges and universities. E-learning shows great promise to increase access to higher education, increase educational attainment of Ohioans, and thus improve the state's economic condition.

A total of 49,470 students enrolled in at least one course at a public institution (autumn 2006 data). E-learning continues to grow in the independent colleges and universities as well, with an additional 49,799 enrolled in fall 2006. (http://www.oln.org/about_oln/pdf/Catalyst_for_Change_2007.pdf)

These increases compare to national enrollments in the Sloan report: *Online Nation: Five Years of Growth in Online Learning,* which counts almost 3.5 million students taking at least one online course during the fall 2006 term, a nearly 10 percent increase over the number reported previous year. E-learning encompasses multiple delivery modes – online, blended, technology-enhanced, interactive video, television, CD or DVD, and correspondence. Web-based remains the most popular delivery method in Ohio with more than 85 percent of e-learning courses offered via the Web.

In Ohio's public colleges and universities, several consistent patterns emerge according to *Catalyst for Change 2007*:

- Mostly women enroll in e-learning courses (68 percent).
- Adults (25 or older) make up half of the enrollments (50 percent).
- High school students (PSEO) represent only 2 percent of total online enrollments in Ohio.
- Ohio's community and technical colleges lead the way in recruiting more students into distance learning courses (31,064). Community colleges have 41 percent of the state's undergraduate students, but 63 percent of all the undergraduate distance learning students.

- As 11 percent of all students at Ohio's public colleges and universities now take distance learning courses (up to 19 percent – almost 1 in 5 – at community and technical colleges), the way that we conceptualize student services needs to change – gone are the days of waiting in line to register at the registrar's office. Now students demand online services.
- Ohio is the fourth largest consumer of commodity Internet amongst the Higher Education Internet Service Providers. Ohio consumes 5.5Gbps of Internet bandwidth, which equates to approximately 20 percent of the total consumption nationally.

ISSUES IN INFRASTRUCTURE AND DISTANCE LEARNING IN OHIO

We now turn to the challenges facing higher education. Ohio Governor Ted Strickland set a goal of 230,000 more learners by 2017. State education officials recognize that a significant portion of those new learners will be working adults and that many of those new learners will use distance technologies. Adult learners currently represent 171,294 enrollments with the 2017 goal of 351,347 learners. (www.universitysystem.ohio.gov)

An additional challenge to higher education is that the student body enters traditional higher education with expectations built on mobile devices, sharable content, and collaborative learning. Teens are highly adaptable to technology, communications and art as evidenced by the widespread use of Internet sites such as MySpace, YouTube, and Flixster. Adults are often slower to adapt to changes that can create both boundaries and barriers. For Ohio's colleges and universities attracting a younger audience, this situation provides one unique set of challenges. For those institutions and state projects targeting working adults spanning a three-decade age range, an assortment of other challenges arise. Technology, it is believed, provides the permeability to bring learners together across barriers.

Infrastructure has its own set of issues. In the traditional multifaceted networks environment, time-sensitive applications such as streaming multimedia, real-time multiplayer games and VoIP and Video over IP do not always perform well. Quality of Service (QoS) implementation and over-provisioning (fat pipes) are two proven solutions to this problem. Yet, these real-time applications face other complexities and challenges, such as traversing firewalls and packet-shapers used for securing the networks. Network administrators and security staff are constantly struggling to strike a balance between security and smooth implementation of applications. Although many major manufacturers claim to have overcome these issues, there are, in practice, configuration tweaks required to overcome these obstacles. These challenges thereby make network connectivity far less reliable than the 99.999 percent that consumers are used to with POTS (the plain old telephone system).

Deployment of broadband last-mile connectivity in remote, rural or economically impoverished areas is challenging because traditional telecommunications carriers cannot generate sufficient ROI on their investments in these areas and so are reluctant to offer services. Defining broadband is a national challenge. The current FCC definition of 200Kbps is far below the acceptable standards in Europe and Asia. In Ohio, higher education wants to achieve 45Mbps as the minimum. Almost 50 percent of Ohio's higher education institutions have reached this target in the past three years. Investments in last-mile connectivity through public-private partnerships using state government and education as anchor tenants is one of the many models being tested in Ohio. Only time will tell if the free market economy in the U.S. is capable of accepting such a model to proliferate broadband and distance learning capabilities to all its citizens.

FUTURE TRENDS: TECHNOLOGIES TO WATCH

The annual Horizon Report (2008) is an excellent resource tracking new and emerging learning technologies. Ohio institutions are incorporating some of these technologies into e-learning and campus-based learning.

From the networking and infrastructure perspective, OSC is partnering with several university labs at The Ohio State University (Dept. of Material Science and Engineering, Dept. of Chemistry, Dept. of Astronomy), Miami University (Electron Microscope Facility, Dept. of Biochemistry), and Ohio University (Dept. of Physics and Astronomy) to explore the potential of these technologies.

Other technologies mentioned in the Horizon Reports and Ohio examples are listed below:

- **Social computing:** Application of computer technology to facilitate interaction and collaboration including blogs, wikis, or group writing tools. Many Ohio colleges and university use blogs as part of class assignments. Students are creating MySpace sites as a way of self-organizing study groups.
- **Personal broadcasting:** Wright State University began using podcasting for faculty development two years ago and has seen a significant increase in faculty using this technology. Some colleges are adding podcasts as recruitment tools in degree listings in the *OhioLearns!* catalog (www.ohiolearns.org). Many colleges add podcasts of lectures to online content.
- **Phones in their pockets:** At the University of Cincinnati, cell phones feature special applications built specifically for the UC Mobile project. These applications include shuttle bus schedules, Mobile Help, and information about courses. The buses contain GPS devices that pinpoint bus locations on the cell phone map display, showing a student where the shuttle is and when it will reach the next stop. Mobile Mobile Help directly connects students to UC Police, with the dispatcher receiving a screen pop of the student name associated with the phone number. Students receive information whenever course or organization content has been added or changed within the Learning Management System. The text message contains an embedded link that enables smartphone users to view the content just added on their cellular device.
- **Educational gaming:** Shawnee State University holds an annual gaming conference and offers a bachelor's degree in Gaming and Simulation Development Arts and Digital Simulation and Gaming Engineering. Ohio University, Kent State University, Lorain County Community College and Washington State Community College are also involved in game development education.
- **Augmented reality and enhanced visualization:** Ohio University began holding classes in Second Life's virtual world last academic year, and OU, the University of Cincinnati, Ohio State University and Bowling Green State University have projects in SL. OLN hosts an 'island' and provides an 'ambassador" for its member-institutions to experiment with learning in the immersive world.
- **Shared Instrumentation:** Access to expensive computer-controlled scientific instruments (e.g. electron microscopes, NMRs, telescopes) to researchers and industry is provided via OSCnet. Shared instrumentation has several benefits, including 1) access to users (i.e., remote students, researchers) who cannot afford to buy expensive instruments; 2) a higher return on investment (ROI) for instrument labs; and 3) avoiding duplication of instrument investments for funding agencies (NSF, Ohio Board of Regents)
- **Remote Instrumentation Collaboration Environment (RICE):** OSC is developing RICE, which is extensible and customizable software that supports use-cases involved in remote instrumentation sessions. It can be used by instructors and researchers to train students or conduct research on computer-controlled scientific instruments (e.g. electron microscopes, NMRs, telescopes) from remote locations on the Internet. Notable features of RICE include: network-aware video encoding, reliable teleoperation that avoids instrument damage caused by unwanted user-actions during network congestion, multi-user collaboration tools (VoIP, chat, control-lock passing, collaborators presence), and image data management.
- **Future applications:** OSC is leveraging its past success to develop a statewide cyberinfrastructure. Under the umbrella of OSC's Blue Collar Computing™ initiative, a newly formed Cyberinfrastructure and Software Development Group at OSC is working to provide wider access to significant networking, computing, and storage resources at the center and around the state.

CONCLUSION

Man-computer symbiosis is an expected development in cooperative interaction between men and electronic computers. It will involve very close coupling between the human and the electronic members of the partnership. The main aims are 1) to let computers facilitate formulative thinking as they now facilitate the solution of formulated problems, and 2) to enable men and computers to cooperate in making decisions

and controlling complex situations without inflexible dependence on predetermined programs.... J. C. R. Licklider in 1960

We can take pride that what Licklider predicted almost 50 years ago has come true; however, we have just scratched the surface of this "symbiosis" through the widespread deployment of the "Internet" in last 20 years. Now the challenge is to bring the society together in a "classroom" full of diversity of knowledge, experience, age, language and ethnicity, while collectively teaching and learning. Ohio is tacking this challenge on multiple fronts as this article demonstrates.

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KEY TERMS

Collective Intelligence: This definition has emerged from the writings of Peter Russell (1983), Tom Atlee (1993), Pierre Lévy (1994), Howard Bloom (1995), Francis Heylighen (1995), Douglas Engelbart, Cliff Joslyn, Ron Dembo, Gottfried Mayer-Kress (2003) and other theorists. Collective intelligence is referred to as **Symbiotic intelligence** by Norman L. Johnson.

Cyberinfrastructure: A rapidly growing and expanding component of information technology focused on distributed computing, data, and communications technology. Hardware and software systems are being rapidly developed and implemented to build virtual research communities, along with the collaborative tools to knit these user communities together.

CLEs: Collaborative learning environments characterized by a technology tool, often called a course management system. CLEs differ from a course management system in that they involve the people and the technology working in collaboration.

E-Learning: In Ohio is any course content delivered away from the central campus and using technology for the delivery method. Courses in the OhioLearns catalog must be 70% or more at a distance.

Learning Communities: Groups of colleagues that come together and commit to work collab0ratively. The Ohio Learning Network was funded communities since 2002. For details see http://wiki.lci.oln.org/page/LC+Defined

Local Area Network (LAN): A computer network covering a small geographic area, like a home, office, or group of buildings. The defining characteristics of LANs, in contrast to Wide Area Networks (WANs),

include their much higher data transfer rates, smaller geographic range, and lack of a need for leased telecommunication lines.

Quality of Service (QoS): Refers to resource reservation control mechanisms. Quality of Service can provide different priorities to different users or data flows, or guarantee a certain level of performance to a data flow in accordance with requests from the application program or the internet service provider policy.

Regional Optical Network (RON): A model of facility-based networking built with owned assets.

ROI, Return on Investment: A calculation to determine the value of a project or program. Various methods are used to create an ROI form sophisticated modeling to simple arithmetic.

TCP/IP: The **Internet protocol suite** is the set of communications protocols that implement the protocol stack on which the Internet and most commercial networks run. It has also been referred to as the TCP/IP protocol suite, which is named after two of the most important protocols in it: the Transmission Control Protocol (TCP) and the Internet Protocol (IP), which were also the first two networking protocols defined.

Voice Over Internet Protocol (VoIP): A protocol optimized for transmission of voice through the Internet or other packet switched networks. VoIP is often used abstractly to refer to the actual transmission of voice (rather than the protocol implementing it). VoIP is also known as **IP Telephony**, **Internet telephony**, **Broadband telephony**, **Broadband Phone** and **Voice over Broadband**. "VoIP" sometimes is pronounced *voyp*.