

Internet2 and Corporate Training  
at American Axle and Manufacturing

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American Axle & Manufacturing is an automotive parts supplier headquartered in Detroit, Michigan. AAM employs more than 8,500 associates that have a variety of educational needs. AAM corporate training includes areas such as health and safety, job skills, technical, information systems, ISO/QS quality certification, and leadership. This paper compared AAM's current training delivery methods with advanced methods currently being investigated by the University Corporation for Advanced Internet Development and its Internet2 project. Topics covered included Internet2's use of the vBNS and Abilene networks. The primary goals of the Internet2 project were discussed, along with examples of advanced Internet2 applications that included Learningware and the Instructional Management System, Digital Libraries, Tele-immersion, and Virtual Laboratory. The paper concluded with a look at the positive effect spinoffs from the Internet2 project would have on AAM.

## Internet2 and Corporate Training at American Axle and Manufacturing

American Axle and Manufacturing, Inc. (AAM) <<http://www.aam.com>> is a tier 1 manufacturer of automotive driveline systems. Headquartered in Detroit, Michigan, the company has five manufacturing facilities (three in Michigan, two in New York, and one under construction in Mexico). Manufacturing at these facilities is supported by a state-of-the-art technical center located in Rochester Hills, Michigan. AAM is planning near-term expansion into the European, Asian, and South American markets.

AAM employs more than 8,500 associates. The educational needs of these associates are quite diverse. Examples of areas covered by corporate training are health and safety, job skills, technical, information systems, ISO/QS quality certification <<http://www.iso9000.org>>, and leadership. In addition, AAM sponsors on-site university courses leading to undergraduate and postgraduate degrees.

In the following pages, this paper will compare AAM's training delivery methods (and network infrastructure supporting these) with advanced methods made possible using technologies currently being investigated by the University Corporation for Advanced Internet Development (UCAID) <<http://www.ucaid.edu>> and its Internet2 <<http://www.internet2.edu>> project.

### Corporate Training At AAM

AAM employs traditional methods of educational delivery for its corporate training. Associates attend classes both on and off-site. While PC-based multimedia training is given in some areas, the workstations used are stand-alone and have no tie to the outside world. As the company continues to grow globally, pressure to employ non-traditional education delivery will also grow. "Internet learning", the most popular form of non-traditional education delivery (Rudich, 1998), has yet to be employed at AAM.

The reason for this is AAM's focus on corporate and network security. This concern established a policy prohibiting Internet access in all but a few well-justified cases. However, customer requirements (i.e. access to GM's supplier site <<http://www.gmsupplier.com>>) have provided justification to connect to the Internet. Prior to the first of the year, AAM will be connecting its network to the Internet via a 1.544 Mbps T1 connection. While this is a clear step forward for the corporation, the bandwidth provided by the new T1 connection falls far short of that required for extensive web-based training. In addition, the Internet, as it exists today, would be unable to support the requirements of an AAM web-based training program even if multiple T1 lines were added.

### Internet2

Universities, private companies, and the U.S. government have recognized the need to upgrade the existing Internet to handle the high-bandwidth applications required to

support distance learning in the future. Their response was the formation of UCAID. UCAID is a non-profit consortium of more than 100 universities and 20 companies that was founded in 1997. The consortium is working closely with Clinton's Next-Generation Internet (NGI) <<http://www.ngi.gov>>. NGI is funding research on high-speed networks for federal agencies.

The Internet2 is a high-speed network administered by UCAID. UCAID defines it as follows:

"Internet2 is a collaborative project by over 110 U.S. research universities, who are engaged in the development of a new family of advanced applications to meet emerging academic requirements in research, teaching and learning. Internet2 is addressing this challenge by creating a leading edge network capability, enabling a new generation of applications, and integrating these efforts with the current academic Internet services" <<http://www.ucaid.edu>>.

UCAID is developing techniques for providing high-speed points of presence known as "GigaPOPs." These gigaPOPs will serve as switching points for Internet2. The first gigaPOP was put into service in late 1997 at the Research Triangle Park in North Carolina. High-bandwidth applications (e.g. full-motion video and 3-D animations) are being developed and tested to determine the transport mechanisms required to carry them in realtime. Internet2 uses existing networks such as the Very high-speed Backbone Network Service (vBNS) and the Abilene Network.

The National Science Foundation (NSF) and MCI developed the vBNS. Launched in 1995, the vBNS is the product of a five-year agreement between the two organizations (Roote, 1998). It currently has 56 (622 Mbps (OC-12)) connections that include four supercomputer centers <<http://www.vbns.net/backbone.html>>. The vBNS employs SONET and other fiber optic and high-speed switching and transport technologies. The vBNS will migrate to gigabit speeds by the year 2000.

The Abilene network is a project of UCAID and several major telecommunications companies <<http://www.ucaid.edu/abilene>>. Companies such as Cisco, 3Com, MCI, Nortel, and Qwest have donated equipment worth more than \$500 million. The network was named after a pioneering railroad outpost in the American West. It will provide an alternate 2.4 Gbps (OC-48) backbone among gigaPOPs with OC12 or OC3 connections. Abilene plans to increase backbone capacity to 9.9 Gbps (OC192) and include multicasting and QoS (Quality of Service) services during 1999.

Internet2 has three primary goals <<http://www.internet2.edu>>. First is to provide leading edge network capability for the national research community. Currently the research community relies upon the network services of the National Science Foundation's NFSNET <<http://www.nsf.gov>>. The NFSNET backbone was created in 1985 to carry research and education traffic (Gaston, 1998). However, privatization of the network and the inability of its commercial replacement to handle network congestion are depriving faculty of the network capability required to do cutting edge research.

The second goal is to focus network development research that will allow next generation applications to take advantage of media integration, interactivity, and real time collaboration. This work is essential to meeting educational goals set forth in distance education and national research. The third goal is to transfer the technology developed and lessons learned quickly over to the Internet for educational use at all levels worldwide.

A primary goal of Internet2 is to create application development tools that take advantage of Internet2 high-speed network services. These tools will be developed in the process of developing certain advanced applications. Examples of Internet2 applications are Learningware and the Instructional Management System, Digital Libraries, Tele-immersion, and Virtual Laboratory.

### **Learningware and the Instructional Management System**

Most instructional software employed today is designed for stand-alone use. One example is the CD-ROM multimedia training currently used for health and safety courses at AAM. Internet2 provides the infrastructure to work on applications that employ the use of distributed learningware. Component technologies are the key building blocks that will allow networked learning materials to be more easily developed. These technologies include Distributed System Object Model (DSOM), Java, Active-X, and OpenDoc. Internet2 will provide an environment for these technologies to fully develop.

Internet2 will also help design a network-based, instructional management system called IMS. IMS is a hybrid between the highly structured classroom and a total lack of structure normally associated with web surfing. IMS is made up of both standards and services. The standards will allow distributed modules to interoperate with one another. Standards create a common method of organizing and retrieving network-based instructional objects. EDUCOM created the National Learning Infrastructure Initiative to create and publish IMS standards <<http://www.educause.edu>>.

### **Digital Libraries and Information Access and Distribution**

The existing Internet provides an environment for developing digital library systems. Examples include the ARPA/NASA/NSF sponsored Digital Library Programs. These programs allow online access to catalogs, indexing databases, and full text journals. However they also suffer from the reliability and performance problems of the Internet. Internet2 plans to move the Digital Libraries program into new areas.

The very high bandwidth and bandwidth reservation environment of Internet2 will allow continuous digital video and audio to become broadly used. Images, audio, and video will move into territory currently occupied by text. Internet2 will also provide sufficient performance at the desktop to evaluate information visualization technologies. This will provide researchers with a valuable tool for organizing, navigating, and understanding large complex information spaces.

In addition to digital libraries and access to information, Internet2 will provide an environment for distributing large amounts of information (e.g. multicasting). Current Web-based push technologies such as PointCast <<http://www.pointcast.com>> give a limited indication of Internet2's capabilities. Internet2 will make it possible to stream information of all types -- telemetry, sensor readings, publication announcements, and database updates. The challenge that Internet2 designers have is to iron out the algorithms that will handle the multicast tress and determine how to route them (Anonymous, 1998).

### **Tele-immersion**

Another Internet2 application is tele-immersion. Tele-immersion is the combination of:

- cave-style immersion technology,
- advanced high-speed telecommunications systems supporting collaborative applications, and
- extensions of current cave technology to recognized the presence and movement of other individuals in the cave.

CAVE (Computer Automatic Virtual Environment) is a virtual reality system that uses projectors to display images on walls and floor. Special glasses make images appear 3-D. CAVE was the first virtual reality system in which multiple users participated in the same virtual experience (Lange, 1998). The Electronic Visualization Laboratory developed CAVE at the University of Illinois during the early 1990s.

Tele-immersion allows individuals at different locations to share the same virtual environment. However, such an advance application requires infrastructure with high bandwidth, low latency, and time-dependent synchronous communications characteristics. Internet2 will provide this infrastructure.

### **Virtual Laboratory**

Internet2 will support development of virtual laboratories. These are distributed problem-solving environments in which researchers from around the world would be able to collaborate on common projects. Virtual research is currently underway at Indiana University, Princeton, and the Massachusetts Institute of Technology.

Work within a virtual laboratory requires massive simulations that are supported by multiple supercomputers working in concert. One example would be the use of a virtual lab to perform multi-disciplinary design of a large and complex product, such as an automobile. The design and simulation process would require simultaneous access to hundreds of subcomputations that would be provided by subcontractors, such as AAM.

## **Conclusion - Corporate Training at AAM in the Future**

As previously discussed, delivery methods for corporate training at AAM are quite traditional. AAM's upcoming connection to the Internet will allow corporate trainers to take advantage of existing web-based training environments. The Internet2's goals of providing leading edge network capability, next generation applications, and technology

transfer will have a significant effect on AAM's future training programs. Advanced applications similar to Internet2's Learningware and Instructional Management System, Digital Libraries, and Virtual Laboratory will provide instructors with the tools needed to train AAM's growing worldwide workforce at a competitive cost.

In addition to the affect on AAM's training programs, Internet2's advanced CAVE technology, along with virtual manufacturing labs, will have a substantial impact on the automotive design process. Future high-speed networks (derived from Internet2 research on Abilene and vBNS) will provide AAM with the infrastructure necessary to remain competitive in the global automotive marketplace. As a tier 1 supplier to General Motors and other manufacturers, the virtual, participative, design environments that will be developed as part of Internet2 will allow AAM and its partners to work as one integrated manufacturing team.

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