Educational Media On-Demand

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Introduction

This report describes a demonstration of multimedia-on-demand for education presented at convocation by the National Academy of Sciences entitled **Reinventing the Schools: The Technology is Now**. To the best of our knowledge this demonstration marked the first use of real-time multimedia on-demand, with intensive use of digital video content, over a network. It therefore has historical value worth documenting.

Motivation

The following motivation was presented as a challenge by the National Academy of Sciences:
Today's children have grown up immersed in a world of computers and other information technologies. They play video games; they listen to music on digital compact disks; they help their families program the computerized controls of videocassette players. With all of the exciting innovations in computer technology, children have the opportunity to gain a wealth of knowledge without ever leaving home. Schools by comparison can seem dull.
Education reformers have been developing new approaches for improving the way in which children learn and interact in the classroom. They now must consider the "technology gap" that exists between the technologically rich experiences children have outside the classroom and the comparatively low-tech, in-school environment. The aim is not just to outfit more classrooms with computers. Schools should be changed so that they encompass and guide out-of-school activities that already embrace technology.

The Use of Technology in Education

As more emphasis is placed on the use of technology in education, teachers must be supported not only in their efforts to bring technology to students, but to bring knowledge to students by effective use of technology. Multimedia technologies hold the promise of enriching classrooms and homes with a wealth of knowledge that is compelling, motivational and meaningful. Multimedia technologies are available and will continue to advance in effectiveness for producing meaningful and vibrant representations of information. Many new sources of information will be tapped and real-life activities will be captured for wide dissemination and repeated analysis. Multimedia, the combination of text, graphics, image, sound and full motion video, represents a powerful and very desirable form of content representation, and can provide interactive communication experiences.

The challenge is how to exploit these technologies to bring about widespread systemic and sustained educational change. It is not sufficient to bring this technology into the classroom; it

is also necessary to use this technology to bring multimedia into the classrooms in a coherent, well-organized way.

The Sources and Use of Multimedia Content

A key aspect of organization is the ability to access materials in a timely manner and when they would be most effective. The wealth of materials already in multimedia form that are sought for use in education makes this a significant problem. Many content providers have libraries of videos capable of enhancing many lesson plans. But these are not always available for public viewing when they would be most relevant and desirable. Even in cases where video materials are available to teachers their deployment is often complex, thus discouraging use.

Other potential sources of multimedia content such as museums go unexploited, except by students in the immediate vicinity. Greatly enriching experiences are often only shared locally. This is also true of research laboratories and universities. Such resources are most commonly accessible to local schools, if at all. Thus partnerships among scientists and teachers cannot be easily shared beyond the immediate sites involved in individual projects. Capturing such resources in the form of multimedia documents would create a legacy of knowledge and information that could be shared more widely.

Accessing Information On-Demand

Even if existing sources were made available, and potential sources were tapped, the problem would still remain of how to access the information on-demand. The information highways of the future will greatly enhance the ability of teachers and students to access materials, to share knowledge and initiatives, to reach and participate in these, and to relate and compare accomplishments to world-class standards. But the technologies to move information must be coupled with technologies for representing, organizing and distributing the information.

The processing power required to manipulate multimedia can be achieved in a workstation, but until now has been confined by the limited capacity of local storage. For example, a single hour of compressed digital video requires 700 megabytes, or 1.5 megabits for each second of video. A library of 1,000 hours of digital video would require 700 gigabytes of storage, far beyond the capacity of any workstation. At 1.5 megabits per second, about 10 digital video streams would quickly exhaust the capacity of most existing local area networks (LANs).

Superserver technologies are required to store and manage large libraries of information that are digital video intensive; to support simultaneous access by many users; and, to provide the communications support to allow both mass delivery of interactive multimedia with full motion video over local area networks, and wide area network (WAN) access by geographically dispersed users to digital content through the telephone network.

The Technology Is Now

In this demonstration a superserver located at the Thomas J. Watson Research Center in Hawthorne, New York, is supporting a LAN server and token ring-network of clients at the National Academy of Sciences in Washington, D.C. Multimedia content is being delivered on-demand over a high-speed (T1) communication line (1.5 megabits per second). Utilizing its enormous memory, storage and high-bandwidth connectivity the superserver could support

close to 2,000 simultaneous random access full-motion video streams on a large ES/9000. This corresponds to a community numbering in the tens of thousands with access to a huge library of multimedia content. Because the host disks are so much faster than the workstation disks, in many instances the data from the host is received at the workstation for processing sooner than if it had come from within the workstation itself.

The creation of a powerful education infrastructure is possible with effective use of technology. It is possible to construct the supportive environment that will bring educational multimedia to every school and home. The technology is here, now.

Architecture of the Demonstration

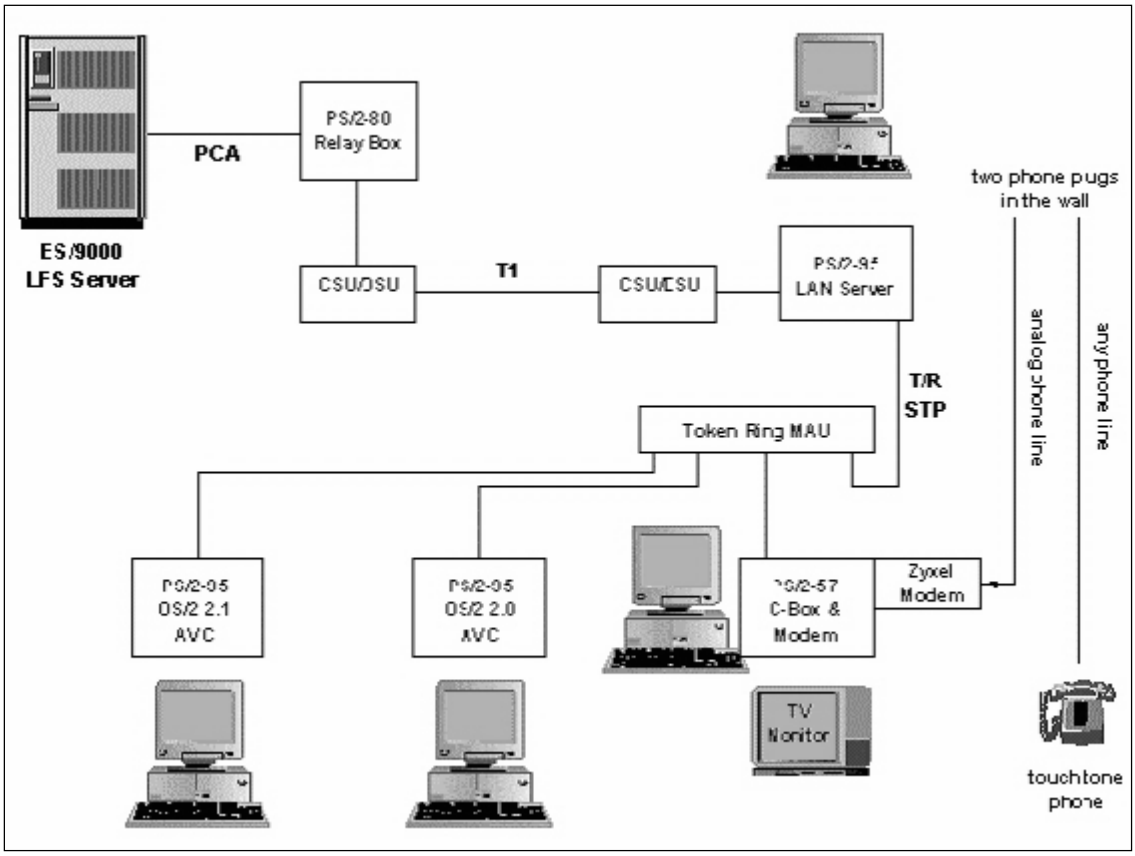

Figure 1. Details of the system architecture.

Conclusion

According to the National Academy of Sciences, closing the technology gap is possible:
Not only is this vision possible, it also is feasible, according to "Reinventing Schools: The Technology is Now," an on-line publication from the National Academy of Sciences and National Academy of Engineering. The document is based on a meeting at which hundreds of leaders from government, education, and the entertainment and information technology industries, developed strategies for reinvigorating the K-12 educational process by integrating the school experience with the information technology that has captured children's imaginations.

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References

For more information on the convocation please see:
STRATEGIES TO DECREASE 'THE TECHNOLOGY GAP' IN SCHOOLS, PRESENTED ON THE WORLD WIDE WEB, June 16, 1995, (http://www.nas.edu).

The National Academy of Sciences and the National Academy of Engineering, Office of News and Public Information, 2101 Constitution Avenue, N.W., Washington, D.C. 20418, Telephone: (202) 334-2138, (Email: news@nas.edu).

REINVENTING SCHOOLS: THE TECHNOLOGY IS NOW is available in multi-media format from the National Academy of Sciences through the World Wide Web, (http://www.nas.edu/nap/online/techgap/welcome.html).

A printed version is planned and will be available through the National Academy Press, Telephone: 1-800-624-6242 or (202) 334-3313.