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Broadband Residential Multimedia Systems as a Training and Learning Tool

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Abstract

This research proposes the use of emerging interactive multimedia residential networks as a training and learning delivery tool. Such a system is currently being built to create a national information infrastructure. However there are many technical and social problems that need to be addressed before this becomes a reality. We specifically show that using such a network can be effective, convenient and cut costs tremendously over other traditional methods of training delivery.

Introduction

Information has recently been accepted as a corporate asset. Information is typically stored, manipulated, delivered and retrieved using a plethora of existing and emerging technologies. Businesses and organizations must adopt these emerging technologies to remain competitive. However, the evolution and progress of the technology (object orientation, high-speed networking, Internet etc.) has been so rapid that organizations are constantly facing new challenges in end-user training programs. These new technologies are impacting the whole organization creating a paradigm shift which in turn enables them to do business in ways never possible before. Thus not only the low-level software developers but the "entire vertical segment of the company structure" is impacted by the resulting paradigm shift (Pancake 1995). The need to spend less money and yet train more people effectively becomes a major concern of end-user training practitioners as well as researchers.

While the training literature provides very valuable insights on training methods that include conceptual models, motivational planning and management (Bostrom, et.al 1988) that influences the training outcomes, it generally ignores the issue of how to set the physical environment to facilitate more efficient learning, especially from a technological point of view. A framework for training includes: *initiation, formal training with learning and post-training* (Compeau, et. al 1995). In this research, we focus on the formal training along with learning phase, specifically the delivery of such contents via advanced telecommunication technologies. We discuss the possibility of disseminating training sessions using broadband interactive multimedia technologies directly to residential customers (Chatterjee, 1997). We investigate the requirements that interactive virtual training brings to such a system and evaluate several different types of access network technologies (including their drawbacks and strengths) and review exciting

applications which could be effectively used for training and learning purposes at an affordable price.

The critical "last mile"

There is currently an effort to build a National Information Infrastructure (NII) in the U.S. that will offer seamless end-to-end delivery of information and communication services. Our research focuses on one important segment of the NII which is often called the "last mile" that will deliver services to millions of homes and virtual offices. This segment is currently the bottleneck which needs upgrading so that broadband voice, video and data communications along with interactivity can be supported. The backbone networks that will interconnect all these "last mile" stretches is also currently undergoing evolution towards high-speed infrastructure.

Access network architectures: An overview and challenges

We are entering the threshold of an era in which seamless, end-to-end, multimedia delivery and services over high-speed communication networks are fast becoming a reality. Interestingly, the senders and recipients of such information can be either static (a residential host on the Internet) or mobile (a laptop with wireless interface in a moving car). A system that can effectively deliver good quality of training will need to have the following technical requirements:

- high bandwidth (greater than 20 Mb/s if HDTV quality is needed)
- low to moderate delay (in the range of conversations)
- an integrated appliance (computer, phone, television, camera etc. all into one ubiquitous device)
- reliable network access

Let us begin by looking at some of the important components of the evolving infrastructure, as shown in Fig. 1. An end-to-end system is comprised of a number of major elements. These include: information service providers, a backbone carrier network, and residential access networks (RAN), and finally a switching office equipped with special gateway functions as the interface between the access network and the backbone.

The access to our homes is currently provided by either the cable operators or the telcos (i.e., the phone company). A twisted-pair copper wire delivers switched voice services (64 kbps) over a connection-oriented TDM mechanism. Limited data communications (up to 33.6 kbps) is possible via modems. Recent ISDN offerings provide 128 kbps, while some new technologies are being experimented to provide higher bandwidths. Notable among them are asymmetric digital subscriber loop (ADSL) that gives 1.5 Mbps downstream and only 16 kbps upstream and high bit-rate digital subscriber line (HDSL) to give full-duplex T-1 (1.5 Mbps) speeds. The cable TV networks have more capacity but have been traditionally a one-way system distributing entertainment analog signals. It does not support interactivity (two-way) nor digital signals. However, recent new architectures such as hybrid fiber-coax can bring interactive multimedia to the home. The high bandwidth of recent fiber cables can digitally modulate 6 MHz channel to carry

anywhere from 3 Mbps to more than 30 Mbps of compressed MPEG-2 digital video. That makes video-on-demand or near video-on-demand based training possible.

Mobile communications is currently focusing on providing telephone service to users over a cellular architecture. The AMPS system built by AT&T was an analog network infrastructure that is being slowly upgraded to a digital system. Since the need for data communications from portable devices arose, a packet switched digital datagram service called CDPD (Cellular Digital Packet Data) is being built on top of AMPS that would provide data communication at a gross rate of 19.2 kbps. The ability to handle high bandwidth and real-time video communications that training environments need is still far away for wireless and mobile communication systems.

The backbone network is designed to carry huge volumes of multiplexed traffic (data, voice and video). The Internet which can function as a backbone, is an interconnected set of subnets (LANs, WANs,, and point-to-point lines) connected together by routers and the TCP/IP software. The telephony community is also carefully planning a Broadband-ISDN using Asynchronous Transfer Mode (ATM) technology (Chatterjee, 1997) to provide backbone bearer services. As the last miles get upgraded, they will push the technology limits within the backbone and we can expect in the near future that such backbones will be based on totally optical networks operating at a range from gigabit/sec to terabits/sec speeds.

Significance of broadband to training

Broadband and interactive residential multimedia communication technology can help reduce training costs because it provides a mechanism for more people who are not physically present at a training site to share the same training class in the convenience of their homes. The advantages of this approach are:

1. Better education - a lot of the literature mentions that the quality training is related to the quality trainer (Pancake, 1995). When lot of people need to be trained in an organization, the number of trainers required can be reduced with the help of real-time multimedia communication. Thus organizations can concentrate on finding a good trainer instead of enough trainers.
2. Cost-saving - real-time multimedia communication is expected to provide more efficient training process and in the long run, outperform the traditional training methods in terms of cost.
3. Time-saving - since more people can learn at the same time, the overall time needed for training will be shortened.
4. Convenience and choice - in the near future, users can access all training material and participate in interactive workshops from the convenience of their home. Not only do they point and click on a particular session, they also will have a choice to choose a trainer or a training site. In fact even within one topic, they will be able to shop from several servers around the world and get different perspectives and even a different flavor of the learning experience. With the advent of mobile and wireless computing, users will be able to continue the training/learning process on the move.

The goal of training is "to produce a motivated user who has the basic skills needed to apply what has been learned and then to continue to learn on the job" (Compeau, et.al 1995). Therefore, the benefits from training actually incorporate "understanding of the system" and "motivation to use" (Bostrom, et. al 1988). Additionally, most literature

agrees that the "social environment can have a strong influence on the success of the training/learning process" (Bostrom, et.al 1988), and the "integrated" training are more efficient (Nelson, et. al 1995).

Better and more efficient learning can be achieved through some form of apprenticeship under which the trainer can provide the trainees appropriate feedback to their work.

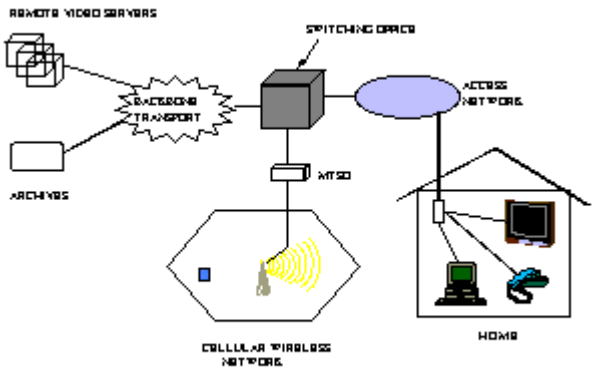

Figure 1: An end-to-end broadband network infrastructure

However, organizations usually couldn't afford this kind of training because it took too much time and money. But this emerging broadband residential networking system will now enable the users for themselves to obtain the necessary training while the organization may reimburse such expenses incurred.

We believe that interactive multimedia technology will likely improve users "motivation of use" through the social environment mechanism (Bostrom, et. al 1988; and Galletta, et, al., 1995). The flexible communication style it provides makes it possible for trainees to share and exchange their learning experience frequently. Thus they learn faster and emotionally support each other through the training process. According to the Positive Motivation Dynamic model (Bostrom, et. al 1988), while the "emotionally supportive sessions" can lead to high motivation during training, the "increased skills lead to competence" can promote high level motivation in post-training phase.

Conclusion

This paper highlights the emerging interactive broadband residential technologies that can be used as a training and learning delivery tool. But before this is possible, several advancements have to take place. These are in the form of bandwidth upgrades, support of interactive two-way traffic, high-speed downloading of video and multimedia information, a global network of servers that can be reached via internetworking and easy to use graphical user interfaces that can help the user to browse and navigate through the diverse choice of training sites. Quality distance training cannot occur until an interactive high-bandwidth network is available to homes and virtual offices. Technical, business, social and economic aspects of such an infrastructure needs to be studied.

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