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VIDEO STREAMING AND SMIL: TECHNOLOGIES FOR TEACHING

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ABSTRACT

The purpose of this technical note is to call the attention of the IS community to two technologies: synchronized multimedia integration language [SMIL] and video streaming that deliver video and audio effectively through the Internet. This note

- describes the technologies
- shows how these technologies improve education
- presents the results of a multinational survey of small groups of students from in Hong Kong, in Seoul, and at the author's institution in the U.S to assess the value of these technologies as an instructional tool.

The survey results confirm the usefulness of the technologies.

KEYWORDS: Multimedia, Streaming Technology, Education

I. INTRODUCTION

E-learning, the delivery of educational content via a web browser over the Internet or Intranet anytime and anywhere, is emerging as a new channel of acquiring education. For example, in April 2001, Massachusetts Institute of Technology (MIT) announced the arrangement of freely available materials for all its courses on the Internet over the next ten years [MIT Press, 2001]. The synchronized multimedia integration language (SMIL) and video streaming technology are two of the technologies that deliver video and audio effectively through the Internet. With the help of these technologies, the web-based learning experience can be more effective and successful.

The purpose of this technical note is to call the attention of the IS community to these two technologies. This note

- describes the technologies (Section II and III)
- shows how these technologies improve education (Section IV)
- presents the results of a multinational survey of small groups of students from in Hong Kong, in Seoul, and at the author's institution in the U.S to assess the value of these technologies as an instructional tool. (Section V).

II. SYNCHRONIZED MULTIMEDIA

THE PRECURSOR: HYPERTEXT

Originally introduced by Vannevar Bush, and then extended and refined by Nelson, Engelbart, and others, hypertext systems were initially defined as a valuable interactive approach for presenting text and graphic information by allowing users to jump from a given subject to related ideas [Horn, 1989; Shim and Chun, 1994]. Ted Nelson, who some believe is the originator of the term, includes all media in the term "hypertext." In the computer industry, however, "hypertext" generally refers to text-on-based systems. In general, we can consider hypertext to be a sophisticated approach for interactive use of text-only databases. Figure 1 depicts the evolution

Figure 1. A History of Synchronized Multimedia

of hypertext, hypermedia, and multimedia from 1935 through 2000. Starting in the early 1990s, technological breakthroughs occurred in multimedia with the development of Internet/Web based multimedia, and Web- based video streaming and synchronized multimedia [Shim, 2002].

STREAMING VIDEO OVER THE INTERNET

Most of the e-learning solution providers, such as *Click2Learn*, *DigitalThink*, *SmartForce*, and *NETg*, claim to use streaming technology to enhance the quality and effectiveness of their products. They argue that streaming media is effective because the video helps people to retain information [Click2Learn 2000]. During the past several years, streaming video over the Internet became routine. Professional journals, including *IEEE Transactions on Circuits and Systems for Video Technology*, devoted special issues to the topic [Wu et al., 2001].

Sidebar 1 describes how streaming video works and Figure 2 shows the architecture of video streaming.

SIDEBAR 1: HOW STREAMING VIDEO WORKS

The two modes of transmission of video over the Internet are the download mode and the streaming mode (video streaming). In the download mode, a user downloads the entire video file and plays back the video file. In the streaming mode, the video content plays simultaneously while parts of the content are being received and decoded. As shown in Figure 2, raw video and raw audio are compressed by video and audio compression algorithms. A streaming server retrieves compressed video and audio data from storage devices. Media synchronization mechanisms are used to achieve synchronization between video and audio presentations. A streaming video can be created with a raw video source such as a video camcorder or videotape, a PC, and encoder, such as Real Producer or Media Producer (see Figures 3 and 4). The encoding software captures the video from the source (e.g., videotape), and encodes the video in streaming format into a file on the PC. Several compression techniques can be used for video streaming. Two of the most widely known compression techniques are RealNetworks' RealSystem and Windows Media. Once the media is ready for use, it can be uploaded to a media server such as Real Server or Microsoft Media Server.

SMIL

The synchronized multimedia integration language (SMIL, pronounced "smile"), which is similar to HTML, enables simple authoring of interactive audiovisual presentations. SMIL is recommended by the World Wide Web Consortium (W3C) for integration of independent multimedia objects with a synchronized multimedia presentation. It is typically used for "rich media" and multimedia presentations which integrate streaming audio, streaming video, images, and text. For example, in Real Player, SMIL allows a user to display graphics simultaneously with the video component. While traditional video allows a user only to view the video itself, a SMIL file allows placing images and a PowerPoint file on different parts of the screen. Thus, the user views both the video and PowerPoint presentation simultaneously.

Streaming video effectively brings audio and video together into one affordable technology. Companies are using this technology to enhance their websites interactively, and to make it more appealing. Over the past several years, numerous companies presented products, promotional materials, and training/education materials using video streaming and/or SMIL. [Saunders *et al.*, 2001, and <http://www.streamingmediaworld.com/smil/cool>]. An example is the Tivoli Business

Source: Adapted from D. Wu et al. , IEEE Transactions on Circuits and Systems for Video Technology, Vol.11, No. 3, 2001

Figure 2. The Architecture of Streaming Video

Manager's presentation. http://www.tivoli.com/products/demos/tbsm/tbsm_noaudio.html

(Note: this SMIL example does not have audio). Toyota, Ford, HP, and Dell also introduced and incorporated video streaming in their websites for visual enhancement of their products, and for customer relations management.

Figures 3 and 4 are flow diagrams that show how to develop Real Systems/ Windows Media files and how to develop SMIL.

IV. VIDEO STREAMING AND SMIL FOR A MIS COURSE

The delivery of information and instruction has been improved by technological developments. Past studies [Callahan *et al.*, 2000, Shim, 2000] prove that traditional lectures can be one of the least effective methods of teaching. Therefore, integrating video streaming and SMIL with these traditional lectures enhances the educational and learning environment, not only for the students but also for the instructors. It allows the instructor to have more flexibility through video streaming technology and SMIL-aided instruction. This flexibility in video streaming technology and SMIL-aided instruction allows the instructor to show students PowerPoint slides (saved as animated JPG file) and a streaming file simultaneously. This method combines the traditional lecture with SMIL and video streaming-aided instruction, as well as other instructional materials such as case studies and independent projects. An example for this type of course (i.e., a regular semester or a short-term intensive seminar) is available on the Internet Website (see Figure 5). The website offers text materials using PowerPoint slides together with links to other relevant and helpful

Figure 3. Developing Real System/Window Media

Figure 4. Developing SMIL

websites. In addition, video streaming and SMIL files are available for each chapter of the relevant MIS materials. For example, the students' presentations and/or guest speakers' lectures can be videotaped, encoded, and then shown through a decoder (either RealPlayer or MediaPlayer). These presentations (including students' term mini-project) can be viewed at: <http://real.msstate.edu:8080/ramgen/dept/bis/att.rm> (a 14-minute video used by AT&T in a class presentation)

http://real.msstate.edu:8080/ramgen/dept/bis/db/dean_byrd.smi (4.5 minutes)

http://real.msstate.edu:8080/ramgen/dept/bis/ck/chong_ki.smi (6.5 minutes)

Figure 5 shows a sample of web-based and SMIL instruction. The figure shows the following items:

1. The first screen encountered by an instructor in creating a web course.
2. The on-line syllabus website accessible to students
3. A listing of course materials
4. Two typical PowerPoint slides on the net
5. Screenshot that shows the author using SMIL in one of his class sessions. Note that because it is a screenshot, the Powerpoint is not as crisp as it is seen by the user.

Editor's Note: Readers wishing to read the details of the individual screen shots will find it useful to enlarge the page on their screen.

V. STUDENT PERCEPTIONS

THE SURVEY

During the 2001 Spring and Summer semesters surveys were run of graduate student perceptions of SMIL and video-streaming-aided instruction in MIS courses at Hong Kong (HK) , Seoul, and Mississippi State University (MSU). A survey instrument, which used a Likert scale (5(strongly agree) to 1(strongly disagree)) was developed and administered to 70 students (n=43 in HK; n=15 in Seoul; n=12 at MSU). The graduate students had completed the MIS course or attended an e-Business seminar. Most respondents were part-time students who worked during the day.

FINDINGS

Videoplayers. As shown in Figure 6, Windows Media Player and Real Player were the two most used decoders in all three countries with Quick Time Player ranking third.

Value of Video Streaming. The survey showed positive and favorable responses (between 4.0 and 4.5 on the scale of 5) on the perceived value of video streaming in areas of education/training and media/entertainment (Figure 7). Other promising areas include video on demand, digital library, banking, home shopping, and transportation. The difference in perceived values among graduate students in the three countries was slight.

What is important for this study is that the respondents believe that video streaming technology will be quite popular in the near future. The students were nearly unanimous in making either "agreed" or "strongly agreed" on "increase understanding of the subject" and "serve needs" (Figure 8). However, they did not believe that the technology would replace lectures.

Figure 6. Videoplayers Used

Figure 7. Perceived Value of Video Streaming

Scale: 1(Strongly Disagree) to 5 (Strongly Agree)

Figure 8. Effects of SMIL and Videostreaming

Table 1 shows the respondents' experience and use of video communication services, such as video-telephony, PC-based conferencing, mobile video-conferencing, and video-streaming/multicasting. Although none of the students had experience with mobile video-conferencing, a few students did know how to build websites/applications using streaming technology.

Table 1. Respondents' Assessment of Streaming Technology

	MSU(n=12)	Seoul (n=15)	Hong Kong (n=43)
Perceived benefits	<ul style="list-style-type: none"> • Eliminate location limitation • Easy to use and understand • Available to many people • Supplements difficult materials 	<ul style="list-style-type: none"> • Entertainment • Education • Communication • Visual 	<ul style="list-style-type: none"> • Shorten download time • More attractive presentation • Less traveling cost • Support multi-user
Perceived barriers	<ul style="list-style-type: none"> • Speed limit • System requirement • High speed tech infrastructure • Unreliable server (sometimes) 	<ul style="list-style-type: none"> • Network speed • Streaming quality • Application cost • Infrastructure 	<ul style="list-style-type: none"> • Hardware capacity & capability • Constant network traffic & bandwidth • User acceptance • Still low bandwidth for most users
Respondents' Experience	Average hr/wk	Average hr/wk	Average hr/wk
• Video-telephony	0	0	0.29
• PC-based Conferencing	0	0.75	0.53
• Mobile Videoconferencing	0	0	0
• Video-streaming/multicasting	0.1	3.6	0.81
Experience in building websites/applications using streaming	Yes 10% No 90%	Yes 10% No 70% N/A 20%	Yes 0% No 97.7% N/A 2.3%

DISCUSSION

By using SMIL and video streaming, instructors are able to familiarize their students with the use of the Internet while presenting concepts and theories in a specific course. In this section we examine the perceived benefits, barriers, future needs/applications/expectations, and technology aspects of video streaming technology. The discussion is based on the findings in Table 1.

Advantages.

- Allows playback of class at anytime,
- Notes and class materials are accessible outside of class, and
- Supplements difficult material.

Disadvantages.

- No interaction with instructor
- Quality is poor or material is slow to appear on screen because of slow connections
- The server is sometimes unreliable.

Prospects for future applications.

- Mobile commerce also known as m-commerce
- education/training,
- entertainment and shopping, and
- mobile industry use including global positioning systems (GPS).

VI. CONCLUSIONS

In previous years, the author has observed that video streaming and the SMIL-aided approach provides more stimulation and productivity for both students and instructors. MIS, e-business, and other business courses are no exception. When teaching information systems courses for students from the United States, their perceived values in 2000 are no different than perceived values from all other students in Hong Kong and Korea in 2001.

Recent statistics [Streaming Media, 2001] showed the streaming penetration rate to be over 70% in Korea because the country has a broad bandwidth infrastructure, whereas in Hong Kong it is over 35%, and in the United States it is about 30% and depends on location. The author believes that increasing streaming penetration rates will provide a good foundation for implementing video streaming and SMIL-aided instruction.

However, the author believes that video streaming and SMIL technology should not be used to replace basic classroom teaching of fundamental principles. Rather, it should supplement class materials, so that students understand concepts, theories and applications better. Considering the high bandwidth infrastructure, especially with the Internet 2 [Internet2.com] environment of major educational institutions in the United States, video streaming and SMIL can be important components in instruction, both locally and in distance education.

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EDITOR'S NOTE: The main text and the following reference list contains the address of World Wide Web pages. Readers who have the ability to access the Web directly from their computer or are reading the paper on the Web, can gain direct access to these references. Readers are warned, however, that

1. these links existed as of the date of publication but are not guaranteed to be working thereafter.
2. the contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
3. the authors of the Web pages, not CAIS, are responsible for the accuracy of their content.
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ABOUT THE AUTHOR

J. P. Shim is professor of MIS at Mississippi State University. He has been a visiting professor at New York U, George State U, and Chinese U of Hong Kong while on sabbatical leave. He received his PhD from the University of Nebraska and completed executive education in Information Systems from Harvard Business School. He co-authored several books and published over 50 refereed journal articles, including *Communications of the ACM*, *Decision Support Systems*, *Interfaces*, *Communications of the AIS*, *Information & Management*, *Omega*, *Journal of the Operational Research Society*. He is the recipient of numerous grants such organizations as the *National Science Foundation* and *Microsoft Corporation*. He serves on the NSF ITR Panel and

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