Chapter 17
Perspectives of the Application of Video Streaming to Education

Marco Ronchetti
Università Degli Studi di Trento, Italy

ABSTRACT
The field of e-learning has been a precursor in using the video streaming over the Internet. Both the synchronous and the asynchronous options have been explored over the last decade, with the asynchronous one becoming the dominant paradigm in recent years. Pedagogical research lecture reported evidence that video-streaming is an effective way of teaching, provided certain conditions are met. Technological research has attempted to investigate various ways to better produce or deploy video lectures: video segmentation, summarization, multimodal extraction of text and metadata, semantic search and gesture analysis are among the research areas that were involved. The present paper reviews the main technological research achievements and trends, and suggests directions in which we may be seeing the streaming of lectures to venture in near future.

INTRODUCTION
The field of e-learning has been a precursor in using the video streaming over the Internet. To our knowledge, the first proposal of an architecture for recording and distributing lectures in the form of video streaming over the Internet dates back to 1995 (Tobagi). Tobagi also implemented and demonstrated a first prototype: however apparently the system was never brought into routine production. The first systematic application of video streaming to teaching followed three years later (Hayes 1998). At that time, a VHS based system for delivering lectures to a geographically remote place (from USA to France) was substituted first with an audio stream with synchronized power point images, and shortly thereafter it evolved into a video transmission that included both the teacher and the slides with a technique called chroma key1. In recent years several custom systems were developed, some were commercialized, some were put in the public domain and others
were used locally as prototypes. A review of the desirable features for such systems can be found in (Ronchetti 2008). After a short time in which pioneers opened the way showing a possible but uncertain future, big players are coming onto the scene today, such as in the case of the Massachusetts Institute of Technology on-line video collection and the one of University of California at Berkeley who, according to U.S. Government news of January 2008, was the first University with a plan to offer full courses on You Tube.

Research has shown that, from a pedagogical point of view, the video streaming of lectures is an effective practice (for a review see Ronchetti 2009). Moreover its production costs are already quite low. Systems like Lode and OpenEya are available at no cost since they are either open-source or free, and their hardware requirements are rather basic for today’s computers. Hence, although there are still some problems, like the unwillingness of some teachers of being recorded, we believe that there are little doubts that the use of video streaming applied to education is here to stay, and will continue to expand. Already today, the list of websites dedicated to offer on-line video-lectures is impressive (see e.g. the partial catalog compiled by University of Wisconsin at Milwaukee).

Although some of the early applications of video streaming to teaching were focusing on synchronous usage, in recent years most of the cases are concerned with asynchronous consumption. These two modalities present very different implications: in synchronous lectures it is desirable to allow remote users to interact with the speaker/teacher, while for the asynchronous ones the focus is shifted to other issues such as intelligent information extraction, ability to search, interconnect, navigate and annotate lectures. This second area has been very active, and has elicited several research streams.

In this chapter we shall review the research directions and results that matured over the last decade. Our coverage will reflect what has been happening in the last years, in which not much emphasis has been paid to the synchronous aspects, and many efforts have gone towards the view of a flexible, searchable collections of multimedia material built around video streaming, available on demand, in which the content allows random access and the user can easily find information about the content and locate interesting spots: a perspective that goes under the name of next generation digital library.

**Synchronous Videolectures**

Synchronous video streaming breaks spatial constraints and allows users to participate in real time to remote events. Students’ physical presence in the teacher’s location is not required any more. This solution allows for distributed classes (e.g. two classrooms on the same campus to accommodate a very large audience) and/or distributed individuals (e.g. students following a lecture in real time from their home). However, by simply using traditional video streaming solutions, an important obstacle arises: the lack of interaction. How can students in the remote classroom, or in their home, request teacher attention for asking a clarification? Ron Baecker (2003) has addressed this issue when designing the e-Presence system. e-Presence is a web-casting tool that was originally designed with the scientific seminar model in mind. It is based on unidirectional synchronous video streaming, with synchronized slides that accompany the speaker’s video. The interaction problem is attacked by integrating a textual chat into the system, and introducing the role of the “mediator”: a person that is located in the physical place where the event takes place, and monitors the chat (Schick et al. 2005). S/he acts as a proxy for the remote user: when a question comes into the chat, s/he calls the attention of the speaker and poses the question. A small problem came from the fact that the streaming of the “synchronous” flow was always 10-15 seconds late (because of the delay induced by the real-time compression