Internet Protocols for Delivery of Real Time E-learning

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Abstract- A number of distance learning approaches have been proposed and practiced over the past few decades. Electronic learning (e-learning) through the Web is one of the most recent approaches to distance learning. E-learning has created a great deal of interest among the Internet users and has grown considerably fast over a few years. In addition to the universities, corporations have utilized this approach to provide training for their employees.

E-learning goes well beyond the delivery of textual data. For instance, a live lecture requires provisions for supporting the delivery of audio, video. Real time traffic (such as audio and video) is sensitive to delay and loss of packet data in a network. When the network load is light the quality of audio and video is reasonable, but the quality degrades rapidly in proportion to the network load. Under realistic scenarios the Internet load is often times highly loaded. Internet Protocol (IP) in its original form cannot guarantee a certain level of delay and loss. Consequently, Internet (in it original form) is not well suited for e-learning. However, the popularity and growth of Internet over the last decade has made it a very attractive media for multi media communications. In response to the need, new protocols have emerged recently by entities such as IETF (Internet Traffic Task Force) to address the real-time traffic delivery.

1.0 Introduction

Many different approaches to distance learning have been proposed and practiced over the past few decades with varying levels of success [1]-[2]. E-learning is one of the most recent approaches to distance learning where Internet is utilized as the medium of the choice for the live and interactive delivery of lectures. The content of e-learning is somewhat different from what Internet has been used to. For this reason, e-learning cannot be looked upon as just another Internet application. In practice, e-learning presents a challenge to Internet and requires new transport protocols capable of providing real-time multimedia.

The content of e-learning (mainly audio-visual signals) is not the typical Internet content for two reasons. First, audio-visual signals (particularly the visual component) require a large amount of bandwidth. Secondly, this kind of information is quite sensitive to delay and packet loss typically encountered over Internet.

Internet load has bearing on the presentation quality. If Internet load is light, the impact on delivery of audio-visual content of e-learning will be negligible. However, the popularity of Internet has lead to its increased usage. Consequently, often times Internet is moderately (and sometimes heavily) loaded. Large latency and packet loss rate results in an objectionable communication quality. New protocols must be devised to enable the effective delivery of high rate and sensitive information.

2.0 Our Goal

In this paper, our goal is to explore and describe the protocols needed to support e-learning. First, we introduce challenges in delivery of e-learning over the World Wide Web (WWW). We then define protocols that provide end-to-end e-learning service. More specifically, we will go over the details of RSVP (Resource SerVation Protocol), Real Time Protocol (RTP), RTCP (Real Time Control Protocol) and RTSP (Real Time Streaming Protocol). A list of remaining problems and future work is also provided. Upon reading this paper, the readers will understand the e-learning delivery issues. Furthermore, he/she will appreciate what the new Internet protocols offer to e-learning; and will observe what weaknesses of the protocols are.

3.0 Required Protocols

3.1 RSVP

Internet resources need to be reserved before an e-learning session starts. A protocol named RSVP is defined on the top of Internet Protocol (IP), which can be considered as an Internet control protocol [3]. The use of RSVP (as the name implies) enables the e-learning application to request a certain Quality of Service (QOS) for the generated traffic. RSVP in each node comprises of two components namely, policy control and admission control. Policy control component decides whether the user has the permission to ask such a request and admission control decides whether the node has the resources to honor the request. A request is honored, if both components return affirmative responses.

Note that, RSVP supports both unicast and multicast requests and is compatible with both IPv4 and IPv6 as well. Bottom line is that a larger number of attendants can be supported by utilizing RSVP without generating unnecessary network traffic.

3.2 RTP

The e-learning content is quite time sensitive. Real Time Transport Protocol (RTP) addresses the timing needs of an e-learning application. This includes functionalities such as time stamping and sequence numbering [3]. The transmitted packets are time

stamped at the transmitting end. At the receiving end, time stamps are used to place the packets in the right order.

Similar to RSVP, RTP is also an IP based protocol and can be used in unicast as well as multicast applications. RTP runs on the top of UDP (User Datagram Protocol)- as opposed to TCP Transmission Control Protocol- since timely delivery of e-learning content is far more important than the reliable delivery of it. Effort has been made to make RTP compatible with IPv6. Among the existing software applications, both Netscape and NetMeeting support RTP.

3.3 RTCP

Real Time Control Protocol (RTCP) is responsible for flow and congestion information control. RTCP and RTP work together to provide feedback on data transmission quality and adjust the control information. The QOS indicators (such as jitter and number of lost packets) are utilized by the transmitting end to tune the transmission rate [3]-[4]. RTCP is also in charge of source identification (a 32 bit identifier is included in RTCP packet) and synchronization among different components of media (such as audio and video).

3.4 RTSP

Audio-visual multimedia files are typically broken into chunks and transmitted over Internet. Receiving application can play the first chunk decode the second chunk and receive the third chunk [3]. This strategy, known as streaming, eliminates the delay associated with receiving the entire file in one shot. Real time Streaming Protocol (RTSP) enables the streaming functionality. It works together with RSVP and RTP and is capable of supporting both unicast and multicast applications. Netscape, IBM, SGI and Sun's player's all support RTSP.

4.0 Issues and Alternative Proposals

RSVP suffers from a number of drawbacks. For instance, RSVP based developments have not been entirely implemented and it is believed that they are not suitable for deployment over the whole Internet. Further more, it has also been pointed out that resource reservation (as the case is in RSVP) can be costly on router resources [4]. Having realized these drawbacks, IETF (Internet Engineering Task Force) working groups (WG) are developing alternative approaches. For instance, in DIFFSERV (Differentiated Service) WG approach packets will have different labels and will be treated differently in accordance to their desired quality of service. Several schemes are under consideration at this time. Further details of these schemes will be published in the future.

5.0 Summary and Conclusions

We examined the content of e-learning. It was observed that audio-visual signals (the main content of e-learning) were quite different from the intended typical Internet content. The various needs of e-learning were listed and it was demonstrated that the existing Internet protocols are not sufficient to address the needs of e-learning. Four new

protocols were introduced. The shortcomings of the protocols as well as their strengths were pointed out. This article is intended to bring the interested reader up to date on recent advances in Internet protocols as relevant to e-learning and place him/her in a position to propose enhancement to the protocols or perhaps devise new ones with superior capabilities.

References

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