Performance Studies of FTP, Voice and Video over ATM-Wireless Backbone Network

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ABSTRACT

Asynchronous Transfer Mode (ATM) is a high-speed networking technology designed to support real-time applications such as voice and video over both wired and wireless networks. This type of network is being used by medium-to-large organizations and the Internet service providers as backbone network to carry data traffic over long-distance with a guaranteed quality of service (QoS). The guaranteed QoS is achieved through a point-to-point link between end users. While the performance of ATM network over wired network has been studied extensively, the performance of real-time traffic over an ATM-Wireless extension has not been fully explored yet. It is useful to be able to compare the performance of ATM network with and without wireless extension against various network performance metrics to find out the effect of wireless extension on system performance.

Keywords: ATM, FTP, OPNET Modeler, QoS, Simulation Modelling, Video, Voice, Wireless

INTRODUCTION AND BACKGROUND

ATM is a high-speed connection-oriented packet-switching networking technology which is designed to support both real-time (e.g. voice and video) and non-real time (e.g. FTP) traffic. The more detailed about Asynchronous Transfer Mode (ATM) network technology can be found in many textbooks (Fitzgerald & Dennis, 2009; Kurose & Ross, 2013; Stallings, 2014). The ATM performance modelling and simulation are reported in many networking literature (Hwang, Do, & Yoo, 2014; Nisar & Sarkar, 2012; Sarkar, Nisar, & Chieng, 2013; Schreiber, Joopari, & Rashid). Both voice and video traffics have more restrictive quality of service (QoS) requirement

DOI: 10.4018/IJAPUC.2015070104
on end-to-end delay and jitter than FTP traffic. Heyman et al. (1992) studied the performance of video conferencing over ATM networks. They found that the traffic periodicity and degree of synchronization of different video sources can affect the loss rate by a factor of 30. To minimize the losses on ATM networks, a multimedia traffic management framework is proposed by Woodruff and Kositpaiboon (1990). It is found that the statistical multiplexing techniques can significantly enhance the bandwidth utilization. However, guaranteed QoS cannot be achieved without an efficient transport and congestion control mechanism. Therefore, Leaky-bucket congestion control scheme is proposed to guarantee the QoS (Tang, Murthy, & Long, 1994). However, having a fixed length cell (53-bytes), no single user can hog all the lines bandwidth in ATM networks. Sarkar et al. (2012) examined (by simulation) the guaranteed bandwidth features of ATM. They found that the applications such as FTP, voice and video do not suffer noticeable performance degradation with the increasing number of nodes.

The increasing demand for new services and applications, as well as the demand for higher capacity, the networks become highly heterogeneous having a variety of connecting devices including fixed and mobile wireless with multiple radio interfaces. Unfortunately, there is no single uniform protocol to integrate network technologies and devices. This opens up opportunities for network researchers to do further research in high-speed network protocol design, modelling and performance evaluation, especially ATM-Wireless Backbone network.

In this paper we study the performance of ATM-Wireless backbone network using OPNET-based simulation and modelling. The objective is to study the effect of increasing the number of mobile nodes (per access point) on system performance. We measure FTP download and upload response times, voice and video throughputs, end-to-end packet delays, and voice jitter. We first develop an ATM backbone network model to get some insights into the performance of ATM network and to validate simulation results. We then incorporate wireless extension to the ATM backbone network model to examine the impact of wireless segment on system performance. A dense ATM-Wireless extension is also considered for comparison purposes. The remainder of this paper is organized as follows. We first focus on modelling aspects of ATM backbone network. We then present the subnet configuration/specification including ATM-Wireless extension. Various QoS performance metrics are discussed and simulation results are presented. A brief discussion in the conclusion ends the paper.

MODELLING THE NETWORK

Figure 1 shows the high-level view of ATM backbone network model. We model the network by considering a star topology with four subnets (Northeast, Northwest, Southeast and Southwest). Figure 2 shows the network topology for each subnet where nodes are linked to ATM switch in a star configuration (point-to-point link). A screenshot of ATM Switch configuration is shown in Figure 3. We use OPNET Modeler 17.5 (a credible network simulator) for network modelling and simulation purposes (Fullmer & Garcia-Luna-Aceves, 1997). The various network configurations are described next.

Subnet Configuration

Each subnet consists of four clients (two for voice and two data traffic), one Switch and a Sever. All clients and Sever are connected to the ATM Switch using ‘ATM_adv’ duplex link of bandwidth (data rate) to DS1 link. The application parameters for Voice 1 and Voice 2 set to constant bit rate (CBR) only; and data 1 and data 2 set to variable bit rate (VBR). The difference between CBR and VBR is that CBR has lower cell loss probability suitable for voice and video traffics, and VBR is used for applications that are not considered delay as priority but has the best effort service.
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