The Performance of Ethernet Under a Combined Data/Real-Time Traffic

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Abstract

In this paper, we investigate the performance of an IEEE802.3 shared-bandwidth hub under a mixed data/real-time traffic load. For the regular data nodes we assume an exponentially distributed packet length with a Poisson arrival. For the video sources, we assumed MPEG encoded video sources at 30 frames per second. We used simulation to study the network performance under the above-mentioned load. We used 2 different protocols, the standard IEEE802.3 and PCSMA, which is suitable for real-time traffic.

I Introduction

Ethernet is one of the most successful local area networks ever implemented. It is widely used in many universities, and industries. Ethernet started as a 2.94 Mbps network built at Xerox PARC. The idea caught on with the network community and soon after that a standard was born (IEEE802.3).

Although Ethernet was not designed for real-time traffic (unbounded delay and no delivery guarantee), recently there is an increase in multimedia and real-time traffic crossing LAN boundaries. (Including Ethernet). Many researchers tackled the problem of Ethernet and real-time audio or video transmission, most of them concentrated on 10Mbps Ethernet. Audio streams combined with non-bursty data is discussed in [1]. Video and data were simulated on a 10Mbps Ethernet in [2] and [3]. CBR Video and data were studied in [4] and [5].

In this paper we consider 100Base-TX shared bandwidth Ethernet and we study its performance under a combined data/real-time traffic, we also investigate techniques to improve the network performance (especially for real-time traffic).

The organization of this paper is as follows. In section II, we discuss our simulation methodology and PCSMA [6].In section III we present our simulation results for CSMA and PCSMA

II Simulation methodology

We used a CSIM simulator [8] to simulate a half-duplex shared bandwidth 100Mbps IEE802.3u Ethernet. In our simulation we assumed a 40 stations connected to a single hub (half-duplex hub). Each station is transmitting either regular data Or MPEG coded video. For data we assumed a Poisson arrival with exponential packet length. For video sources we used the model developed in [7].

We also considered a protocol called PCSMA that was proposed in [6]. PCSMA was proposed for a factory automation environment to guarantee delivery of real-time traffic. PCSMA divides the transmission into real-time and regular transmission. For real-time transmission it adds a long preamble and does not check for collision during the preamble. The idea that, if a real-time and regular transmissions started simultaneously, the real-time transmission, with its long preamble, will survive the collision. The regular transmission detects the collision and stops while the real-time transmission continues successfully. Of course two real-time transmissions may collide, abort, and try later. We didn't simulate the reservation mechanism proposed in [6].

III Simulation Results

We ran our simulation for 30 seconds. We found that this time is more than sufficient in order to reach steady state conditions. We calculated the average delay for both data packets and video frames, we also calculated the number of video frames that was discarded because the new frame was generated while the previous one is still waiting to be transmitted (we call this missed frames). Figure 1 shows the delay vs. utilization for video frames (1v, 5v, and 10v means one, five and 10 video sources among the 40 nodes). While Figure 2 shows the same thing for PCSMA. Notice the huge improvement of PCSMA over CSMA/CD. Although that is on the expense of data packets delay, which is not shown here

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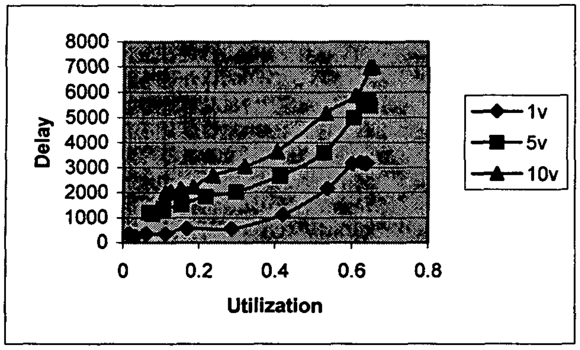

Figure 1 Delay vs. utilization for video frames (CSMA)

Figures 3 and 4 shows the percentage of lost video frames for both CSMA/CD and PCSMA. We also notice that PCSMA has a much better performance although it is very sensitive to variations in utilization.

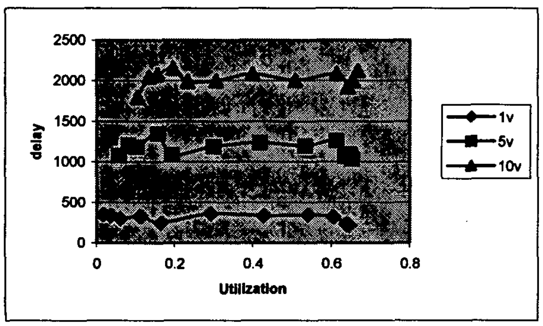

Figure 3 Delay vs. utilization for video frames (PCSMA)

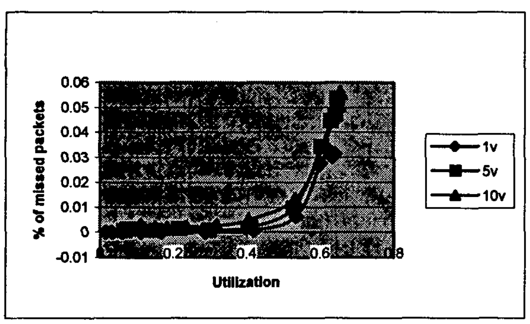

Figure 4 Percentage of missed frames vs. utilization (CSMA)

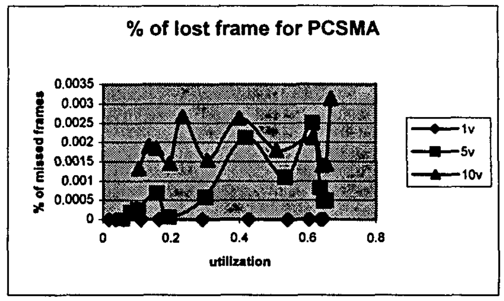

Figure 6 Percentage of missed frames vs. utilization (PCSMA)

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