IP PREMIUM SERVICE TRAFFIC MODELING AND PERFORMANCE ANALYSIS

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ABSTRACT

In this study, we analyze the stochastic properties of IP premium service traffic such as voice and video traffic from measured traffic trace, and develop a mathematical model for IP premium service traffic. In addition, we develop a bandwidth allocation algorithm for IP premium service traffic by using our mathematical model. To show the validity of algorithm, some numerical studies with the NS-2 simulator are also provided.

INTRODUCTION

One of the most important issue in network traffic engineering is a effective bandwidth which provides a measure of the resource requirements of a traffic, given the QoS requirement. If bandwidth is allocated less than input traffic, then QoS cannot be satisfied. On the other hand, bandwidth is allocated more than input traffic, then the network resource may be wasted.

In this study, to develop a bandwidth allocation algorithm for IP premium service traffic, we first analyze the stochastic properties of IP premium service traffic such as voice and video traffic from measured traffic trace at IP network, and develop a mathematical model for IP premium service traffic. Then, we develop a bandwidth allocation algorithm for IP premium service traffic by using our mathematical model. We can allocate the bandwidth for both a single IP premium service traffic and multiplexed IP premium service traffics using our bandwidth allocation algorithm.

SYSTEM MODELING AND ANALYSIS

We consider IP premium service traffic trace measured at IP network. IP premium service traffic usually consists of voice and video packets, so in the measured trace packet inter-arrival times and packet sizes of both voice traffic and video traffic are recorded.

In this study, we first analyze the measured trace to observe the stochastic characteristics of IP premium service traffic, and then mathematically model IP premium service traffic for performance analysis.

Our analysis shows the following:

(1) Voice traffic is modelled by a renewal process with deterministic inter-arrival times. Arriving packets of voice traffic are of fixed size.

(2) Video traffic is modelled by an ON and OFF source where ON and OFF periods are according to Gamma distributions with respective parameters.

Based on our mathematical model we compute the required bandwidth of IP premium service traffic for a given loss probability requirement. In this analysis we set the required loss probability of IP premium service to 10^{-3}. Since voice traffic is deterministic, we allocate a deterministic bandwidth $P/E[D]$ for voice traffic where P denotes the packet size in unit of bits and $E[D]$ denotes the estimated expectation of the packet inter-arrival time in unit of second. On the other hand, for video traffic we use fluid flow analysis[1-3] to compute the required bandwidth, where we approximate ON and OFF periods with respective mixtures of exponential distributions. The total bandwidth of IP premium service is then the sum of required bandwidths for voice traffic and video traffic. To check the validity of our results, we perform simulation studies by using the NS-2 simulator. In simulation studies, we assume there is(are) $N = 1(10, 25)$ IP premium service flows and the required loss probability is 10^{-3} as mentioned before. The results are shown in Tables. Our simulation studies show that our mathematical model is appropriate to compute the required bandwidth and hence can be used for CAC (Connection Admission Control) algorithm.

Table 1 Loss Probability with Flow=1

Flow=1	Buffer = 10 Kbytes, BW=1.931 Mbps
Loss prob.	$1.14e^{-4}$

Table 2 Loss Probability with Flow=10

Flow=10	Buffer = 30 Kbytes, BW=14.096 Mbps
Loss prob.	$5.10e^{-4}$

Table 3 Loss Probability with Flow=25

Flow=25	Buffer = 50 Kbytes, BW=33.42 Mbps
Loss prob.	$6.80e^{-4}$

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