Passive Calibration of Active Measuring Latency

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Abstract. Network performance obtained from the active probe packets is not equal to the performance experienced by users. To gain more exact result, the characteristics of packets gained by passive measuring are utilized to calibrate the result of active measuring. Taking the number of user data packets arriving between probe packets and the latency alteration of neighborhood probe packets into account, we propose the Pcoam (Passive Calibration of Active Measurement) method. The actual network status could be reflected more exactly, especially when the network is in congestion and packet loss. And the improvement has been validated by simulation.

1 Introduction

Measurements and estimation of performance parameters, such as end-to-end delay, in IP network are becoming increasingly important for today's operators [1], [2], [3], [4], [5]. In general, conventional schemes to measure the network delay are classified into two types, active and passive measurements. Active measurement measures the performance of a network by sending probe packets and monitoring them. In passive measurement, the probe device accessing the network records statistics about the network characteristics of data packets. Unfortunately, both types have drawbacks especially when they are applied to delay measurement [6].

Masaki Aida *et al.* have proposed a new measuring technique, called CoMPACT Monitor [6], [7], [8]. Their scheme requires both active and passive monitoring using easy-to-measure methods. It is based on change-of-measure framework and is an active measurement transformed by using passively monitored data. Their scheme can estimate not only the mixed QoS/performance experienced by users but also the actual QoS/performance for individual users, organizations, and applications. In addition, their scheme is scalable and lightweight.

The CoMPACT scheme supposes that the interval of sending probe packets can be very short and thus ensures that the interval of receiving those probe packets is also short. The error of estimator would increase as the interval of the probe packets arriving increases, especially when the network is in congestion or the loss ratio is high.

We can use the characteristics of user packets gained by passive measuring to calibrate the active measuring for more exact measuring result. We consider not only the number of user data packets, but also the relationship of the adjacent probe

P. Lorenz and P. Dini (Eds.): ICN 2005, LNCS 3421, pp. 746 – 753, 2005.

packets' delay. We propose the Pcoam method (Passive Calibration of Active Measurement) and our method could reflect the actual network status more exactly in the case of network congestion and packet loss.

The paper proceeds as follows. We analyze the adjacent packets latency alteration and propose the Pcoam method in section 2. In section 3, we show the validity of the Pcoam method by simulation. Finally, conclusions deriving from the effort are presented and future work is discussed in Section 4.

2 Pcoam Method

2.1 Pcoam Method

It is difficult to measure user packets delay directly in that not only should the time clocks of the monitoring devices be synchronized, but also the identification process is hard as the packet volume is huge in a large-scale network.

Although we could not measure user packets delay directly, we can use the active probe packets delay to estimate the users packets delay according to different network status.

Let $V(t)$ be the delay at the time t. When the network is not busy, we can assume the change of delay is little if the interval of sending probe packets Δt is short enough compared to the time variance of $V(t)$. Then

$$\forall s, s' \in [t, t+\Delta t) = V(s) \cong V(s') \tag{1}$$

We can obtain the number of user packets between the neighborhood probe packets through the simplified passive monitoring device as same as the device used in the CoMPACT monitor [6], [7], [8], which is proposed by Masaki Aida *et al.*. The simplified passive monitoring device only monitors the arrival of the probe packets and counts the number of the user data packets.

Suppose there are n user data packets and m probe packets arriving in the measuring period. Let A_i be the delay of active probe packet i, the indicator function ϕ is as:

$$\phi(i,a) = \begin{cases} 1, A_i > a \\ 0, A_i \le a \end{cases}. \tag{2}$$

Let X be the measuring objective that is the delay of a user's data packets. Supposing ρ_i is the number of user data packets between active probe packet i and active probe packet $i-1$, the distribution function of user packets delay is obtained by the estimator of active probe packets:

$$\Pr(X > a) = \sum_{i=1}^{m} \phi(i,a) \frac{\rho_i}{n}. \tag{3}$$