An Enhanced Available Bandwidth Estimation Technique for an End-to-End Network Path

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Abstract - This paper presents a unique probing scheme, a rate adjustment algorithm, and a modified excursion detection algorithm (EDA) for estimating the available bandwidth (ABW) of an end-to-end network path more accurately and less intrusively. The developed design is based on the well known concept of self-induced congestion and it features a unique probing train structure in which there is a region where packets are sampled more frequently than in other regions. This high-density region enables our algorithm to find the turning point more accurately. When the dynamic ABW is outside of this region, we readjust the lower rate and upper rate of the packet stream to fit the dynamic ABW into that region. We appropriately adjust the range between the lower rate and the upper rate using spread factors, which enables us to keep the number of packets low and we are thus able to measure the ABW less intrusively. Finally, to detect the ABW from the one-way queuing delay, we present a M-EDA from Path Chirps' original M-EDA to better deal with sudden increase and decrease in queuing delays due to cross traffic burstiness. For the experiments, an android OS-based device was used to measure the ABW over a commercial 4G/LTE mobile network of a japanese mobile operator, as well as real test bed measurements were conducted over fixed and WLAN network. Simulations and experimental results show that our algorithm can achieve ABW estimations in real time and outperforms other stat-of-the-art measurement algorithms in terms of accuracy, intrusiveness, and convergence time.

Keywords- wireless, Probe, Queuing Delay, Rate Adjustment, MEDA, 4G / LTE Network.

I. INTRODUCTION

Available bandwidth (ABW) estimation is crucial for traffic engineering, quality-of-service (QoS) management, multimedia streaming, server selection in application services, congestion management, and network capacity provisioning in wireless mobile networks. ABW measurement can be considered essential to ensure that wireless mobile operators can achieve the QoS standard guaranteed by them while providing desired data rates to users. This can also be considered when comparing the performance index of various Telecom operators in a specific region. Let us first define the terms ABW, bottleneck link (L) or narrow link,1 and tight link precisely. The unused bandwidth on the tight link, $Bt - Ct$ is called the ABW of the path. There could be different possible definitions of ABW, depending on whether we use an approach based on unused capacity or an approach based on achievable rate. In wired networks, these two approaches are equivalent leading to the widely accepted definition of ABW as the unused capacity of the tight link. But in wireless networks, interference makes the two concepts quite different. Due to radio interference, the unused capacity may not be completely available. On the other hand, when a new flow is established in the given path to occupy some of that unused capacity, the interfering cross traffic can re-accommodate itself in response to the new flow, changing the perception of the new regarding its ABW . Since, in wireless settings, the unused capacity approach does not take into account this possible adaptation to network conditions, in this paper, we use the achievable rate approach.

II. RELATED WORK

A new end-to-end probing and analysis method for estimating bandwidth bottlenecks was done by Melander, et al (2000). Regression based available bandwidth measurements Bjrkman et al (2002). A measurement tool for end to-end available bandwidth was done by Jain, et al (2002). A measurement study of available bandwidth estimation tools was done by Strauss, et al (2003). Evaluation and characterization of available bandwidth probing techniques was done by Hu et al (2003). Path chirp: Efficient available bandwidth estimation for network paths was done by Ribeiro, et al (2003). Ten fallacies and pitfalls on end-to-end available bandwidth estimation were done by Jain, et al (2004). Multi hop probing asymptotic in available bandwidth estimation stochastic analysis was done by Liu, et al (2005). A bandwidth estimation tool for IEEE 802.11 wireless networks was done by Mark, et al (2008). Experimental comparison of bandwidth estimation tools for wireless mesh networks was done by Gupta, et al (2009). Passive aggressive measurement with MGRP was done by Papageorge, et al (2009). On an efficient estimation of available bandwidth for IEEE 802.11-based wireless networks was done by Zhao, et al (2011). NEXT: New enhanced available bandwidth measurement technique, algorithm and evaluation were done by Paul, et al (2014). On the applicability of available bandwidth estimation techniques and tools was done by Guerrero, et al (2015).

III. EXISTING SYSTEM

3.1 EDA

EDA to better deal with sudden increase and decrease in queuing delays due to cross traffic burstiness. Due to the bursty arrival of CT (cross traffic), a sudden increase in queuing delays of packets (called excursion) occur for a short period of time in the router even though the packet's rate is much below the ABW of the tight link. So, to detect these sudden increases in queuing delays and to filter out them is the main purpose of the excursion detection algorithm

IV. PROBLEM IDENTIFICATION

In wireless fidelity the air is the main channel the electromagnetic waves passes through it. But some interference in that medium the bandwidth is medium for users, during congestion period takes place so many user entered into allocated bandwidth to take slow our speed and performance so we would overcome this problem using this algorithm.

V. PROPOSED CONCEPT

5.1 MODIFIED EXCURSION DETECTION ALGORITHM

From Path-Chirp's original Excursion Detection Algorithm (EDA), we have developed a MEDA. PathChirp estimates the ABW by launching a series of particular packet trains, called chirps, each of which consists of *k* packets sent with an inter-packet gap that is exponentially reduced. The chirps are sent from sender to receiver and then statistical analysis is conducted at the receiver by taking into account the one-way-delays (OWD), $q(m)k$, faced by each packet *k* on the intermediate router. Path-Chirp uses the shape of the signature to make an estimate $E(m)k$ of the per-packet available bandwidth $B[t(m)k, t(m)k{+}1]$, where $t(m)k$ is the sender transmission time of packet *k*.

ALGORITHM

Require: *qd*: Queuing Delay; *F*: Decrease Factor;
$i = 0$ (current location in chirp);
Set $j = 0$ (current location where queuing delay increases);
Set *N*=Total number of packets in a chirp.
Ensure: *TP*: Turning point of the queuing delay signature.
While $qd[j] \geq qd[j+1]$ and $j < N$ do
Increment j by 1;
end while
Set $i = j + 1$
While $i \leq N$ do
Set $qdsum = 0$ and $count = 1$;
for $k = 0$ to j do
$qdsum = qdsum + qd[k]$;
Increment *count* by 1;
end for
if $count > 1$ then
$avgQdelay = qdsum/(count - 1)$;
end if
if $qd[j] > avgQdelay$ then
$maxQdelay = max(maxQdelay, qd[i] - qd[j])$
if $(qd[i] - qd[j]) < (maxQdelay/F)$ then
$j = i$;
while $qd[j] \geq qd[j+1]$ and $j < N$ do
increment *j* by 1;
end while
Set $i = j$;
end if
else
increment *j* by 1;
end if

increment *i* by 1;
end while
if *j* = *N* then
decrement *j* by 1
end if
Set *TP* = *j*;

V. RESULTS AND DISSCUSION

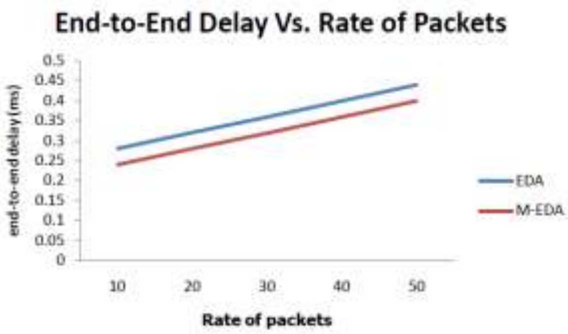

Fig 1 End-to-End Delay Vs. Rate of Packets

This is a simple example from a single chirp's queuing delay to better understand how our modified algorithm achieves better accuracy than Path-Chirp. However, we do understand that, during our whole simulation time, we have sent many chirps and every chirp's queuing delay signature is not the same. So, we are not justifying our idea based on this single queuing delay signature. We have conducted large scale simulation and we have measured the ABW by averaging out all the detected turning point values from all the chirp's queuing delay signatures and based on the large-scale simulation results, we can claim that our idea works better than Path-Chirp and other related state-of-the-art ABW measurement tools.

VI. CONCLUSION

In this research work, we presented the details of an active probing algorithm that features an efficient measurement scheme for end-to-end ABW estimation in a fixed, WLAN and 4G/LTE network. We have proposed a unique packet train structure, a MEDA to identify the ABW with higher accuracy, less convergence time and less overhead.

VII. REFERENCE

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