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Verifying Bandwidth Control Functions in a Real Networking

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Abstract: In recent years, because of the explosion of Internet information exchanges, there have been great demands for local area network bandwidth. While applying networks for multimedia, and hypermedia, bandwidth has become a primary issue for obtaining stable performance. Unfortunately, in most cases, there is finite bandwidth in a local area network. How to provide guaranteed bandwidth has become an important issue. For exploring this issue, this research choice one product called iTracer to verify bandwidth control functions under constant bandwidth in network, by using differences between measured bandwidth and guaranteed bandwidth, and differences between measured bandwidth and restricted bandwidth, to see if through the bandwidth control device, whether can we control and obtain a certain level of bandwidth.

Key-Words: Bandwidth control, Bandwidth allocation, iTracer

1 Introduction

While applying networks for multimedia, and hypermedia, bandwidth has become an important issue for obtaining stable performance. The current network resource (bandwidth) is a critical factor for admission control. If the bandwidth is known as a priori amount, the optimal bandwidth for each workstation can be the minimum requirement. However, in most cases, bandwidth is distributed randomly and will run short while increasing numbers of workstations access data within the network. User service provisioning in constant bandwidth is more challenging due to channel fading, inherent mobility, and so on. Even though channel fading can be improved with better transmission and reception systems, mobility may cause server fluctuation in constant network bandwidth.

To avoid insufficient bandwidth for each workstation in a network, bandwidth control

equipment is required. Purchase suggestions of bandwidth control equipment are: easy to install, easy setup, port control, IP control, power off as a switch.

One of the key mechanisms for providing QoS guarantees is call admission control (CAC) that enables efficient system resource utilization while application QoS requirements are satisfied. [1] This paper will verify the basic function under simplified situations and not providing QoS.

2. Motivation and contribution

Adaptive bandwidth is promising in network since it mitigates the fluctuation in resources caused by traffic collision.[2-5] The scarcity in bandwidth resources motivates us to research the adaptive bandwidth control, which can operate over a wide range of available bandwidth. In adaptive bandwidth control, each workstation will operate normally[6-9]. In order to characterize effectively the bandwidth saturation and to provide optimal quality of service under a controlled situation to users, we propose a device for adaptive bandwidth control, namely iTracer. Simulations reveal that this device in terms of effective characterization of bandwidth adaptation while maintaining quality of service under controlled situations.

3. Preparations before experiment

Before the experiment of verifying bandwidth control functions under constant bandwidth, we need to do the following work.

- Preparing a network
- Installing the bandwidth control device
- Preparing FTP software
- Software installation
- To be familiar with installed software

For preparing a network, a computer classroom is a good choice. For this research, iTracer is the proposed bandwidth control device and Net Transport is the FTP software and the software installation are Web Server, FTP Server, Sniffer, Web Stress, NetMeter etc. All these software tools may help us to monitor the process and results of the experiment.

4. Constant bandwidth allocation with control device

In most cases, the bandwidth of a network is constant and will cost a lot of money to extend. The bandwidth control device, iTracer we verified, provides an easy way, through the Web to setup bandwidth control. The bandwidth control device setup screen is as show in Figure 1.

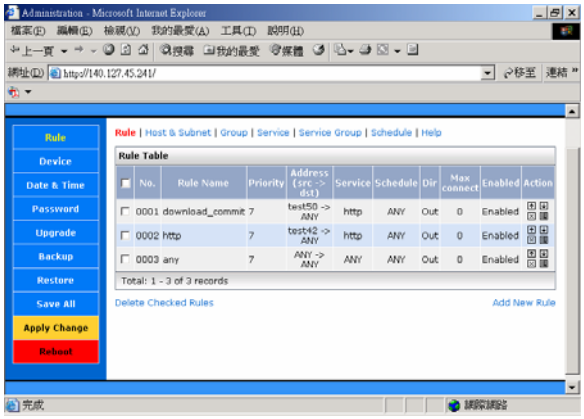

Figure 1. Bandwidth control device setup screen

The bandwidth control device, iTracer we verified has two main functions, restrict and guarantee. Restrict and guarantee for bandwidth setup screen as show in Figure 2.

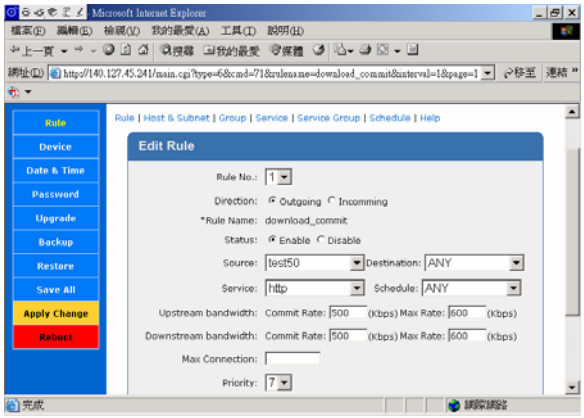

Figure 2. Bandwidth restrict and guarantee setup screen

These two main functions setup fields, one is Comment Rate for guarantee and the other is Max Rate for restriction. The Comment Rate lets the administrator setup workstations with IP to guarantee the bandwidth. For some high priority, more bandwidth is needed. Administrator can setup different bandwidth by priority to guarantee sufficient bandwidth for each workstation. The Max Rate lets administrators to setup workstations with IP to restrict the bandwidth. Thus can avoid some users occupied too much bandwidth and reduce the network efficiency.

5. Performance simulation

In this section, by simulation, we present how our proposed bandwidth control device can guarantee to users and compare it with no such device environment. In a real environment, we may measure the transfer rate by using FTP (File Transfer Protocol) with and without the bandwidth control device.

Before starting the simulation experiment, we need to provide the guarantee and restrict bandwidth values to the bandwidth control device. Bandwidth control setup screen for simulation experiment is as shown in Figure 3. We provide the value of 2500 Kbps (=312.5 Kilo Byte Per Second) for the guarantee bandwidth and 3000 Kbps (=375 Kilo Bytes Per Second) for the restricted bandwidth. The Kbps means “Kilo Bit Per Second”.

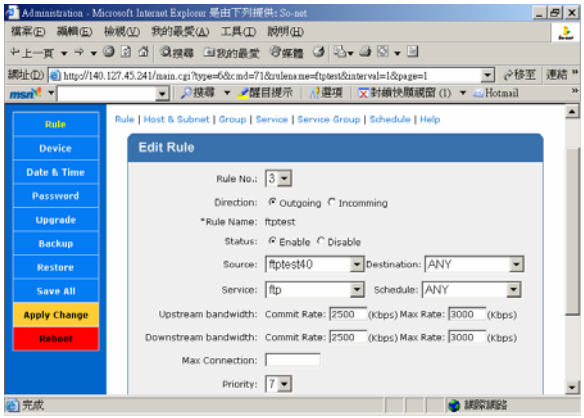

Figure 3. Bandwidth control setup screen

As shown in Figure 4, the topology of the simulated network with the bandwidth control device. Put the bandwidth control device between the Internet and the Intranet.

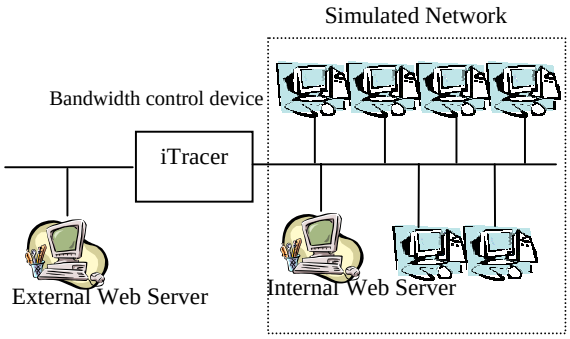

Figure 4. Topology of the simulated network

The experiment records of performance simulation, FTP without iTracer and FTP with iTracer are list in Table 1 and Table 2. The under control measured bandwidth are list in Table 2. The unit in field KB means “Kilo Byte” and KB/S means “Kilo Byte Per Second”.

Table 1. FTP without iTracer

Test No.	File size(KB)	Access times(Seconds)	KB/S
1	56,891	113	503.47
2	56,891	112	507.96
3	56,891	112	507.96
4	56,891	112	507.96
5	56,891	112	507.96
6	56,891	112	507.96
7	56,891	112	507.96
8	56,891	112	507.96
9	56,891	112	507.96
10	56,891	112	507.96

Table 2. FTP with iTracer

Test No.	File size(KB)	Access times(Seconds)	KB/S
1	56,891	218	360.08
2	56,891	217	362.37
3	56,891	217	362.37
4	56,891	218	360.08
5	56,891	217	362.37
6	56,891	218	360.08
7	56,891	218	360.08
8	56,891	217	362.37
9	56,891	217	362.37
10	56,891	219	357.81

As in Table 1, the maximum transfer rate is 507.96 KB/S and the minimum is 503.47 KB/S. The average transfer rate is 505.72 KB/S. Use this average value to run one-sample T test statistics with SPSS 9.0 to see there is an obvious difference between two experiments.

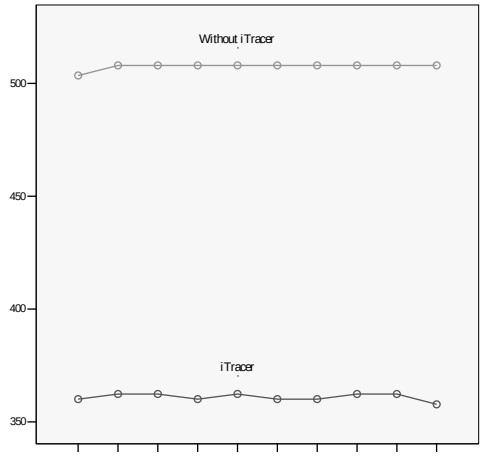

Figure 5. Transfer rate chart with and without iTracer

There are some data considerations before One-Sample T Test. They are: “To test the values of a quantitative variable against a hypothesized test value, choose a quantitative variable and enter a hypothesized test value. This test assumes that the data are normally distributed; however, this test is fairly robust to departures from normality.”(SPSS 9.0 on-line document)

6. Statistical hypothesis

6.1. Ho: There exists no significant difference between guarantee bandwidth and measured bandwidth.

The difference between guarantee bandwidth 312.5 KB/S and measured bandwidth are listed in Table 3.

Table 3. Difference between measured and guarantee bandwidth

Test No.	Table 2 KB/S	Guarantee Bandwidth	Difference
1	360.08	312.5	47.58
2	362.37	312.5	49.87
3	362.37	312.5	49.87
4	360.08	312.5	47.58
5	362.37	312.5	49.87
6	360.08	312.5	47.58
7	360.08	312.5	47.58
8	362.37	312.5	49.87
9	362.37	312.5	49.87
10	357.81	312.5	45.31

Table 4 and 5 are the statistics of One-Sample T Test for the difference between guarantee bandwidth and measured bandwidth listed in Table 3. Since the significant value is less than .05, the guarantee bandwidth is significant higher than the setting value.

Table 4. N, Mean, Standard Deviation and Standard Error Mean for difference between measured nd guarantee values

	N	Mean	Std. Deviation	Std. Error Mean
GUARANTE	10	48.4980	1.5967	.5049

Table 5. One-Sample T test for difference between measured and guarantee values

	Test Value = 0					
			Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
	t	df			Lower	Upper
GUARANTE	96.048	9	.000	48.4980	47.3558	49.6402

6.2. Ho: There exists no significant difference between restricted bandwidth and measured bandwidth.

The difference between restrict bandwidth 375 KB/S and measured bandwidth are listed in Table 6.

Table 6. Difference between measured and restrict bandwidth

Test No.	Table 2 KB/S	Restrict Bandwidth	Difference
1	360.08	375	-14.92
2	362.37	375	-12.63
3	362.37	375	-12.63
4	360.08	375	-14.92
5	362.37	375	-12.63
6	360.08	375	-14.92
7	360.08	375	-14.92
8	362.37	375	-12.63
9	362.37	375	-12.63
10	357.81	375	-17.19

Table 7 and 8 are the statistics of One-Sample T Test for the difference between guaranteed bandwidth and measured bandwidth listed in Table 6. Since the significant value is less than .05, the restricted bandwidth is significantly lower than the setting value.

Table 7. N, Mean, Standard Deviation and Standard Error Mean for difference between measured and restrict values

	N	Mean	Std. Deviation	Std. Error Mean
RESTRICT	10	-14.0020	1.5967	.5049

Table 8. One-Sample T test for difference between measured and restrict values

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
RESTRICT	-27.730	9	.000	-14.0020	-15.1442	-12.8598

7. Conclusion

While applying networks for multimedia, and hypermedia, bandwidth has became an important research for obtaining stable performance. It is anticipated that the adaptive bandwidth control is useful for users from the bandwidth saturation. Using the bandwidth control device, we propose a simulation to provide assurance for adaptive bandwidth services in network. Simulation reveals that the bandwidth control device is effective in terms of characterization of bandwidth adaptation.

This bandwidth control device iTracer provides assurance. The results of our experiments suggested that using a bandwidth control device under saturated bandwidth is a way of providing assured bandwidth.

After the simulation of the bandwidth control device, the applications can be as below:

- Computer classroom in instructional environment, the bandwidth management for students and teacher
- Bandwidth management for viewing Web Server
- Bandwidth management for FTP download and upload
- Bandwidth management for streaming
- Bandwidth management for Database access

Therefore, by using a bandwidth control device, the administrator can easily maintain network bandwidth without any worry of insufficient bandwidth situation and the network can perform smoothly without adding or having to upgrade the computer hardware.

References

[1] P. M. Ruiz, J. A. Botia, and A. Gomez-Skarmeta, "Providing QoS through machine-learning-driven adaptive multimedia applications," *IEEE Trans Syst Man Cybern B Cybern*, vol. 34, pp. 1398-411, 2004.

[2] F. Castanie, C. Mailhes, and S. Henrion, "End-to-End Signal Processing from the Embedded Body Sensor to the Medical End User Through QoS-Less Public Communication Channels: The U-R-SAFE Experience," *Stud Health Technol Inform*, vol. 117, pp. 172-9, 2005.

[3] S. L. Zhang and C. Q. Ye, "An adaptive mechanism to guarantee the bandwidth fairness of TCP flows," *J Zhejiang Univ Sci*, vol. 5, pp. 1361-6, 2004.

[4] Y. Yokoya, "Dynamics of traffic flow with real-time traffic information," *Phys Rev E Stat Nonlin* Soft *Matter Phys*, vol. 69, pp. 016121, 2004.

[5] I. M. Noordhoek, T. Houtgast, and J. M. Festen, "Measuring the threshold for speech reception by adaptive variation of the signal bandwidth. II. Hearing-impaired listeners," *J Acoust Soc Am*, vol. 107, pp. 1685-96, 2000.

[6] D. Taubman and J. Thie, "Optimal erasure protection for scalably compressed video streams with limited retransmission," *IEEE Trans Image Process*, vol. 14, pp. 1006-19, 2005.

[7] P. Siripongwutikorn, S. Banerjee, and D. Tipper, "Fuzzy-based adaptive bandwidth control for loss guarantees," *IEEE Trans Neural Netw*, vol. 16, pp. 1147-62, 2005.

[8] S. Sarkar and L. Tassiulas, "Back pressure based multicast scheduling for fair bandwidth allocation," *IEEE Trans Neural Netw*, vol. 16, pp. 1279-90, 2005.

[9] Y. Jung, S. B. Lee, J. W. Lee, and K. Oh, "Bandwidth control in a hybrid fiber acousto-optic filter," *Opt Lett*, vol. 30, pp. 84-6, 2005.