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SciVerse ScienceDirect
Physics Procedia 24 (2012) 756 – 761
Physics Procedia

2012 International Conference on Applied Physics and Industrial Engineering

Research on Robustness of Tree-based P2P Streaming

Chen Chu†, Jinyao Yan‡, Kuangzheng Ding* and Xi Wang*

Communication university of China,Beijing, China 100024

Abstract

Research on P2P streaming media is a hot topic in the area of Internet technology. It has emerged as a promising technique. This new paradigm brings a number of unique advantages such as scalability, resilience and also effectiveness in coping with dynamics and heterogeneity.
However, There are also many problems in P2P streaming media systems using traditional tree-based topology such as the bandwidth limits between parents and child nodes; node's joining or leaving has a great effect on robustness of tree-based topology.
This paper will introduce a method of measuring the robustness of tree-based topology: using network measurement, we observe and record the bandwidth between all the nodes, analyses the correlation between all the sibling flows, measure the robustness of tree-based topology. And the result shows that in the Tree-based topology, the different links which have similar routing paths would share the bandwidth bottleneck, reduce the robustness of the Tree-based topology.

Keywords:component; P2P streaming meidia; robustness; network easurement; Iperf; Planet-Lab;

1.Introduction

P2P technique is a hot topic in Internet research, and it is widely used in several aspects such as resource sharing, distributed computing, instant communication, information retrieval, network storage in WAN and so on. P2P streaming media technique is formed by leading P2P technique into streaming media system [1]. P2P streaming media technique can effectively reduce the streaming media server's pressure in C/S mode, full use of network bandwidth, and improve the audio/video streaming transmission quality.

Currently, according to their work principle, P2P streaming media system can be divided into two modes: tree-based protocol and extensions model and data driven model [2].

In the tree-based protocol and extensions model (Figure 1), the root of the tree is the server of streaming media source, every parent node in the multicast tree sends the data to its child nodes. In Figure.1, node A and B get data from source node, node C and D get data from node A, node E gets data

 doi:10.1016/j.phpro.2012.02.112

from node B. This mode can remove the link not necessary and minimize the system, ensure that all packets can be transmitted to each node in the system.

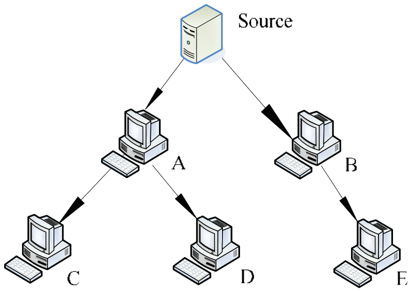

Figure.1 Tree-based Protocol and Extensions Model

However, the bandwidth of parent node in multicast tree limits maximum bandwidth of its sub-tree, the bottleneck of bandwidth exists everywhere in the multicast tree[3]. In this situation, if the link between parent and child nodes sharing a bottleneck under different branches, it will have a bad effect on the quality of streaming media playing worse on child node greatly. Therefore, the purpose of this paper is to do network measurement to observe the sibling flows' bandwidth changing when a new node join into the Tree-based topology, measure the robustness of this Tree-based topology.

2.Network Measurement Technologies

2.1.Measurement Method

Since it has many classifications of the measurement method, this article only introduces some most basic classifications[4] [5]:

- According to the number of nodes in the measurement environment, it can be divided into single-peer-based network measurement and multi-peer-based network measurement.
- According to that whether the node tested is known, it can be divided into cooperative network measurement and non-cooperative network measurement.
- According to the location of the node, it can be divided into end to end network measurement and distributed network measurement.
- According to the behavior of measurement, it can be divided into active network measurement and passive network measurement.

2.2.object of network measurement

According to the object of network measurement, it can be divided into network topology discovery, Network Flow measurement, Network Performance measurement and Routing Explore etc. Among them, Network Performance measurement can reflect the level of network service quality best. Network Performance parameters include: performance Indicators based on Network layer (Way delay, Round Trip Time, Packet loss ratio, bandwidth, connectivity, etc), Transport layer and Application layer.

2.3.Measurement Tools

Measurement tool is an important component of measure behavioral characteristics. At present, the measurement tools based Network Performance measurement such as ping, fping, pathchar, based flow measurement such as Iperf, netperf, netflow and nettramet, based topology explore such as traceroute, ASExplorer and RouteRracker. Selection of network measurement tool is an important impact on network measurement results. In this paper, the system simulation main use based Network Performance measurement tool(Iperf) and routing explore measurement tool (traceroute).

3.Simulation Tools Introduction

In this paper, P2P streaming media tree topology was built by the node selected in Planet-Lab, using Iperf to do bandwidth measurement.

3.1.Planet-Lab

Planet-Lab [6] is a group of computers available as a testbed for computer networking and distributed systems research. It was established in 2002, and nowadays Planet-Lab sites had including 1038 nodes in 505 sites until May 18, 2010, and this number continues to increase. Each research project has a "slice" or virtual machine access to a subset of the nodes. Figure 2 shows the distribution of these nodes' location.

Figure 2. Locations of Planet-Lab nodes

Because the nodes are widely distributed in the Internet, the advantage using Planet-Lab for researchers is that it can do large-scale research on lots of services in the real-world conditions. In addition, it can observe and record the status of the network; Easily control and to the nodes used in experiments.

3.2.Iperf

Iperf [7] is developed by the National Laboratory for Applied Network Research (NLANR), and it is maintained by the University of Illinois currently. Iperf provides several different types of TCP/UDP communication test between two network hosts, and can be run on both UNIX/LINUX and Windows. Its primary goal is to help system administrators to fine-tune network applications and TCP parameters on servers.

Iperf can be used to determine the standard performance statistics information of network, and TCP window performance of network test flow between UNIX/LINUX and UNIX/LINUX, UNIX/LINUX and Windows, or Windows and Windows. By fine-tuning network hosts and applications, it can improve application performance its network environment [4]. It is based on C/S mode, and it can test TCP and UDP maximum bandwidth by adjusting various parameters, and reports bandwidth, delay jitter, packet loss, maximum transmission unit size and maximum statistics.

According to the feature about sending real TCP flow to do the bandwidth measurement, the Iperf flow can simulate the P2P flow when it do the measurement work.

4.System building and Experiment

4.1.Experiment Topology

The experiment use a traditional Tree-based topology (Figure 3.) built with the nodes selected in the Planet-Lab.

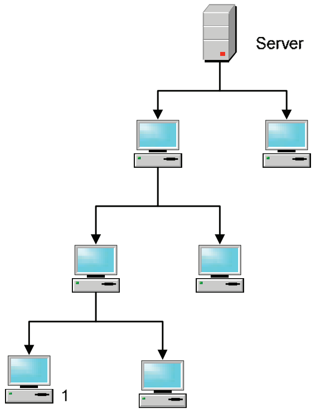

Figure 3. the Tree-based topology for the experiment

4.2.Experimental Methods

At the Beginning of the experiment, the Iperf links between each parent-child node were established separately except node 1, measure their bandwidth and record it into a TXT file. After a period of time, join node 1 to the experiment topology with Iperf. Measure its bandwidth and record it into another TXT file.

4.3.Experimental data and analysis

After node 1 joined to the topology, the bandwidth to most node was not changed except the link between U1->V1 and U2->V2 showed in Figure 4, and with the bandwidth jitter in one link, the bandwidth was also jittering in the other link.

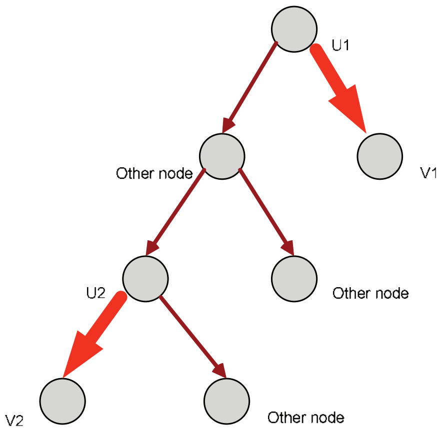

Figure 4. . the Tree-based topology for the experiment

And parts of the bandwidth data of these two links are shown in Figure 5.

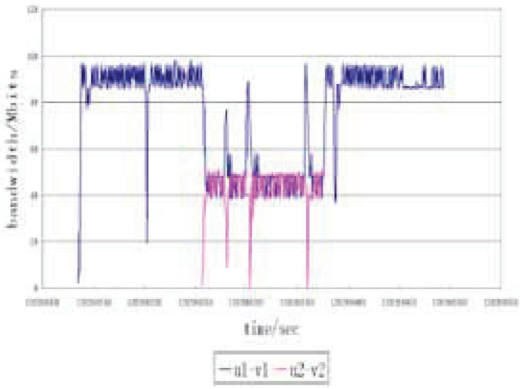

Figure 5. the bandwidth data of U1->V1 and U2->V2

We used traceroute to find the routing paths of these two links and found that, their paths all have the same part:

- 2. ve-51.cisco2.notemachi.wide.ad.jp
- 3. apan-jp.t-lex.net
- 4. losa-tokyo-tp2.transpac2.net
- 5. bilene-1-lo-jmb-702.lsanca.pacificwave.net
- 6. xe-0-1-0.0.rtr.hous.net.internet2.edu
- 7. xe-2-0-0.0.rtr.kans.net.internet2.edu
- 8. ks-42-tenge4-1-110.r.greatplains.net
- 9. 164.113.238.206
- 10. wsec6-ge3-13.unl.edu
- 11. wsec-c1-te1-7.unl.edu
- 12. oldh-d1-te1-1.unl.edu

The result shows that the routing paths of two links are similar. We make the topology simple to be another direct shape just show in Figure 6.

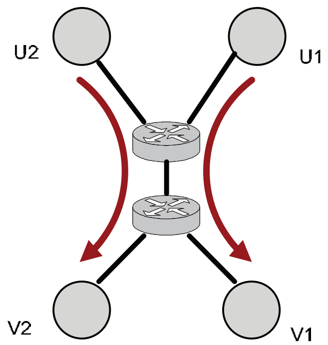

Figure 6.the routing paths of the two links

As we all know, two different links with similar routing paths will share the bandwidth, When the two links are shared in paths, as shown in Figure 5, the bandwidth of link U1 to V1 dropped immediately from the relatively stable condition after the Iperf link was joined, and it has a corresponding jitter with the jitter of link U2 to V2.

The results shows that in the traditional P2P streaming media Tree-based topology, after the link between new node joined to the topology and its parent node have established, it greatly impact on bandwidth conditions of other slip-link which have similar routing paths with it, and the two similar links share bandwidth bottleneck. Because the parent node of the multicast tree limits its maximum input bandwidth of its sub-tree, so the shared bandwidth bottleneck will not only decrease their own bandwidth, have a bad effect on their child nodes about the quality of streaming media, but also affect the playback quality of streaming media the node in the lower link, resulting in decline in the robustness of Tree-based topology. And we found a method to measure the robustness of Tree based topology in P2P streaming media system.

5.Further Research

This paper found and verified a method to measure the robustness of Tree based topology in P2P streaming media system. So a new algorithm for node searching should be designed in order to avoid the occurrence of shared bandwidth bottleneck, preserve the robustness of traditional Tree based topology.And use this method to feedback the merits of the new algorithm for node searching.

Acknowledgements

This work is supported by the National Natural Science Foundation of P. R. China (No. 60970127), Science Technology Research key Project of Ministry of Education (No.109029) and partly supported by Program for New Century Excellent Talents in University (NCET-09-0709).

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