신뢰성 있는 멀티캐스트를 위한 서버라우터의 활용 방안에 관한 연구

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A Study on the Application method of Server Router for Reliable Multicast

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Abstract

Multicast protocols are efficient methods of group communication, but they do not support the various transmission protocol services like a reliability guarantee, FTP, or Telnet that TCPs do. The purpose of this dissertation is to find a method to utilize server routers to form multicasts that can simultaneously transport multicast packets and TCP packets. For multicast network scalability and error recovery the existing SRM method has been used. Three packets per TCP transmission control window size are used for transport and an ACK is used for flow control. A CBR and a SRM is used for UDP traffic control. Divided on whether a UDP multicast packet and TCP unicast packet is used simultaneously or only a UDP multicast packet transport is used, the multicast receiver with the longest delay is measured on the number of packets and its data receiving rate. It can be seen that the UDP packet and the TCP's IP packet can be simultaneously used in a server router.

1. Introduction

The multimedia data transfer is the fundamental element in allowing various applications possible on the Internet. The explosive growth of the internet under high speed network such as the current ATM provides mutlicast data services like remote video conference, Video on Demand (VOD), Virtual Reality game, and Internet broadcasting. Continuing research on satisfying various requirements of network users are in progress. Current application services are based on TCP/IP protocols which constitute a sub system for information exchange. In order to provide services in group communication, a typical characteristic of multimedia application service, IPv4 networks along with Internet Group

Management Protocol (IGMP) need to extend the host's function in order to provide IP multicast service. The next generation IP, the IPv6, has supplemented its multicast service. Using an IP multicast, one sender can transfer multicast data to all members who have joined the group and this service is the basic function for the transport layer service, the upper layer of the network layer. From one-to-one communication service to one-to-many or many-to-many communication service, as requirements and the need for reliability increase, the IP multicast protocol's communication service reliability alone cannot support all these services. Thus methods of adding reliability functions in the transport layer is proposed. Also, since the multicasting router can only process group entries in datagram units like UDP, the TCP cannot process the many protocol services that the TCP supports. That is, due to the heterogeneous nature of the transport layer protocol we face the problem of not establishing a compatible network communication environment. This dissertation looks to design a server router that can transmit multicast UDP packets and TCP packets at the same time as well as use simulation to evaluate performance. Also, by using a scalable reliable multicast (SRM) to re-transmit and recover data when errors occur to multicast groups during the data transmission process a reliable multicast router can be formed. TCP, in particular, can use Acknowledgement (ACK) to re-transmit data error[1][2].

2. Related work of Reliable Multicast

2.1 Requirements of Reliable Multicast

2.1.1 Scalability

We can consider the scalability of multicast groups in two separate views - the sender view (sight or side) and the receiver view. In one-to-many communication service, assuming that many receivers exists, each receiver responds to the received packet by sending feedback to its sender in order to receive reliability. This process causes a state of feedback implosion to the sender causing a stoppage in communication. Therefore, to secure a group's extension an important characteristic of the protocol must be that its capabilities are independent to the number of group members that participate.

2.1.2 Error Recovery

Error recovery can be divided into either Centralized Error Recovery (CER) or Distributed Error Recovery (DER). Depending on whether they are or are not DER local groups, the DER group can also be divided into grouped DER and ungrouped DER. The CER is a sender based error recovery method that is responsible for all the error recoveries of all group members. It is a non-effective method with multicast response explosions and unnecessary packet re-transmissions. The current multicast error recovery strategy mainly uses the DER which decreases the sender's error recovery load. The grouped DER method lowers the amount of re-transmission because the re-transmission occurs within the local groups.

2.2 Scalable Reliable Multicast (SRM)

To form a reliable multicast, the SRM, Reliable Multicast Transport Protocol (RMTP), and Tree-based Multicast Protocol (TMTP) methods are proposed. The SRM reduces the generation possibility of No-Acknowledge (NACK) allowing minimal NACK feedback to senders. The RMTP and TMTP are layered group based methods that divides and manages multiple groups. This dissertation focuses on the SRM.

The SRM transmits reliable multicast packets in the form of many-to-many. Every group member can be the receiver and sender at the same time allowing them to exchange session messages, gather information about other members in their group, and measure the necessary delay time in packet losses. Session messages control the generation frequencies of control messages within the 5% limit of multicast traffic. This method is similar to the state message process of the Real-time Transport Protocol (RTP). If the RTT (Round Trip Time) has passed and the packet loss has occurred, it multicasts the NACK so that the NACK does not receive. Thus, if the same packets are received within the delay time NACKs do not generate. Other members that received NACK multicast the recovery packet if no data is received after the waiting time. The SRM can re-transmit all members in the group being flexible to the change of network topology and multicast error. However, during re-transmission request it uses the waiting time to control response explosion causing additional recovery delay and duplicated recovery request data[3][6].

3. TCP and Multicast Service Using Server Router

3.1 Characteristics of Multicast Routers

It will be cost effective if multicast services are possible in all network surroundings regardless of the networks different features. That is, the sender can reduce network traffic by sending data transmission once to multiple or potentially large number of receivers at the same time. This allows the streaming service to make Internet broadcasting, which uses multimedia data, and internet video conferences to be very effective. However, only UDP services are possible in the transport layer for the multicast protocols. Therefore, FTP and Telnet cannot support reliable TCP protocol services allowing a limitation to the amount of the various network environments it can use. This limited transmission service problem can be directly corresponded to the routers that relay data packets[4][5].

3.2 Limited Server Router Structure and Movement

In real network environments, UDP multicasts, the one-to-one packet transfer applications, like the FTP and Telnet, and effective error control TCP protocols are frequently used. Thus, it must support all transport layer traffic features. The dissertation focuses on solving existing network related problems stated earlier to propose creating a server router with reliable transmission

Figure 1 shows a block diagram of the proposed server router. The sender simultaneously transmits multicast UDP traffic and TCP traffic. While adding key numbers in the head part of each packet and increasing the key value allowing the value to affect the ACK flow control, the routing is categorized into the muticast processing part and the TCP processing

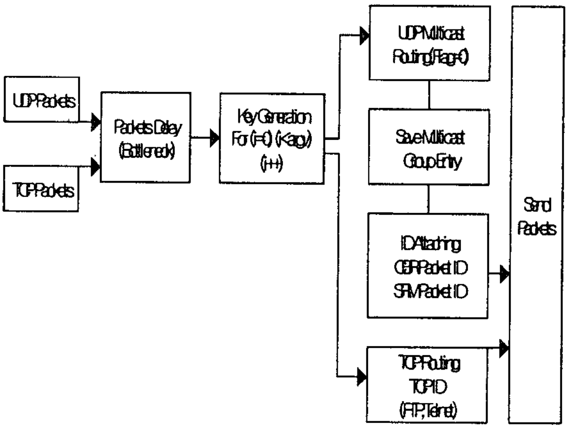


Figure 1 : The Block Diagram of Server Router

part. To process UDP multicast, the multicast group address "mcast grp = $dest" is used as the address entry is saved and to acquire routing information in receive it must be joined to a router. The TCP packet must be configured so that the FTP and Telnet packet is transmitted during simulation setup. For a reliable error control of UDP multicast, the SRM method mentioned above needs to be used.

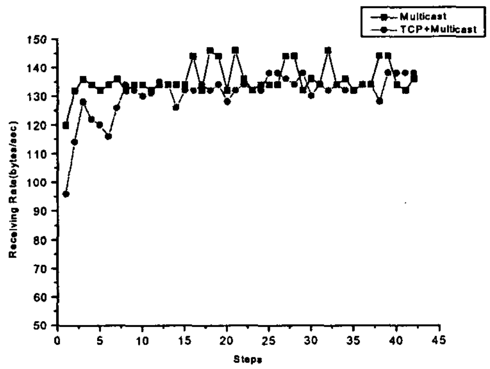
4. Simulations

The simulation measures the receiving rates of two network configuration models as the number of receivers are changed at 2.5 second intervals for 200 seconds. The multicast packet used Constant Bit Rate (CBR) traffic configured at a size of 1000 bytes. The average data transmission rate is calculated by multiplying the number of transmitted packets and the packet size and dividing it by the amount of time to transfer

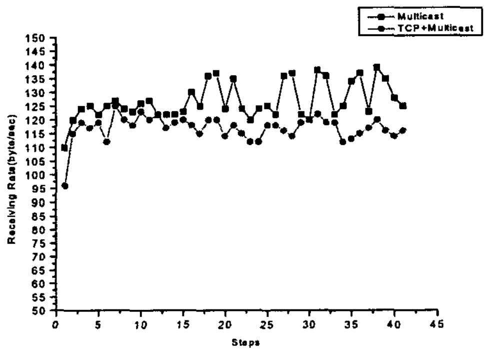
4.1 Simulation Model

Simulation network topology 1 has a sender and receiver node for each of the one sender, 2 receivers, and a TCP packet in the UDP multicast packet. There is a shared link between the sender side server and the receiver side server. The propagation delay and bandwidth is configured as follows: The sender is

15ms and 1.0Mbps, in-between the shared router and router 20ms, 0.5Mbps, and the receiver 10~20ms, 1.0Mbps respectively. It is configured so that the SRM based server router can show various delay times, which is a feature of the SRM, and the packet loss rate generated in-between the server routers are considered. Figures 2 and 3 show the receiving rate changes in server router changes of when the TCP and the UDP multicast are used simultaneously and when only the UDP multicast is used using the change of the number of receivers as its parameter



Figures 2: The 3 receivers receiving rate



Figures 3 : The 6 receivers receiving rate

5. Conclusion

This dissertation focused on proposing using the UDP multicast packet and TCP packet simulaneously used multicast method for a server router. The server router is divided into the inner TCP's IP packet routing part and the outer UDP multicasting routing part. The multicast routing environment is designed so that the each packet can simultaneously process and transfer to the receiver reliably. Also for performance evaluation a simulation two network models - one containing a low burden and the other a high burden - of server routers are tested and compared. The network parameters used in the simulation are link delay time, bandwidth, data transmission rate according to the increase of the number of multicast receivers, and the total number of packets according to time. After seeing the results, using the proposed server router, in other words using the UDP multicast packet and the TCP packet simultaneously, did not cause a sufficient decline in ability compared to using the UDP multicst packet only which is done so much in normal multicast services. Each packet in the proposed server router creates fairness in the bandwidths by allowing them to share it. It can be confirmed that the TCP protocol can be used as a reliable multicast service

References

[1] S.E Deering, "RFC-1112 : Host Extension for IP Multicasting", August, 1989.

[2] Jorg Nonnenmacher,"How bad is Reliable Multicast without Local Recovery?", INFOCOM'98 Mar., 1998.

[3] Jon Lin Sanjoy Paul, "Reliable Multicast Transport Protocol (RMTP)", INFOCOM'96 Mar., 1996.

[4] Injong Rhee, "MTCP: Scalable TCP-like Congestion Control for Reliable Multicast", January, INFOCOM'99

[5] L.Vicisano, L. Rizzo, and J. Crowcroft,"TCP-like congestion control for layered Multicast data transfer," in. Proc. of IEEE INFOCOM '98. Dec., 1998

[6] M.Luby, L. Vicisano, A. Haken," Reliable Multicast Transport Congestion Control," IETF Internet draft, draft-ietf-rmt-bb-mrcc-00.txt, July 2000

[7] U. Black, "IP Routing Protocols-RIP, OSPF, BGP, PNNI & Cisco Router Protocols," Prentice Hall PTR, 2000.