NAT Free Open Source 3D Video Conferencing using SAMTK and Application Layer Router

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***Abstract*— SAMTK: Scalable Adaptive Multicast Toolkit is a toolkit to bridge the gap between network researchers and application developers in the field of multi-point communication. SAMTK includes a Qt based GUI that ensures a single source multi-platform use (Linux, FreeBSD, Windows and MacOS). It provides interfaces for network plugins used by one-to-many network sockets and a simple application programming interface for application developers to develop multi-point communication applications quite easily. ALR: Application Layer Router is a router which parses UDP packets and does a lookup in its internal forwarding table to duplicate and deliver the packets to multiple destinations. It provides NAT traversal function by using a singe UDP port both for session registration and packet delivery. The demo shows the feasibility of NAT free 3D video conferencing using Application Layer Router and the ease of development of video conferencing applications using SAMTK.**

Keywords-SAMTK; Multi-point Communication; 3D Video Conferencing; NAT traversal; Application Layer Multicast

I. INTRODUCTION

There is strong demand for multi-point communication including video conferencing via the Internet. Many researchers and developers in both network and application areas try to provide schemes to meet this demand. For example, network researchers try to provide scalable frameworks so as to establish low delay and provide stable communication paths amongst the participants. Researchers of group communication systems such as remote education, remote office, or interactive collaboration try to provide effective and productive environments. Researchers in networking do not want to come up with complex applications but need to demonstrate the effectiveness of their protocols. On the other hand, application developers need not to care about the underlying method of packet delivery but need to demonstrate the feasibility of such applications in the real Internet. However at times, they fail to realize this when they encounter the NAT[3] problems. SAMTK(Scalable Adaptive Multicast Took kit)[1][2] is a toolkit developed to fill the gap between network researchers and application developers. By using SAMTK, both researchers and developers can easily share their results. We have also developed ALR(Application Layer Router), to overcome the NAT problems. Finally, we have developed a 3D Video Conferencing System using SAMTK to exemplify the ease of application development using SAMTK.

This document explains SAMTK and ALR in the following two sections, then describes the 3D conferencing in section four and concludes with future work in section five.

This work is partly funded by Strategic Information and Communications R&D Promotion Programme (SCOPE, 061106004),MIC, Japan.

II. SAMTK: SCALABLE ADAPTIVE MULTICAST TOOLKIT

This section describes the requirements of a multipoint communication toolkit and the key functions of SAMTK. SAMTK can be obtained through the open source license[4].

A. Requirements

1) Decrease the complexity of multi-point communication

In multi-point communication applications, complexity tends to increase exponentially. For example, the thinkable number of paths between multiple receivers increases in a non-polynomial combinatorial order. The toolkit should therefore provide a method that decreases the complexity of multi-point communication when developing prototypes of group communication applications.

2) Provide easy visualization method

Effective visualization method is required by both network researchers and application developers. However realizing this is time consuming. The toolkit should therefore provide an easy way of visualizing the internetworking on the application.

3) Overcome the obstacle in the real network

Researches want to show the feasibility of their proposal in the real world. However, real network has several obstacles like NATs and firewall. Tools which overcome such obstacles should be prepared and availed.

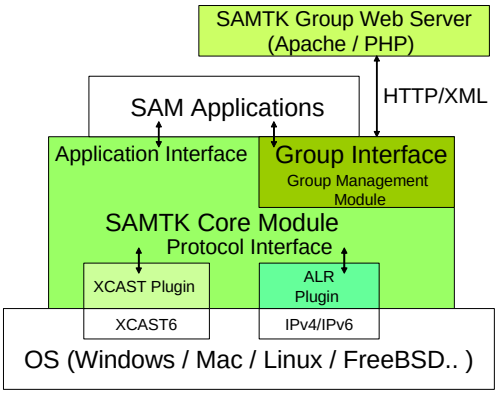

Figure 1. SAMTK Architecture

B. SAMTK Architecture

1) SAMTK components

SAMTK is mainly composed of three components (Fig.1). SAMTK Core Module provides a basic function of packet delivery such as multi-point and multi-layer communication. It also has a measurement function for packet delivery status. The

Core Module abstracts the underlying network protocols. Plug-ins module enables connection between abstract sockets and the specific protocol. Currently SAMTK provides XCAST6[5], ALR and Application Layer Multicast(ALM) plug-ins. The Group Interface Module provides functions to manage the multi-point destinations in coordination with the Group Server.

2) Group Management

SAMTK utilizes a URI as a group identifier. So we currently employ a PHP-based Group Server. Each application (client) can obtain entire group information through the Group Server. Developers can easily add the Group Manager button on the GUI to obtain the group information.

3) API for application

For the application developers, SAMTK provides abstract sockets and group addresses. Programming with SAMTK is almost the same as the usual UDP socket programming. We also develop a series of media processing schemes on SAMTK.

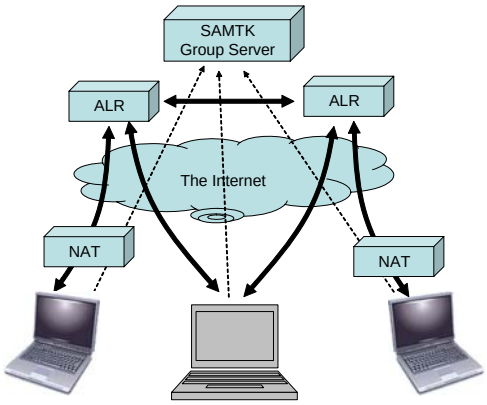

Figure 2. NAT traversal using ALR on SAMTK.

III. ALR: APPLICATION LAYER ROUTER

A. *Necessity of ALR*

Fig.2 shows a NAT traversal of SAMTK using ALR. If we have a NAT boxes in the connections to the Internet, it is not always easy to realize multi-point communication. There are several NAT traversal technologies such as STUN[6]/SIP ALG. However these technologies do not always work for some situations. Also for multi-point communication, it is better to copy the stream traffic near the endpoint. So we put ALR on the Internet to help in multi-point communication. To overcome the Symmetric NAT, we need to use the same port for registration and communication.

B. *Design of ALR*

Each client first registers itself to the ALR. The ALR then issues a unique number (ALR-ID=IP:Port:id-number) for each client. The client then registers its ALR-ID to the SAMTK Group Server. Other clients can read the ALR-ID through the Group Server. The packets are sent to the ALR and then appropriately copied to their correct destinations. In each ALR packet, there are several destination ALR-IDs and global addresses. Like XCAST[5], ALR enables efficient use of the network bandwidth.

C. *Implementation*

We have implemented the ALRs on Linux, FreeBSD and MacOS. A user can setup an ALR on the user land.

Figure 3. SAMTK 3D Video Conferencing

Figure 4. Screen Shot of 3D Video Conferencing

IV. 3D VIDEO CONFERENCING SYSTEM

To show the usefulness of the SAMTK, we build a 3D virtual video conferencing software. It only requires adding a few hundred lines of C++ code to implement a core part of the conferencing software by using SAMTK. We can send communication traffic through both ALM and ALR by using SAMTK plug-in facilities. By using ALR plug-ins and ALR in the Internet, we can overcome the NAT problems. Fig.3 shows a sample demo setup of the 3D conferencing. It includes a SAMTK group server, ALRs, NAT-boxes and SAMTK clients like Fig.2. Fig. 4 shows a screenshot of the system.

V. CONCLUSION AND FUTURE WORK

In this paper, we introduce SAMTK and ALR. By using them, we exemplify the ease of development of a NAT Free 3D Video Conferencing application. SAMTK enables switching between the plug-ins such as ALR, ALM and XCAST.

For the future work, we need to implement the automatic adaptation of the traffic class, network topology and ALR selection. Additional network plug-ins such as SCTP(Stream Control Transmission Protocol) are also required.

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