

Design of IP Sharing Device for Multimedia Streaming using UDP Datagram Switching Mechanism

Jong Wook Nam*, Kam Yong Kim*, Kee Sung Cho**, Hwa Suk Kim**, Seong Gon Choi*

**School of Electrical & Computer Engineering, Chungbuk National University*

410, seongbong-ro, Heungdeok-gu, Cheongju, Chungbuk, Korea, 361-763

***Electrics and Telecommunications Research Institute*

138, Gajeongno, Yuseong-gu, Daejeon, Korea, 305-700

amplengin2@cbnu.ac.kr, kamyong@cbnu.ac.kr, chokis@etri.re.kr, hwskim@etri.re.kr, sgchoi@cbnu.ac.kr

Abstract— In this paper, we propose a mechanism to support switching of multimedia services toward one display equipment among others connected to IP sharing device especially in home network. For this, we developed a client agent mounted on display equipment for recognizing of user's information, a switching agent mounted on IP sharing device, which is related to IPtables management in the device, and embedded board with NAT(Network Address Translation) function. A user can be provided a seamless multimedia service with his information without other signaling procedure between multimedia streaming server and IP sharing device.

Keywords— seamless multimedia service, mobility, handover, IPTV

I. INTRODUCTION

In future network, home networking is one of the most critical issues, and user's demand on multimedia service has been increased in home network. Moreover, users want to be provided seamless multimedia services after moving to other display equipment in NATed(Network Address Translated) environment of home networking.

There have been researches related to these issues. One thing deals with location-based architecture for service portability[1]. Another is for agent-based user mobility support mechanism in RFID networking environment[2]. However, these mechanisms are not suitable for the NATed environment. And these take a long time to switch multimedia service traffic. Moreover, Multimedia service which is based on the user datagram protocol (UDP), like other Internet applications, cannot avoid the NAT traversal problem [3][4]. Also, the details regarding binding tables were not considered on previous researches.

Therefore, we propose the UDP datagram switching mechanism which is suitable for NATed environment using IP sharing device and the IPtables management which is the UDP hole punching technique to avoid NAT traversal problem. And we developed software and embedded board

for switching of multimedia service on IP sharing device. Moreover, our mechanism considered binding table details.

This paper is organized as follows. In section II, we describe about the related works. The proposed mechanism is explained in section III. In section IV, we implement software and embedded board which includes NAT function for operating the proposed mechanism. The performance analysis of the proposed mechanism is shown in section V. Finally, conclusion is given in section VI.

II. RELATED WORKS

A. IPTV SERVICE based on UDP datagram

IPTV is a digital television service which is delivered using IP over a network infrastructure. IPTV service market will grow significantly, due to a variety of services provided. For example, basic TV video, premium video, VoIP, DVR, VOD, DVR, HDTV, and etc[8]. IPTV service contents, especially real-time service such as live TV, are transported to user by using UDP. STB is located in a NATed environment, like other Internet applications, it cannot avoid the NAT traversal problem. Due to this, the service continuity of IPTV service can't be guaranteed.

B. NAT Traversal Problem

A NAT allows several terminals to share a single public IP address. Private IP addresses are assigned to hosts behind NATs. A NAT maintains port and address translation information, which means that communication between terminals and the public Internet nodes pass through the NAT [3]-[7].

A NAT allows the inside session formation. But, NAT blocks session from outside as a fire-wall, so it has problem which makes difficult communication between outside and inside [3]. To solve this problem, many kinds of mechanisms are studied such as STUN, ALG, UDP Hole Punching, and etc. [7]

Simple traversal of UDP through NATs (STUN) is a protocol which is able to detect kinds of NAT like Symmetric

NAT, Cone NAT and information of mapping [3]. However, STUN needs additional server in public network and has to add a STUN-client to terminal.

III. PROPOSED MECHANISM

Proposed mechanism supports rapid switching of multimedia service using signaling procedures between display equipment and IP sharing device without signaling with MSS.

Figure 1. Network configuration to support switching of multimedia service based on IP sharing device

IP sharing device includes NAT function, networking function, authentication function, binding table managing function and switching agent function. This includes two binding tables. One is the authentication binding table to manage user's authentication information. Another is the session binding table to manage the user's location information and service information.

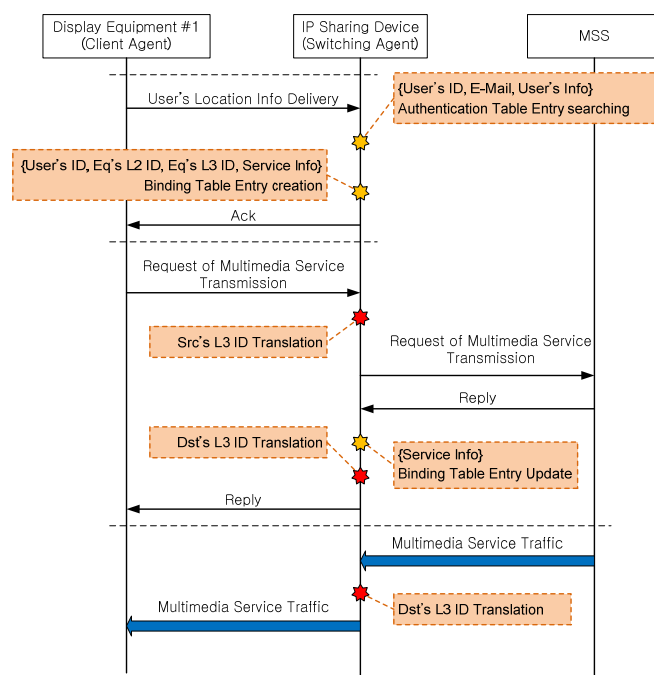


Figure 2. The initial request procedure of multimedia service transmission

delivery message from display equipment #1.

If there is the preregistered user's authentication information, the switching agent creates the new session binding table entry which includes user's ID, display equipment's L2 ID, display equipment's L3 ID and service information. And if there is no information, the proposed mechanism does not operate.

This means that if there is the session binding table entry related user's ID, the authentication operation was completed. Therefore, authentication operation does not need any more.

IP sharing device translates source's(src's) L3 ID which includes the signaling message into IP sharing device's L3 ID after receiving the signaling message which requests the multimedia service transmission.

MSS sends the reply message to IP sharing device. IP sharing device sends the reply to display equipment#1 after translating destination's(dst's) L3 ID which includes the reply into display equipment's L3 ID. Destination's L3 ID included in multimedia service traffic received from MSS is translated into display equipment's L3 ID and translated traffic is sent to display equipment.

As the result of procedure mentioned above, a user can receive the multimedia service traffic.

Figure 3 shows the request procedure of multimedia service transmission when a user joins NATed environment after moving to display equipment #2. Before illustrating the detail procedure, we assume that session binding table already includes entry about user's ID.

When a user presses the keyboard, display equipment #2 recognizes user movement and gets user's ID information which is preregistered in display equipment.

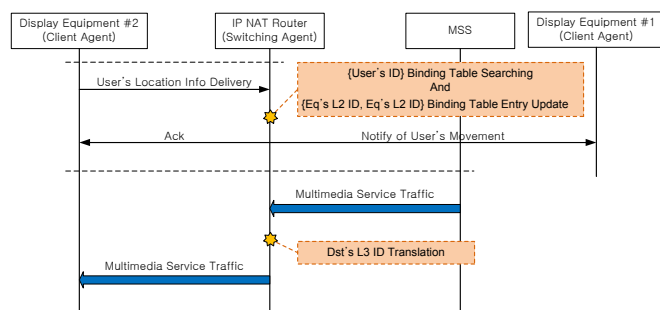


Figure 3. The request procedure of multimedia service transmission to receive the seamless multimedia service traffic from MSS

IP sharing device sends Ack signaling message to display equipment #2. And this sends notification of user's movement signaling message to display equipment #1 to stop display.

After signaling messages, multimedia service traffic from MSS to display equipment is delivered via the IP sharing(NAT) device. At this time, switching agent mounted on the IP sharing device translates L3 ID which included in packet from MSS into NATed L3 ID. And translated packets are forwarded to display equipment.

As the result of procedure mentioned above, when a user moves to other display equipment in the NATed environment, he can be provided the multimedia service as soon as possible by this procedure.

B. Management mechanism of two binding tables

We used two binding tables to manage the authentication information and the session information.

Table 1. Format of authentication binding table

No.	User ID	E-Mail	Auth Info	Time
1				
2				
.....				

Table 1 presents the format of authentication binding table to store the authentication information of a user who joins home network. Here, user's authentication information is preregistered by administrator.

Table 2. Format of session binding table

No.	User ID	L2 ID	L3 ID	Session ID	Service ID	Time
1						
2						
.....						

Table 2 shows the format of session binding table to store user's location, session and service information.

Two binding tables which mentioned above include time column. This is the maintenance time of binding table entries.

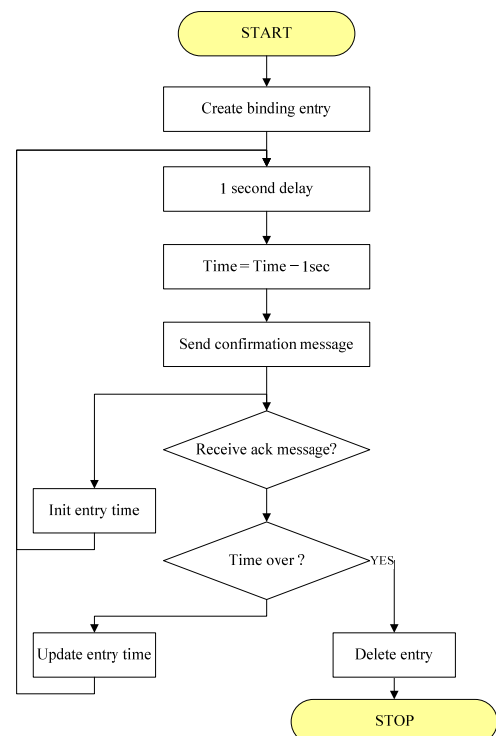


Figure 4. The flow chart for managing binding table entry

Figure 4 shows the operation to maintain binding table entries.

When switching agent starts, authentication binding table is created. And when user authentication successfully completes, session binding table is created. Entries of two binding table managed by binding table managing function. And the flow chart presents the operation of respective entry.

When client agent is down or user terminates the client agent unusually, error is occurred in switching agent. To prevent this problem, switching agent need to confirm the validation of client agent.

For this, switching agent sends the confirmation message to client agent periodically. And client agent sends the ack message after receiving the confirmation message from the switching agent. Here, periodic time is one second.

If there is no ack message which received from the client agent during the maintenance time, switching agent delete the binding table entry. If there is ack message, switching agent changes the maintenance time into initial value.

Our proposed mechanism for multimedia service switching operates very stable and dynamic by using flow mentioned above.

C. IPtables management to avoid NAT traversal problem

In the IP sharing(NAT) device, translation of destination's L3 ID which is included in multimedia service packets(UDP) using IPtables needs to avoid NAT traversal problem for multimedia service switching.

Most IP sharing devices hold an idle timer for a UDP session and block the hole for the given period. Due to the reasons mentioned above, NAT traversal problem is occurred.

There are several mechanisms for solving NAT traversal problem in existing research. Among the mechanisms, we used UDP hole punching mechanism for solving NAT traversal problem.

Our mechanism is very simple method without additional server, application or user handling. The mechanism only has two steps for modifying the UDP hole timeout value.

Firstly, a location of UDP hole timeout value is searched in IP sharing device. Secondly, the UDP hole timeout value is modified to zero.

Modifying this value to zero means that UDP hole timer do not work. As the result of method mentioned above, IP sharing device can solve a NAT traversal problem.

IV. IMPLEMENTATION

Figure 5 shows the developed embedded board with NAT function. Here, IP sharing device is the developed embedded board.

Table 3 presents main features about developed embedded board with NAT function.

Developed embedded board includes port mirroring function, JTAG Debugging function, UART console function and IGMP snooping function apart from main features.



Figure 5. The developed embedded board with NAT function

Table 3. Main features of developed embedded board

Main Features
ARM 922T Core at 166 MHz
64MB Memory space
8Kb I-Cache and 8Kb
33MHz 32-bit PCI Interface
4 LAN Interface
1 WAN Interface
1 Wireless Interface

Moreover, the embedded board automatically generates TCP/UDP/IP packet header checksum to reduce CPU loads. And, to support more extensive ports or peripherals, this provides sixteen GPIO(General Purpose Input/Output).



Figure 6. The demonstration environment of our software and IP sharing device

Figure 6 shows the demonstration environment of our software and IP sharing device.

Table 4. System properties

Object	Attributes CPU	Memory	OS	NIC
Laptop	2.1GHz	1GB	Win XP	100Mbps
Desktop	2.4GHz	2GB	Win XP	100Mbps
MSS	3.0GHz	2GB	Fedora 9	100Mbps

Table 4 presents system properties of demonstration environment. In the table 4, Laptop and Desktop are display equipment to receive multimedia service from the MSS.

In the demonstration environment, Client agent included in our Software package operates on the windows XP service pack 3. MSS must be able to send UDP multimedia service traffic.

Switching agent included in our software operates on this embedded board which is based on Arm 922T CPU and linux platform.

V. PERFORMANCE ANALYSIS

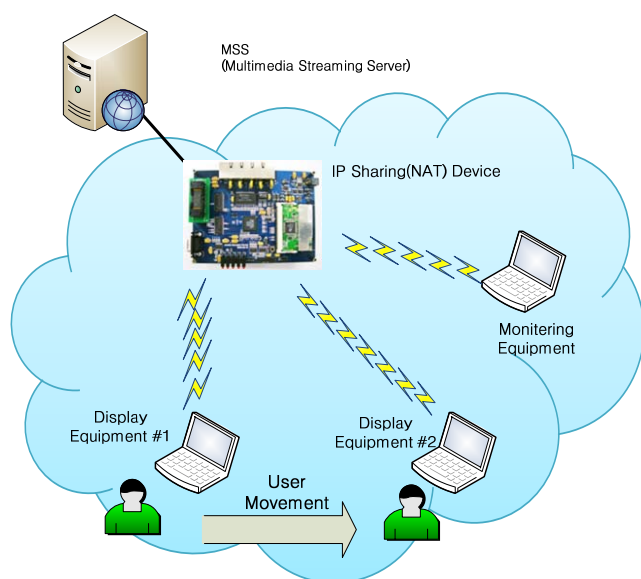


Figure 7. Implemented network configuration

In figure 7, the IP sharing device is connected to MSS by wire which located out of NATed environment. And two display equipment and monitoring equipment are connected to this IP sharing device by wireless.

IP configuration of figure 7 is as follows.

MSS's L3 ID is configured with "210.125.147.232". "192.168.1.55" is L3 ID which is configured at display equipment #1. And L3 ID of Display equipment #2 is "192.168.1.66"

The situation that a user moves from display equipment #1 to display equipment #2 is possible by pushing the keyboard of display equipment #2. When user's movement is recognized, signaling message for multimedia service switching is occurred.

We used WIRESHARK, network packets analyzing tool, to capture packets which are transmitted and received service between IP sharing device and display equipment on monitoring equipment.

Also, in order to get multimedia service switching time, we used I/O filtering graph of WIRESHARK.

Figure 8 shows the traffic change which follows in user movement between one display equipment and another one.

In this graph, graph1 is flow between MSS and display equipment #1, and graph2 is flow between MSS and display equipment #2.

Packet filtering rules applying to analyze captured packets are as follows.

Graph1's filtering rule is "ip.src == 210.125.147.232 && ip.dst == 192.168.1.55"

Graph2's filtering rule is "ip.src == 210.125.147.232 &&

ip.dst == 192.168.1.66"

The switching time which occurred from process of multimedia service switching can be calculated by analyzing the packets which got from demonstration environment.

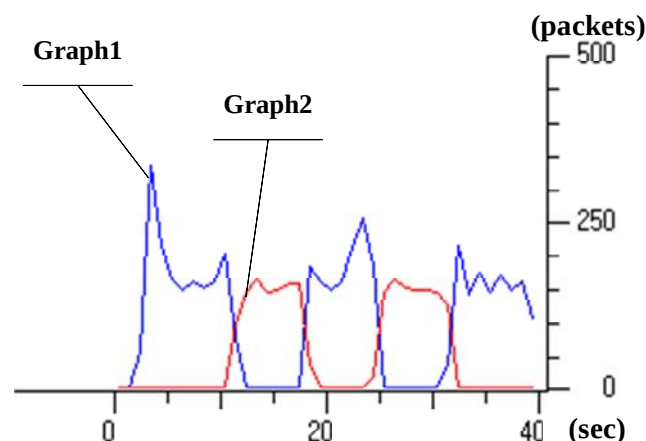


Figure 8. The flow of multimedia service traffic

The switching time is the time interval between time sending signaling message after user's movement and time sending multimedia service packets after establishment of signaling process.

Table 5. Multimedia service switching time

Movement	Signaling starting time(ms)	Service starting time(ms)	Service switching time(ms)
1	11587	111678	91
2	18239	18341	102
3	24905	24997	92
.....			
Average			98

Table 5 presents switching time occurred from process of multimedia service switching according to user's movement.

We measured about 350 times to calculate the average multimedia switching time. As shown in table 5, measured multimedia service switching time is averagely 98ms.

From this measured result, we confirmed that proposed mechanism can be used in NATed environment of home network.

VI. CONCLUSION

In this paper, we proposed the UDP datagram switching mechanism and the method of IPtables management to support multimedia service switching in NATed environment of home network.

To support proposed mechanism, we developed software package(client agent and switching agent) and embedded board. And to measure this performance, we built test environment and used WIRESHARK tool.

From this measured result, we confirmed the more fast switching time than previous researches. And this mechanism stably operates for long time.

As a result, we show the possibility that our proposed mechanism can be used in NATed environment of home network.

For further works, we plan to study the switching schemes which are required to support global multimedia service switching when a user moves from one NATed environment to another one.

VII. ACKNOWLEDGMENT

The work was supported by the IT R&D program of KEIT&MKE&KCC, Rep. of Korea. [2009-S-026-01, Development of Group Service and Service Continuity Control Technology in the Broadcast and Telecommunication Converged Environment]

*Corresponding Author: Seong Gon Choi
(sgchoi@cbnu.ac.kr)

VIII. REFERENCES

- [1] Ron Shacham, Wolfgang Kellerer, "An Architecture for Location-based Service Mobility Using the SIP Event Model," Mobisys2004, May 2004.
- [2] Dong Guen Yun, Jong-Min Lee, Myung-Ju Yu, Seong-Gon Choi and Chang Ho Seo, "Agent-based User Mobility support mechanism in RFID Networking Environment," International Conference on Consumer Electronics 2009, May 2009.
- [3] Choongul Park, Kitae Jeong, Sungil Kim, Youngseok Lee, "NAT Issues in the Remote Management of Home Network Devices", IEEE Network Volume 22, Issue 5, Sep. 2008.
- [4] H. Khelifi and J. Gregoire, "VoIP and NAT/Firewalls: Issues, Traversal Techniques, and a Real-World Solution", IEEE Communications Magazine, Volume 44, Issue 7, July. 2006.
- [5] M. Holdrege, "IP Network Address Translator (NAT) Terminology and Considerations", IETF RFC 2663, Aug. 1999.
- [6] B. Ford and P. Srisuresh, "Peer-to-Peer Communication Across Network Address Translators", USENIX Annual Technical Conf., 2005.
- [7] A. Muller, G. Carle, A. Klenk, "Behavior and classification of NAT devices and implications for NAT traversal", IEEE Network Volume 22, Issue 5, Sep. 2008.
- [8] R. Droms, "Dynamic Host Configuration Protocol", RFC 2131, 1993.
- [9] Droms, R. "Automated configuration of TCP/IP with DHCP", IEEE Internet Computing, Vol. 3, Issue 4, Jul. 1999.
- [10] A. Yarali, "Internet Protocol Television (IPTV)", TENCON, 2005.