A Multimedia Sharing Scheme on IMS-based Digital Convergence Platform

Jian-Wei Li
Department of Information and Communication Engineering, Chaoyang University of Technology
Taichung, R.O.C
lijw@cyut.edu.tw

Yen-Lun Chiu
Department of Information and Communication Engineering, Chaoyang University of Technology
Taichung, R.O.C
s10030610@cyut.edu.tw

Yi-Chun Chang*
Department of Computer Science and Information Engineering, Hungkuang University
Taichung, R.O.C
changyc@sunrise.hk.edu.tw

ABSTRACT

In this era with network environment omnipresent, a person accesses network services anytime through the mobile network and a personal device but probably fails in sharing video streaming among all surrounding friends via his/her own mobile device with a finite-sized screen. In this paper, we studied and designed a multimedia sharing scheme by which a sharer allows synchronous video streaming to be accessed by other users through their own mobile devices as is the sharer. Preferably, the sharing service constructed on the IP Multimedia Subsystem (IMS) in this study can be available for more users via different access networks in the future.

Keyword: multimedia sharing; IMS; video streaming; synchronous video streaming.

I. INTRODUCTION

People who live in a technology-advanced environment have more channels to catch information or to enjoy multimedia services, for example, data query, e-mail and multimedia service access which is realized by Quad-Play technology through mobile networks (e.g., Wi-Fi and 3/3.5G) and personal devices (e.g., Android Phone and iPhone) in recent years. With existing telecommunication networks, broadcast TVs and Internet integrated, the Quad-Play technology provides convenient mobile application services to users who can use a single platform to access multiple services including data, audio, video and mobile communications [1] in addition to traditional desktop computers and wired networks.

Although convenient, the mobile network service such as multimedia streaming enjoyed by one user through a personal handheld device outdoors may not be shared by surrounding friends simultaneously due to a finite-sized screen on a handheld mobile device.

Against this background, we designed the multimedia sharing scheme through which the authority to enjoy multimedia streaming possessed by one user originally is shared by surrounding friends according to control of SIP (Session Initiation Protocol). In this regard, these people depending on the mobile network and personal mobile devices utilize the same multimedia streaming broadcasted synchronously as does the original owner who still owns exclusive session control over multimedia contents. Similar to a conference call in which all invitees or participants communicate with each other through a host control server, the multimedia sharing still has its feature different from the conference call, for example, the multimedia sharing is based on REFER that allows receivers to make conversations with the multimedia source and synchronously receive but not control multimedia from the source.

In this study, the multimedia sharing service is constructed on the IP Multimedia Subsystem (IMS) network which is not only the core architecture of the Next Generation Network (NGN) formulated by 3GPP and 3GPP2 [2][3] but also one platform accessed by users who intend to use top-level application services through different network technologies (e.g., 3G, LTE and Wi-Fi). IMS supports multimedia application services such as Push to Talk over Cellular (PoC), Voice over IP (VoIP) [4] and Internet Protocol Television (IPTV) [5]. Based on SIP to control and manage the multimedia session, IMS is able to find appropriate application services after processing a user's service requests .

The other sections in this paper are introduced as follows: section 2, background of IMS network system/architecture and introduction of the similar multimedia sharing technology; section 3, the system architecture of multimedia sharing technology used in our research; section 4, introduction of environment and methods to use multimedia sharing and the process to transmit message on the IMS network(s); section 5, conclusion.

II. BACKGROUND KNOWLEDGE

As one platform on which the services such as multimedia sharing are constructed, the whole IMS network needs to be introduced and understood, for instance, its basic architecture and operation of relevant components. Another topic to be investigated herein is session mobility [6] related to multimedia sharing in SIP.

A. *IMS Network*

The IMS Network, i.e., IP Multimedia Subsystem Network, which is the control layer of the Next Generation Network (NGN) and formulated by 3GPP and 3GPP2 [2][3], is used to access different network technologies such as Wi-Fi, LTE, 3G/3.5G and wired network and depends on SIP as the communications protocol to control SIP signals by the Call Session Control Function (CSCF). The brief network architecture of IMS is shown in Fig. 1.

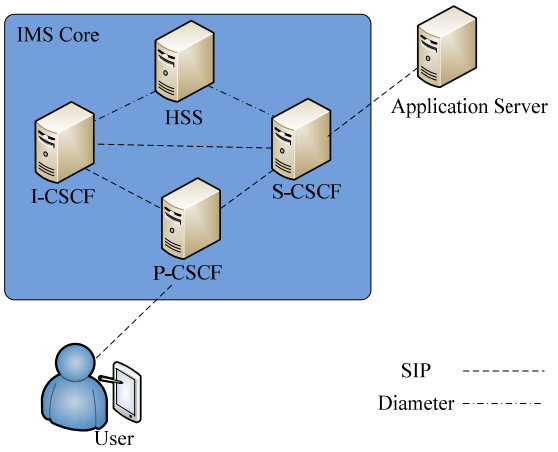

Figure 1. Brief network architecture of IMS

1) P-CSCF (Proxy-CSCF): As the first IMS network server faced by one user, P-CSCF forwards a user's messages into IMS, SIP messages to I-CSCF for further processing, and any SIP signal response to a user.

2) I-CSCF (Interrogating-CSCF): I-CSCF is a query server which relies on a user's SIP requests or information brought by P-CSCF to find an appropriate S-CSCF for relevant services and saves the information in HSS for other queries later.

3) S-CSCF (Serving-CSCF): S-CSCF is a service server which is particularly used in processing a user's service requests and depends on the requests to find a corresponding application server.

4) HSS (Home Subscriber Server): HSS in IMS is particularly used in storing users' data such as e-mail, phone number and user's authority to access services.

5) Application Server (AS): As a top-layer application server such as multimedia streaming and monitoring system, AS depends on S-CSCF to give a user services.

B. *Session Mobility*

The session mobility means current sessions transferred from one communications device to the other one by SIP with no session service interrupted and utilizes a mechanism known as Call Transfer classified into two methods, REFER and 3PCC (Third Party Call Control), which are formulated by RFC 3515[7] and RFC 3725[8].

As shown in Fig. 2, 3PCC is used to construct a session between a third party controller who is responsible for media negotiation and two or more other participants. Controller initiates a session and controls the session between two users including Customer Service (CS) and User Phone: Controller sends "INVITE" with no SDP inside to CS; CS responds "200 OK" with supported session types included; Controller sends "INVITE" including CS information to User Phone; User Phone responds its own "200 OK" with supported session types included to "INVITE"; Controller provides information for supported session types to CS; all participants own equivalent information; the conversation is completed [9].

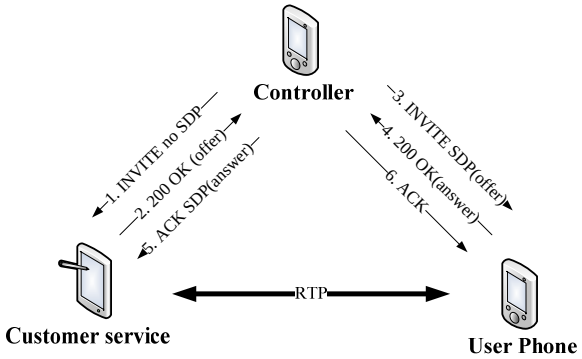

Figure 2. Schematic diagram of a 3PCC process [9]

As shown in Fig. 3, REFER that is one technique of inviting a new user or one device to join a session through an original user defines the header "Refer-To" recording the third party's SIP URI by which the original user can invite the third party to construct a session after receiving "REFER".

In Fig. 3, Alice, who has a session with Bob and intends transferring the session to Carol, sends Bob "REFER" with Carol's URI included; Bob gives Carol "INVITE" and Alice "Accepted" by which Alice recognizes "REFER" is received by Bob; Bob receives "200 OK" from Carol, who agrees the session, and sends Alice "NOTIFY"; Alice identifies the session between Bob and Carol and completes the session with Bob [9].

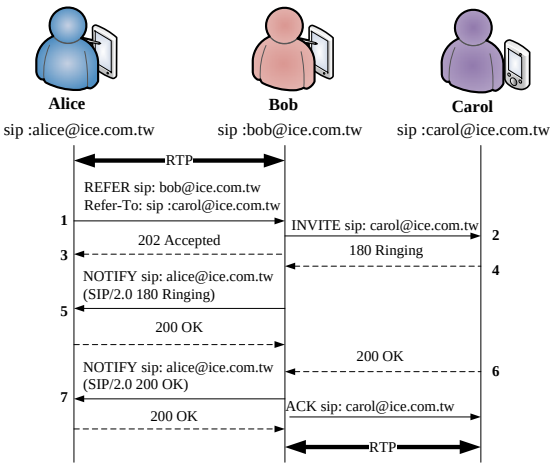

Figure 3. Steps to transmit REFER signals [9]

Based on 3PCC and REFER, session mobility contributes to a session transferred to an appropriate device by one user at a different environment, for example, a video session via the 3G network and a user's mobile device switched to via a home computer and the network by session mobility for endless service. In addition to session mobility, session split is another service introduced in [6][10]. For instance, the multimedia streaming video or audio program broadcasted via a mobile device and the 3G network outdoors is also played on an Internet Protocol TV or stereo at home with streaming split to a distinct device according to prevailing environment and equipment.

In the case of users' and their friends' personal mobile devices rather than alternative devices, multimedia sharing is effective in multimedia streaming shared among the surrounding friends' mobile devices and synchronously watched by device owners through the mobile network. In this regard, the method based on REFER for multimedia sharing is particularly introduced in section 4.

III. System Architecture

In this study, multimedia sharing is constructed on an IMS platform with system architecture as shown in Fig. 4. The IMS platform can be separated into three parts, IMS Core, IMS Client, and IMS Application Server (IMS AS). IMS Clients includes users and their mobile devices or are classified into sharers and receivers: a sharer (User1 in Fig. 4) shares multimedia streaming with receivers (User2 and User3 in Fig. 4) who access no multimedia service in the beginning. IMS AS includes servers such as Multimedia Agent (MA) and Presence Server (PS): MA provides users multimedia sources, e.g., multimedia streaming server, webcam, etc.; PS presents information of on-line friends, who are recognized by a sharer, and contributes to multimedia sharing services on the IMS network.

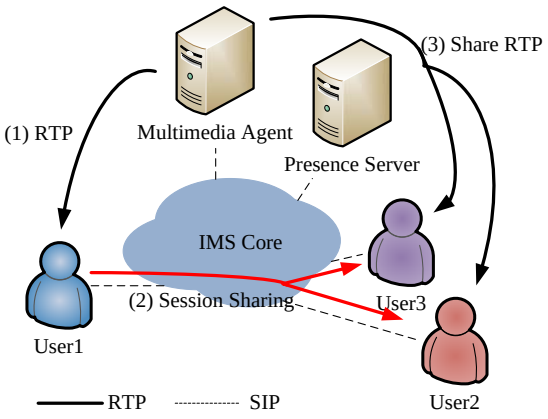

Figure 4. IMS-based multimedia sharing architecture

As shown in Fig. 4, RTP (Real-time Transport Protocol) streaming between a sharer and MA has existed before a session is shared by a sharer. Then, the sharer identifies any on-line receiver via PS and makes multimedia sharing available to the receiver who prefers the sharer's streaming services.

IV. Method of Mutimeida Sharing

A. *Context of Application Service*

Alice and her friends Bob and Carol go to a party outside. Suddenly, Alice who has been staying gossiping with her friends wants to check her home and links a household webcam via her handheld device to find something interesting about her family members. Alice intends to share it with both guys but the image on her handheld device is too small to be watched by three persons simultaneously. Considering no device with a bigger display there, Alice shares her own multimedia streaming at Bob's and Carol's handheld devices and makes an interesting thing at home clearly displayed on their personal devices.

In this context, Alice's role is the sharer, Bob & Carol are receivers accepting multimedia sharing, and the household webcam is MA which is accessed and controlled by someone with the authority, for example, premium channel or private web camera installed in a house or office and accessed by others who are authorized by the sharer. In this regard, these devices or services cannot be controlled by an authorized receiver watching videos but by the service sharer who possesses control rights.

B. *Designs of Signal Transmission in a Process of Multimedia Sharing Service*

In this study, the multimedia sharing service is constructed on the IMS network(s). Against this background, Alice, who has interacted with MA to get multimedia streaming before sharing, utilizes REFER to request a connection built between a receiver, Bob or Carol who needs multimedia streaming, and MA. Fig. 5 illustrates the first design for Alice, Bob and Carol on the same IMS network.

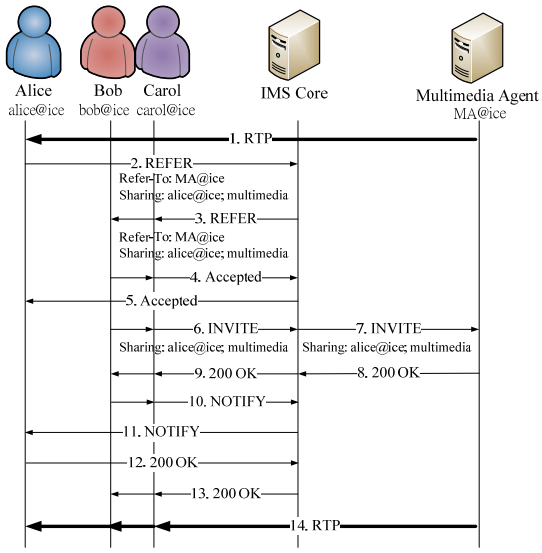

Figure 5. Steps for signal transmission of multimedia sharing (a sharer and receivers on the same IMS network)

The detailed steps for signal transmission of multimedia sharing in Fig. 5 are shown as follows:

Step 1: Alice interacts with MA to get multimedia streaming before multimedia sharing.

Step 2: Alice sends “REFER” to Bob and Carol recognized as on-line users by Alice through the Presence Server before sharing multimedia streaming.

Steps 3-5: Bob and Carol respond “Accepted” to Alice through the IMS network after receiving “REFER”.

Steps 6-7: The “INVITE” along with the header “Sharing” from Bob’s and Carol’s personal mobile devices is sent to MA through the IMS network.

Steps 8-9: MA sends “200 OK” after receiving “INVITE”.

Steps 10-11: Bob and Carol send “NOTIFY” to Alice via the IMS network after receiving a response from MA.

Steps 12-13: Alice who has received “NOTIFY” recognizes multimedia sharing and sends “200 OK” to Bob and Carol for the same multimedia streaming shared by the sharer and receivers.

V. Efficiency Analysis and Comparison

In contrast to a traditional conference call which depends on a host server to control and transmit conversations or multimedia videos among participants who invite other users to join the conference anytime, the multimedia sharing features a sharer who manages other conference members (i.e., receivers) and administers multimedia. In the case of fixed users on the same network who have mobile devices and try to enjoy authority-based multimedia streaming, the users can access multimedia provided by a sharer after accepting the sharer’s sharing on the basis of multimedia sharing scheme; however, a sharer in a conference call has to post the source location of multimedia streaming and provide authority information such as username and password to fixed receivers who incline to access multimedia but spend more time to take them.

VI. Conclusion

The advantage of this study is a sharer, who tries to share authority-based multimedia streaming with surrounding users or friends holding personal mobile devices only, is able to reach his/her goal by way of multimedia sharing, for example, the users or friends watch synchronous video streaming on their own mobile devices. Moreover, users can access services via different wireless network technologies (e.g., Wi-Fi, 3G and LTE) in the IMS network environment.

VII. Acknowledgment

The research is supported by the National Science Council of the Republic of China under the grant Number NSC 102-2221-E-324-012 and NSC102-2221-E-241-015

Reference

[1] J. Ulm, B. Weeks, “Next Play Evolution: Beyond Triple Play & Quad Play,” IEEE International Symposium on Consumer Electronics (ISCE) , pp. 1-6, 20-23 June 2007.

[2] IP Multimedia Subsystem (IMS) Handbook. Syed A. Ahson, Mohammad Ilyas: CRC Press.

[3] Converging NGN Wireline and Mobile 3G Networks with IMS: Converging NGN and 3G Mobile. Rebecca Copeland: CRC Press.

[4] Y. He, J. Veerkamp, A. Bilgic, “Analyzing the Internal Processing of IMS-based and traditional VoIP systems, ” Telecommunications: The Infrastructure for the 21st Century (WTC) , pp. 1-6, 13-14 Sept. 2010.

[5] E. Mikoczy, S. Schumann, P. Podhradsky, T. Koski, M. Heinikangas, “Hybrid IPTV Services with IMS: Integration of IMS Based IPTV with Broadcast and Unicast Mobile TV Services Using DVB-H,” International Conference on Next Generation Mobile Applications, Services and Technologies (NGMAST) , pp. 76-81, 14-16 Sept. 2011.

[6] M. Rawashdeh, A. Karmouch, “Seamless Video Handoff in Session Mobility over the IMS Network,” IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks & Workshops (WoWMoM) , pp. 1-6, 15-19 June 2009.

[7] R. Sparks, “The Session Initiation Protocol (SIP) Refer Method,” RFC 3515, IETF, April 2003.

[8] J. Rosenberg, J. Peterson, H. Schulzrinne, G. Camarillo, “Best Current Practices for Third Party Call Control (3pcc) in the Session Initiation Protocol (SIP) ,” RFC 3725, IETF, April 2004.

[9] M. Chen, C. Peng & R. Hwang, “SSIP: Split a SIP Session over Multiple Devices,” Computer Standards and Interfaces, vol. 29, no. 5, pp. 531-545, Jan. 2007.

[10] K. Geunhyung, Y. Gunil, “Streaming Session Mobility across Multiple Devices in Mobile IPTV Environments,” Proceedings of the 4th International Conference on Ubiquitous Information Technologies & Applications (ICUT) ,pp. 1-6, 20-22 Dec. 2009.