

Design and Implementation of IMS Service Continuity between IPTV and mobile

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Abstract— Session Initiation Protocol (SIP) has been widely applied to multimedia telephony service in Broadband Converged Network (BCN). SIP is also adopted as the basic signalling protocol of VoIP and 3GPP. IP multimedia subsystem (IMS) is a SIP based multimedia telecommunication infrastructure in 3GPP. Recently, many mobile operators have selected IMS as a core infrastructure because IMS has a flexible architecture to support converged service to support session mobility from one device to another. Nevertheless, SIP has some drawbacks such as undesirable latency during the session reestablishment procedure. In this paper, we design and implement the enhanced IMS service continuity in order to shorten the session mobility latency. To verify our work, we launched the developed system as a pilot service in our service network.

Keywords— BCN, IMS, Session Mobility, SIP

I. INTRODUCTION

Session Initiation Protocol is a popular choice for establishing media sessions [1]. There are many devices and servers which interoperable to SIP. 3GPP (3rd Generation Partnership Project) adopt SIP as the signalling protocol for multimedia telecommunication, IP multimedia Subsystem (IMS) is a SIP based infrastructure to provide converged services [2]. In order to provide uninterrupted services in all IP network environments, session mobility should be supported. 3GPP provides the IMS Service Continuity (ISC) technical specification which supports session mobility [3]. ISC is evolved from the Voice Call Continuity (VCC) technical specification which supports domain transfer between the packet switched domain and the circuit switched domain [4]. Similarly, IETF supports the session mobility which is the transfer of media of an ongoing communication session from one device to another and more related works are reported [6, 7, 8]. In general, ISC can be divided into two concepts. One is providing the capability of transferring ongoing communication sessions with multiple media across different access networks. The main need for such continuity arises because user equipments (UEs) with multimedia capabilities can move across a multiplicity of different access networks. The other is providing the capability of transferring the communication sessions with multiple media across different UEs [3].

In this paper, we focus the session mobility which is mentioned secondly. Though ISC presents its advantages in

handling session mobility, it has its own problems which are inevitable latency during the session reestablishment procedure. In order to overcome these problems, we suggest the mechanism which the session mobility latency can be shortened. To verify our mechanism, we design and implement the IMS service continuity between IPTV and mobile.

The remainder of this paper is organized as follows. The overview of ISC is discussed in section II. In section III, our mechanism of design and implementation is proposed, as well as how the session mobility is enhanced. In section IV, we describe the performance analysis to show the latency improved in the proposed scheme. Finally, the conclusion is given section V.

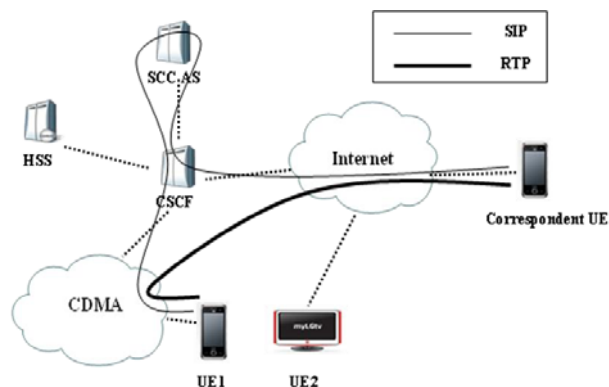


Figure 1. Reference architecture of ISC

II. OVERVIEW OF IMS SERVICE CONTINUITY

IMS Service Continuity provides the capability of continuing ongoing communication sessions with multiple media across different access networks or across different user equipments under the control of the same subscriber [3]. Figure 1 shows the reference architecture of ISC. The IMS core network predominantly consists of the Call Session Control Function (CSCF) and Home Subscriber Server (HSS). The CSCF plays an important role in IMS. The CSCF node facilitates SIP session setup and teardown. The HSS plays the role of a location server in IMS, in addition to acting as an AAA server. The HSS also serves as a single point of provisioning for IMS subscribers and their services.

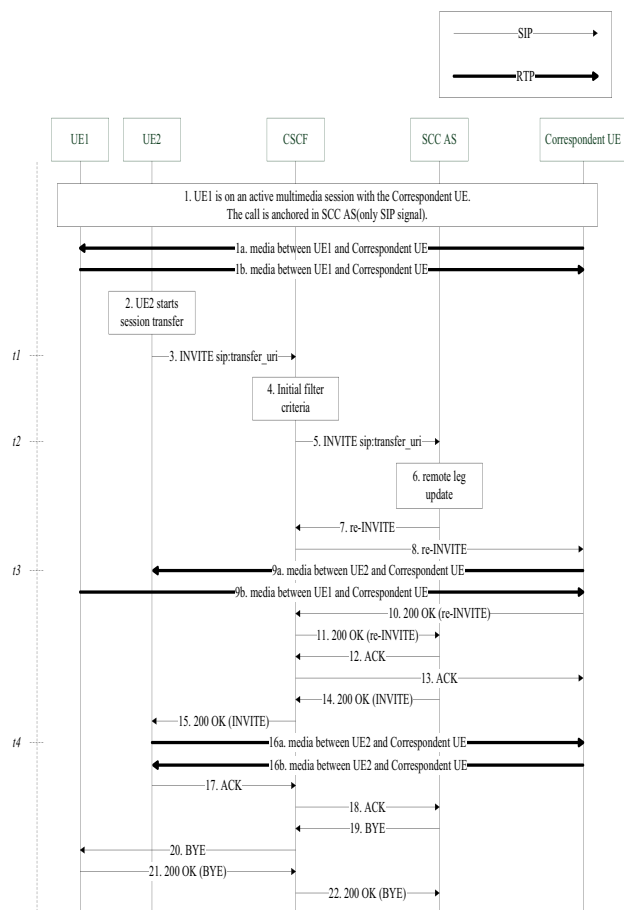


Figure 2. ISC signalling flow for session mobility

Service Centralization and Continuity Application Server (SCC AS) plays the role of IMS service continuity control. The call between the UE1 and the correspondent UE is anchored in the SCC AS with SIP signal channel. As mentioned in previous section, our focus is session mobility across different UEs. The user communicates with the correspondent UE in outdoor by the mobile device (UE1) and he starts a session transfer from mobile (UE1) to IPTV (UE2) when he moves home or vice versa. The ISC signalling flow shown in figure 2 describes the session transfer procedure when all media of an ongoing communication session and the associated signalling are transferred from UE1 to UE2 of the same subscriber.

UE1 is on an active multimedia session with the correspondent UE and the call is anchored in SCC AS with only SIP signal channel. UE2 requests session transfer to the CSCF by sending an INVITE method with transfer_uri at t_1 . Upon the evaluation of the initial filter criteria, the CSCF routes the request to the SCC AS at t_2 . For remote leg update, SCC AS sends a SIP re-INVITE method to the correspondent UE via the CSCF. The correspondent UE starts to send the media to the UE2 at t_3 . However, the UE2 cannot send the media to the correspondent UE until the UE2 receives a 200 OK response from the correspondent UE. After receiving 200 OK, the UE2 starts send the media to the correspondent UE at

t_4 . There is an issue that needs to be resolved to provide proper Quality of Service (QoS). The latency in session mobility is essentially the time required by the re-INVITE method to reach the correspondent UE.

III. DESIGN AND IMPLEMENTATION

In this section, we suggest the media anchoring mechanism to shorten the latency which is transferred by the communication sessions with multiple media across different UEs. And the issues of design and implementation are described.

A. Media Anchoring

In figure 3, the SCC AS is replaced by Media Anchor based SCC AS (MA-SCC AS). Unlike the SCC AS, the call between UE1 and correspondent UE is anchored in MA-SCC AS with both SIP signalling channel and RTP media session.

The signalling flow shown in figure 4 describes the session transfer procedure using the media anchoring.

The UE1 is on an active multimedia session with the correspondent UE via MA-SCC AS. In other words, the call is anchored in MA-SCC AS with both SIP signalling channel and RTP media session. Hence, the session reestablishment procedure which sends the re-INVITE method to reach the correspondent UE is eliminated. MA-SCC AS can switch from the UE1 to the UE2 the ongoing media session from the correspondent UE. The session mobility latency is decreased dramatically.

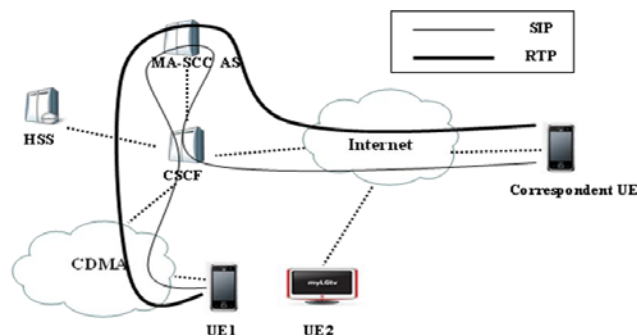


Figure 3. Media Anchoring

B. Issues of Design and Implementation

We developed the MA-SCC AS in order to provide the IMS service continuity between IPTV and mobile. The main functionalities of the MA-SCC AS are as follows:

1) Call Anchoring: The call which is originated or terminated by the ISC subscriber is anchored in MA-SCC AS. Both SIP signalling message and RTP media are anchored. This mechanism can shorten the latency of the session mobility.

2) Session Mobility: The session transfer procedure works when all media of an ongoing communication session and the associated signalling are transferred from one device to another of the same subscriber.

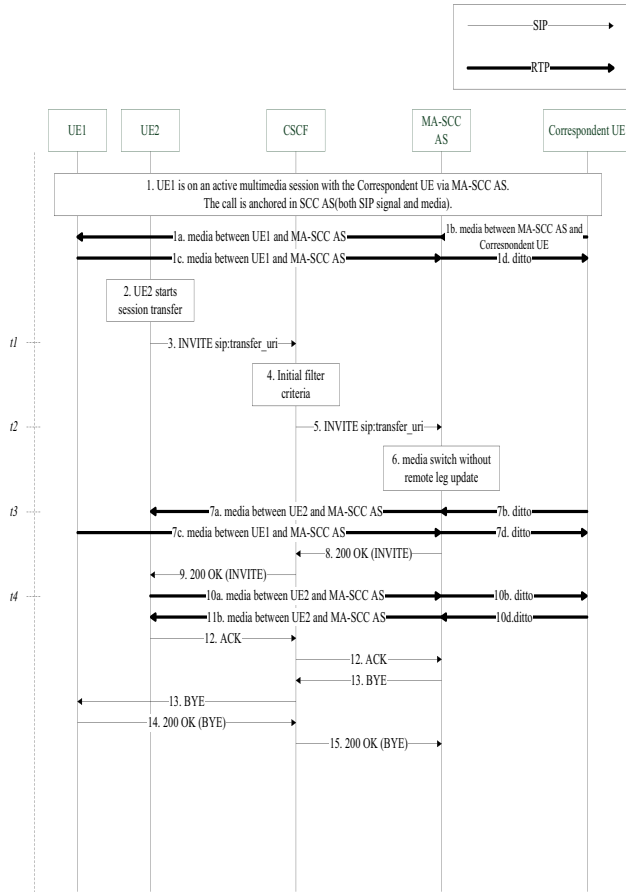


Figure 4. Media anchor based signalling flow for session mobility

3) Subscriber management: The same subscriber can have two or more devices like mobile, IPTV, PC and so on. We assign a private user ID for subscriber identification and a public user ID for device identification.

4) Media transcoding: The codecs which supported by different UEs are different. For example, the mobile device supports AMR but IPTV supports G.711. MA-SCC AS provides transcoding to translate into different codecs.

We have deployed the MA-SCC AS in service network of LG Uplus which is an operator for mobile, broadband and IPTV services. The pilot service snapshot shown in figure 5 describes the multimedia session between IPTV and the correspondent mobile after session transfer.



Figure 5. The snapshot after session transfer

IV. PERFORMANCE ANALYSIS

The session mobility performance can be measured as session mobility latency. In this section, we will analyse the session mobility latency taken for the 3GPP's ISC and the proposed media anchoring. We define parameters for performance analysis in table 1.

TABLE 1. PARAMETERS FOR PERFORMANCE ANALYSIS

parameter	definition
l_1	Network transmission latency between UE and CSCF
l_2	Network transmission latency between CSCF and SCC AS or MA-SCC AS
l_3	Network transmission latency between CSCF and correspondent UE

The session mobility latency of the 3GPP's ISC can be calculated as:

$$l_{ISC} = 2l_1 + 5l_2 + 3l_3 \quad (1)$$

As it is described in figure 2, the session mobility latency means the interval from $t1$ to $t4$. Due to remote leg update using re-INVITE method, the latency is increased.

However, as shown in figure 4, the session mobility latency of the proposed media anchoring can be decreased since the media anchoring eliminates the re-INVITE method based remote leg update. The latency of the proposed media anchoring is the interval from $t1$ to $t4$ in figure 4 as follows:

$$l_{MA} = 2l_1 + 2l_2 \quad (2)$$

Since the network transmission latency is proportional to the distance between the sender and the receiver, l_2 is much shorter than l_1 or l_3 , and l_1 is shorter than or equal to l_3 as follows:

$$l_2 \ll l_1 \leq l_3 \quad (3)$$

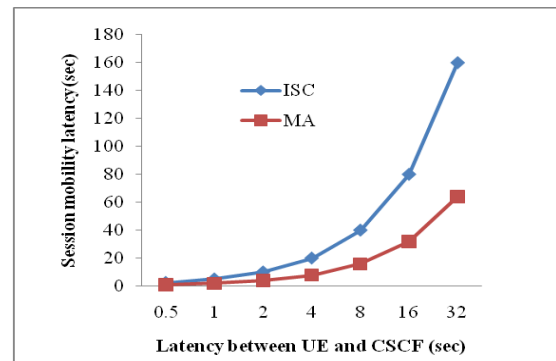


Figure 6. The snapshot after session transfer

l_2 is ignored since the CSCF and the AS are located in the same core network of the operator. Therefore l_{ISC} and l_{MA} are

respectively 5 and 2. In the proposed media anchoring, the session mobility latency is improved 60%. In figure 6, we show that the gap of the session mobility latency between the ISC and the MA is increased according as the latency between UE and CSCF is increased.

V. CONCLUSIONS

In this paper, we suggest the media anchoring mechanism in IMS service continuity to shorten the session mobility latency. In addition to this, the MA-SCC AS is implemented and the ISC service is deployed as a pilot service for IPTV and mobile. Our work can be applied to provide the n-screen service that combines mobile devices and IPTV set top boxes allowing the viewing of the same TV programs and movies over multiple platforms.

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