

Network Initiated Inter UE session transfer control in IMS

Jong-choul Yim, Sang-ki Kim, and Byung-sun Lee

Service Convergence Research Team, Convergence Service Platform Research Department, ETRI

161, Gajeong-dong, Yuseong-gu, Daejeon, 305-350, KOREA

Tel: +82-42-860-1191, Fax: +82-42-861-1342

E-mail: (hektor, kimsang, bslee)@etri.re.kr

Abstract— The Next Generation Network will encompass diverse access technologies, devices and services. In order to provide a user the best service experience in that circumstance, the NGN will cover not only terminal mobility, which is the main concern in current mobile network domain, but also personal mobility and service mobility. The IMS architecture, which is considered as session control layer in NGN, and SIP is the basic protocols for controlling sessions in IMS. Therefore, Session mobility management in NGN is tightly coupled with IMS and SIP. There could be a few ways how to control session mobility in IMS. Basically, Session mobility can be controlled in UE based or network based. In UE based approach, a UE initiates the session transfer while network initiates a session transfer in network based approach. This paper especially focuses on the network initiated session transfer. This paper describes how the network initiated session transfer using SIP is implemented in IMS in detail

Keywords—Session Mobility, Service Continuity, IMS, SIP

1. Introduction

Currently, we are undergoing the convergence of networks which means there're multiple services on top of a single managed network instead of a separate network per each specific service domain, and also telecommunication environments are rapidly changing thanks to advent of diverse access technologies, devices and services.

The Next Generation Network has been researched to cope with these changes. One of key promises of the NGN is to support the full mobility which includes terminal mobility, personal mobility and service mobility. Traditionally, mobility was the topic covered in mobile network area, and the terminal mobility has been mainly supported in mobile network because a user is likely to move around with having a single terminal for telecommunication services. However, in the NGN, not only terminal mobility support is essential but also support for personal mobility and service mobility are critical. We expect that a user will be likely to have multiple terminals due to network convergence in the NGN. For instance, a user could have a mobile terminal in his/her own hand, the navigation system in a car and an IPTV settop box at home, and all the terminals are connected to the NGN. Given a user has multiple terminals, a user still want to use services over the

multiple terminals in a seamless way. It amplifies not only support for terminal mobility but also significance of personal mobility and service mobility support.

Terminal mobility is the mobility for those scenarios where the same terminal equipment is moving or is used at different locations. Personal mobility is the mobility for those scenarios where the user changes the terminal used for network access at different locations. Service mobility is the mobility, applied for a specific service, i.e., ability of a mobile object to use the particular (subscribed) service irrespective of the location of the user and the terminal that is used for that purpose [1].

Another key aspect of the NGN is to make ongoing service to be continuous even though the terminals are changed, i.e., service continuity. Session mobility technically manages that. Session mobility allows a user to maintain a media session even while changing terminals [2].

The IMS architecture, which is considered as session control layer in NGN, exists to support a wide range of advanced new services in addition to the traditional voice and data connectivity offerings of "old" telecommunications. Using session initiation protocol (SIP[3]) as a central enabling technology, IMS is able to deliver – in an integrated way – a host of value-added services and applications such as instance messaging, on-line gaming, video push and pull, presence and location – to a variety of different wired and wireless devices, across both NGN and legacy environments.

Therefore, Session mobility management in NGN is tightly coupled with IMS. Currently 3GPP is trying to support session mobility in IMS. Session mobility management in IMS is supposed to be managed in application layer using SIP. There could be a few ways how to control session mobility in IMS. Basically, Session mobility can be controlled in UE based or Network based. In UE based approach, a UE initiates the session transfer while network initiates a session transfer in network based approach. There have been many works dealing with session mobility using SIP. Most of works are focused on the UE based approach [4][5][6][7].

This paper especially focuses on the network initiated session transfer. This paper describes how the network initiated session transfer using SIP is implemented in IMS in detail.

2. Related works

There has been lots of research works on the SIP based Mobility Management. [2] is the very initial paper on how mobility management can be accomplished using SIP. It shows feasibility for mobility management using SIP in order to support terminal mobility, session mobility, personal mobility and service mobility for SIP based applications.

[8],[9],[10] and [11] are focusing on the terminal mobility management including handover using SIP. [8] and [11] introduce middleware approach to deal with terminal mobility where the terminal which might have multiple radio interfaces is moving around various access network. [8] is focused on how non-SIP based application can be supported and how application layer can be transparent to the changes of IP address due to connecting another access network while [11] is focused on how to optimize handover using SIP. SIP can provides elegant application-layer mobility support that solves the problems associated with lower-layer mobility protocols in next generation heterogeneous wireless access networks. However, the handoff delay in SIP may be substantial, thus causing considerable packet loss, which seriously affects the quality of voices or multimedia streams. [9] introduces a SIP based mobility architecture for soft handoff in order to alleviate the problem of packet loss in next generation wireless network basically using the proxy mechanism for duplicating and/or discarding the packets.

[6] and [7] are introducing session mobility management using SIP including inter UE session transfer. One of challenges of session mobility management is to how to find other devices and their capabilities to which ongoing session is transferred. [6] solves the problem of device discovery using MPEG-21 DI.

3. Use Cases

The basic use case of session migration might be the case simply moves the ongoing session from one device to other device. There can be lots of use cases derived from the basic use case such that a) media contents can be adapted according to characteristics of the new devices and/or access networks and b) multiple devices can be used simultaneously, which brings session splitting. Following scenario explain this concept.

- ♦ A user is talking with mobile hand set. As soon as he enters the office, the call is transferred to the fixed phone in the offices which is much cheaper than the mobile.
- ♦ Given that a user is watching the multimedia video, when he enters the room, the video is displayed on the wall TV, and the audio is played on the Hi-Fi audio system.
- ♦ A user is enjoying the movies with high quality at home. As he is going out, the movie is transferred to the mobile handset and the quality is adapted to low quality.

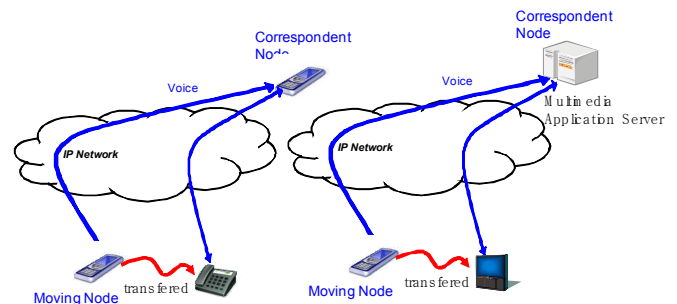


Figure 1. The basic use case

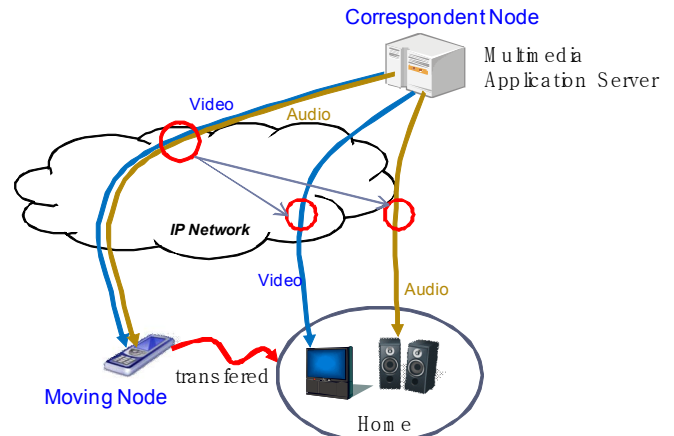


Figure 2. Session splitting use case

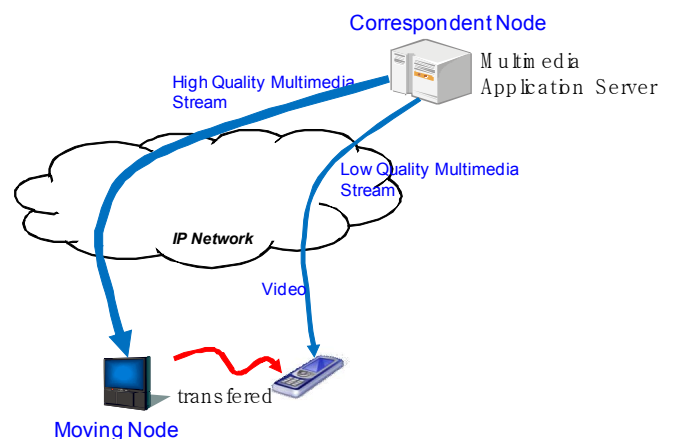


Figure 3. Content adaptation use case

4. IMS

In this section, I'll describe the basic architecture of IMS. IMS is getting considered as a core system in supporting entirely new telecommunications business models across both the fixed and mobile. Not only 3gpp accepts it as core system for NGN, but also ITU-T and ETSI adapt IMS to NGN architecture. At its highest possible definition level, the IMS architecture exists to support a wide range of advanced new services in addition to the traditional voice and data connectivity offerings of "old" telecommunications. Using session initiation protocol (SIP) as a central enabling technology, IMS is able to deliver – in an integrated way – a host of value-added services and applications such as instance messaging, on-line gaming, video push and pull, presence and

location – to a variety of different wired and wireless devices, across both NGN and legacy environments.

Figure 4 illustrates functional architecture for the provision of service in the IMS. As shown figure X, IMS defines reference point, so called ISC based on SIP, can be used for an Application Server to control the session for providing the diverse services including application level session transfer/merge services.

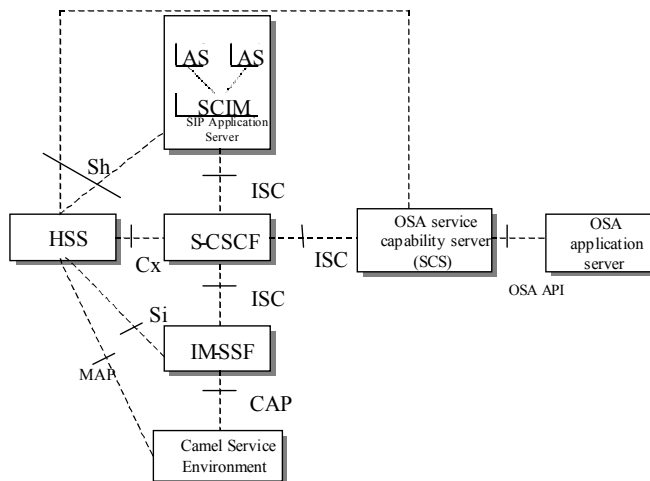


Figure 4: Functional architecture for the provision of service in the IMS

5. Session mobility control in IMS

To control session mobility, it is essential to discover other devices, to which the session moves, and to know the capabilities of them, and it might be also critical to know the context of a user which would force the session migration. The session mobility control has two phases. One is decision phase, the other is execution phase. In the decision phase, the devices are discovered, and other contextual information is collected and analyzed, and finally the decision made to fire the execution phase. In the execution phase, the control for session migration occurs.

Another subject of session mobility control might be who is in charge of that. There are possibly two approaches- UE based and network based. Most of works takes the UE based approaches [4][6][7] including 3GPP [5]. UE based approach is simple and it does not give any burden to the network. However, due to limitation of terminal capabilities, the decision is made on the simple information mainly extracted from the devices information in vicinity. It is difficult to use collective and analyzed contextual information and to adapt the media contents according to the context. The activation of session migration is rather reactive than proactive which mean the user initiates the session migration explicitly. One the other hand, network based approach is little bit complex and It might give little burden to the network because the application server, who is in charge of session mobility control, is needed and the application server should in the path of all signaling. It is easy to use collective and analyzed contextual information and media content adaptation is easily supported. The activation of session migration can rather be proactive which

means network initiates session transfer based on context before the user requests the session migration.

In network based approach, It is also challenging work that finding out the efficient way to discover resources including devices and to store information creating contextual information. But this paper just focuses on the control mechanism itself because resource discovery mechanism and contextualization process is to be too big to deal within the same paper.

Figure 5 shows network architecture for session mobility control.

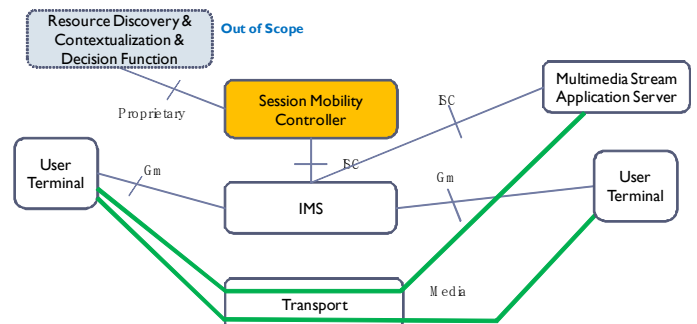


Figure 5: network architecture for session mobility control

The Session Mobility Controller is a kind of application server which is defined in 3GPP TS 23.228 [13], and is charge of controlling session migration.

All users who is willing to use session mobility are needed subscription to the session mobility services which make a call to be anchored in the Session Mobility Controller. Figure 6 illustrate this in case of basic call. INVITE message is redirected to the Session Mobility Controller. The Session Mobility Controller is acting as B2BUA and putting itself in signaling path by using Route header. After that, all subsequent messages are going through the Session Mobility Controller.

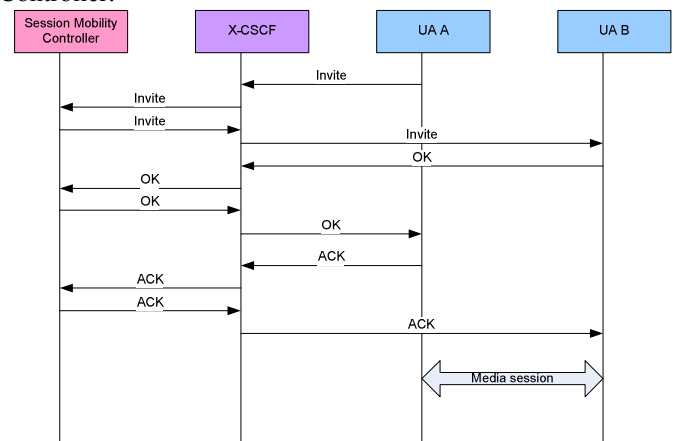


Figure 6: Triggering for the service mobility control

6. Call flows

1) Inter UE session transfer using 3PCC

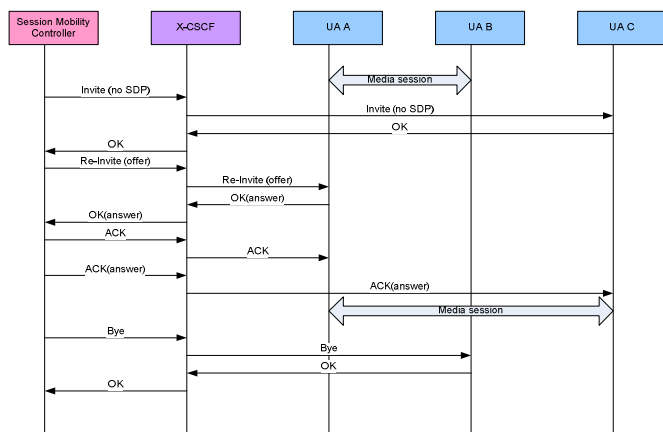


Figure 7: Inter UE session transfer using 3PCC

Figure 7 illustrates the case the session between UA A and UA B is transferred to the session between UA A and UA C using 3rd Party Call Control (3PCC). The Session Mobility Controller sends new INVITE to UA C and UA C sends back 200 OK which contains the SDP of UA C to the Session Mobility Controller. The Session Mobility Controller send RE-INVITE to UA A. RE-INVITE Message contains the SDP of UA C. UA A answers with SDP of UA A conforming to the offer/answer model [14]. The Session Mobility Controller sends ACK to UA A and UA C. ACK message to UA C contains the SDP of answer of UA A. After confirming the session transferring, the Session Mobility Controller sends BYE to UA B.

2) Inter UE session transfer using REFER

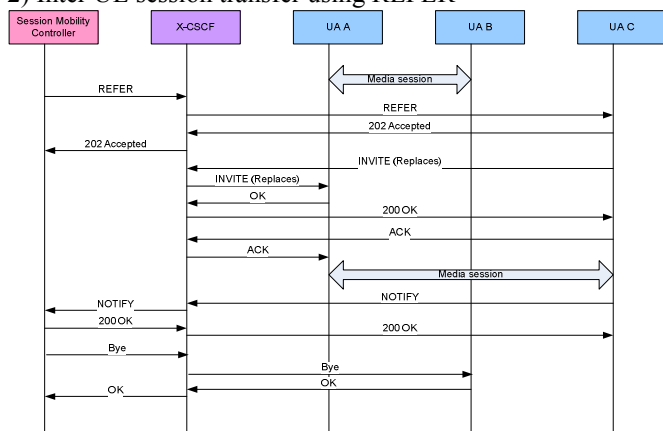


Figure 8: Inter UE session transfer using REFER

Figure 8 shows the simple approach to control session mobility by using REFER message. The Session Mobility Controller just sends REFER message to the new device which is UA C, and then session migration procedures is taken over by UA C. After completion of new session establishment between UA A and UA C, UA C sends NOTIFY to the Session Management Controller, and the Session Management Controller initiates disconnection procedures for UA B.

3) Session Splitting and media adaptation

In order to split the session and to adapt the media, the Session Mobility Controller makes a connection between the

Multimedia Streaming Server and the Media Server. The Media Server is connected to the UA B, which is responsible for rendering the video, and UA C for audio rendering. The Media Server processes video transformation (e.g., from high quality to low quality) on the fly.

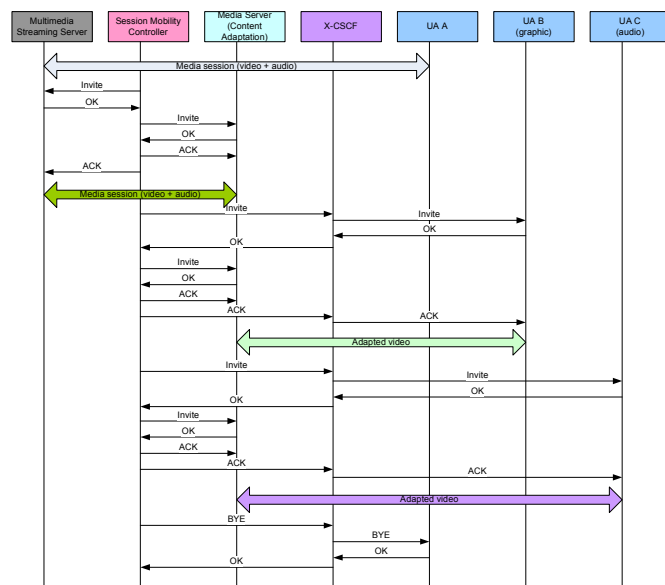


Figure 9: session splitting and media adaptation

7. Conclusion

In this paper, we have discussed what is the session mobility and why it is needed. There are two ways for supporting the session mobility. One is the UE based approach, the other is network based approach. We have tried to identify differences between two approaches. We have also tried to how network based session mobility control can be supported in IMS which is considered as a common session control platform for NGN. In this paper, we have just shown the feasibility of session mobility control in IMS. We have not considered the performance and efficiency aspect. That will be further works.

Acknowledgements

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