

A Mobile VoIP Architecture over LTE & WLAN networks

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Abstract— Mobile VoIP based on IP Multimedia Subsystem (IMS) is one of the most issues according to introducing UTRAN long term evolution (LTE) networks. In addition to, there are many hot spot such as WLAN of free worldwide directory. In order to provide a mobile VoIP service over various networks, it is important to define VoIP architecture and provide interconnection at the service & media layer between heterogeneous networks. In this paper, we suggest a VoIP architecture over LTE & WLAN and extend existing technologies about Mobile VoIP solutions to operating in a variety of access networks, including basic call flow and handover scenario.

Keywords— Mobile VoIP, LTE, WLAN

I. INTRODUCTION

Recently, VoIP has been a key service because of powerful networks capacity supporting a variety of multimedia services. For example, LTE system that supports the peak data rate of 100 Mbps in down link and 50 Mbps in uplink is specified in 3GPP standardization. Also, 802.11n is being improved in order to support throughput of 50~144 Mbps. Therefore deploying of VoIP over cellular networks such as LTE networks will be made possible with reasonable quality and efficiency. In addition to, using VoIP in WLAN networks will bring many benefits and cost saving opportunities for end users, network operators. For example, VoIP over LTE or WLAN introduces the possibility to move into All-IP networks instead of using separate CS network elements for voice and PS network elements for data. This would lead to cost savings as the CS related part of the core network would not be needed anymore.

On the other hand, mobile vendors have been developed DBDM handsets with mobile operators which make a plan to launch FMC service over a variety of access networks. Especially, WLAN and LTE technology make it attractive to integrate them to provide ubiquitous wireless access. However, there are substantial challenges to overcome in supporting and providing mobile VoIP services over LTE or WLAN networks.

In this paper, we study the various VoIP solutions on the 3GPP standardization and suggest a mVoIP architecture over LTE & WLAN networks. By studying history of VoIP

architecture in 3GPP, we define the VoIP infrastructure based on the IMS service continuity and explain the main call flow.

The rest of the paper is organized as follows. In Section II, we introduce some basic background of VoIP technology in 3GPP. In Section III, we suggest the VoIP Architecture in LTE & WLAN networks. In Section IV, we summarize and conclude the paper, and the short appendix contains a list of acronyms.

II. VOIP TECHNOLOGY IN 3GPP

3GPP provides each case of the voice transformation technology. We focus on three technologies, eg. IMS architecture, Combining CS Bearers with IMS, IMS Service Continuity.

A. IP Multimedia Subsystem

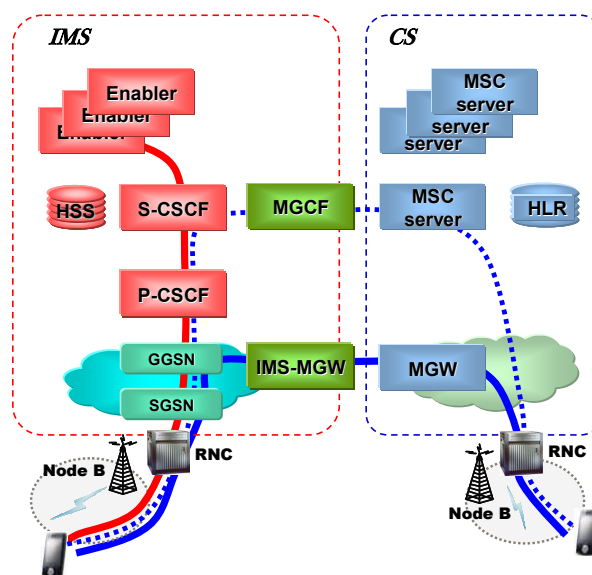


Figure 1. Architecture of the IMS system

The IP Multimedia Subsystem (IMS) provides a framework that accommodates current and future services in wired and wireless network. IMS is a set of specifications that describes

the basic architecture of All IP network for implementing IP based voice service and Rich Communication Suite based services offering a wealth of features and benefits to both, mobile users and network providers.

However, since voice transmission over the air is less efficient than CS voice in UMTS, now Voice over IMS is not major services. Figure 1 present interworking between IMS and CS over UMTS.

B. Combining CS Bearers with IMS

Combining CS Bearers with IMS (CSI) architecture supports a simultaneous IMS session and CS call between UEs and manages each separated network. The CSI AS is a key application server in the IMS terminating network because the AS decides to terminate an IMS session or part of the IMS session to the CS domain for voice service. Figure 2 shows a architecture of a CS call and an IMS session being established at the same time from UE[3].

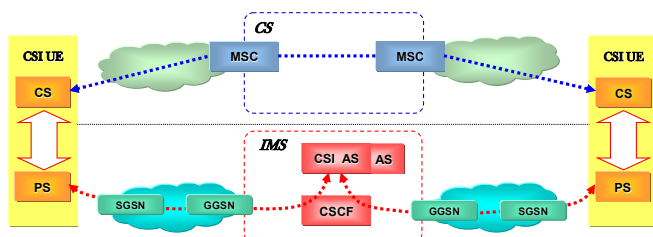


Figure 2. Architecture of the 3GPP CSI

C. IMS Service Continuity

In 3GPP R8 specifications, IMS Service Continuity (ISC) is introduced as an enhancement of VCC concept. The PS-PS session continuity refers to session transfer between two different access networks. The Figure 3 illustrates an example of an ISC architecture from WLAN access to an UMTS access. The ISC AS acts as a B2BUA and anchors the session and performs session transfer of the media path[6].

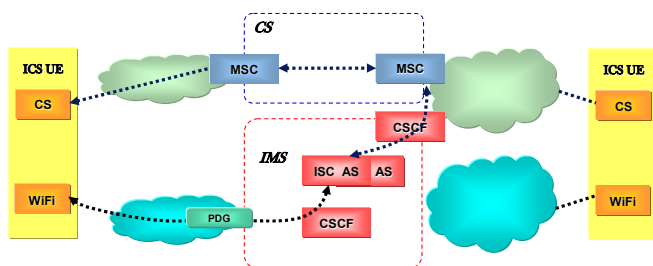


Figure 3. Architecture of the 3GPP ISC

III. VOIP ARCHITECTURE IN LTE & WLAN NETWORKS

Since 3GPP IMS architecture is still evolving, the issue of between various access networks in order to support VoIP

service through IMS is a main research area. In this selection we discuss the framework solutions in the VoIP Architecture over LTE & WLAN networks (VALWN) networks and explain call flows in detail.

A. Architecture

VoIP Architecture in LTE & WLAN networks (VALWN) is based on IMS service continuity[6]. VALWN includes two procedures, PS handover(LTE↔WLAN) and an originating/terminating call including an registration in IMS domain. As IMS is considered as the future central network, VALWN will support voice service smoothly through IMS. The architecture of the VALWN is shown in Figure 4.

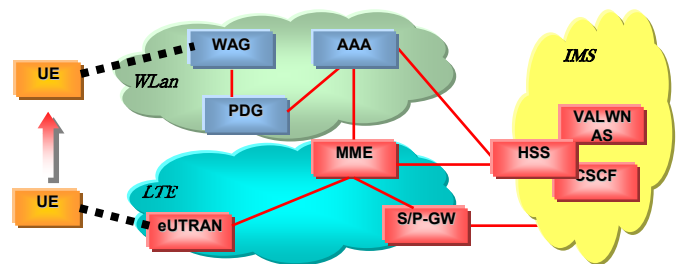


Figure 4. VoIP Architecture of the 3GPP LTE & WLAN networks

Figure 4 present an interworking model for LTE and WLAN networks based on the IMS acting as signaling mediator. The most significant benefit of this architecture is its ability to support VoIP service on LTE and WLAN. In order to develop a successful LTE/WLAN interworking solution based on IMS, voice service continuity must continue in different networks as well as same networks. Therefore the IMS networks include VALWN Application Server (AS), performing service continuity process with handover procedure. The AS is able to identify that the session transfer to the WLAN domain will be followed by a session transfer to the LTE domain in the first request. Also, the AS takes part in the session transfer decision by applying policy rules.

B. Call Flows

1) Registration Flow on LTE

A UE#1 needs to register with the LTE network to receive services. This registration is described as network attachment[1] and IMS registration procedure. During the attach procedure, the UE#1 requests for an IP address allocation and conducts IMS registration procedure including performing 3rd party registration towards the VALWN AS. The registration flow is shown in Figure 5.

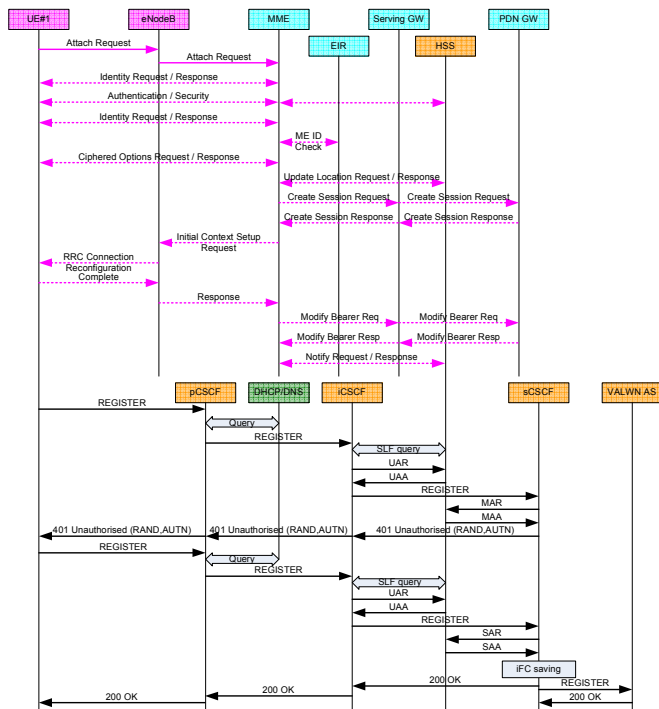


Figure 5. Registration Call Flow

2) Origination and Termination Flow

A UE#1 initiated multimedia sessions are anchored at the VALWN AS in order to enable voice service continuity. Originating iFC for the UE#1 results in routing of the session to the O-AS and terminating iFC for the UE#2 results in routing of the session to the T-AS in order to identify the session transfer.

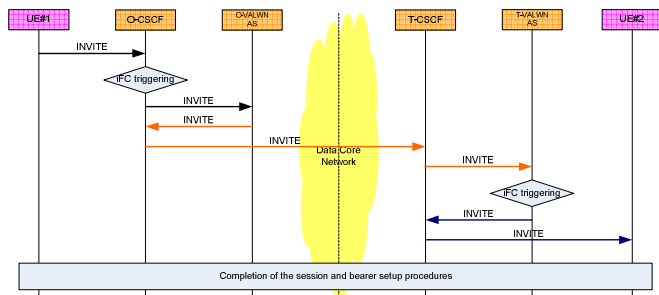


Figure 6. Originating and Terminating Call Flow

3) LTE PS → WLAN PS handover

During connecting media sessions between UE#1 and UE#2, the source eNodeB interprets an UE to be out of LTE coverage and decides to initiate a handover to the target WLAN network. After receiving a Handover Required message from eNodeB, the source MME initiates the Handover resource allocation procedure by sending a Forward Relocation Request message to the target PDG.

When the PDG complete the handover procedure, the PDG inform the PDN GW the changed information.

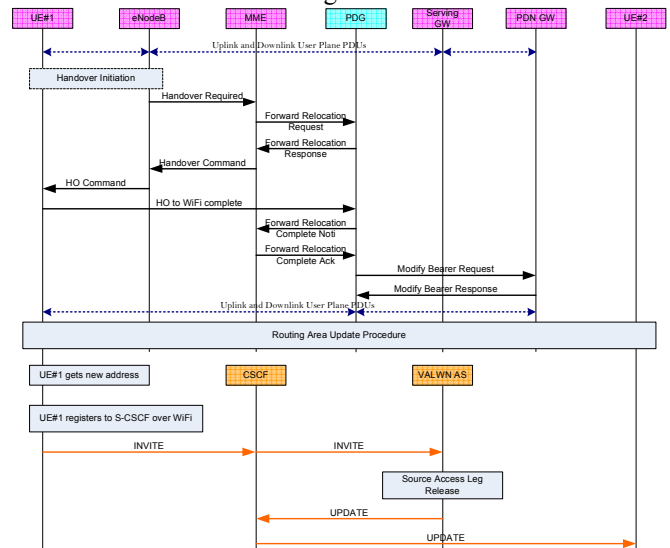


Figure 7. LTE PS → WLAN PS Handover Call Flow

An UE#1 is attached to WLAN network and it registers to the CSCF in the home network. After changing to the new network, UE#1 sends an INVITE message on the new access network towards the VALWN AS that performs access transfer with media transfer and the AS updates the session over the remote access leg and completes session setup with UE#1 on the new access leg and releases old session. After that, the AS performs the Remote Leg Update according to SIP session modification through UPDATE message. An UE#1 establishes an active multimedia session with UE#2 via WLAN network.

IV. CONCLUSIONS

This paper presented our research of the Mobile Voice over IP architecture over LTE & WLAN networks. We suggested the VALWN architecture for the Voice over IP solution to the future network. By reviewing each 3GPP architecture we pointed out main features that include IMS based network, voice call continuity. Especially, in this study we presented call flows over hybrid access networks, e.g. LTE, WLAN, including handover flow.

Currently, revised versions of 3GPP specifications are being studied and published to improve and specify the VoIP architecture over various access networks.

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GGSN	Gateway GPRS Support Node
GERAN	GSM/EDGE Radio Access Network
ISC	IMS Service Continuity
IMS	IP Multimedia Subsystem
LTE	Long Term Evolution
MME	Mobility Management Entity
NB	Node B
PDN GW	Packet Data Network Gateway
PDG	Packet Data Gateway
SGSN	Serving GPRS Support Node
SGW	Serving Gateway
SRVCC	Single Radio Voice Call Continuity
UTRAN	UMTS Radio Access Network
VoIP	Voice over IP
WAG	WLAN Access Gateway

APPENDIX: LIST OF ACRONYMS

3GPP	3 rd Generation Partnership Project
CSCF	Call Session Control Function
CSFB	Circuit Switched Fall Back
CSI	Combining CS Bearers with IMS
eUTRAN	Evolved UTRAN
FMC	Fixed Mobile Convergence