Implementation Agreement for MSF Release 2 Architecture Framework - Application to 3G Mobile Networks

MSF-AF.2-2.1.4-FINAL

Multiservice Switching Forum
Implementation Agreement

Multimedia Switching Forum
Contribution Number: msforum2002.117.00
Document Filename: MSF-AF.2-2.1.4-FINAL
Working Group: Architecture (Mobility)
Title: Implementation Agreement for MSF Release 2 Architectural Framework
- Application to 3G Mobile Networks
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Abstract: This contribution is an Implementation Agreement for the mobility support architecture IA in MSF Release 2.

Date: June 17, 2002

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This contribution is an Implementation Agreement for the mobility support architecture IA in MSF Release 2.

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1 Objectives of Mobility Support within MSF Framework Architecture

The MSF has, as its stated purpose, the goal of enabling vendors and service providers to find ways to deploy technology that will provide customers with new and valuable services. An important focus of the MSF effort is to accelerate the development and deployment of open communication systems that will make it possible to provide flexible support of a full range of network services using multiple infrastructure technologies. The focus is on developing architectures and industry agreements that enable interoperability and innovation in a rapidly evolving environment. The current set of Release 1 implementation agreements is freely available in the public space of our website at http://www.msforum.org/provisional_ia.html.

In IA Release 2, the MSF will address the issue of supporting mobility in multi service networks (MSNs). It is our intent to show how 3rd G (third Generation) wireless networks can be supported on top of the MSN architecture.

The objectives we are pursuing to support the mobility features in the MSF architecture are as follows:

1) to make the MSF open network architecture applicable to various kinds of mobile networks;
2) to establish liaisons with wireless standard organizations, i.e., 3GPP, 3GPP2, and ITU-T in order to give implementation guidelines on distributed mobile nodes;
3) to accelerate the deployment of universal system platforms which can be applied to both fixed and mobile networks;
4) to accelerate development of integrated systems, aiming at Fixed Mobile Convergence (FMC) and Fixed Mobile Integration (FMI);
5) to enable mobile network operators to build networks by combining multi-vendor network elements.

2. MSF Architecture applied to Mobile Networks

2-1. Mobile related functions

This document focuses on the mobile core network because the multi service switch studied in MSF is mainly adapted to the core network. (The architecture of Radio Access Network (RAN) is FFS.) Referring to the ITU-T Recommendation Q.1711 [1], which defines the generic functions in mobile networks, the following four major mobile related functions should be newly specified in the MSF Release 2 architecture model.

1) Location Management Function (LMF) and Location Information Function (LIF):

LMF handles the basic terminal mobility logic, and LIF contains user information (e.g., user location information, subscriber ID, data protocol, etc). In existing cellular networks, LMF and LIF are implemented as the Home Subscriber Server (HSS) and the Visitor Location Register (VLR).

These functions are used upon the location registration and call related/unrelated processing. (e.g., user registration and, call routing, respectively).

2) Authentication Management Function (AMF) and Authentication Information Function (AIF):

AMF handles the authentication logic to identify and validates a user who requesting to use a particular network service. AIF contains the authentication information (e.g., authentication triplets; authentication algorithms, authentication keys, and random numbers). In existing cellular networks, AMF and AIF are also implemented as the HSS and the VLR.

These functions perform user authentication by interacting with LMF and LIF in the location registration and the call setup phases.

3) HandOver Control Function (HOCF):

HOCF handles overallhandover control and interacts with the Radio Access Network (RAN) to set up, release, and maintain a branch of a handover link.

4) Radio Access network Control Function (RACF):

RACF handles the access network related procedures as follows;

- Paging execution:

This function is the act of seeking a mobile terminal by using multicast signaling.

- Ciphering execution control:

This function preserves the confidentiality of user data and signaling across the radio channels and protects the mobile network from intruders.

- Radio resource management:

This function manages the radio resource and executes admission control upon the call setup to provide the Quality of Service (QoS) requested by the user.

2-2. Reference architecture model for mobility support

2-2-1. MSF Release 2 reference architecture model

In MSF Release 2, the Application Plane is composed of three functional blocks; Service Logic Function (SLF), Service Information Function (SIF), and Service Coordination Function (SCF). _

SLF handles service logics (including the basic call or connection setup/release) that direct transport resources via control layers for a specific customer._SIF stores information that is common or shared across multiple SLFs, and controls access rights._SCF performs the service related signalling control, routing, and policing functions that coordinate interoperability of multiple SLFs and NSICFs for each customer. In the Control Plane, NSICF controls the state of each communication association on the behalf of services independent of transport technologies and independent of connectivity control for a specific communication (media) type. The remaining functions of NSICF are described in MSF IA 1.0 [2].

The MSF Release 2 reference architecture model is shown in Figure 1.

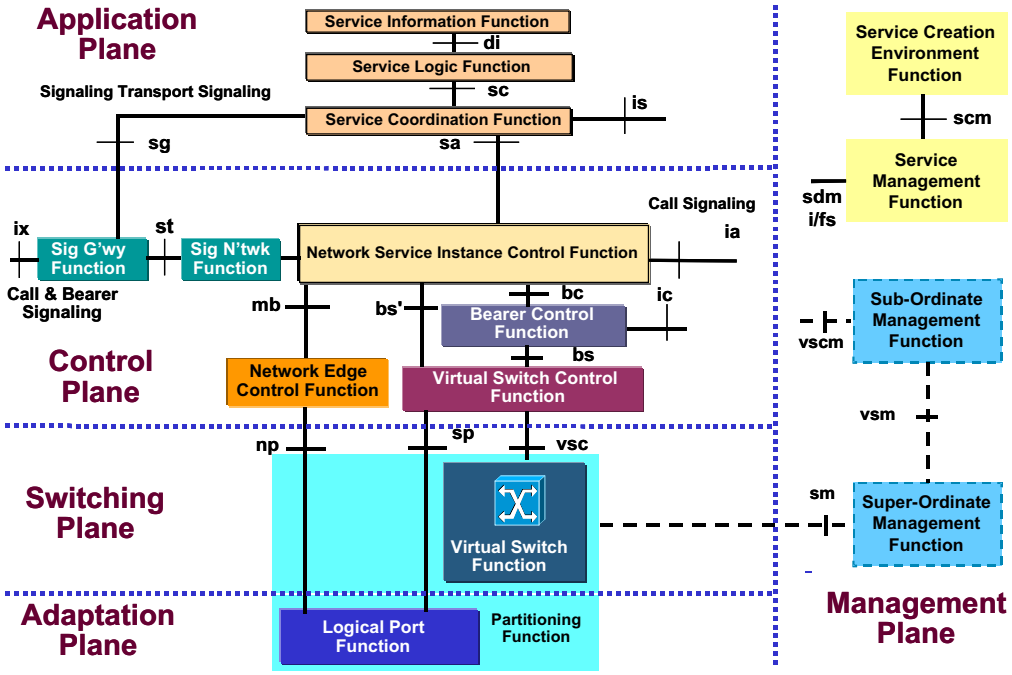


Figure.1 MSF Release 2 reference architecture model

2-2-2. Mapping of mobile related functions in MSF Release 2 architecture model

The mobile related functions described in Section 2-1 can be mapped to MSF Release 2 architecture model as follows.

- LMF and LIF

In MSF Release 2 architecture model, all of the service related functional blocks are located in the Application Plane as SLF and SIF. LMF handles the service logic functionality that delivers basic communications capabilities to mobile users. LIF contains service information (user information). LMF acts as SLF and LIF acts as SIF in the Application Plane,.

- AMF and AIF

Same aAs are LMF/LIF, these functional blocks are located in the Application plane. AMF acts as SLF and AIF acts as SIF, respectively.

- HOCF

This functional block is mapped to NSICF as an additional function for mobile communications. It is needed because setup/release of the handover links needs call level signaling and address control.

- RACF

This functional block is also mapped to NSICF as an additional function for mobile communications. It controls radio access related (call related and call unrelated) service instances.

[NOTE]: On mobile communications, HOCF and RACF perform the basic call or session control functions, which are included with NSICF block. They can be described as Mobility Control Functions (MCF). In future releases of the architecture these functions may be defined as stand-alone blocks.

Here, “LMF/LIF”, “AMF/AIF”, “HOCF”, and, “RACF” correspond to “LMF”, “AMF”, “ARF”, and, “SACF” in ITU-T Recommendation Q.1711 [1], respectively.

The MSF Release 2 reference architecture model for mobility support is shown in Figure 2.

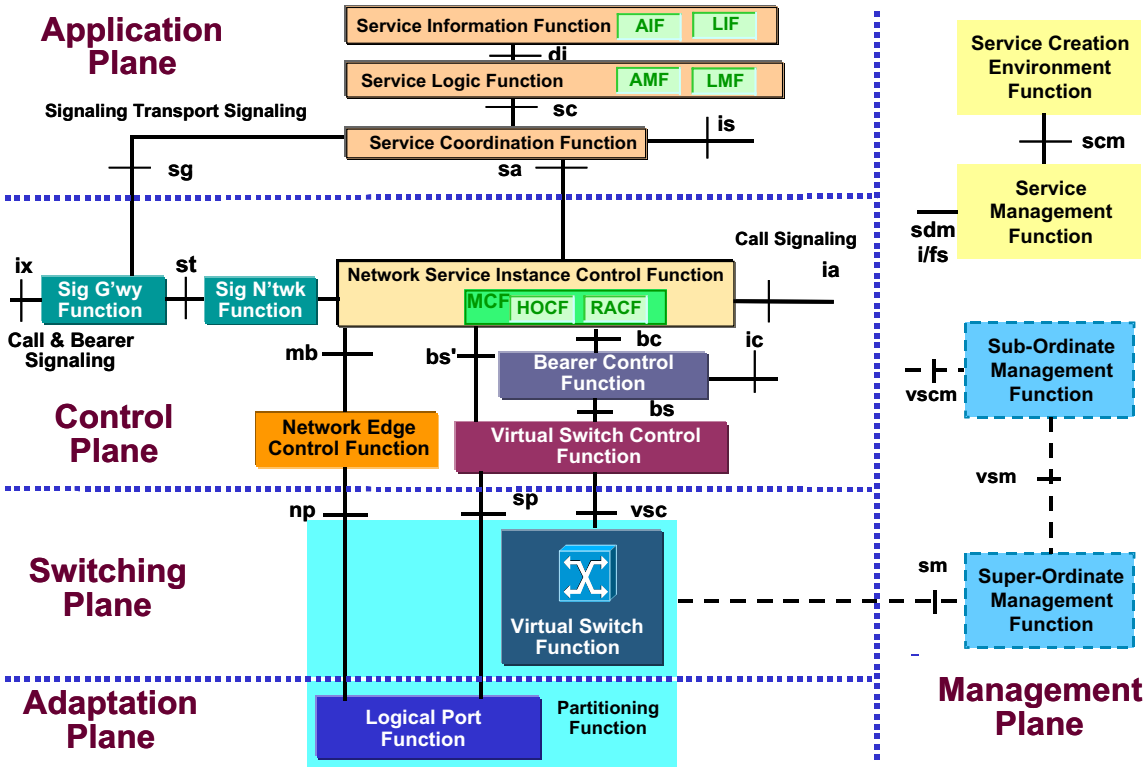


Figure.2 MSF Release 2 reference architecture model for mobility support

2-3. Functional requirements

In the architecture model shown in Figure 2, the mobile related functions are described as follows;

The Application plane functions are as follows.

1) LMF: Location Management Function
LMF performs two functions:

a) to contain the basic terminal mobility logic.
b) to interact with NSICF and AMF upon the location registration and call-related/unrelated processing for mobile communications.

2) LIF: Location Information Function
LIF performs two functions:

a) to store user information. (e.g., location information, subscriber ID, and etc.)
b) to interact with LMF upon the location registration and call-related/unrelated processing for mobile communications.

3) AMF: Authentication Management Function
AMF performs two functions:

a) to provide the user authentication function and confidentiality control
b) to interact with LMF upon the location registration and call-related/unrelated processing for mobile communications

4) AIF: Authentication Information Function
AIF performs two functions:

a) to contain authentication data. (i.e., authentication triplet and user information)
b) to interact with AMF to provide the user authentication function

Additional functionalities of NSICF are as follows.
The mobility control supported NSICF should perform three functions:

a) to interact with LMF/LIF and the Application Plane upon the location registration and call-related and call-unrelated processing for mobile communications.
b) to interact with BCF and other NSICF to set up, release and maintain the branch of handover links for mobile communications.
c) to interact with RAN to control access network related function (e.g., paging execution, ciphering execution control, and radio resource management).

3. Example Architectures

3-1. 3GPP R5 core network architecture

In this section the MSF architecture model is applied to the cellular network being standardized in 3GPP (3rd Generation Partnership Project). Figure 2 shows the 3GPP Release 5 (R5) core network architecture [3]. The following examples are based on the current approved specifications/technical reports and hence subject to change. The core network is mainly composed of two network domains. One is the Circuit Switched Core Network (CS CN) domain and the other is the Packet Switched Core Network (PS CN) domain. In addition, the IP Multimedia Subsystem (IMS) has been identified as an enabling nucleus, allowing support for IP multimedia services in 3rd generation mobile architectures and eventually supporting all services on an IP-based Core Network, with connection to the different access networks.

The CS CN domain consists of Mobile Switching Center (MSC) and Gateway MSC (GMSC). In the R5 network, the call control function is separated from the bearer transfer function. That is, MSC is decomposed into MSC Server and CS Media Gateway (CS-MGW), GMSC is also decomposed into GMSC Server and CS-MGW, respectively. The adoption of this decomposed architecture is operator's matter. This architecture is specified in [3].

The PS CN domain consists of Serving GPRS Support Node (SGSN) and Gateway GSN (GGSN). This architecture is also specified in [3].

The IMS consists of several functional models; call control function, call routing function, media gateway function, etc. This architecture is specified in [3], [4], [5].

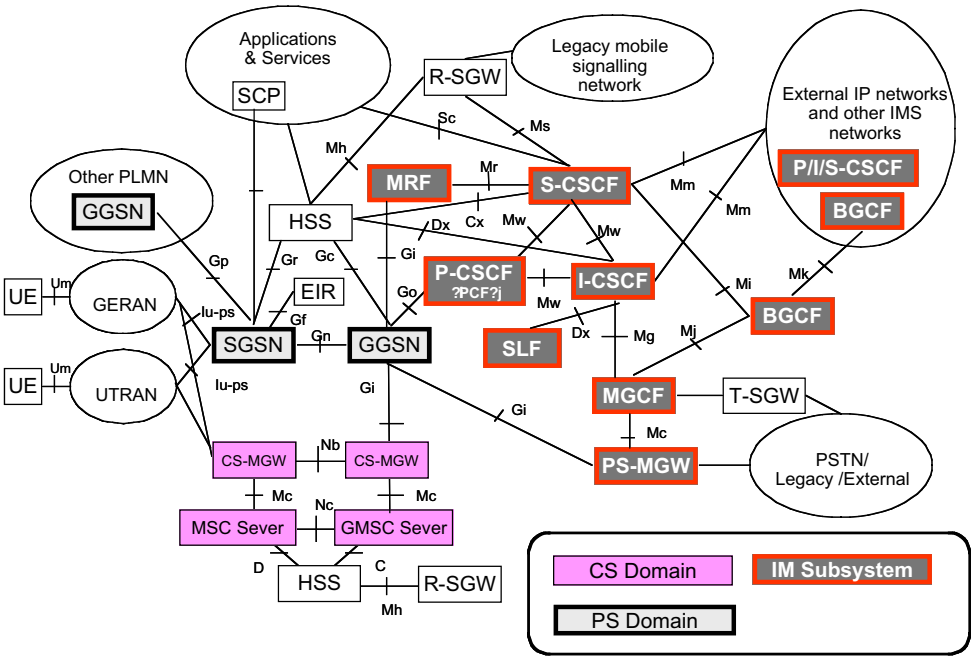


Figure.3 3GPP R5 network architecture

3-1-1. CS CN domain architecture (3GPP R5 CS architecture)

Figures 4 and 5 show the current 3GPP R5 MSC and GMSC architecture models, respectively. There are several alternative protocols for the CS CN domain (e.g., ATM based, STM based and IP based), in the example the network between MSC and GMSC (including signaling) is assumed to be IP based, and the signaling network between call servers and HSS/SCP is assumed to use the existing SS7 based network. The RAN is ATM (AAL2) based. The supported protocol at each reference point is shown in table 1, and the functions of each MSF functional block are shown in table 2, which is referred to [6], [7].

[NOTE]: In the following figures and tables, the subscripts v, and h that mean visitor, and home, respectively.

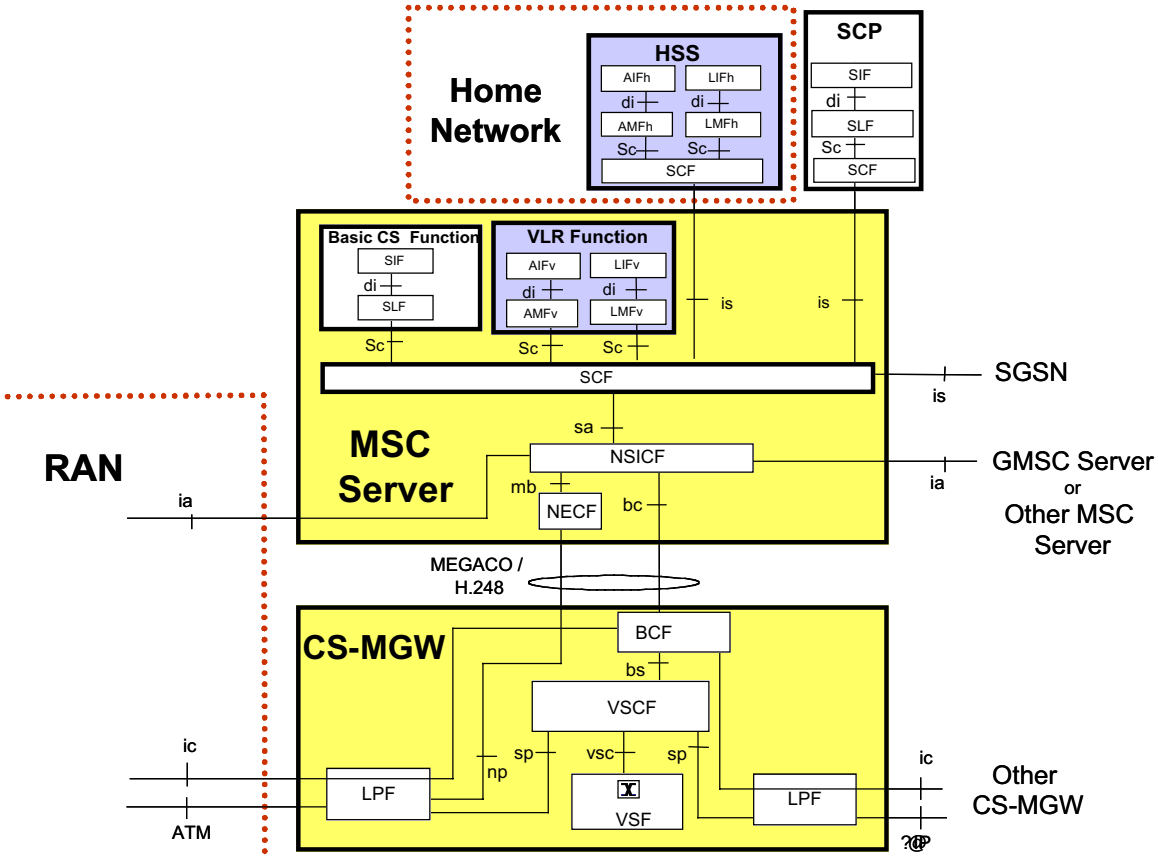


Figure.4 Physical model of R5 MSC

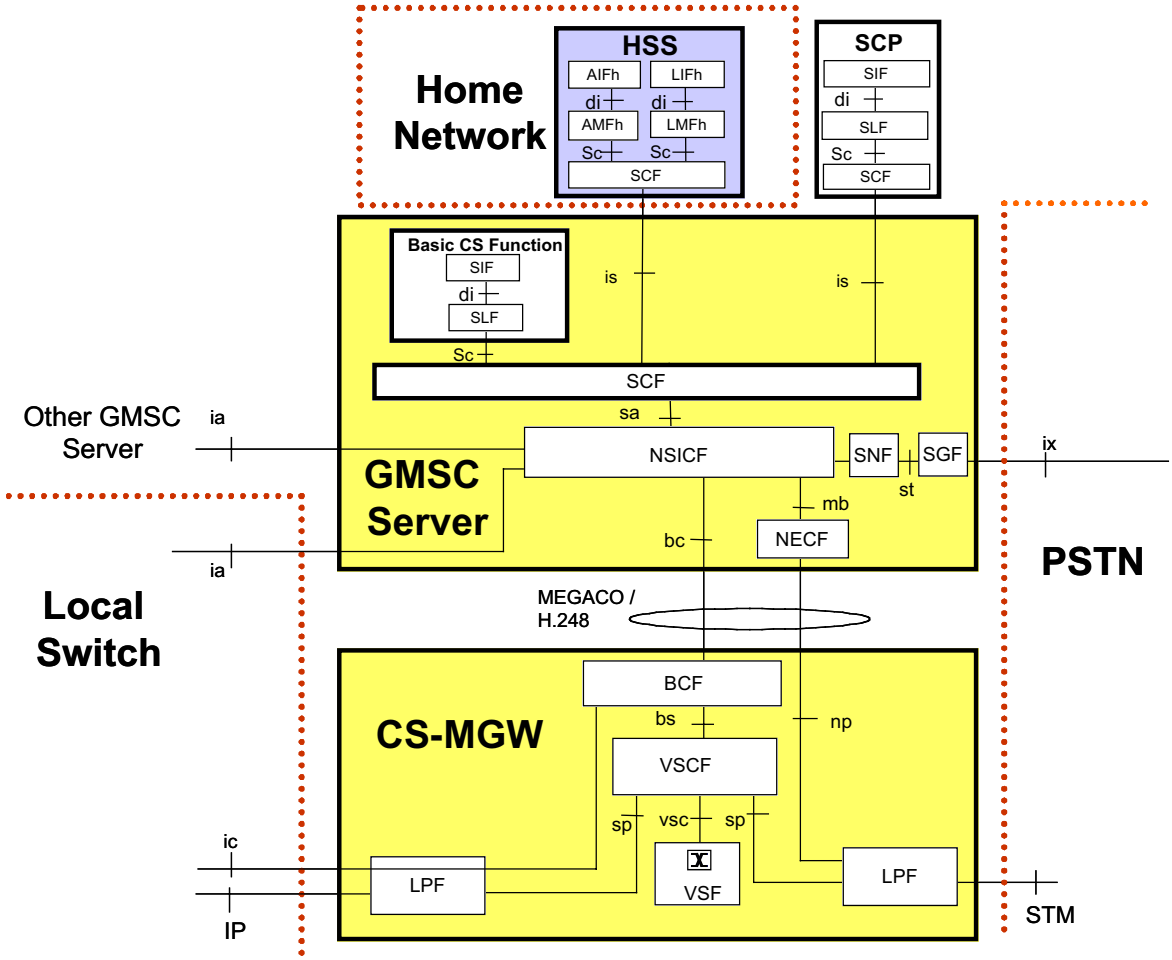


Figure.5 Physical model of R5 GMSC

Table.1 Protocol supported at each reference point for R5 CS CN domain

Reference point	bc	bs	di	ia	ic	is	ix
Protocol	MEGACO/ H.248	-	-	**to:Core NW** BICC, SIP **to:Access NW** GSM Signalling	OSPF, RSVP	**to:SCP** INAP **to:HSS** MAP	**to:PSTN** ISUP
Reference point	mb	np	sa	sc	sp	st	vsc
Protocol	-	MEGACO/ H.248	-	-	-	-	-

Table.2 Functions in R5 CS CN domain

Plane	MSF Block	Function	Note	Elements in 3GPP
Application Plane	SLF/SIF	Location Management (LMF) Location Information (LIF)	These functions contain the basic terminal mobility logic and manage user information (user location, subscriber ID, data protocol and address), which is used upon the location registration and call related/ unrelated processing (e.g., user registration and call routing). The LMFv/LIFv performs temporary and local location management at the visited network node. LMFh/LIFh performs permanent and global location management its belonging users.	HSS, MSC Server
		Authentication Management (AMF) Authentication Information (AIF)	These functions perform the identification, authentication of the service requester, and the validation of the service request type. The AMF performs in association with LMF/LIF and executes authentication, in association with AIF, which contains the authentication information. The AMFh/AIFh perform permanent authentication management for the belonging users. The AMFv/AIFv perform temporary authentication management at visited network node based on information from AMFh/AIFh.	HSS, MSC Server
		Basic CS Function (SLF/SIF)	These functions consist of two functional blocks; SLF and SIF. SLF has service logic to provide CS (Circuit Switching) service. SIF stores user information (e.g., billing information, QoS information, and etc).	MSC Server, GMSC Server
	SCF	Multiple services management	This function routes the signaling information to select the appropriate SLFs during the location registration and the call or connection setup/release phase. For example, SCF interacts with LMF, AMF, and other necessary functional blocks to provide the mobile user's location registration and call setup.	HSS, MSC Server, GSMC Server
Control Plane	NSICF	Call control	This function performs basic call/connection control and signaling for mobile communications to setup,	MSC Server, GMSC

			release, and maintain call instances. This function includes bearer network address resolution. (e.g., MGW number <--> IP address.)	Server
		Radio Access Network Control (RACF)	This function manages radio resources and executes admission control upon the call setup to provide the QoS requested by the user. This function also executes paging by using multicast signaling and performs ciphering execution control.	MSC Server
		Handover link control (HOCF)	This function handles overall control for handover and interacts with RAN to set up, release, and maintain a branch of a handover link.	MSC Server, GMSC Server
		Network interworking	This function is the gateway function to support interworking with other networks (e.g., PSTN). It supports protocol/address conversion.	GMSC Server
		Message screening	This functionfilters out unauthorized or unsolicited messages.	GMSC Server
		Charging data collection	This function collects the data needed to support subscription and/or traffic fees.	MSC Server, GMSC Server
		CS-MGW Selection	This function selects the optional CS-MGWs.	MSC Server, GMSC Server
		MAP termination	This function terminates MAP protocols to support signaling exchange with location registers (e.g., HSS).	MSC Server, GMSC Server
		CAP termination	This function terminates CAP protocols to support signaling exchange with Intelligent Network (i.e., SCP).	MSC Server, GMSC Server
	SNF	Signaling delivery	This function delivers control-signalling information to the appropriate SGF for PSTN.	GMSC Server
	SGF	Signaling gateway	This function converts signaling protocols to/from PSTN.	GMSC Server
	NECF	Media conversion control	This function controls the resources related to media conversion at the edge (LPF) of the mobile core network. (e.g., MSC Server: ATM based access network <- -> IP based core network, GMSC: IP based core network <- -> PSTN.)	MSC Server, GMSC Server
	BCF	Routing control	This function performs the routing control for IP base mobile core network by using routing protocol.	CS-MGW

		Bearer connection control and signaling	This function performs bearer connection control for RAN. (e.g., in ATM based access network, this function handles AAL2 signaling.)	CS-MGW
	VSCF	Switching control	This function controls VSF and LPF based on commands from BCF and NSICF.	CS-MGW
Switching Plane	VSF	Switching	This function is the packet switching function from one LPF to another.	CS-MGW
Adaptation Plane	LPF	Media conversion	This function converts transport media. (e.g., MSC: ATM based access network <- -> IP based core network, GMSC: IP based core network <- -> PSTN.)	CS-MGW
		Ciphering	This function preserves confidentiality of user data and signaling across radio channels and protects mobile network from intruders.	CS-MGW

3-1-2. PS CN domain architecture (3GPP R5 PS architecture)

Figures 6 and 7 show the current 3GPP R5 SGSN and GGSN architecture models, respectively. In the example, the network between SGSN and GGSN (including signaling) is IP-based, while the signaling network between the GSN servers and HSS/SCP is SS7 based. The RAN is ATM (AAL2) based. The supported protocol at each reference point is shown in table 3, and the functions of each MSF functional block are shown in table 4, which is referred to [6], [7].

[NOTE]: In the following figures and tables, the subscripts v, and h that mean visitor, and home, respectively.

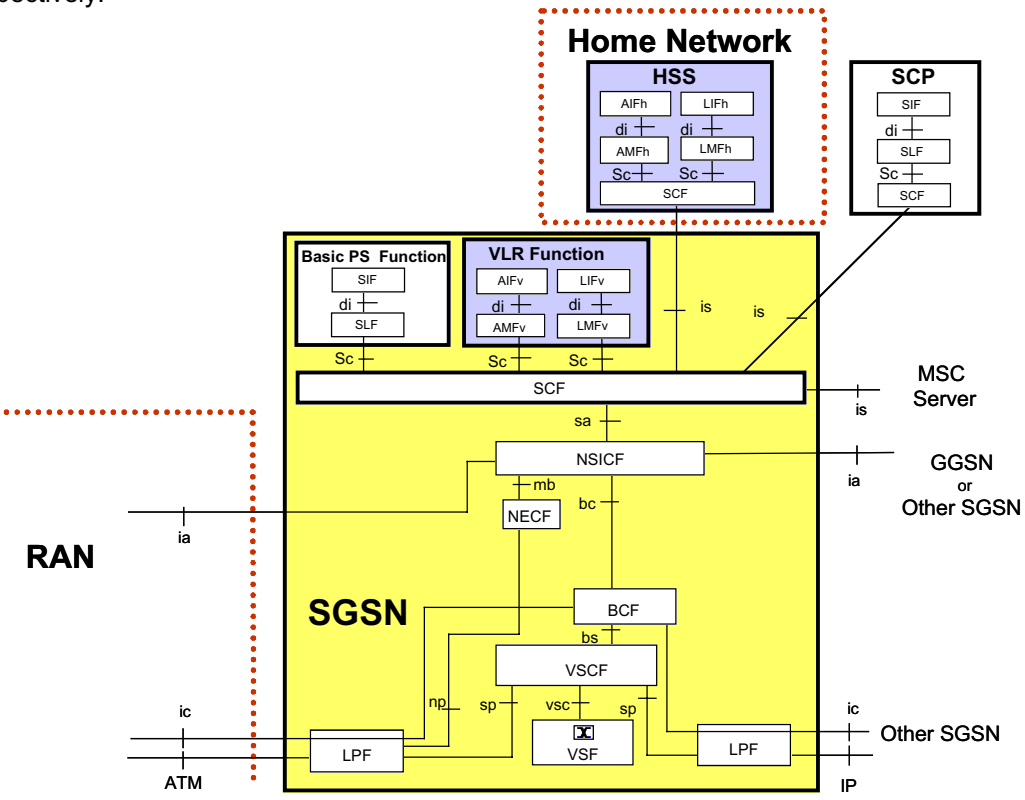


Figure.6 Physical model of R5 SGSN

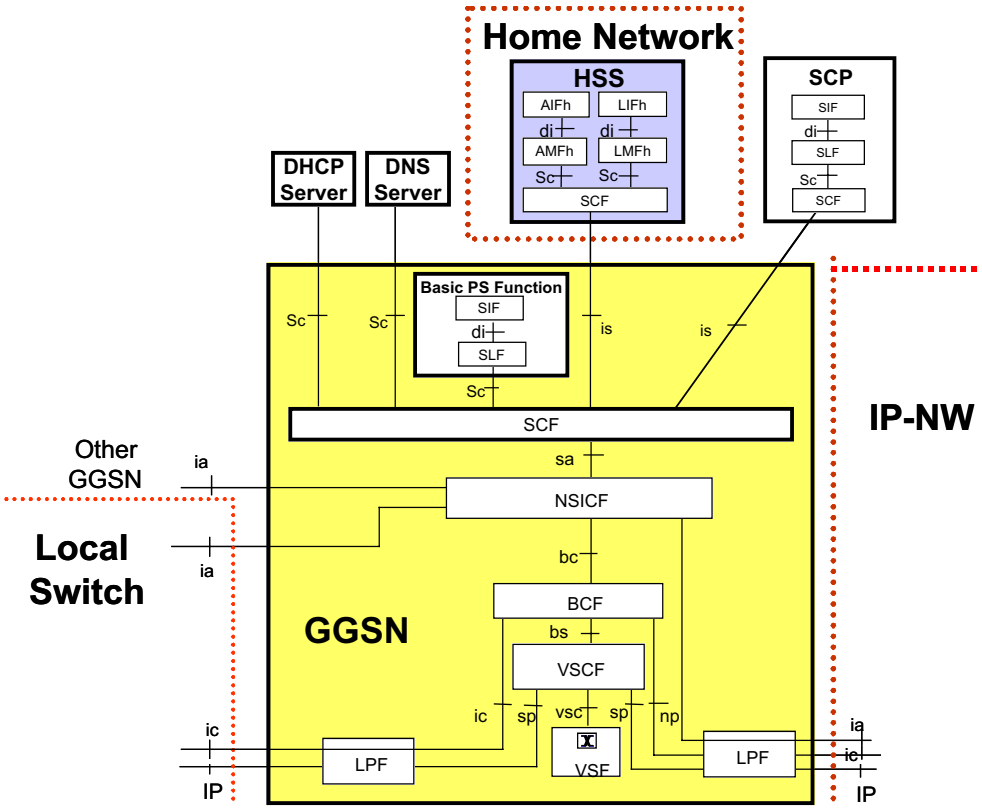


Figure.7 Physical model of R5 GGSN

Table.3 Protocol supported at each reference point for R5 PS CN domain

Reference point	bc	bs	di	ia	ic	is	mb
Protocol	-	-	-	**to:Core NW** GPRS Signalling, SIP **to:Access NW** GPRS Signalling, SIP	OSPF, RSVP	**to:SCP** INAP **to:HSS** MAP	-

Reference point	np	sa	sc	sp	vsc
Protocol	-	-	**to:DNS Server** RFC 1034 **to:DHCP Server** RFC 2131	-	-

Table.4 Functions in R5 PS CN domain

Plane	MSF Function	Function	Note	Elements in 3GPP
Application Plane	SLF/SIF	Address resolution	This function resolves logical GSN names to GSN addresses according to RFC 1034.	DNS Server
		IP address assignment	This function assigns IP address to each user according to RFC 2131.	DHCP Server
		Location Management (LMF) Location Information (LIF)	These functions contain the basic terminal mobility logic and manage user information (user location, subscriber ID, data protocol and address), which is used upon the location registration and call related/ unrelated processing. (e.g., call routing and user registration.) The LMFv/LIFv performs temporary and local location management at the visited network node. LMFh/LIFh performs permanent and global location management its belonging users.	HSS, SGSN
		Authentication Management (AMF) Authentication Information (AIF)	These functions perform the identification, authentication of the service requester, and the validation of the service request type. The AMF performs in association with LMF/LIF and executes authentication, in association with AIF, which contains the authentication information. The AMFh/AIFh perform permanent authentication management for the belonging users. The AMFv/AIFv perform temporary authentication management at visited network node based on information from AMFh/AIFh.	HSS, SGSN
		Basic PS Function (SLF/SIF)	These functions consist of two functional blocks; SLF and SIF. SLF has service logic to provide PS (Packet Switching) service. SIF stores user information. (e.g., billing information, QoS information, and etc.)	SGSN, GGSN
	SCF	Multiple services management	This function routes the signaling information to select the appropriate SLFs during the location registration and the call or connection setup/release phase. For example, SCF interacts with LMF, AMF, and other necessary functional	HSS, SGSN, GGSN

			blocks to provide the mobile user's location registration and call setup.	
Control Plane	NSICF	GTP connection control	ItThis function handles basic GTP connection control for mobile communications to setup, release, and maintain GTP tunnels between SGSN and GGSN.	SGSN, GGSN
		Radio access network control (RACF)	This function manages radio resources and executes admission control upon the call setup to provide the QoS requested by the user. This function also executes paging by using multicast signaling and performs ciphering execution control.	SGSN
		Handover link control (HOCF)	This function handles overall control for handover and interacts with RAN to set up, release, and maintain a branch of a handover link.	SGSN, GGSN
		Address translation /mapping	This function converts one address type to another. (e.g., from external network protocol address to internal network address.)	SGSN, GGSN
		Network interworking	This function is the gateway function to support interworking with other networks. (e.g., IP networks.) It supports protocol/address conversion.	GGSN
		Message screening	This function filters out unauthorized or unsolicited messages. (e.g., by use of Internet firewalls.)	GGSN
		Charging data collection	This function collects the data needed to support subscription and/or traffic fees.	SGSN, GGSN
		MAP Termination	This function terminates MAP protocols to support signaling exchange with location registers. (e.g., HSS).	SGSN, GGSN
		CAP Termination	This function terminates CAP protocols to support signaling exchange with Intelligent Network. (i.e., SCP.)	SGSN, GGSN
	NECF	Media conversion control	This function controls the resources related to media conversion at edge (LPF) of mobile core network. (e.g., SGSN: ATM based access network.)	SGSN
	BCF	Routing control	This function performs the routing control for IP based mobile core networks by using routing protocols. (e.g., OSPF.) It selects the transmission path for the "next hop" in the route.	GGSN
		Bearer connection control and signaling	This function performs bearer connection control for RAN. (e.g., in ATM based access network, this function handles AAL2 signaling.)	SGSN

	VSCF	Switching control	This function controls VSF and LPF based on commands from BCF and NSICF.	SGSN, GGSN
Switching Plane	VSF	Switching	This function is the packet switching function from one LPF to another.	GGSN
Adaptation Plane	LPF	Media conversion	This function converts transport media between ATM based access network and IP based core network.	SGSN, GGSN
		Encapsulation/ Decapsulation	This function performs Encapsulation and Decapsulation for terminating GTP tunnels. Encapsulation means adding address and control information to data unit for routing packets within and between mobile core networks. Decapsulation means removing address and extracting information from received packet.	SGSN, GGSN
		Ciphering	This function preserves confidentiality of user data and signaling across radio channels and protects mobile network from intruders.	SGSN

3-1-3. IP Multimedia Subsystem (3GPP R5 IMS architecture)

Figure 8 shows the current 3GPP R5 IMS architecture model. The IMS consists of several functional blocks: call control function, call routing function, media gateway function, and etc.

Call control function can be classified into four functional blocks; S-CSCF (Serving-CSCF: Call State Control Function), I-CSCF (Interrogating-CSCF), P-CSCF (Proxy-CSCF), and MGCF (Media Gateway Control Function). S-CSCF actually controls the call/service related states interacting with applications in SCP, and MM APL. I-CSCF is the main contact point between IMSs of multiple PLMNs (Public Land Mobile Networks), which acts as firewall. This functional block can hide user information and network topologies from other PLMN. Moreover, I-CSCF has S-CSCF selection function according to traffic conditions. P-CSCF is characterized by being the first contact point from access network within IMS. This functional block receives the call/service related requests from access network and forwards them to S-CSCF via I-CSCF. MGCF performs protocol conversion (SIP <- -> ISUP) between IMS and PSTN.

Call routing function can be classified into two functional blocks; BGCF (Breakout Gateway Control Function) and SLF (Subscription Locator Function). BGCF selects the network in which PSTN breakout is to occur. If the breakout point is in another network, BGCF forwards this session signalling to another BGCF, or MGCF, depending on network configuration. SLF has an HSS resolution mechanism. If there are several HSSs in the home network, SLF selects a suitable HSS for the user and registers the user subscription to the HSS.

Media gateway function corresponds to PS-MGW. It performs bearer conversion (e.g., IP bearer <- -> CS bearer).

The IMS is overlaid on R5 PS CN domain. The protocol supported at each reference point is shown in table 5, and the functions of each MSF functional block are shown in table 6, which is referred to [6], [7].

[NOTE]: In the following figures and tables, the subscripts v, and h that mean visitor, and home, respectively.

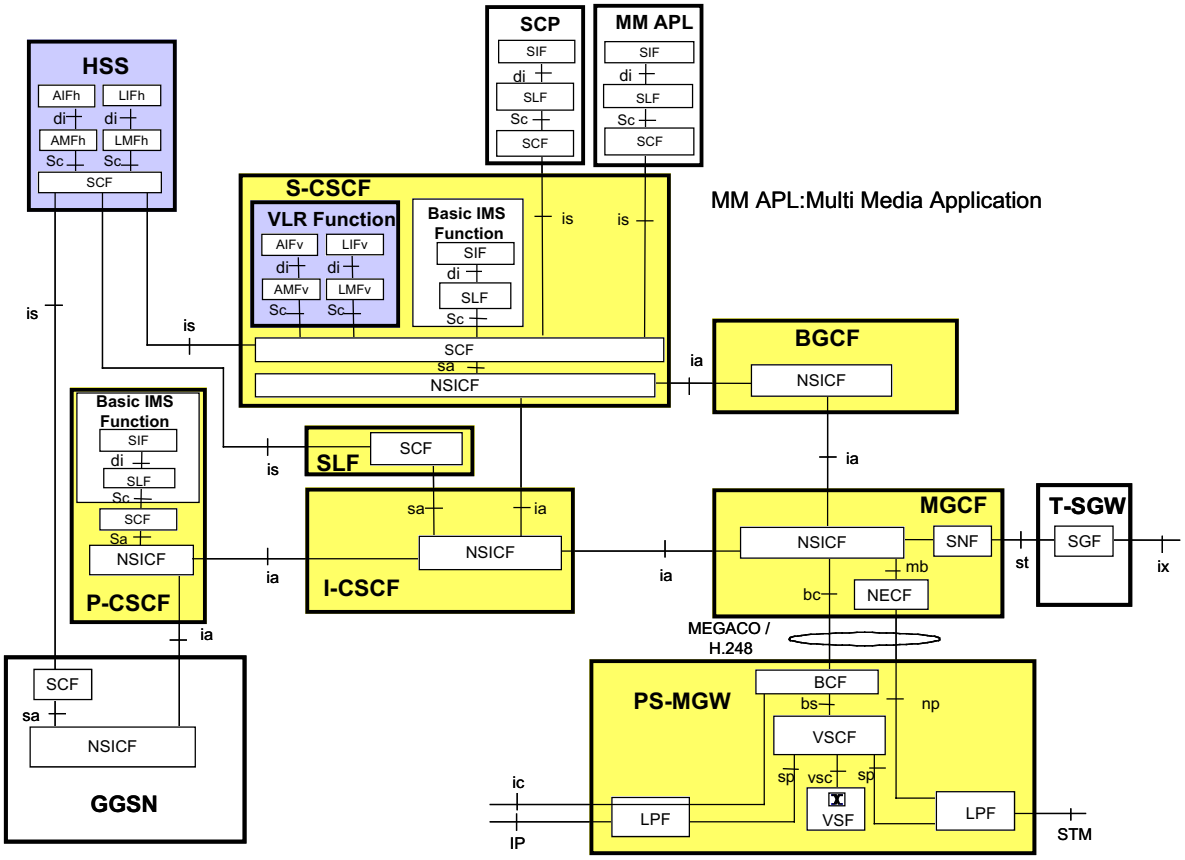


Figure.8 Physical model of R5 IMS

Table.5 Protocol supported at each reference point for R5 IMS

Reference point	bc	bs	di	ia	ic	is	ix
Protocol	MEGACO/ H.248	-	-	SIP	OSPF, RSVP	**to:MM APL** SIP **to:HSS** MAP **to:SCP** INAP	ISUP
Reference point	**mb**	**np**	**sa**	**sc**	**sp**	**st**	**vsc**
Protocol	-	MEGACO/ H.248	-	-	-	SIGTRAN	-

Table6. Functions in R5 IMS

Plane	MSF Function	Function	Note	Elements in 3GPP
Application Plane	SLF/SIF	Location Management (LMF) Location Information (LIF)	These functions contain the basic terminal mobility logic and manage user information (user location, subscriber ID, data protocol and address), which is used upon the location registration and call related/ unrelated processing. (e.g., call routing and user registration.) LMFv/LIFv performs temporary and local location management at the visited network node. LMFh/LIFh performs permanent and global location management its belonging users.	HSS, S-CSCF
		Authentication Management (AMF) Authentication Information (AIF)	These functions perform the identification, authentication of the service requester, and the validation of the service request type. AMF performs in association with LMF/LIF and executes authentication, in association with AIF, which contains the authentication information. AMFh/AIFh perform permanent authentication management for the belonging users. AMFv/AIFv perform temporary authentication management at visited network node based on information from AMFh/AIFh.	HSS, S-CSCF
		Basic IMS Function (SLF/SIF)	The characteristics of these functions have two. First one is address-handling function, and the other one is SIP server's function. The Address-handling function means to	P-CSCF, S-CSCF

			perform analysis, translation and mapping of alias addresses and do temporary address handling for inter-network routing. SLF/SIF in S-CSCF performs global address translation. (e.g., E.164 <- -> SIP URL translation.) SLF/SIF in P-CSCF performs local address translation. (e.g., number internationalization; 911 <- ->110 translation.) SIP server's function means as follows. At initial access, this function notifies of users information and cache access related information. (e.g., terminal IP addresses where user may be reached.) SLF/SIF in S-CSCF behaves as a User Agent and SLF/SIF in P-CSCF behaves as a Proxy server, respectably. These functions are defined in IETF SIP.	
	SCF	Multiple services management	This function routes the signaling information to select the appropriate SLFs during the call or connection setup/release phase. 's The SLF selects a suitable HSS from several HSSs in home network.	HSS, P-CSCF, S-CSCF, SLF
Control Plane	NSICF	Call control	This function performs the basic call or connection control and signaling for all services, including mobile communications, to setup, release, and maintains call instances.	MGCF, P-CSCF, I-CSCF, S-CSCF
		PSTN routing	This function selects a suitable forwarded PSTN based on local policy. (e.g., IETF TRIP)	BGCF
		Network information hidden	This function hides the configuration, capabilities and topology of its network from the outside.	I-CSCF
		MAP Termination	This function terminates MAP protocols to support signaling exchange with location registers. (e.g., HSS.)	S-CSCF, SLF
		CAP termination	This function terminates CAP protocols to support signaling exchange with Intelligent Network. (i.e., SCP.)	S-CSCF
	NECF	Media conversion control	This function controls resources related to media conversion at edge (LPF) of mobile core network. (e.g., CODEC conversion.) It includes bearer network address resolution. (e.g., MGW number <--> IP address.)	MGCF

	SNF	Signaling delivery	This function delivers control-signalling information to the appropriate SGF. (i.e., PSTN.)	MGCF, S-CSCF
	SGF	Signaling gateway	This function performs the routing control for IP based mobile core networks by using routing protocols. (e.g., OSPF.) It selects the transmission path for the "next hop" in the route.	T-SGW
	BCF	Routing control	This function performs bearer connection control for RAN. (e.g., in ATM based access network, this function handles AAL2 signaling.)	PS-MGW
		Bearer connection control and signaling	This function controls VSF and LPF based on commands from BCF and NSICF.	PS-MGW
	VSCF	Switching control	This function is the packet switching function from one LPF to another.	PS-MGW
Switching Plane	VSF	Switching	This function converts transport media between ATM based access network and IP based core network.	PS-MGW
Adaptation Plane	LPF	Media conversion	This function performs the routing control for IP based mobile core networks by using routing protocols. (e.g., OSPF.) It selects the transmission path for the "next hop" in the route.	PS-MGW

3-2. Mobile IP Network architecture

Mobile IP is a candidate technology for achieving of IP level mobility, and is being standardized in IETF [8], [9], [10]. 3GPP and 3GPP2 have already started to study the introduction of Mobile IP technology to their mobile core network architecture. 3GPP tried to introduce Mobile IP as the upper level network of the GPRS network to enable global roaming among different wireless access networks [11]. 3GPP2 has specified Mobile IP as the mobility technology in the 3rd G mobile core network [12]. Figure 9 shows two examples of the Mobile IP network architecture model.

In this section, a generic Mobile IP network architecture that can be applied tomobile networks is assumed, as shown in Figure 10, and the MSF architecture model is applied to the generic architecture. The Mobile IP network basically consists of Home Agent (HA) and Foreign Agent (FA). HA permanently holds the location information of belonging mobile terminals, and FA temporarily holds information of the visited mobile terminals. Although an FA can be implemented within the access network termination equipment (e.g., GSN, PDSN), in this section, we focus on Mobile IP related functions so that discuss an access network independent FA architecture.

Figures 11 and 12 show the current FA and HA physical models respectively. These models are based on the classic IP router model described in MSF IA section 4.2.2, which separates IP routing logic component and IP forwarding component. If MPLS or QoS control are supported, the necessary functions must be added to these models based on the result of the MLPS/QoS discussion. The protocol supported at each reference point is shown in Table 7 and the functions of each MSF functional block are shown in Table 8.

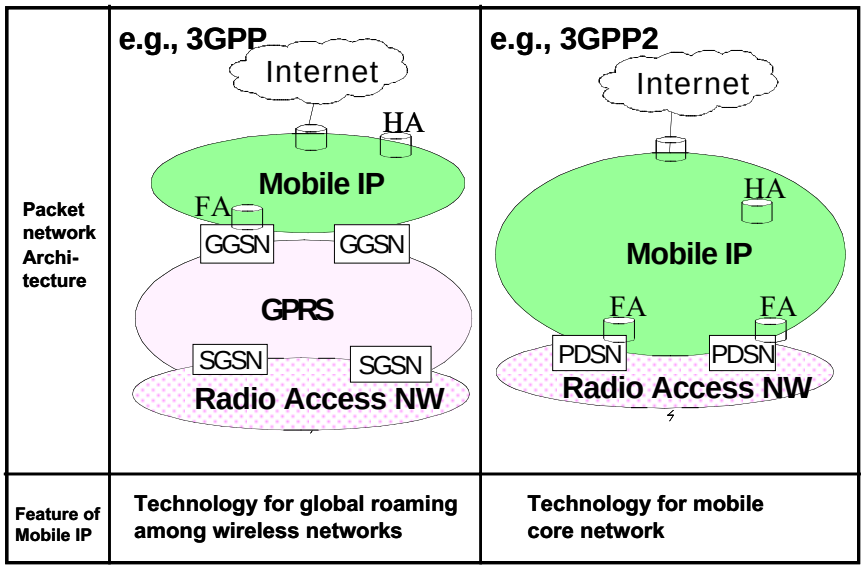


Figure.9 Examples of Mobile IP architecture model

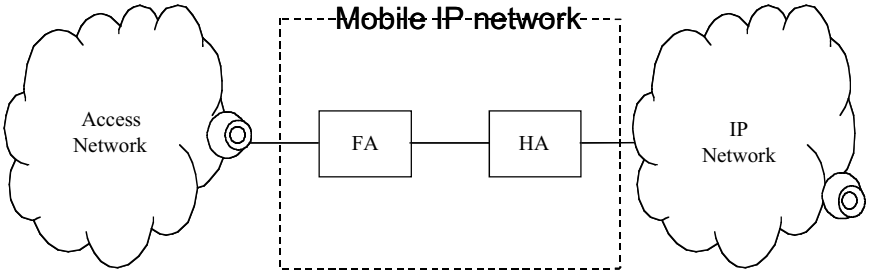
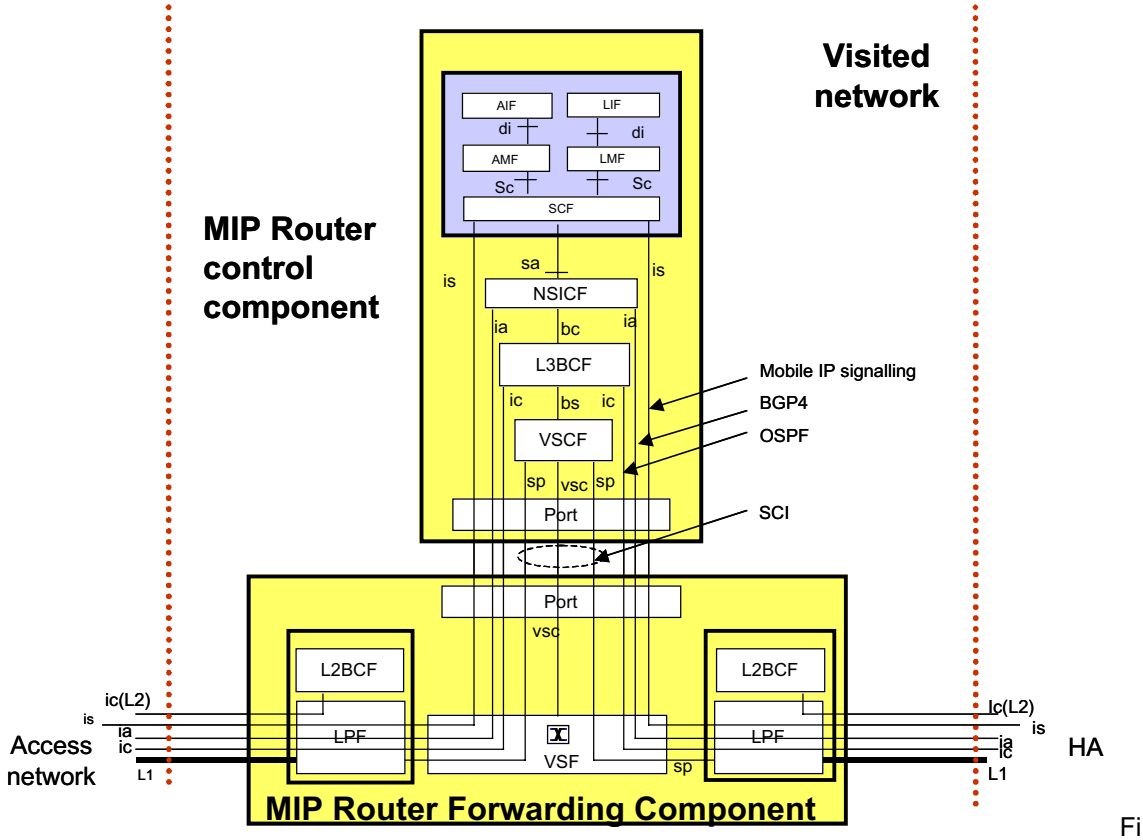


Figure.10 Generic Mobile IP network architecture



Fi

gure.11 Physical model of FA

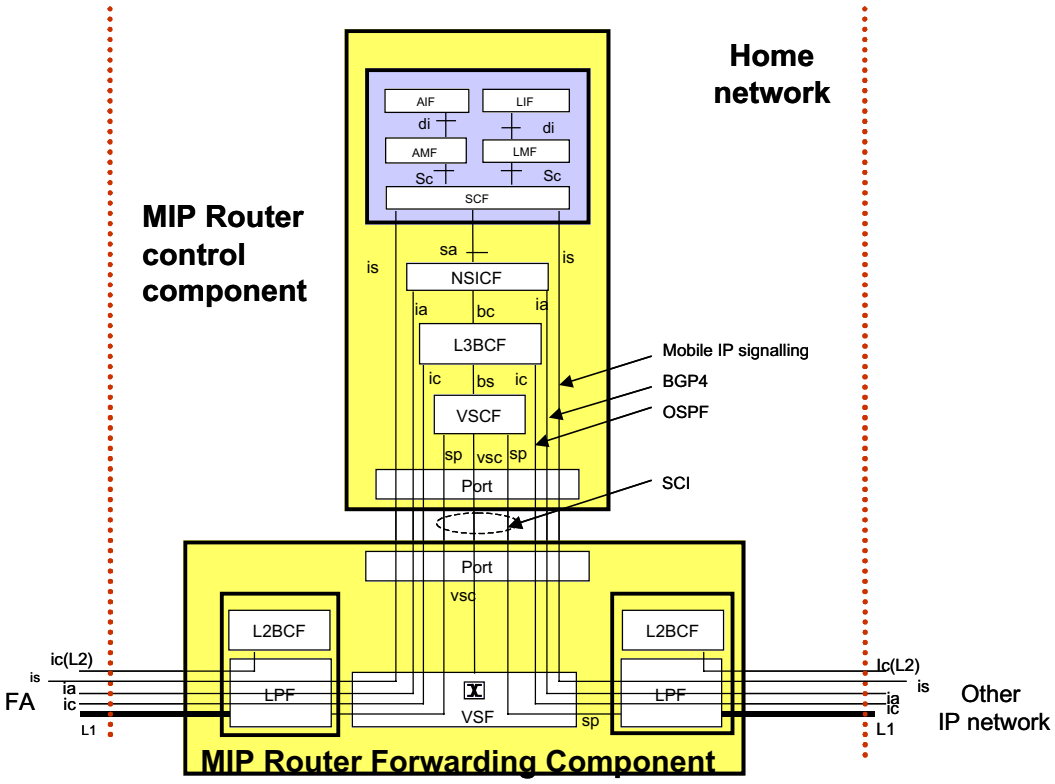


Figure.12 Physical model of HA

Table.7 Protocol supported at each reference point

Reference point	bc	bs	di	ia	ic	is	sa
Protocol	-	-	-	RFC2002 BGP-4	**L3:** OSPF	-	-
Reference point	sc	sp	vsc				
Protocol	-	FFS (SCI)	FFS (SCI)				

Table.8 Functions in Mobile IP network

Plane	MSF Block	Function	Note	Elements in Mobile IP
Application Plane	SLF /SIF	Authentication Management (AMF) Authentication Information (AIF)	These functions perform the identification, authentication of the service requester, and the validation of the service request type. The AMF performs in association with LMF/LIF and executes authentication, in association with AIF, which contains the authentication information. The AMFh/AIFh perform permanent authentication management for the belonging users. The AMFv/AIFv perform temporary authentication management at visited network node based on information from AMFh/AIFh.	FA, HA
		Location Management (LMF) Location Information (LIF)	This function contains basic terminal mobility logic and manages user information (user location, user IP address, etc.), which is used upon location registration, handover, route optimization, IP in IP tunneling, etc. The LMFv performs temporary and local location management using a Visitor List for visited users, and LMFh performs permanent and global location management using a Binding List for its belonging users.	FA, HA
	SCF	Multiple service management	This function routes the signaling information to select the appropriate SLFs during the call or connection setup/release phase. For example, SCF interacts with LMF, AMF and, other necessary functional blocks to provide the mobile user's	FA, HA

			location registration.	
Control Plane	NSICF	Mobile IP signaling Termination	controls Mobile IP messages including -Llocation registration, handover, route optimization, etc.	FA, HA
		Mobile IP control	-Llocation registration, handover, route optimization, IP in IP tunneling, etc. It controls establishment and release of IP in IP tunnels.	FA, HA
		Routing Control (EGP)	This function controls routing for IP based mobile core networks by using external routing protocols (e.g., BGP4).	FA, HA
		Message screening	This function filters out unauthorized or unsolicited messages.	FA, HA
	BCF	Routing Control (IGP)	This function controls routing for IP based mobile core networks by using internal routing protocols (e.g., OSPF).	FA, HA
	VSCF	Switching control	This function controls IP packet forwarding to VSF/LPF based on routing control information from BCF and NSICF.	FA, HA
		Encapsulation /Decapsulation control	This function controls Encapsulation and Decapsulation in LPF based on tunneling control information from NSICF.	FA, HA
Switching Plane	VSF	Switching	This function is the packet switching function from one LPF to another.	FA, HA
Adaptation Plane	LPF	Encapsulation /Decapsulation	This function performs Encapsulation and Decapsulation for terminating IP in IP tunnels. Encapsulation means adding address and control information to data unit for routing packets within and between Mobile IP routers. Decapsulation means the removing address and extracting information from received packet.	FA, HA

4. For Future Study

- Application Plane Architecture:

Details of the Application Plane Architecture for MSF Release 2 is still under study in the MSF architecture working group. Sections 2 and 3 of this document are based on the current specification. When the specification is changed in the future the correspondent parts of this document will be modified.

- Media Resource Function (MRF):

Inclusion of Media Resource Function (MRF) to the MSF functional architecture model is discussed in MSF Architecture WG. MRF performs setting up media connections and allowing building blocks to be invoked, controlled, and interacted with (within the media connections) to manipulate media. Future version of this IA will include the way of mapping this MRF to the 3G mobile networks according to the result of above discussion.

5. References

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[11] 3GPP TR 23.923v3.0.0 (1999-11) “Combined GSM and Mobile IP Mobility Handling in UMTS IP CN”
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