

IMS + VoLTE Overview

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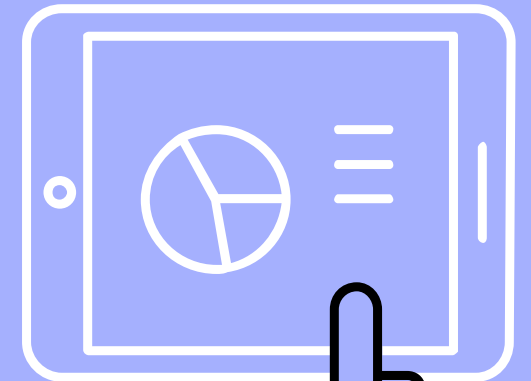
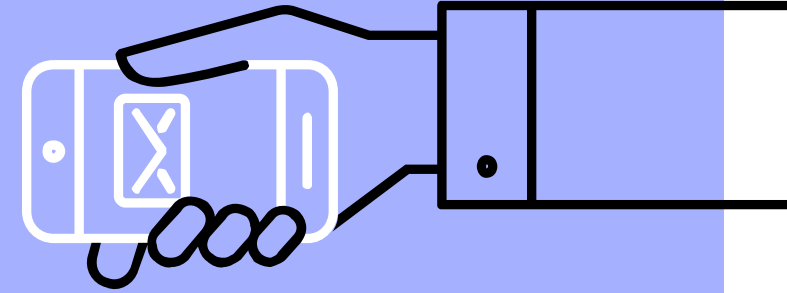
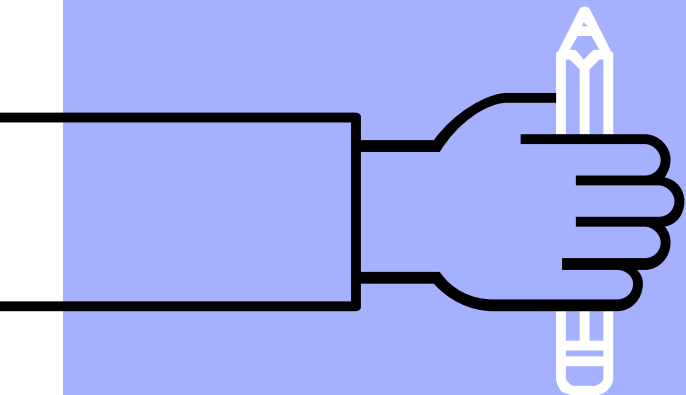
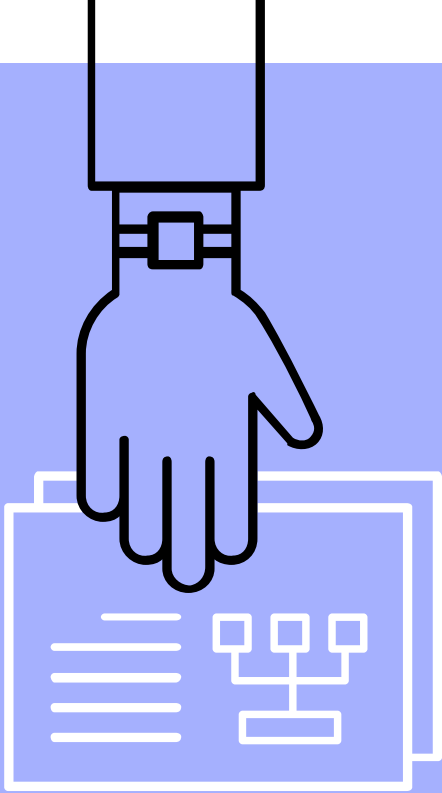
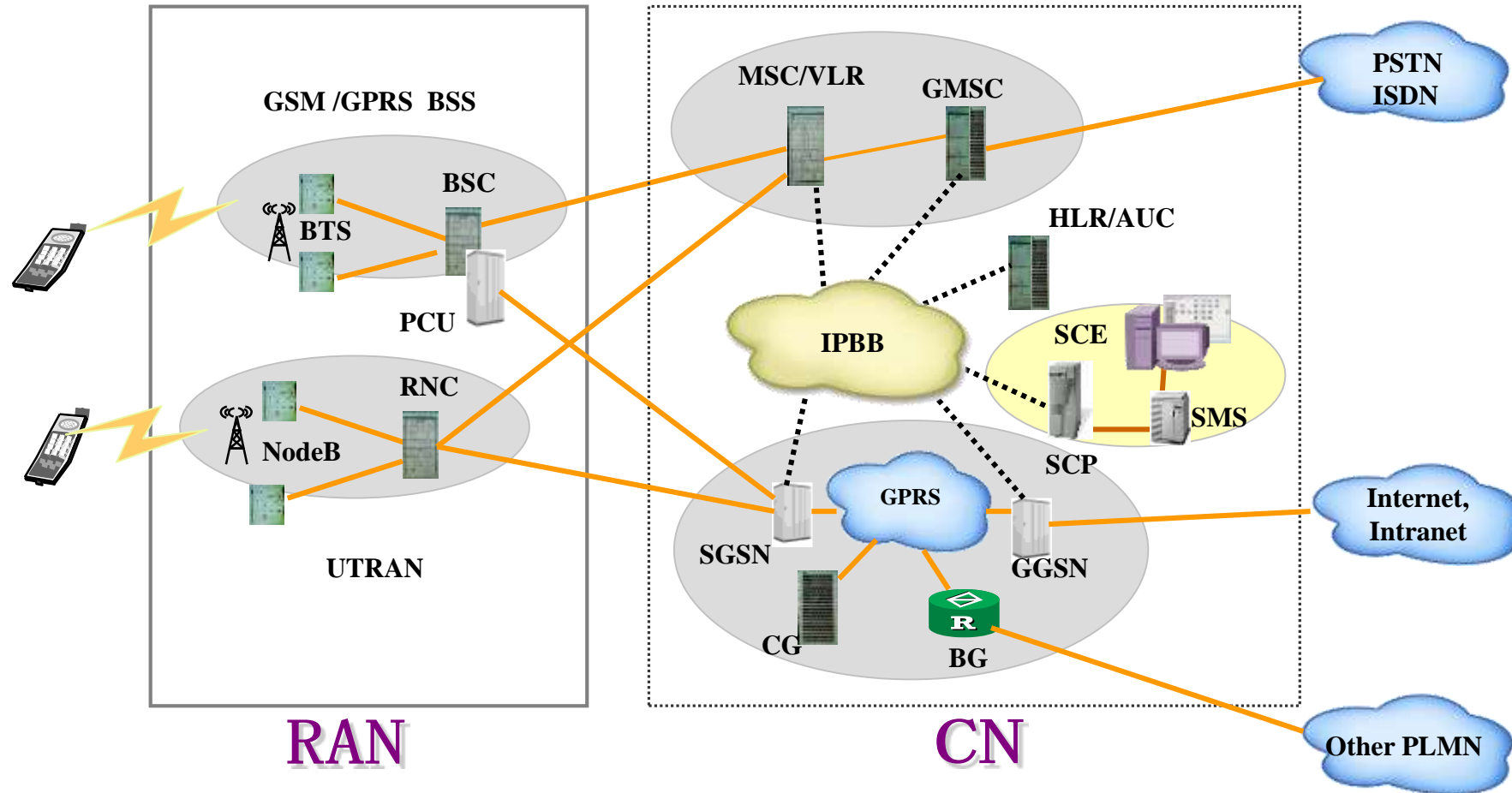




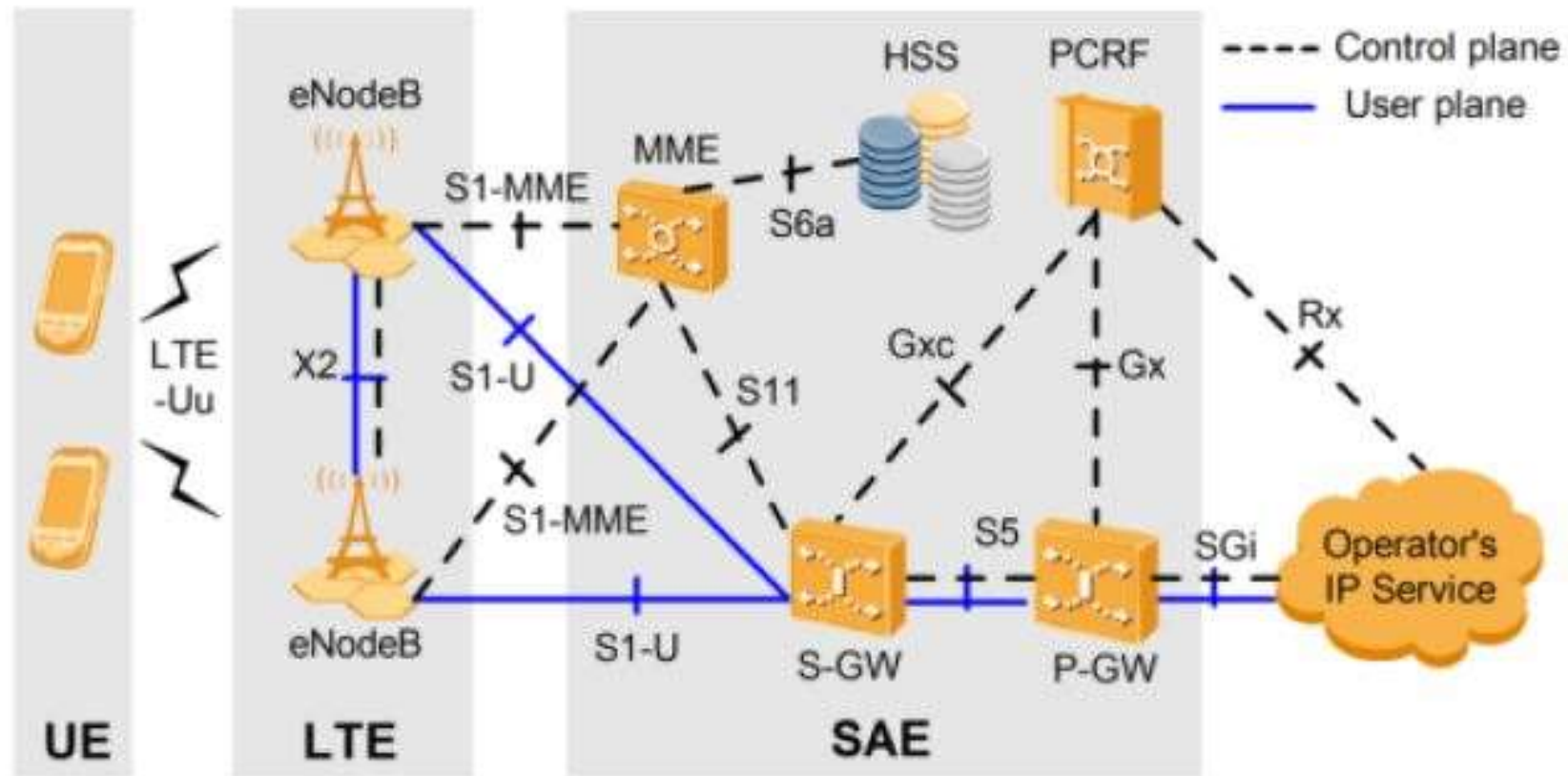
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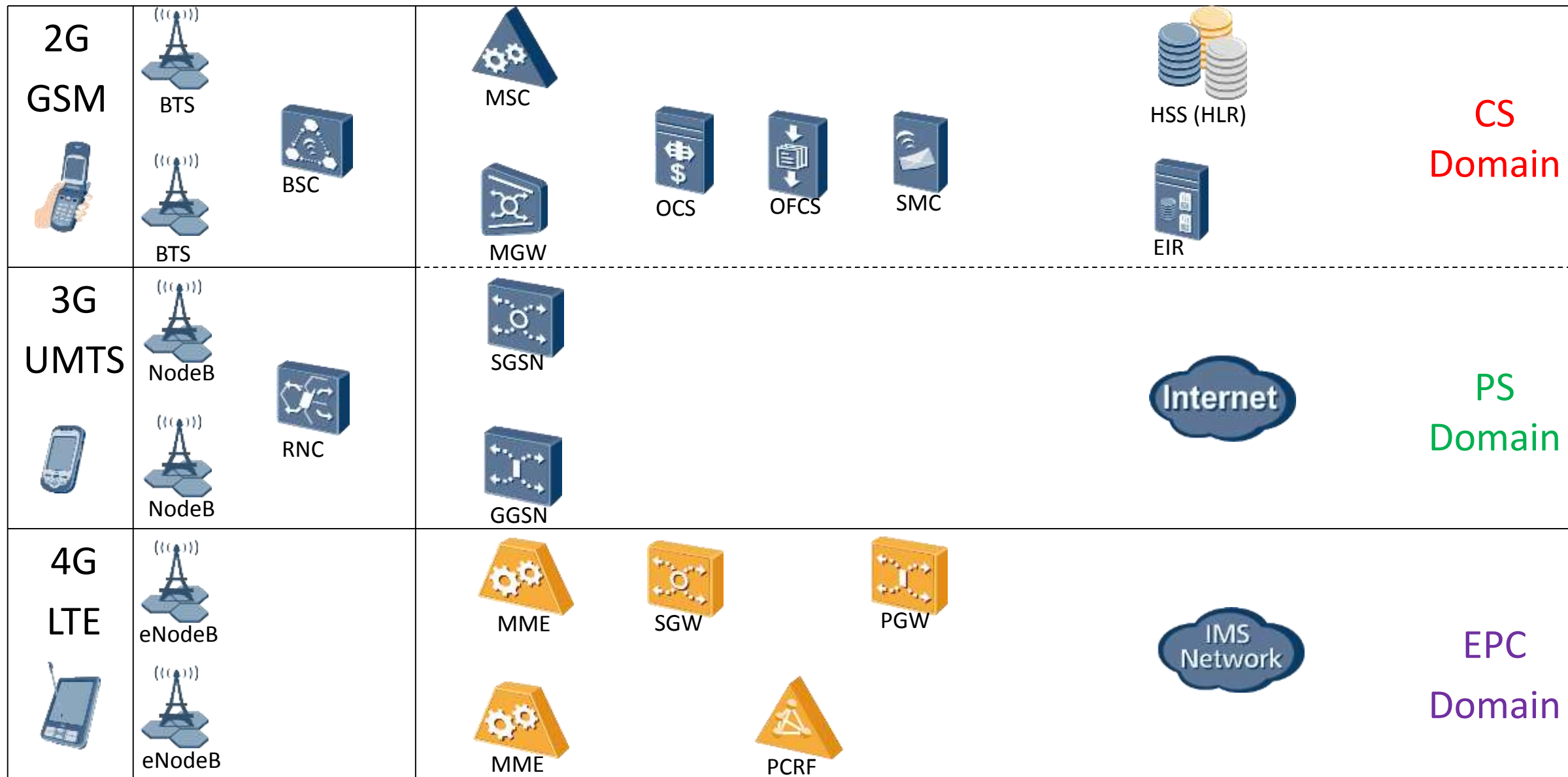
■ 2G/3G Overview



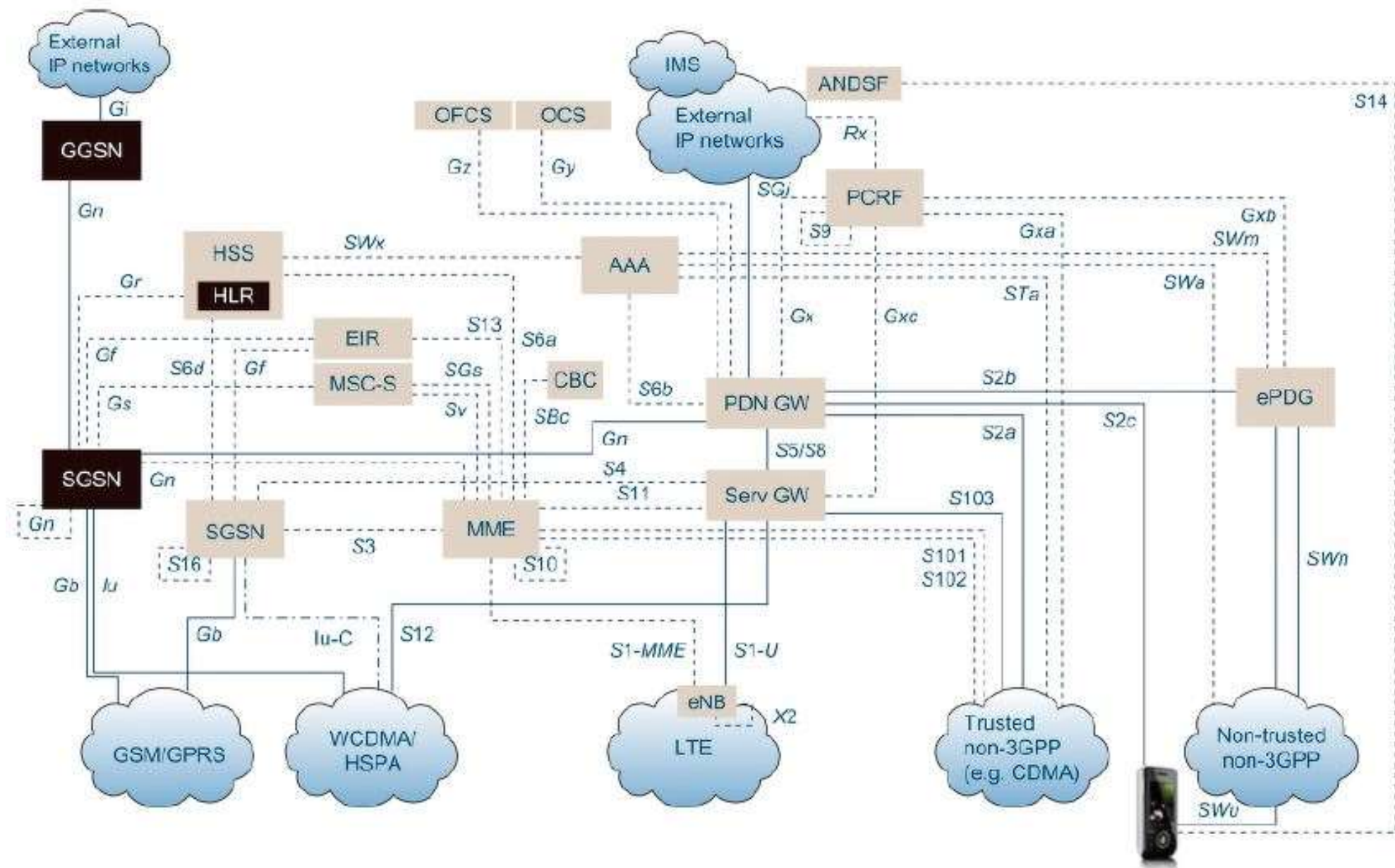
■ 4G/LTE Network Topology



2G/3G/4G Network Overview



2G/3G/4G Network Overview



■ What is IMS?

IMS is IP Multimedia Subsystem

- Base on IP bear network
- Use SIP protocol as core session control protocol
- Support access-independent and thus provide more competitive service packages

Multiple Access Modes

- Mobile Network:
WiMax
LTE/ SAE
GSM/ WCDMA/
CDMA/ TD-SCDMA
- Fixed Network:
LAN、WLAN、xDSL

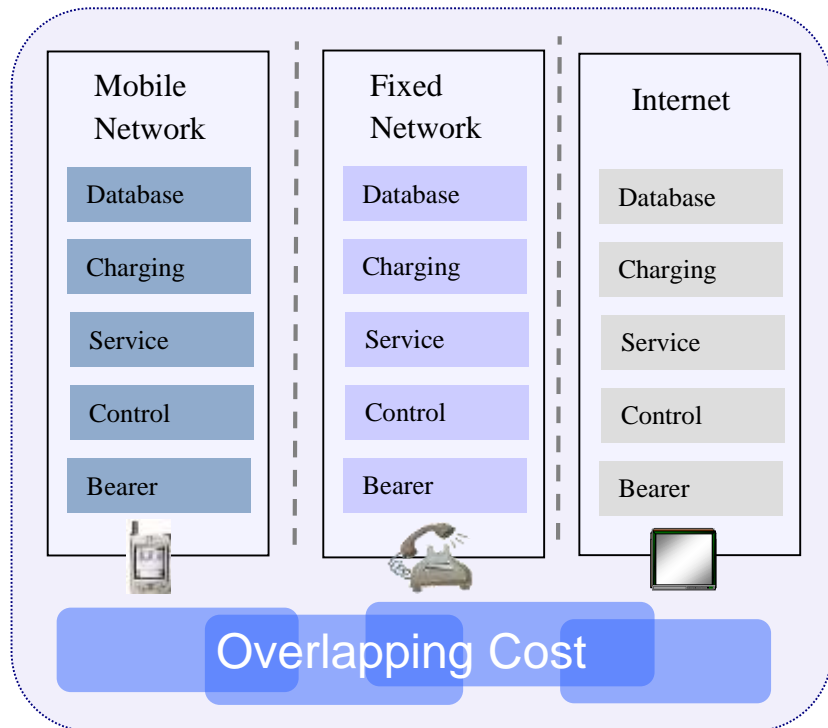
IP Multimedia Service

- Session Service:
Voice and Video Call
Conference
Message
- Non-Session Service:
IPTV、Media、Web

■ IMS Motivation / All IP Convergent

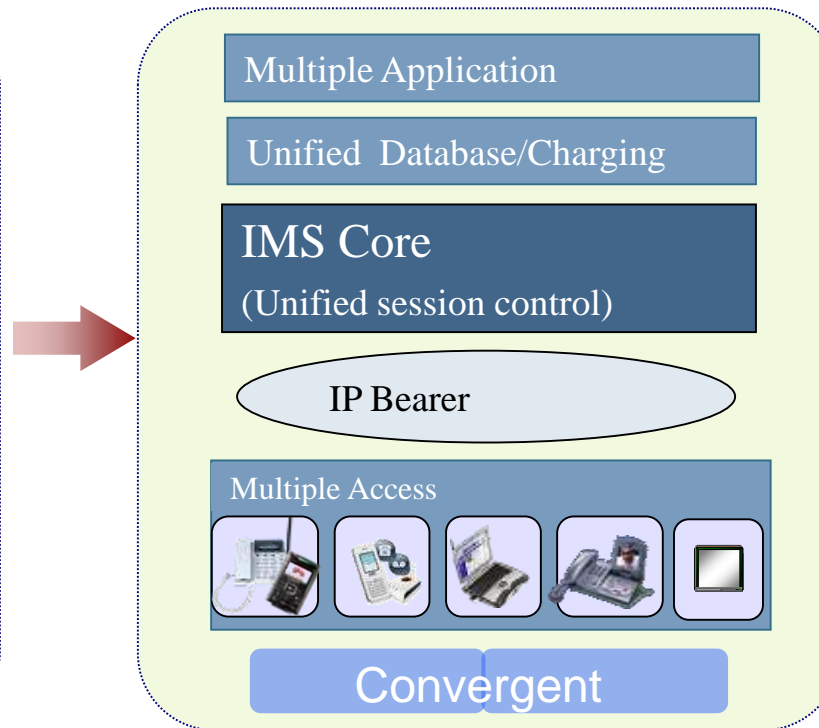
Legacy Core Network Arch.

- Vertical network, overlap in hardware, service and database
- Separated user and service
- Difficult to decrease OPEX/CAPEX



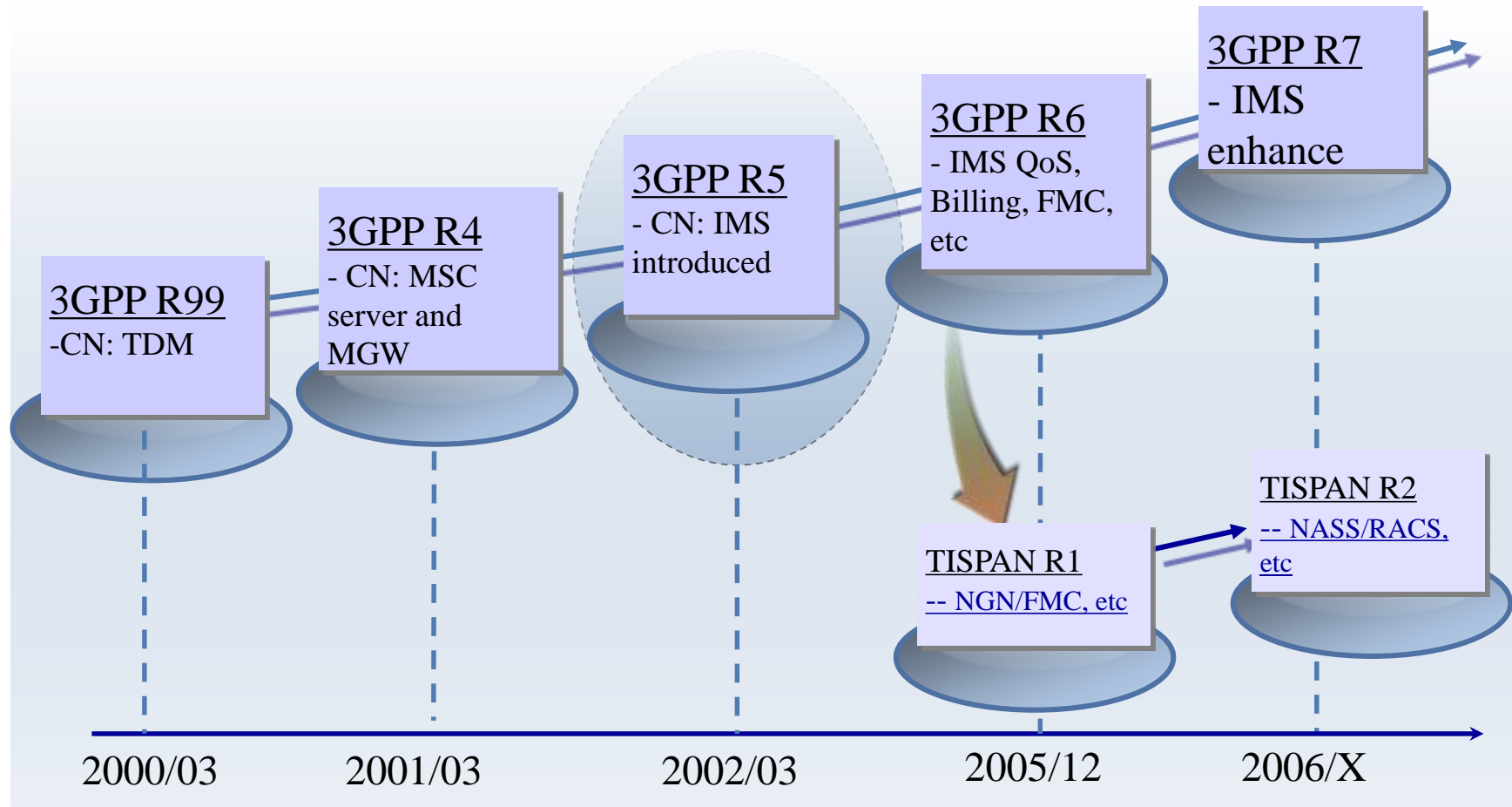
Converged Multi-service Arch.

- Horizontal network, converge fixed, mobile and data service network
- Unified database and service
- Access independent



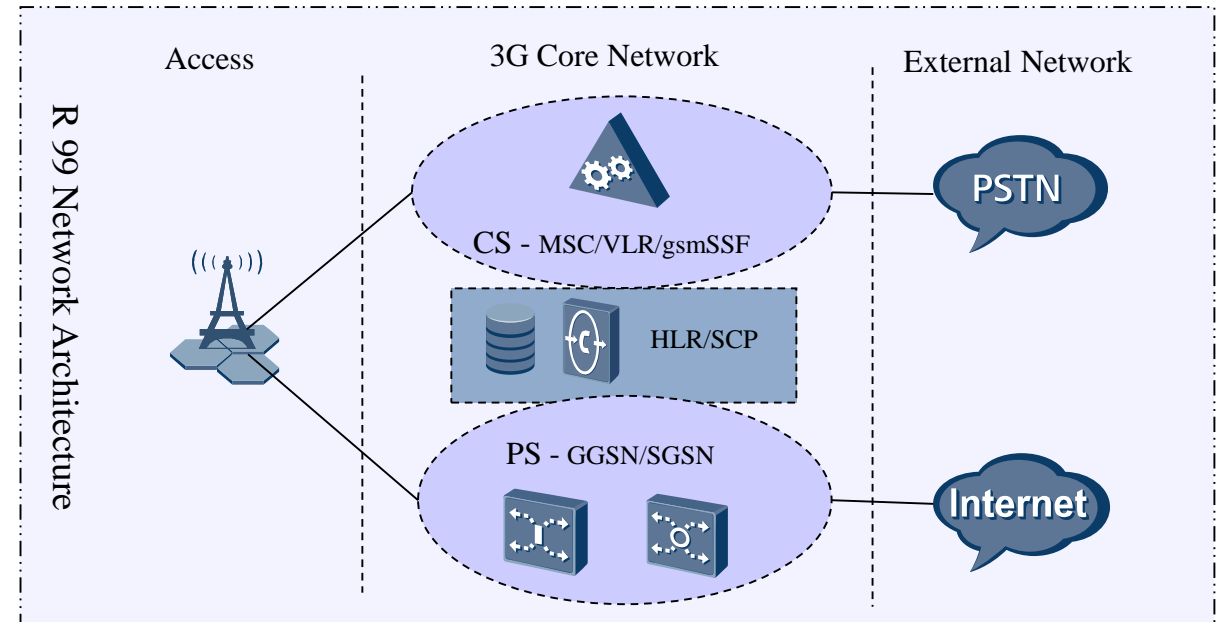
■ History of IMS

The IMS is introduced as part of 3GPP specifications at the R5 stage, act as the subsystem of PS domain.

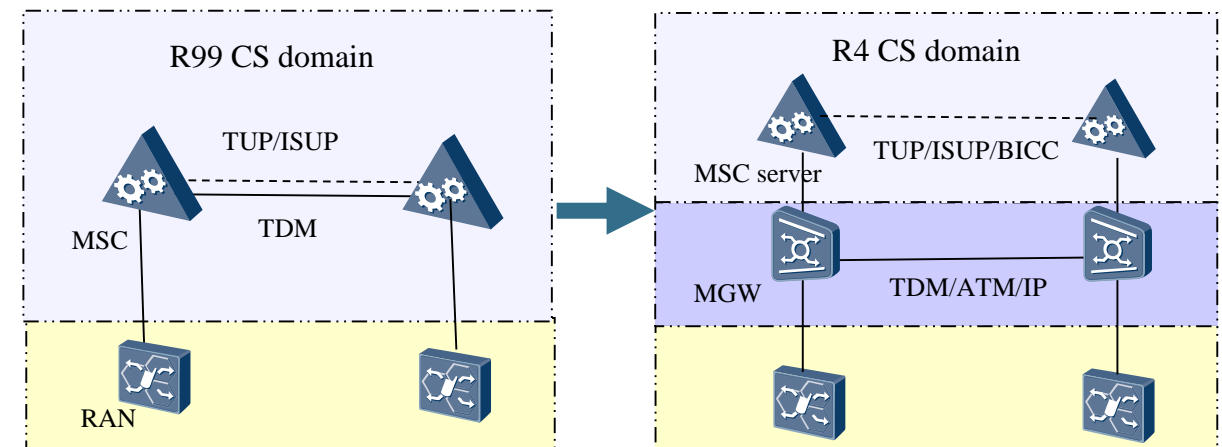


■ Network Architecture of 3GPP R99 and R4

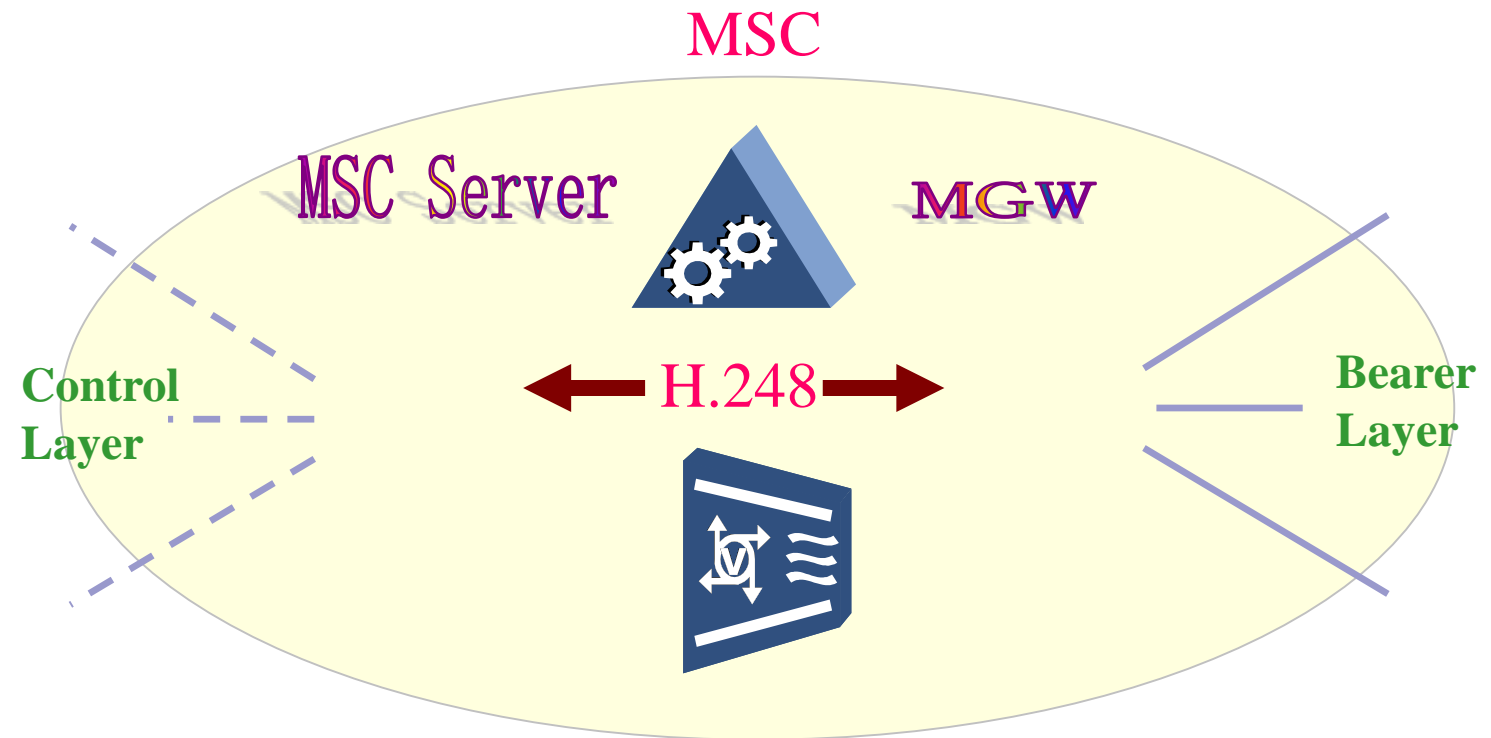
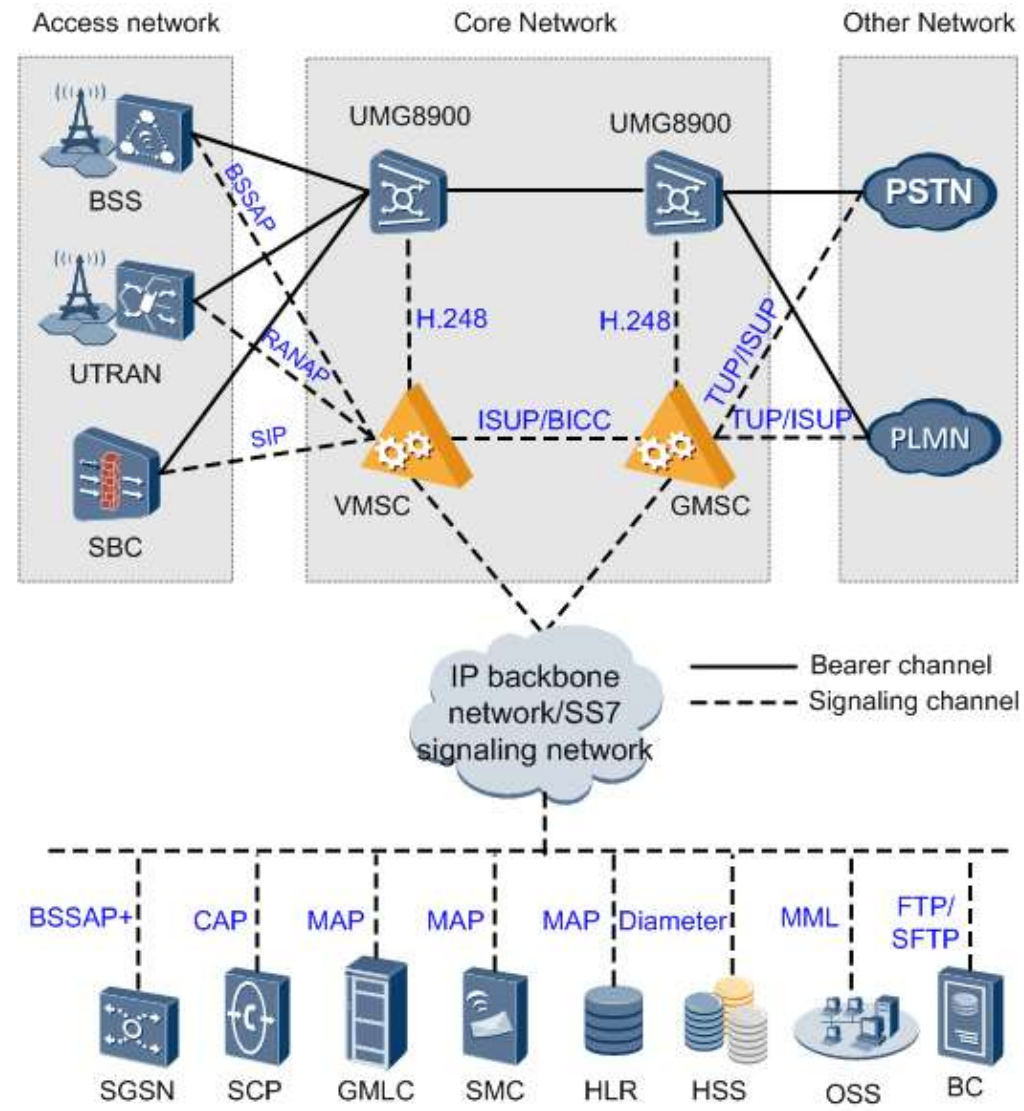
- In R99, 3G Core Network is separated into CS and PS Domain.



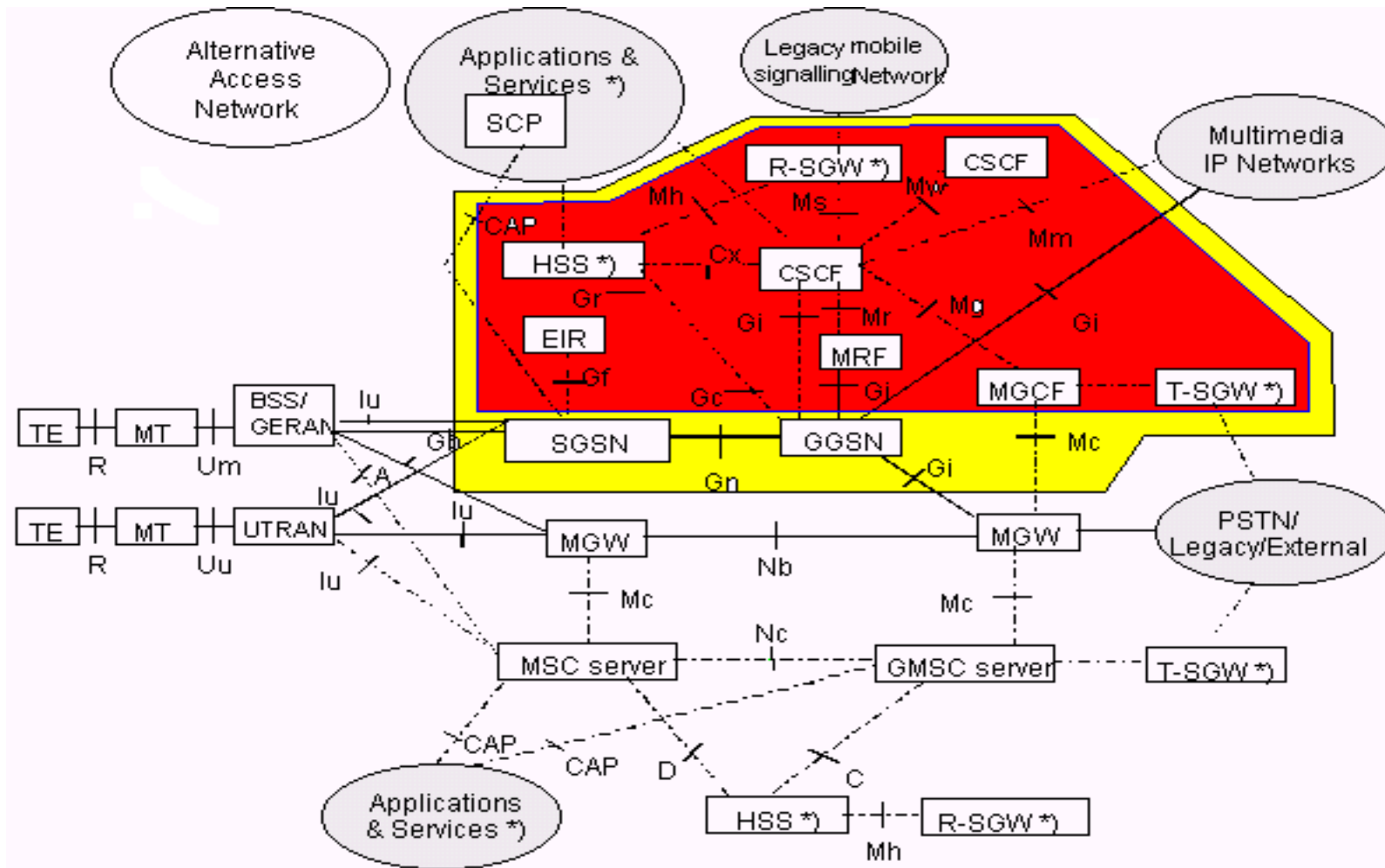
- In R4, MSC divided into MSC server and MGW, call control is separated with the media bearer function.



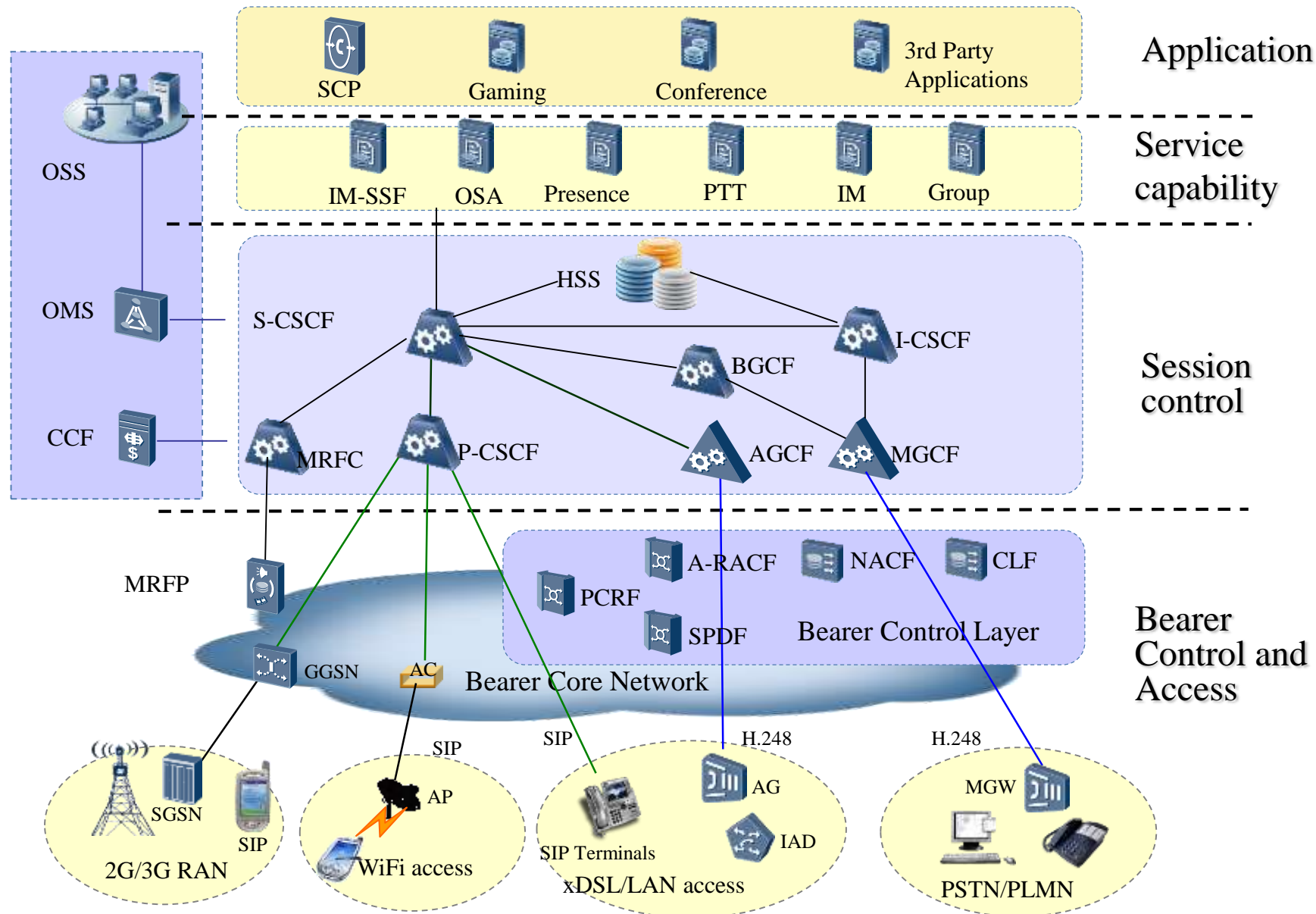
■ 3GPP R4 Network Architecture



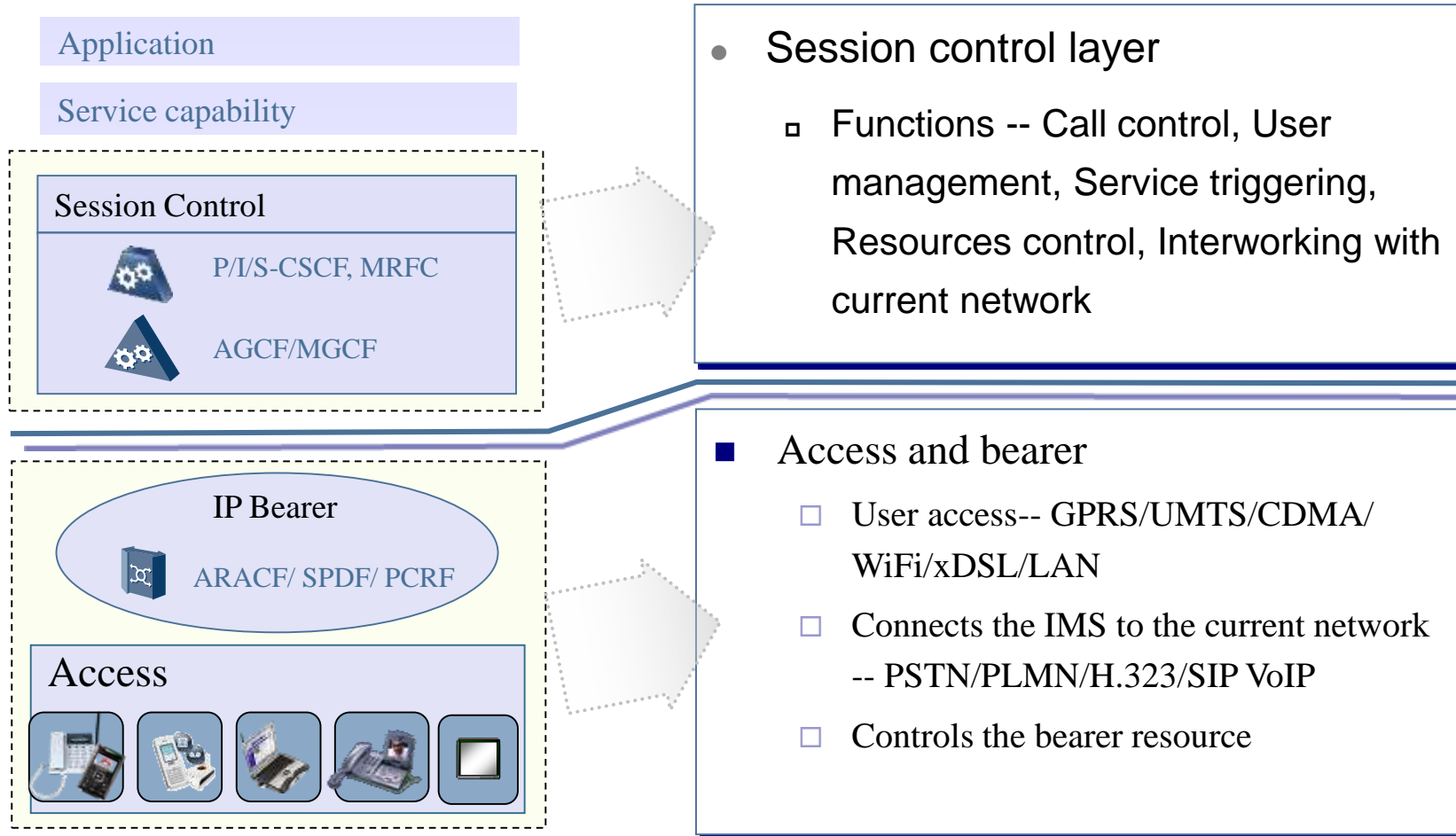
■ 3GPP R5 Network Architecture



IMS Network Structure













■ IMS Network Layers Architecture

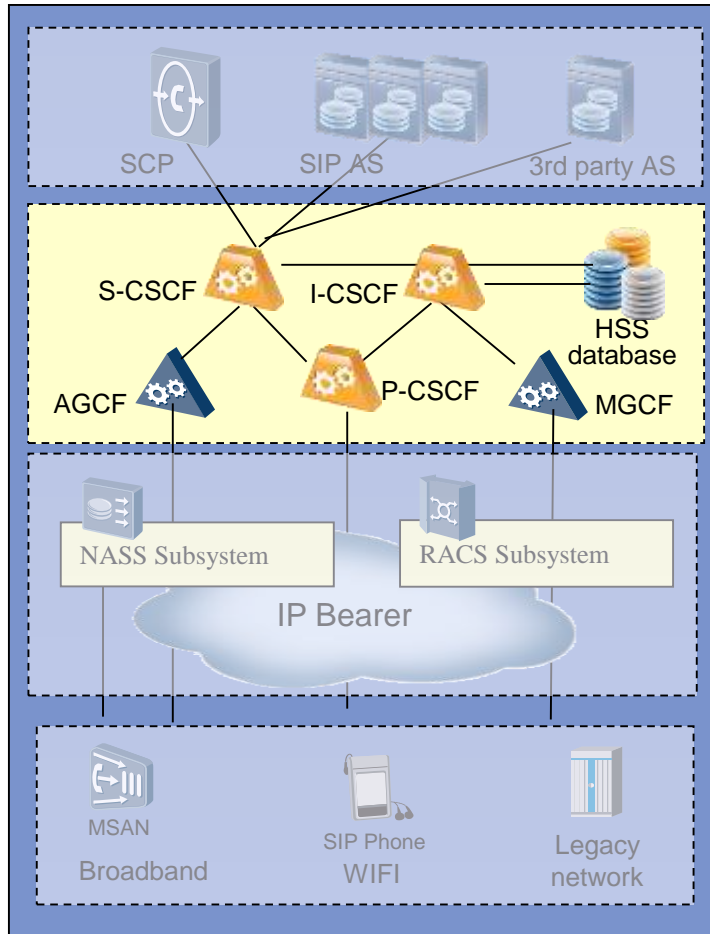


■ IMS Network Entities

The Network Elements of IMS in Session Control Layer are:

Function	NE	Function	NE
Call control	P—CSCF 	Network interworking	MGCF 
	I—CSCF 		IM—MGW 
	S—CSCF 		BGCF 
User management	HSS 	Media resource	MRFC 
	SLF 		MRFP 

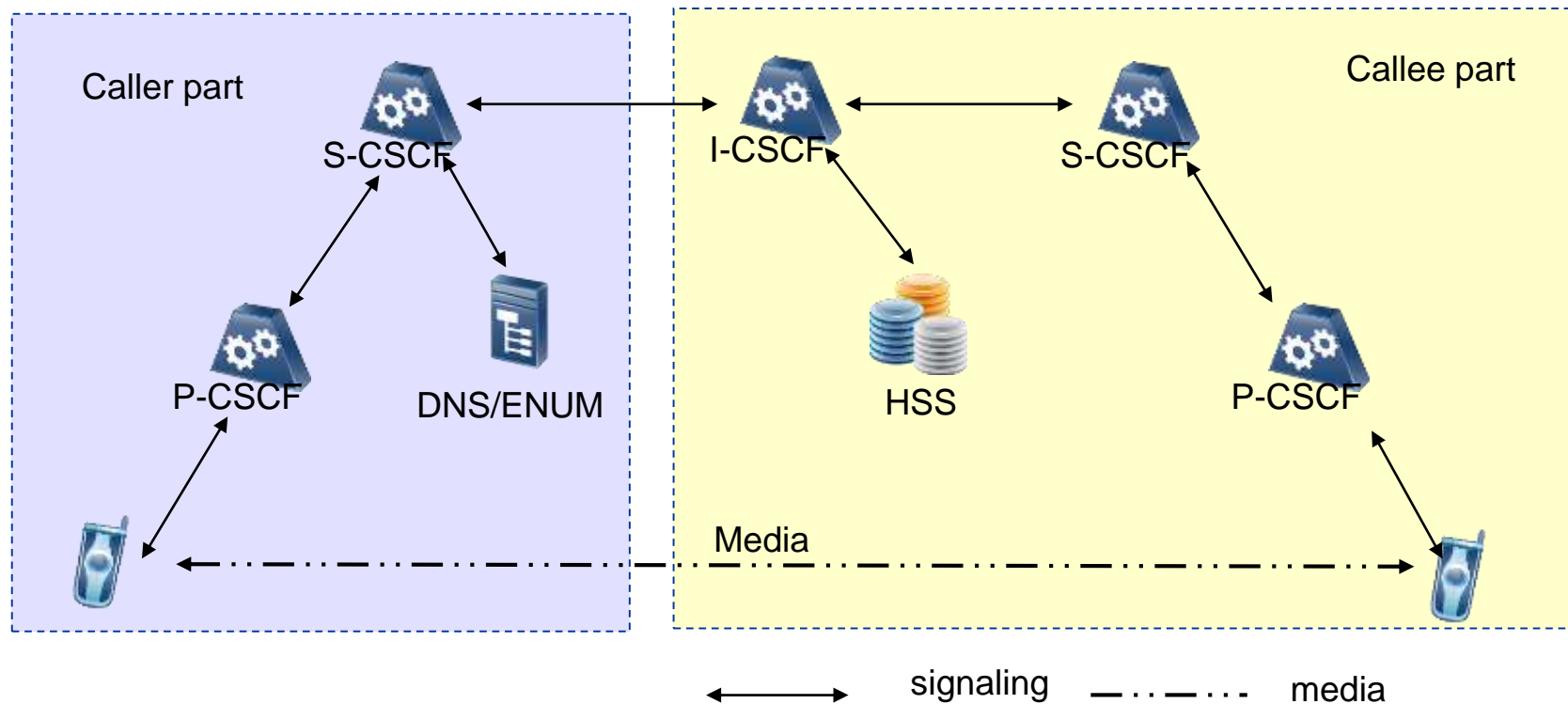
■ CSCF - Call Session Control Function



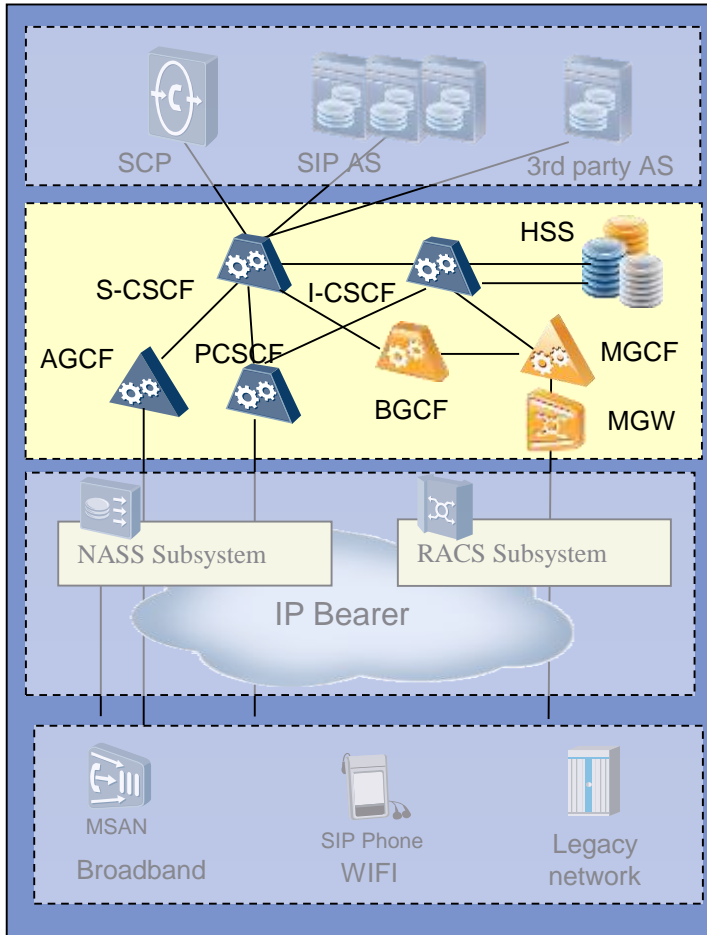
CSCF	Key Functions
P-CSCF (Proxy)	1: The 1 st contact point to the IMS network in the visiting domain or home domain 2: Access network control 3: QoS control, NAT control and security control
I-CSCF (Interrogating)	1: First entry to the IMS network of a carrier 2: S-CSCF assignment and session routing 3: Topology hiding
S-CSCF (Serving)	1: User registration authentication 2: Session route control (Normal, interworking, Emergency call) 3: Service trigger

■ Simple Model for IMS Call Procedure

While two IMS users call each other, the P/I/S-CSCF can handle the whole signaling routing procedures.



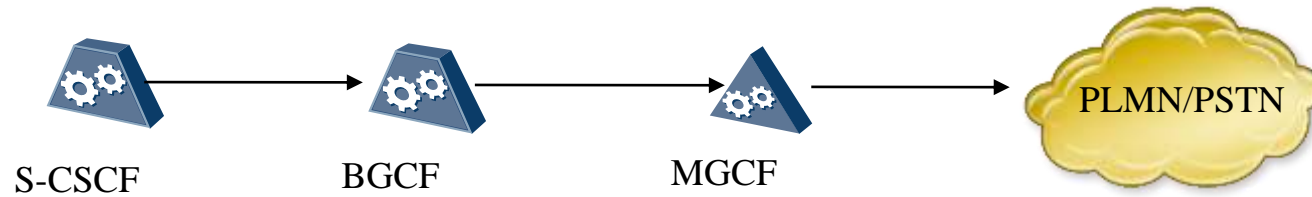
■ IMS Interworking Nodes



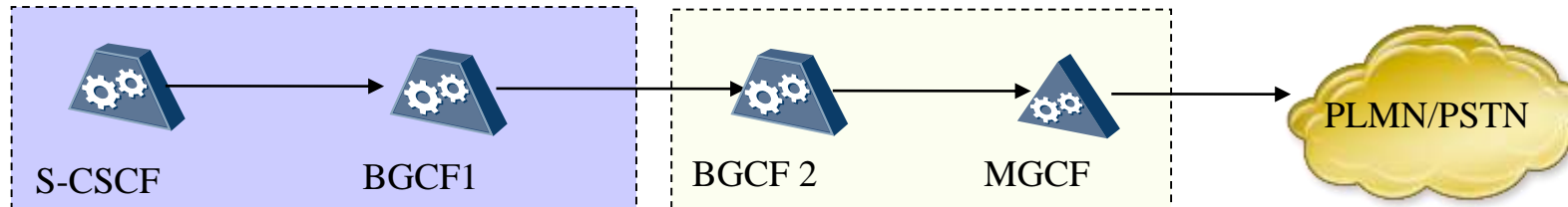
NE	Key Functions
MGCF	<p>Media Gateway Control Function</p> <ol style="list-style-type: none"> 1: Controls the IMS-MGW for establish/modify/delete media channels 2: Selects the I-CSCF for incoming calls from PSTN/CS. 3: Performs protocol conversion between ISUP and SIP.
IM-MGW	<p>IM-MGW-- IMS-Media Gateway Function</p> <ol style="list-style-type: none"> 1: Terminate bearer channels from a switched circuit network and media streams from a packet network
BGCF	<p>Breakout Gateway Control Function</p> <ol style="list-style-type: none"> 1: Select a proper MGCF for interworking with the PSTN/CS domain

■ Connection to Legacy Networks

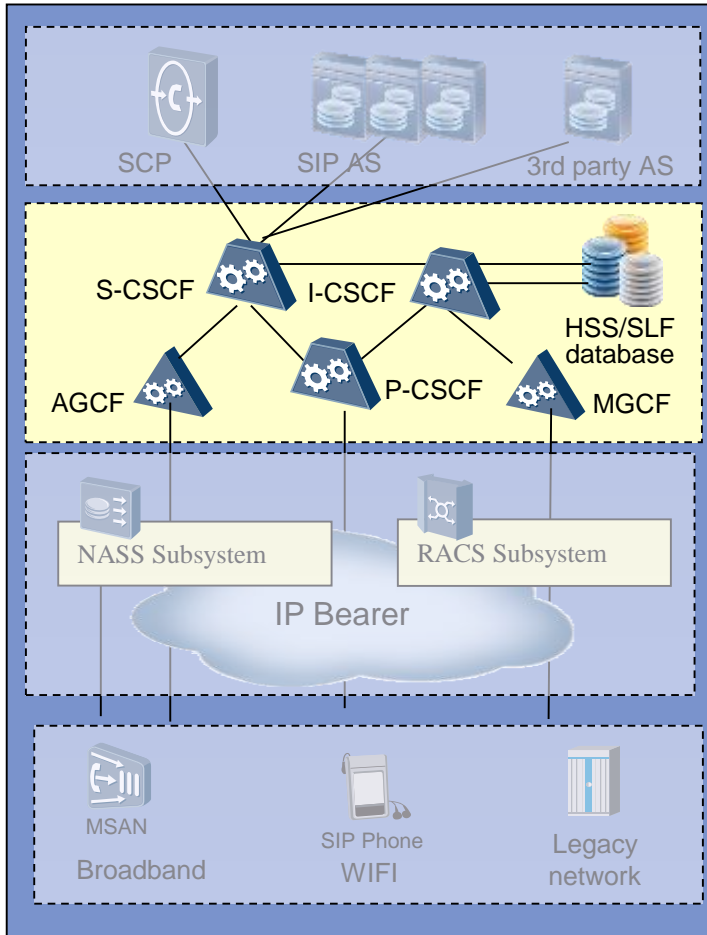
While an IMS user call a PSTN/CS user



While an IMS user call a PSTN/CS user which belongs to other operator

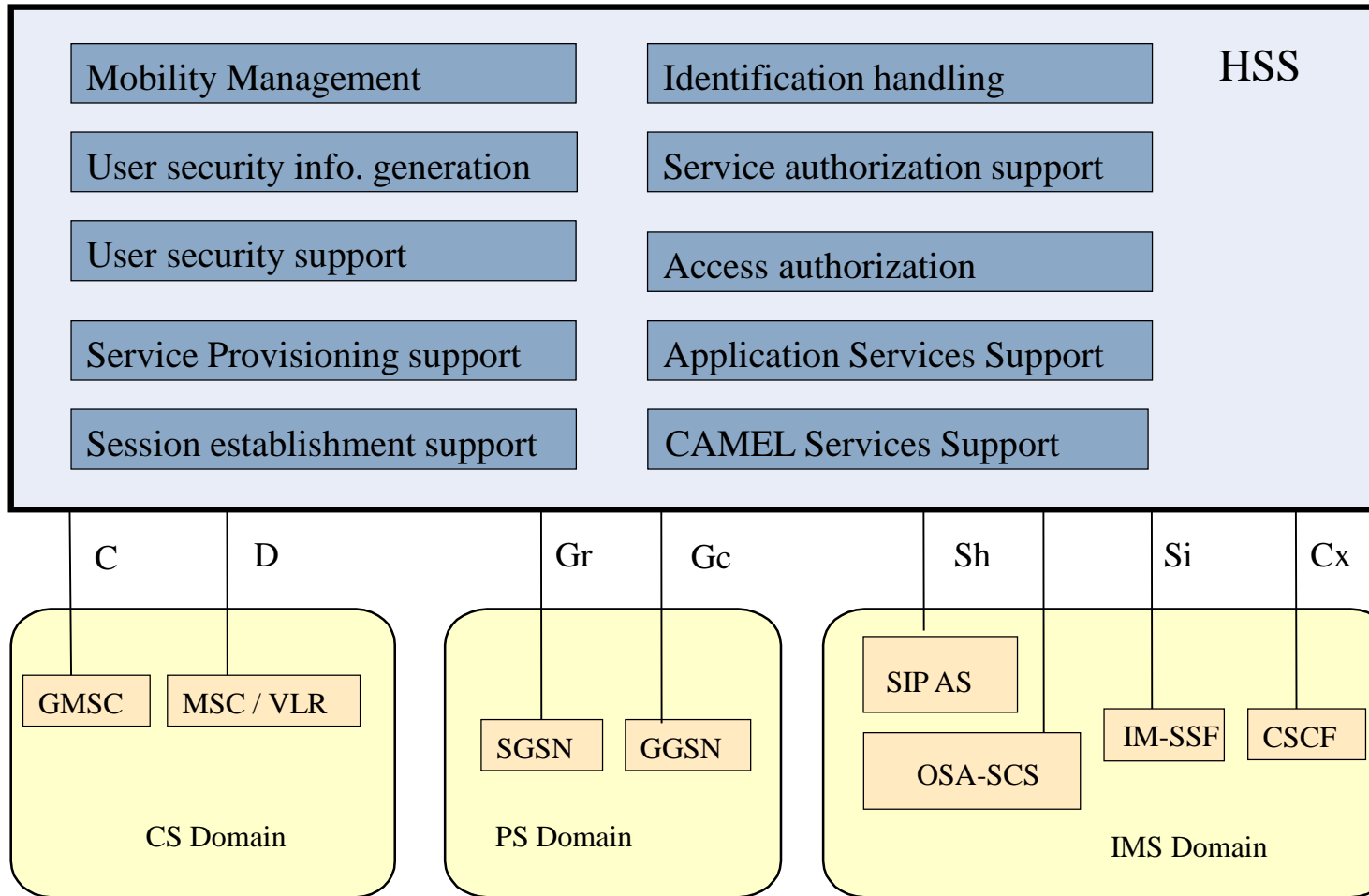


■ Database Function – HSS and SLF

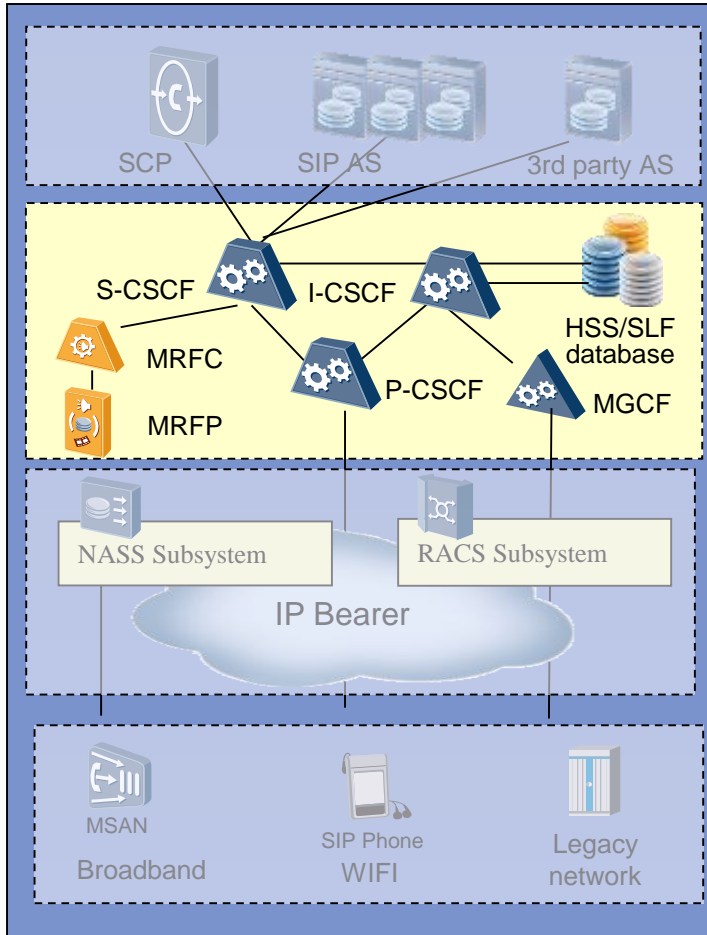


NE	Key Functions
HSS Home Subscriber Server	1: User Identification, Numbering and addressing information; 2: User Security information: Network access control information for authentication and authorization; 3: User Location information at inter-system level; 4: User profile information (iFC, etc).
SLF Subscription Locator Function	When an operator has more than one HSS, SLF is used to select the related HSS, and usually SLF is combined with the HSS

■ Database Function – HSS and SLF

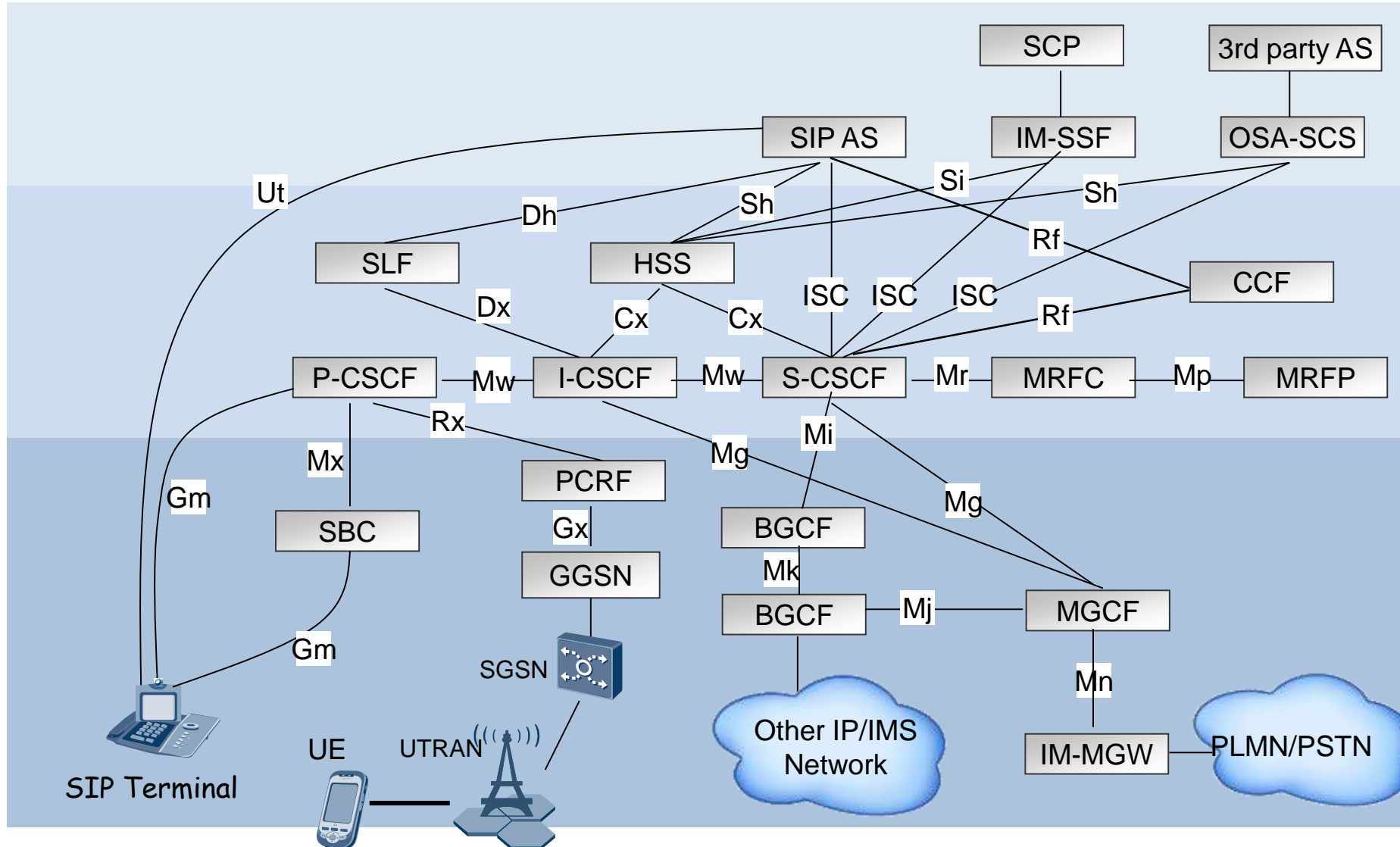


■ IMS Multimedia Resource Function



NE	Key Functions
MRFC	<p>Multimedia Resource Function Controller</p> <p>1: Controls the media stream resources in the MRFP.</p> <p>2: Interprets information coming from an AS and S-CSCF (e.g session identifier) and control MRFP accordingly.</p>
MRFP	<p>Multimedia Resource Function Processor</p> <p>1: Provides resources to be controlled by the MRFC.</p> <p>2: Mixes incoming media streams (e.g. for multiple parties).</p> <p>3: Processes media streams (e.g. audio transcoding, media analysis).</p>

■ Interfaces of IMS Network



■ IMS Interface and Protocols

NE A	NE B	Interface	Application Layer Name	Transport Layer Protocol
UE	P-CSCF	Gm	SIP	IPSec / UDP
PGW	P-CSCF	SGi	IP	IP
P-CSCF	I-CSCF	Mw	SIP	UDP
S-CSCF	MGCF	Mj	SIP	UDP
S-CSCF	ATS	ISC	SIP	UDP
MGCF	I-CSCF	Mg	SIP	UDP
SRVCC IWF	ATS	I2	SIP	UDP
P-CSCF	PCRF	Rx	Diameter	SCTP
I-CSCF	HSS	Cx	Diameter	SCTP
S-CSCF	HSS	Cx	Diameter	SCTP

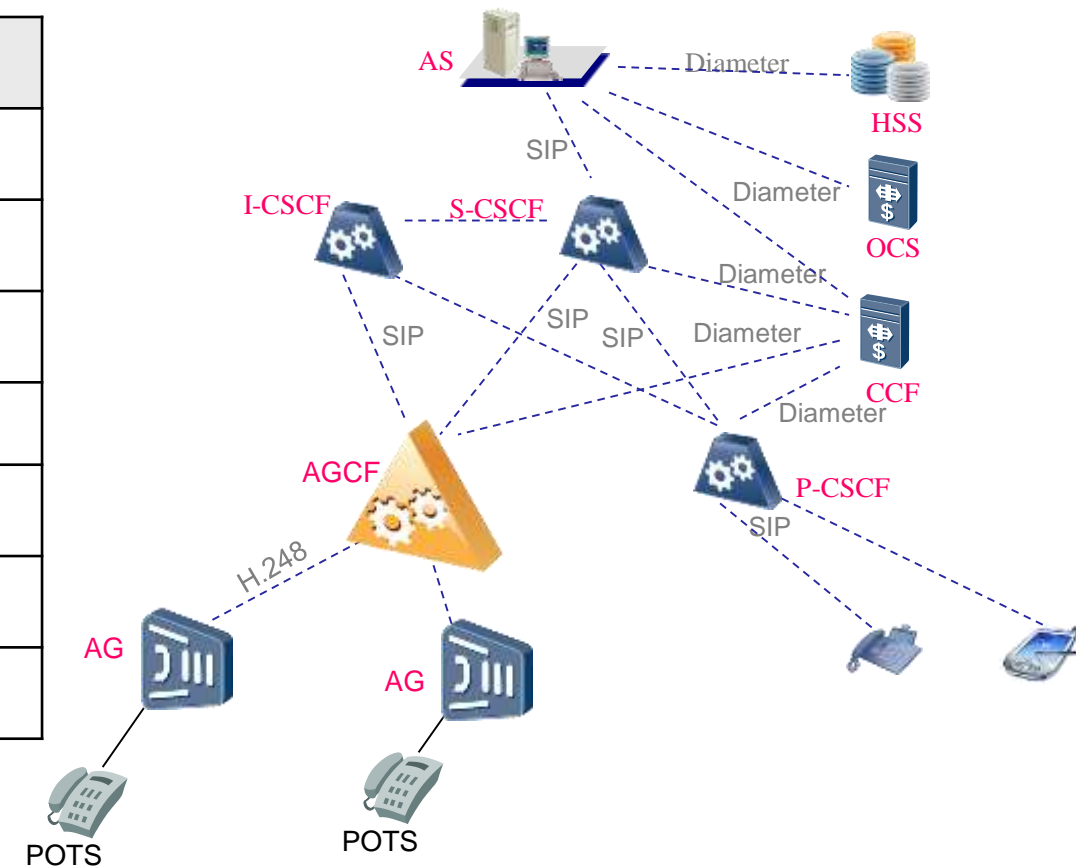
■ SIP & H.248 / Reference Points

Reference point (SIP)	Endpoints
Gm	UE, PCSCF
Mw	P-CSCF, I-CSCF, S-CSCF
ISC	I-CSCF, S-CSCF, AS
Mg	S/I-CSCF, MGCF
Mi	S-CSCF, BGCF
Mj	BGCF, MGCF
Mk	BGCF, BGCF
Mx	SBC, P-CSCF
Mr	S-CSCF, MRFC

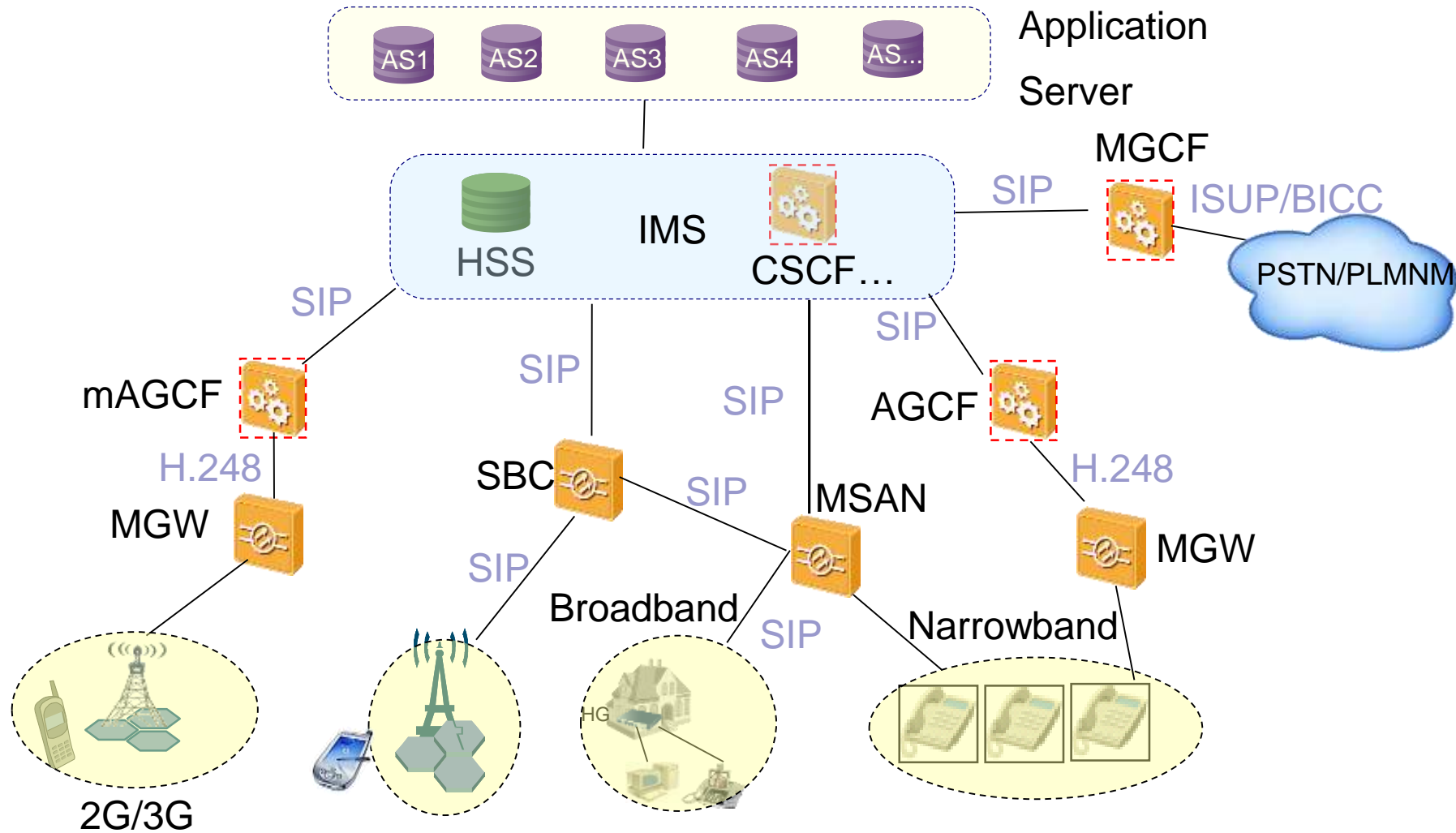
Reference point (H.248)	Endpoints
Mn	MGCF, IM-MGW
Mp	MRFC, MRFP

■ Diameter / Reference Points

Reference point	Endpoints
Cx	I-CSCF, S-CSCF, HSS
Dx	I-CSCF, S-CSCF, SLF
Rx	P-CSCF, PCRF
Gx	GGSN, PCRF
Rf	CCF, S-CSCF, AS, MRFC
Sh	HSS, AS
Dh	SLF, AS

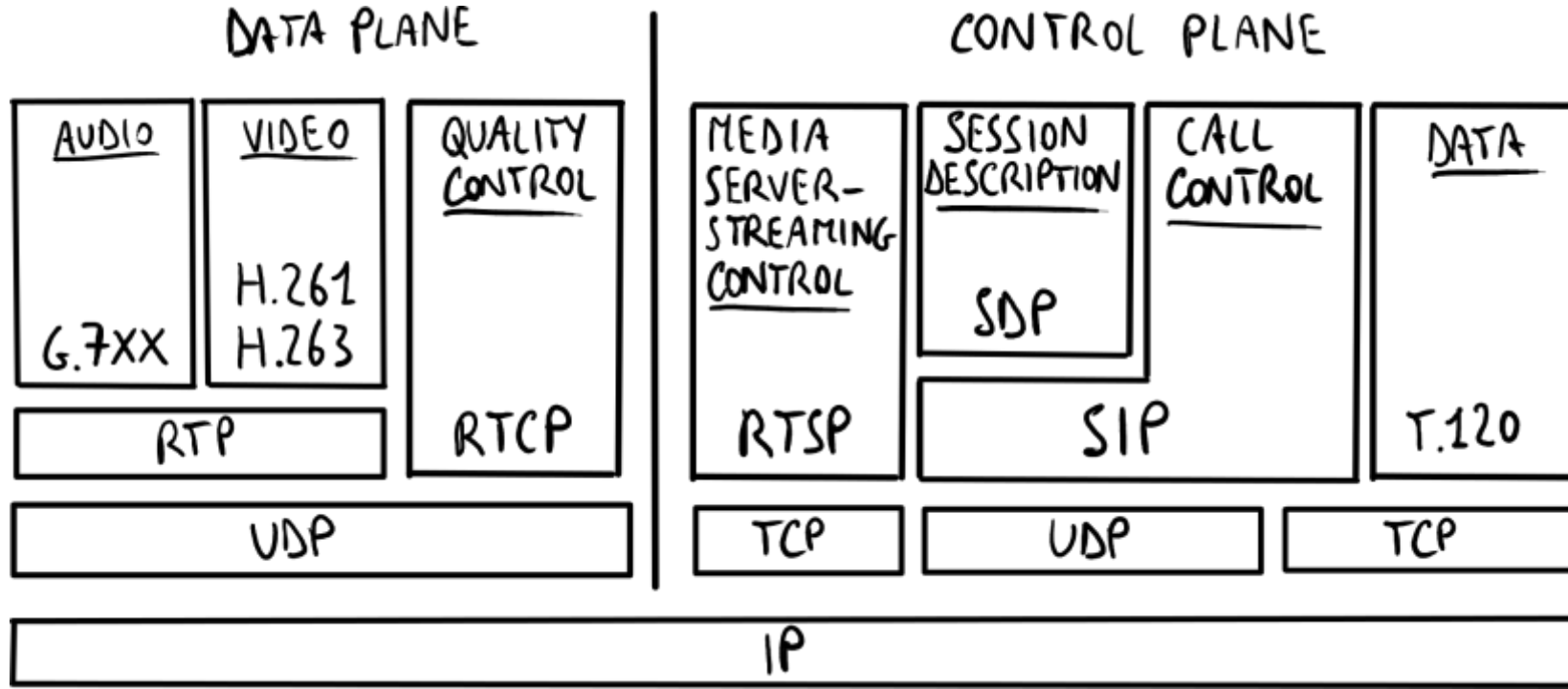


■ IMS Evolving Target Network



■ SIP Protocol

- The SIP was originated in Mbone (Multicast Backbone) experiment in 1996.
- IETF Standard defined by RFC 3261. (July, 2002)
- The **Session Initiation Protocol (SIP)** is an application layer protocol (Signaling) for creating, modifying and terminating sessions with one or more participants.
- Can be used for Voice, Video, Instant Messaging, Gaming, etc.
- SIP is **Text based** like HTTP, Request / Reply Protocol and mostly used on UDP.

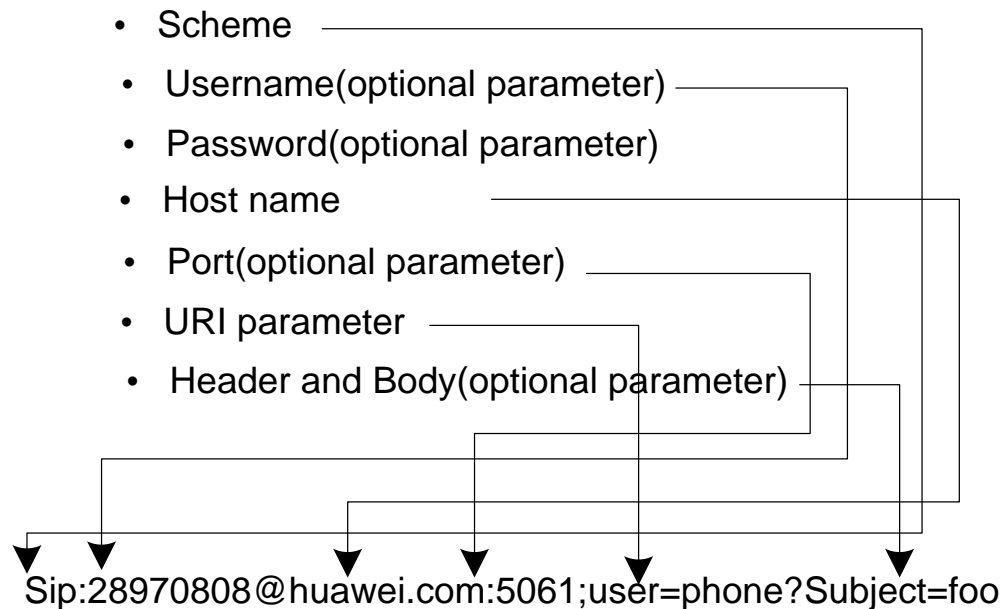


■ SIP Protocol

■ Use URIs for addressing – Single Communications Identity

- mailto:dbaron@MIT.edu for email
- xmpp:dbaron@MIT.EDU for instant messaging
- sip:dbaron@MIT.EDU for voice and video

◇ The URI in a SIP request is used for call routing or subscriber location. The URI consists of the following parts:



■ Username replaced by numbers for telephone applications.

■ SIP Components

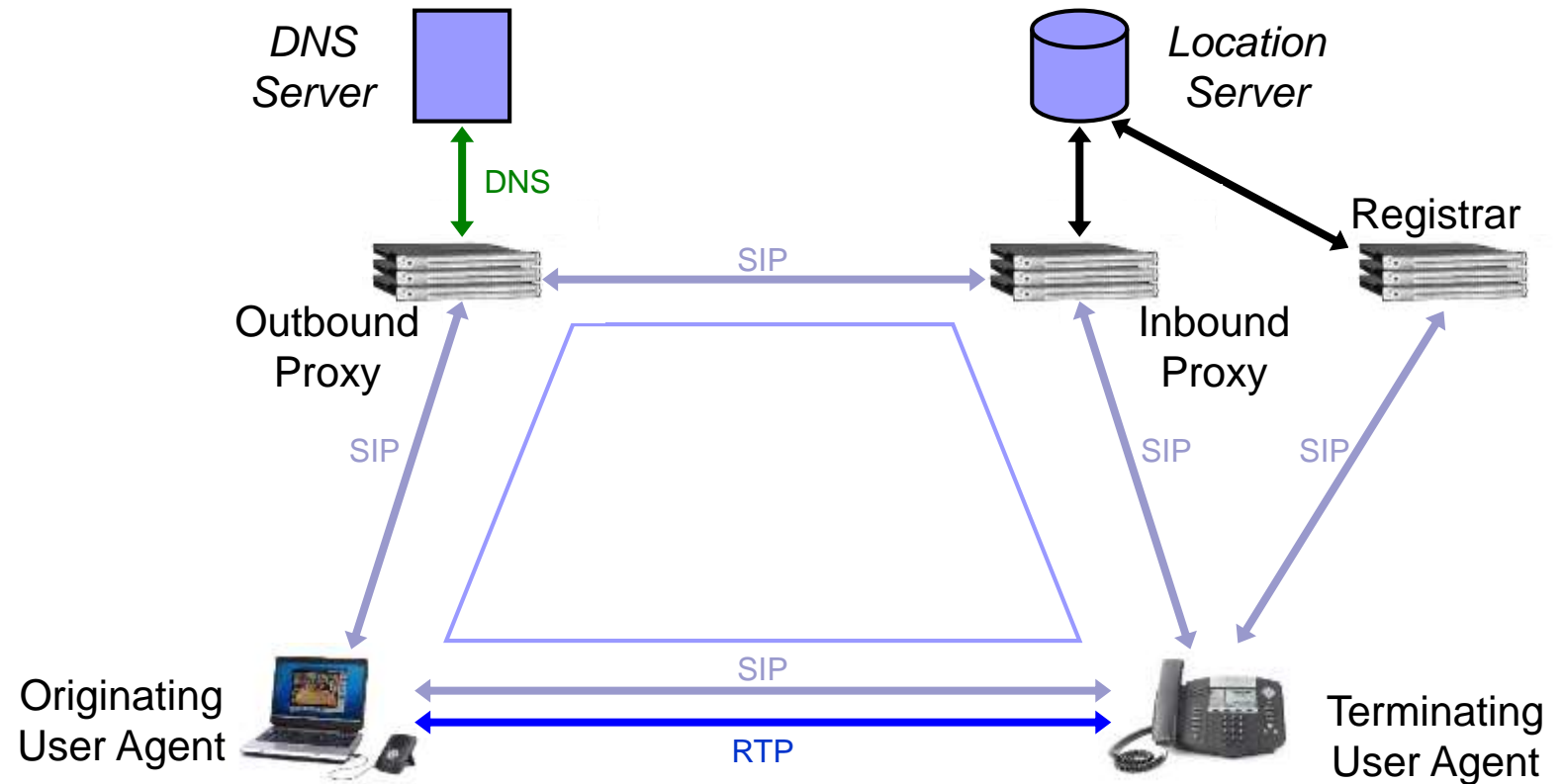
■ User Agents

- Clients – Make Request
- Servers – Accept Requests

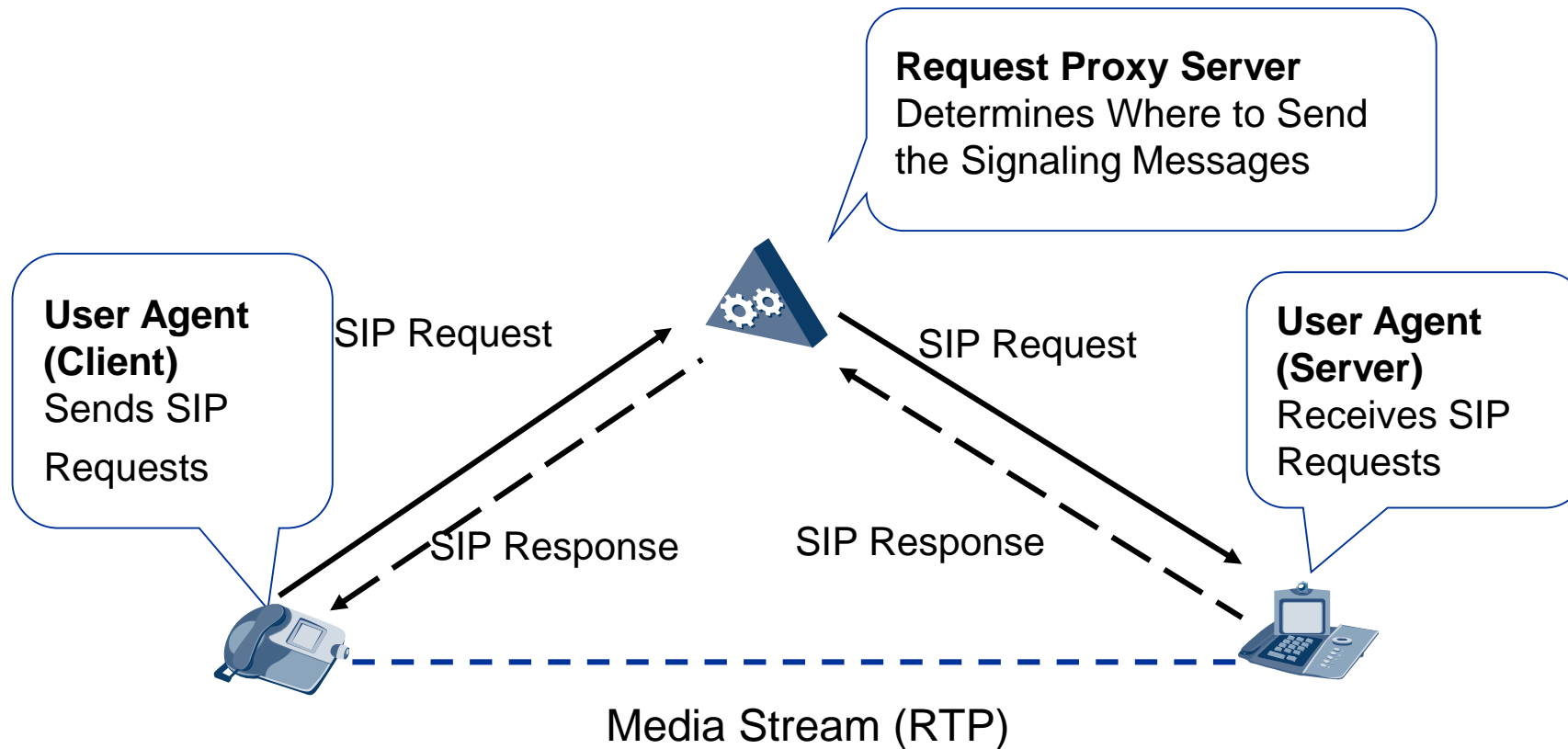
■ Server Types

- Redirect Server
- Proxy Server
- Registrar Server
- Proxy Server
- Location Server

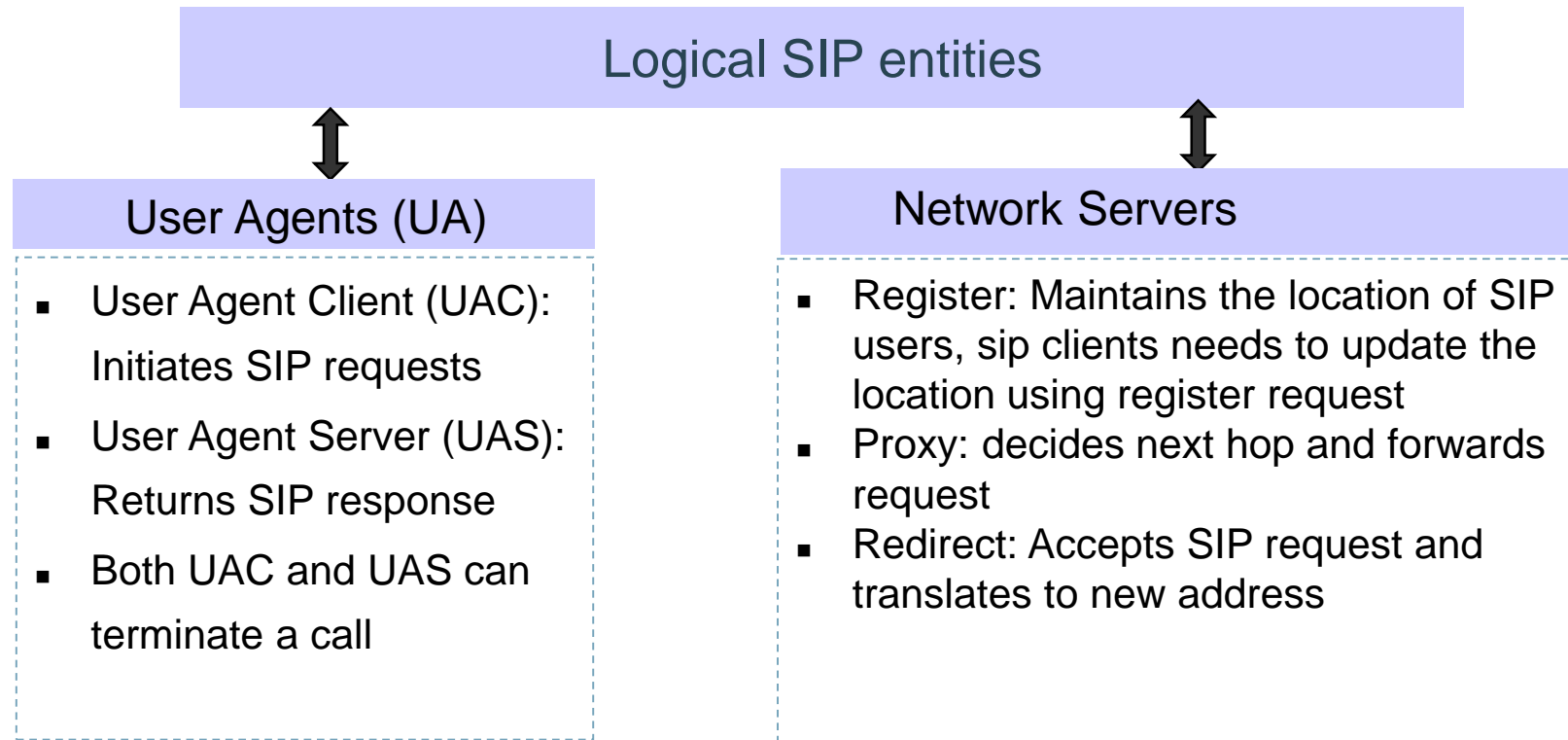
■ Gateways



■ Simplified SIP Network Architecture



■ Logical Entities of SIP





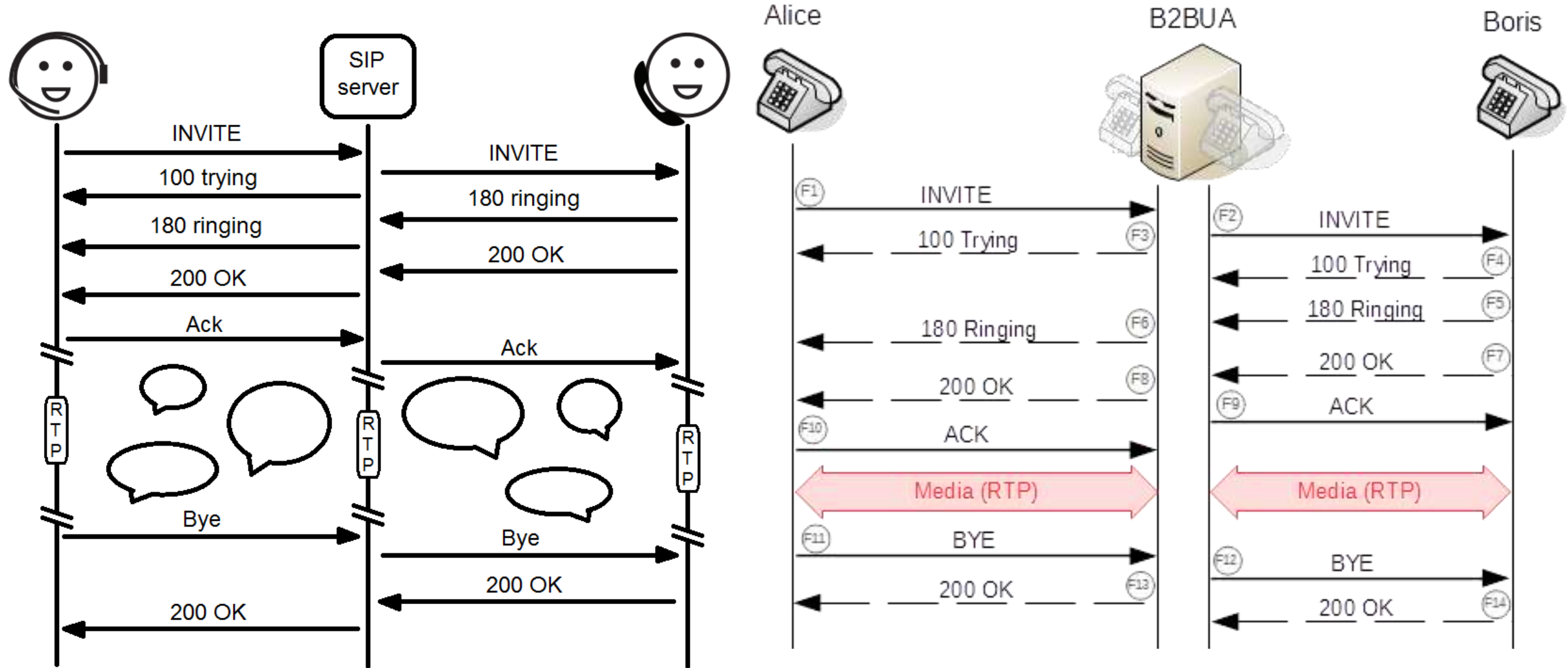
■ SIP Methods

Method	Description
INVITE	Requests a session
ACK	Final Response to the INVITE
OPTIONS	Ask for server capabilities
CANCEL	Cancels a pending request
BYE	Terminate a session
REGISTER	Send user's address to server

■ SIP Responses

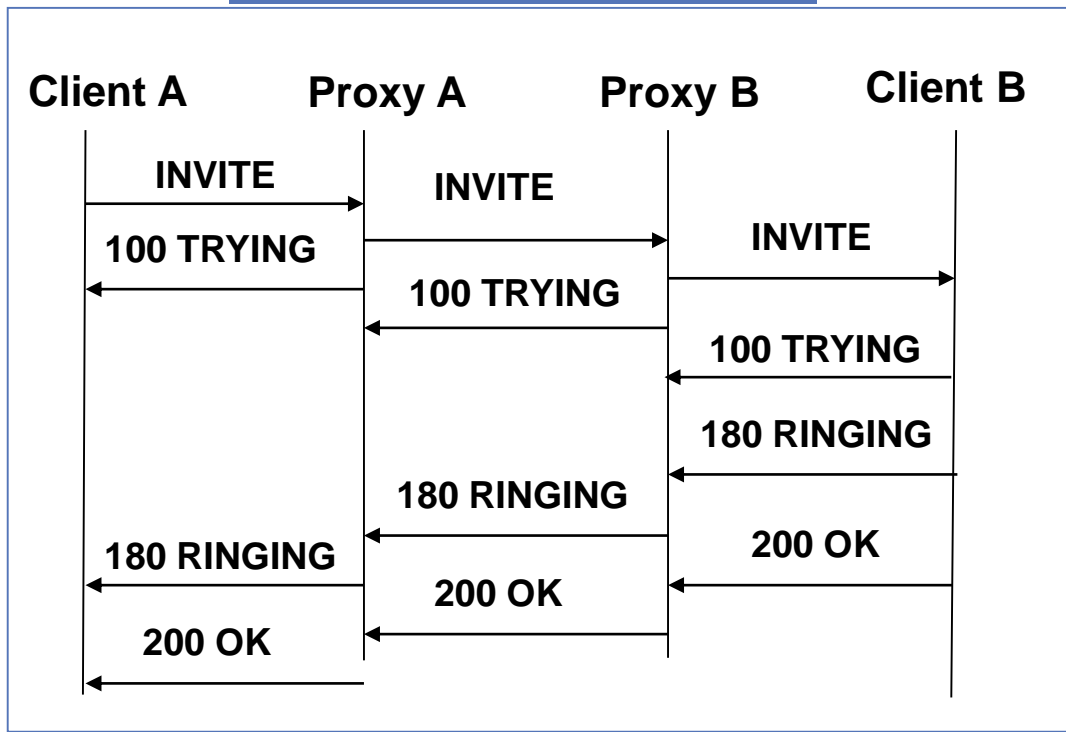
Response	Type	Sample
1XX	Provisional	100 Trying
2XX	Successful	200 OK
3XX	Redirection	302 Moved Temporarily
4XX	Client Error	404 Not Found
5XX	Server Error	504 Server Timed-Out
6XX	Global Failure	603 Decline

■ SIP Flows - Basic

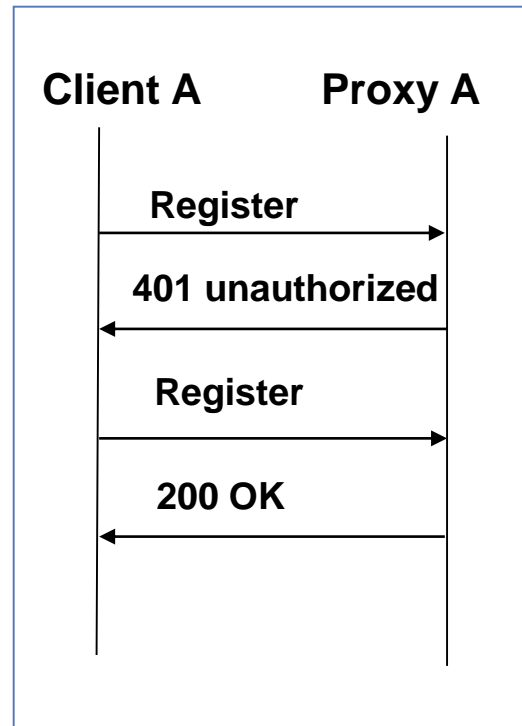


■ SIP Flows - Basic

■ Session setup



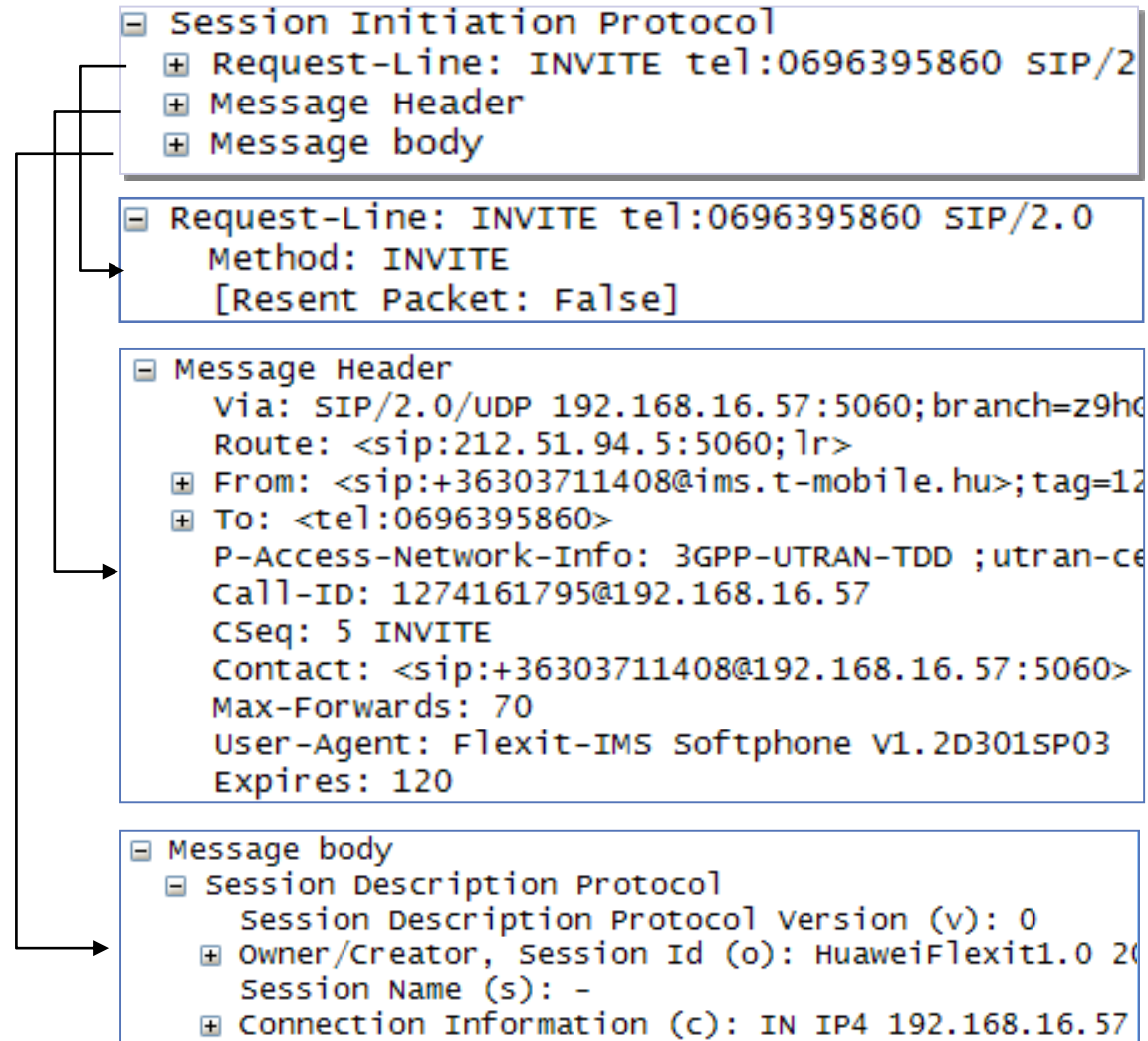
● Registration



■ SIP Message Structure

- SIP is a Text based protocol and comprised by 3 parts:

- ☐ Request-Line
- ☐ Header
- ☐ Body



■ SIP Request / Response Example

Request Line

```
INVITE sip:Gonzalo.Camarillo@ericsson.com SIP/2.0
```

Header

```
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];branch=z9hG4bKnashds7
Max-Forwards: 70
Route: <sip:pcscf1.visited1.net;lr>, <sip:scscf1.home1.net;lr>
From: <sip:user1_public1@home1.net>;tag=171828
To: <sip:Gonzalo.Camarillo@ericsson.com>
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Content-Type: application/sdp
Content-Length: 248
```

Body

```
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3458 RTP/AVP 97 96 0 15
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

Annotations:

- Method:** INVITE
- Request-URI:** sip:Gonzalo.Camarillo@ericsson.com
- SIP Version:** SIP/2.0
- Header Field:** To: <sip:Gonzalo.Camarillo@ericsson.com>
- Header Field Name:** Content-Type
- Header Field Value:** application/sdp

Status Line

```
SIP/2.0 200 OK
```

Header

```
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];branch=z9hG4bKnashds7
Record-Route: <sip:scscf1.home1.net;lr>, <sip:pcscf1.visited1.net;lr>
From: <sip:user1_public1@home1.net>;tag=171828
To: <sip:Gonzalo.Camarillo@ericsson.com>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
CSeq: 127 INVITE
Contact: <sip:[5555::eee:fff:aaa:bbb]>
Content-Type: application/sdp
Content-Length: 220
```

Body

```
v=
o=- 2987933615 2987933615 IN IP6 5555::eee:fff:aaa:bbb
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=audio 3458 RTP/AVP 97 0
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

Annotations:

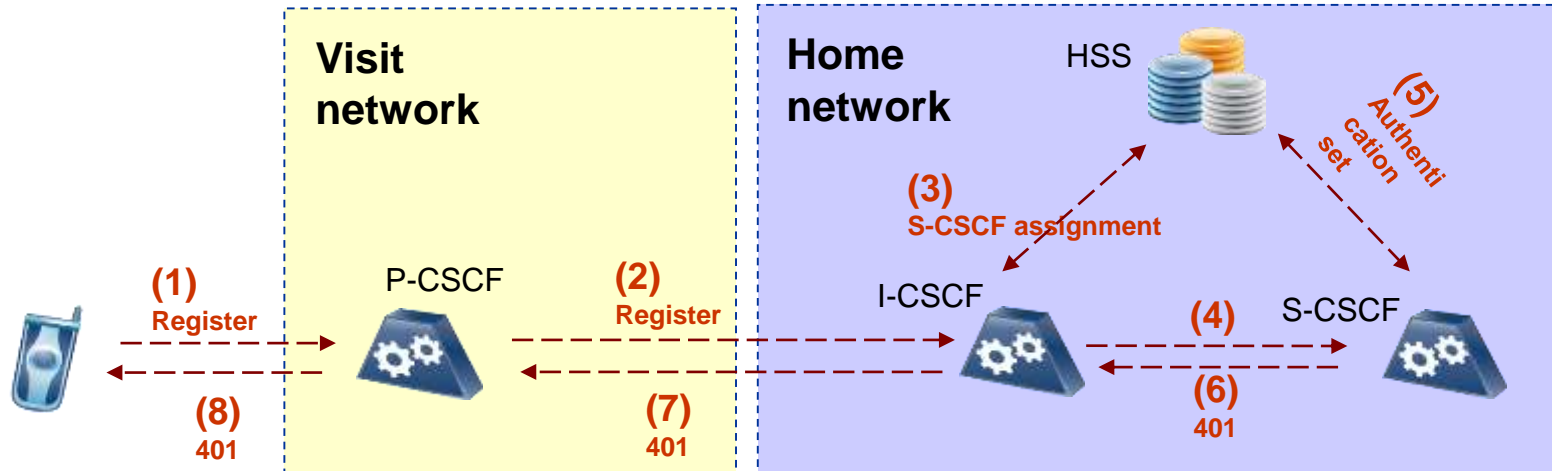
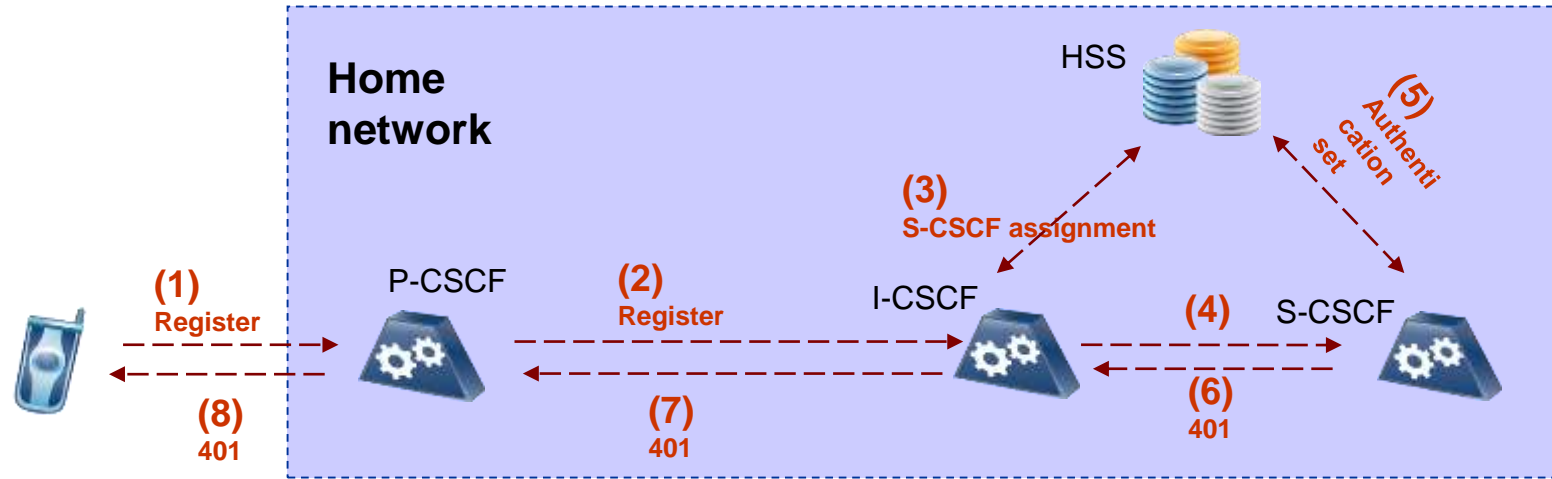
- SIP Version:** SIP/2.0
- Status code:** 200
- Reason phrase:** OK
- Status code in SIP:** 2xx - Success

■ SDP Example

```
v=0
o=HuaweiSoftX3000 868 868 IN IP4 10.216.9.200
s=Sip Call
c=IN IP4 10.216.6.108
t=0 0
m=audio 17368 RTP/AVP 8
a=rtpmap: 8 PCMA/8000
```

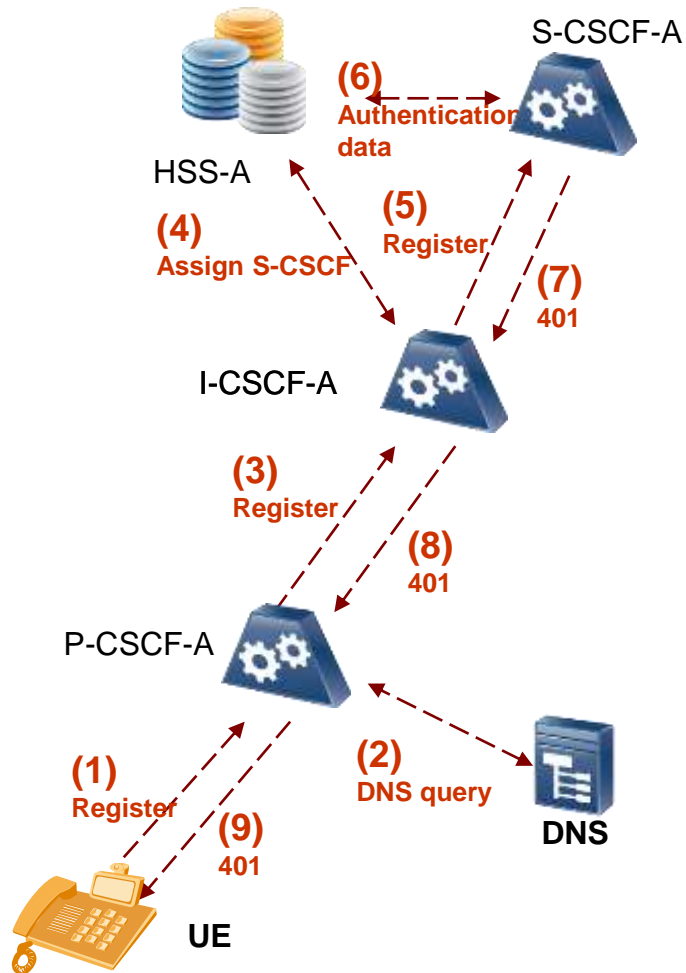
SDP Parameter	Parameter Name	Remarks
v	Version number	v=0
o	Origin containing name	o=<user name> <session id> <version> <network type> <address type> <address>
s	Subject	
c	Connection	Connection IP address(10.216.6.108)
t	Time	t=<start time> <stop time>
m	Media	Media format (audio); Port number(17368)
a	Attribute	Media encoding (PCM A Law); Sample rate (8000Hz)

■ IMS User Registration Procedure

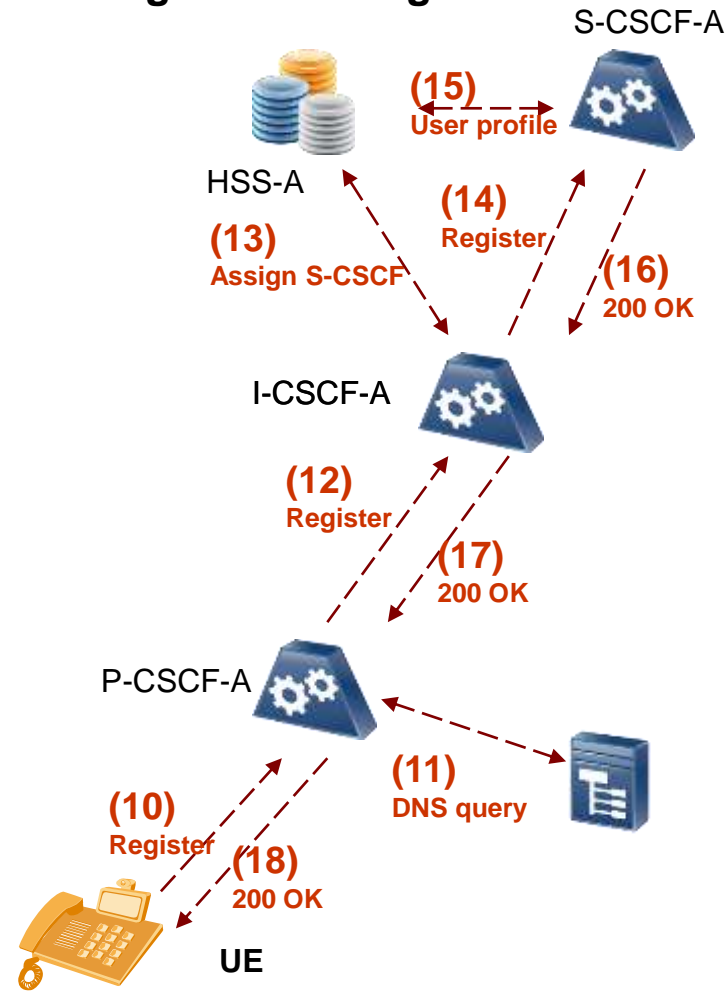


■ IMS User Registration Procedure

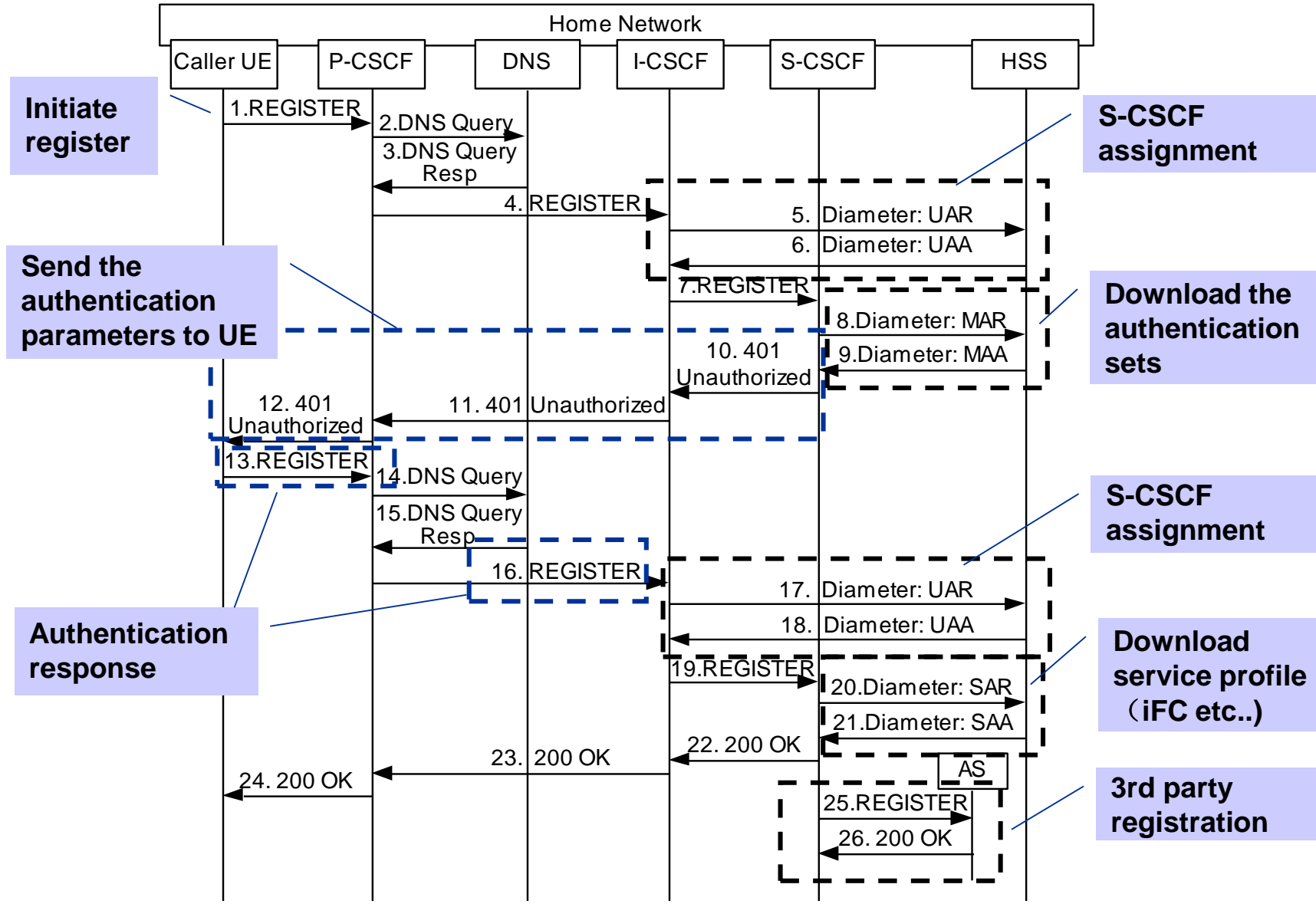
1 — Initial register message



2 — 2nd register message

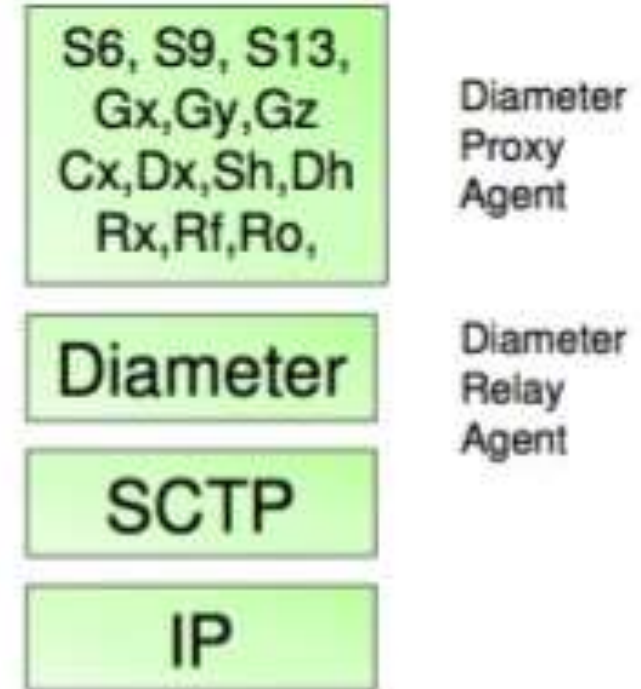


IMS Registration Signaling Flow

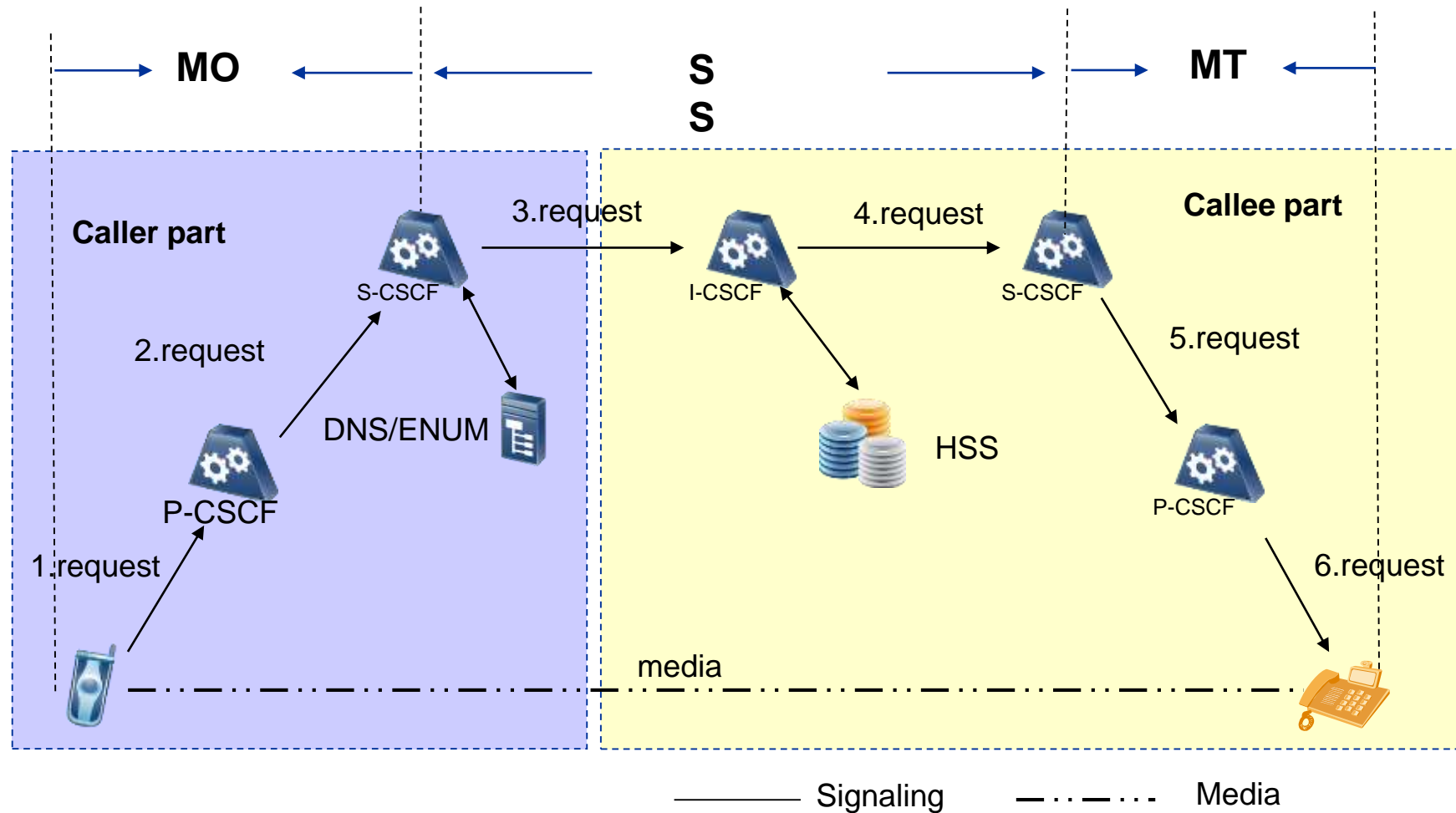


■ Related Diameter Messages

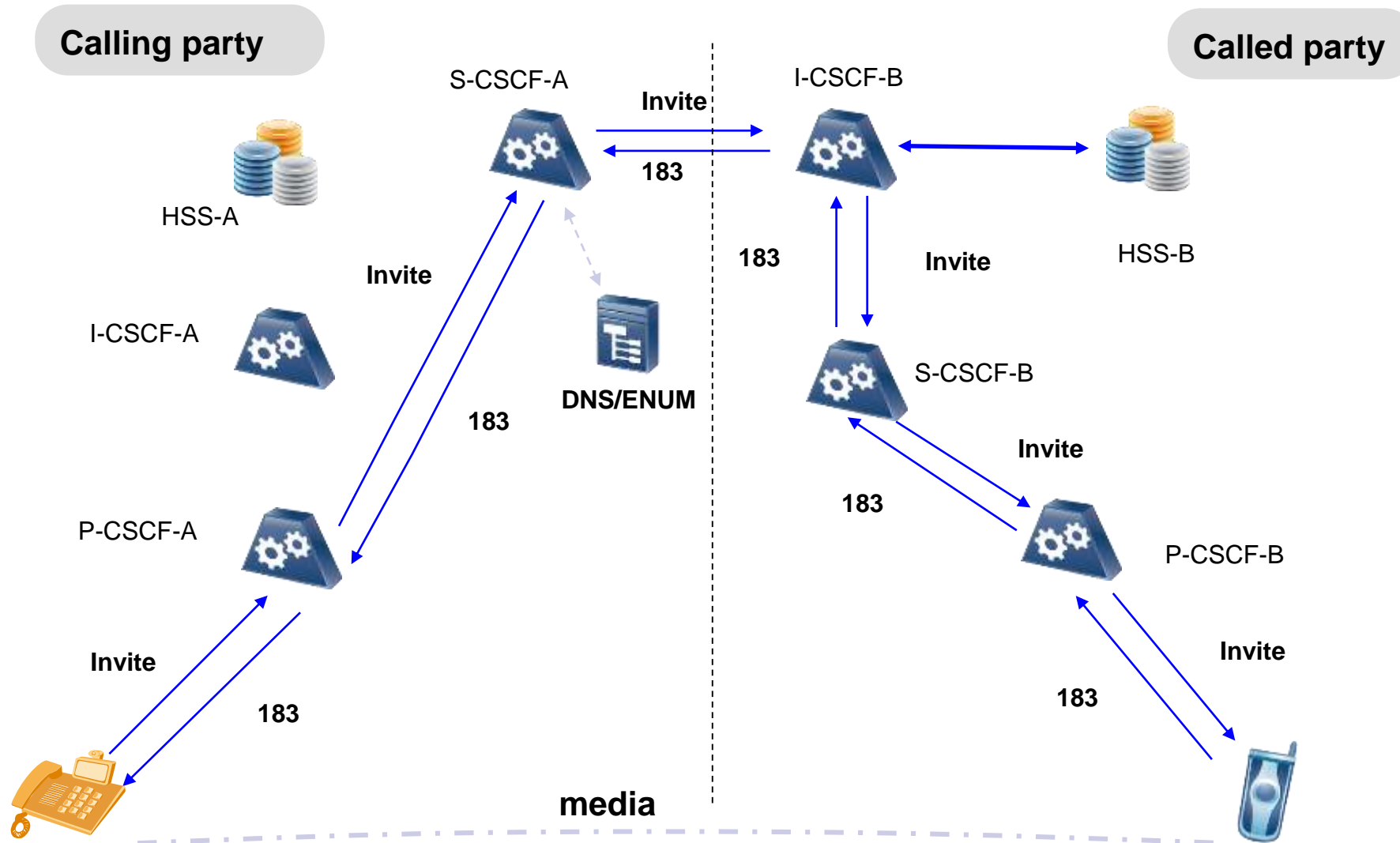
Message	Explanation
UAR	User Authorization Request
UAA	User Authorization Answer
MAR	Multimedia Authentication Request
MAA	Multimedia Authentication Answer
SAR	Server Assignment Request
SAA	Server Assignment Answer



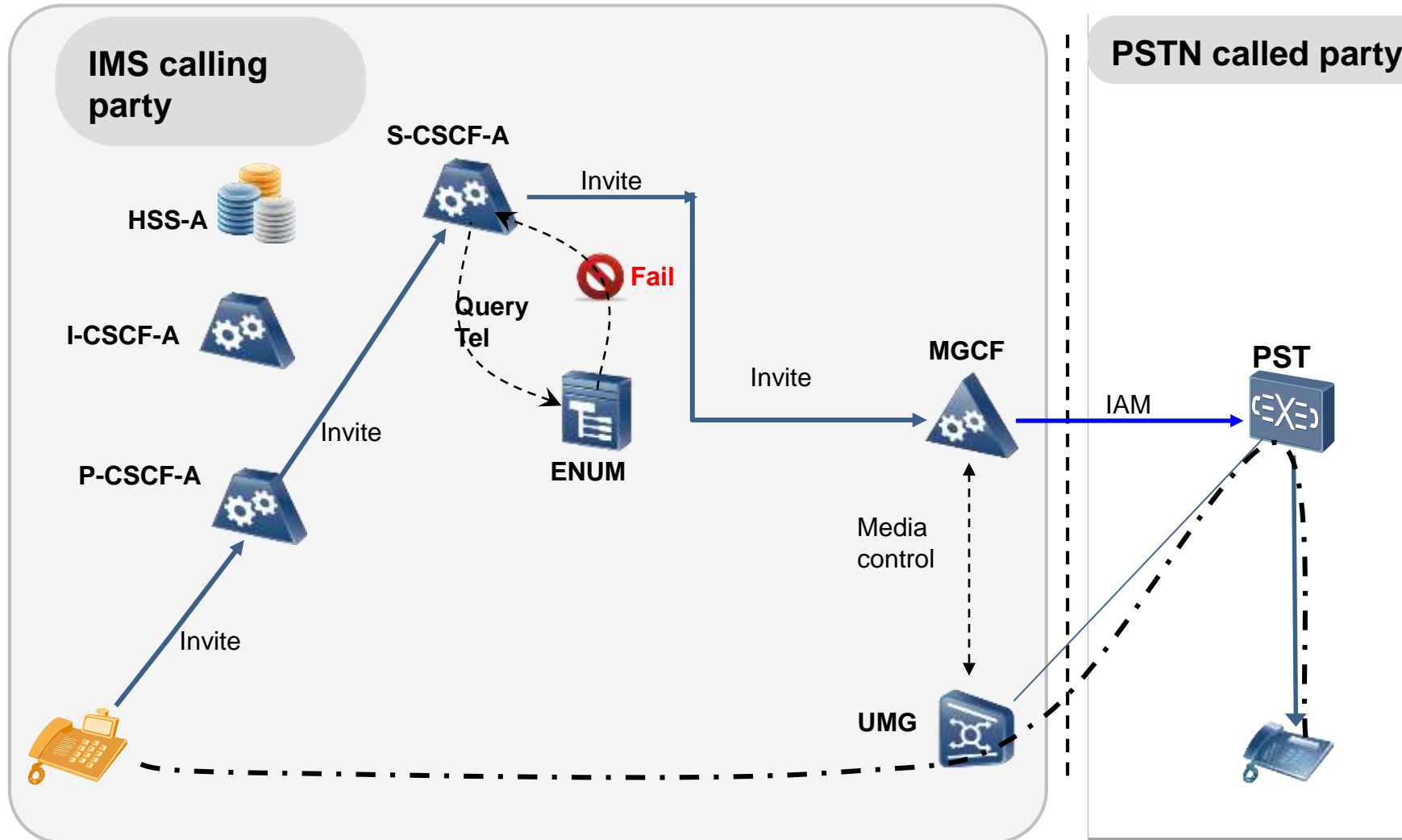
■ Simple IMS Call Flow



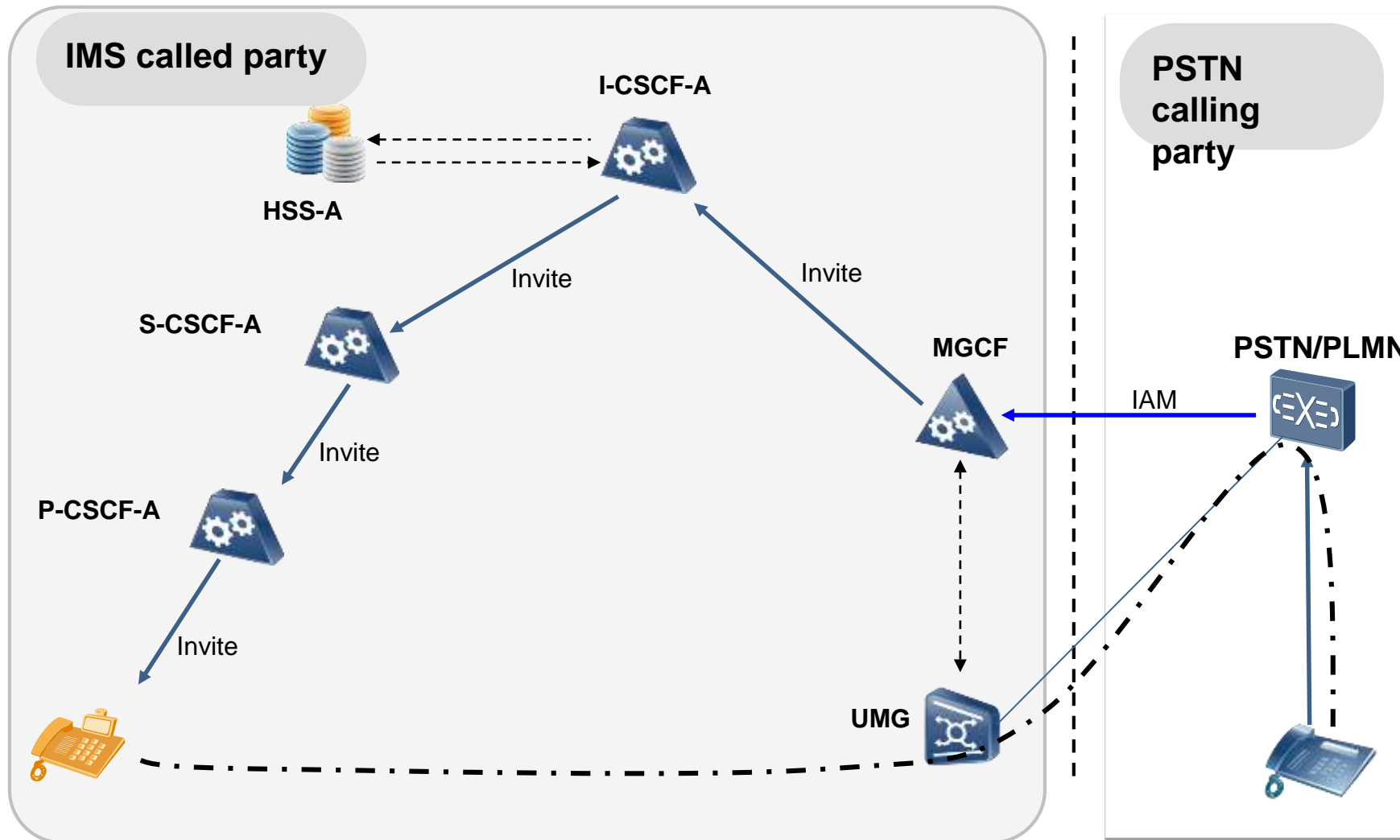
■ Basic Session Establishment between 2 IMS Users



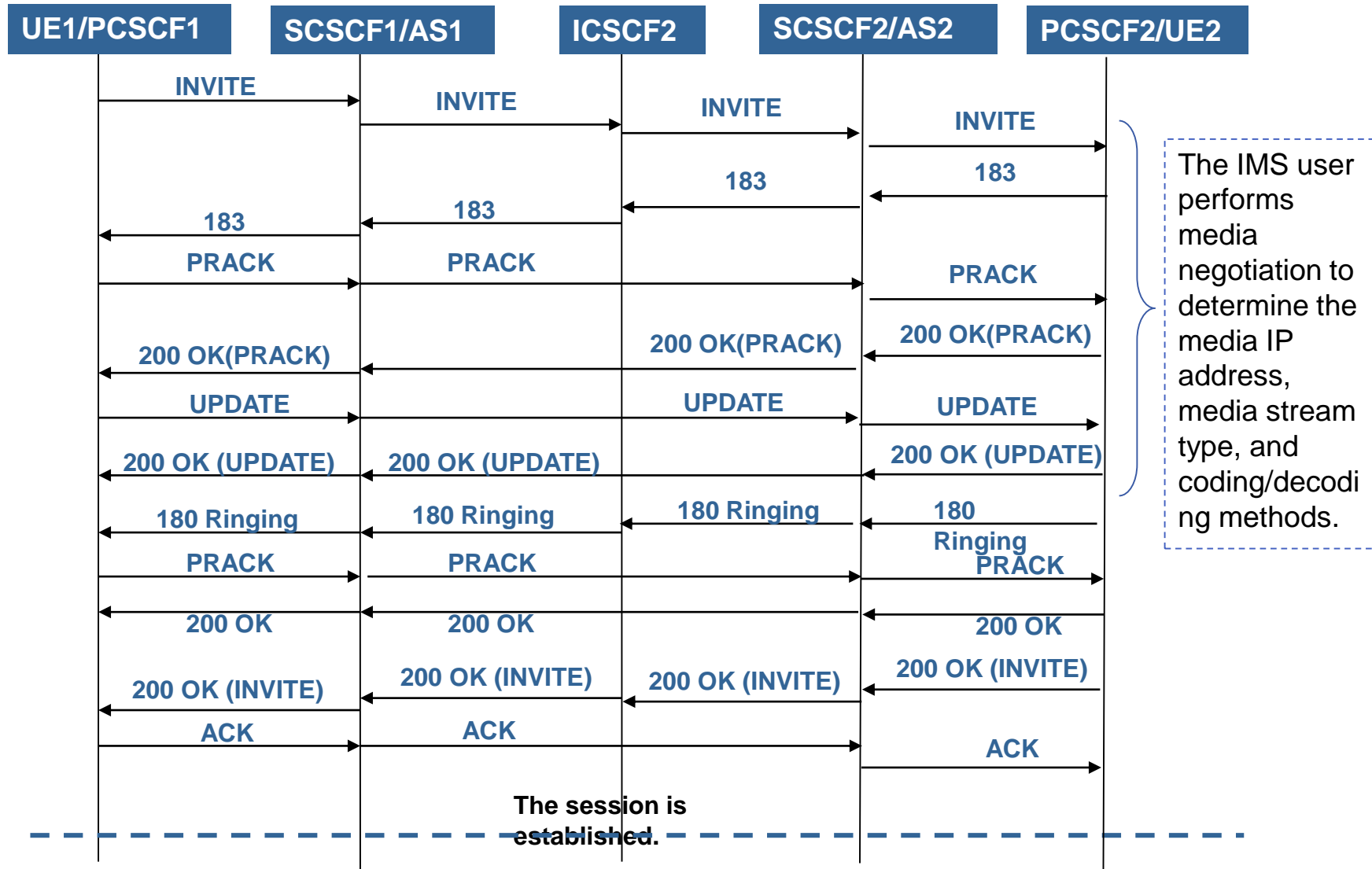
■ IMS User Call PSTN User



■ PSTN User Call IMS User



■ IMS Session Establishment Signaling Flow



Thanks For Your Attention!



Hamid Reza Bolhasani
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