

# NGN Interfaces & Protocols

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# Agenda

- ***Standardization for NGN***
- *Functional Architecture of NGN*
- *Interfaces & Protocols*
- *Examples of Flow of Information in NGN*

# Standardization landscape

Application Enablers  
Interoperability testing



Next Generation  
Network for wireline  
services



Define IMS architecture  
Select protocols to use  
Define Radio interface



Specify protocols,  
e.g. IPv6, SIP, XDMS,  
DIAMETER, ...



Referencing the  
outcome from  
3GPPs and ETSI

# JRG on NGN

- ITU-T SG 13 launched JRG-NGN at 1<sup>st</sup> August 2003 : 3 Meetings
- Joint Special Rapporteur Group Activity within SG 13
- Focus on “Foundational Documentation of NGN” until June. 2004

## Draft Recommendations in AAP

Y.NGN-Overview (Y.2001)	Overview of the NGN
Y.NGN-GRM (Y.2011)	General principles and general reference model for NGN

## Deliverables for further study

Deliverables	Title
Y.NGN-GRQ	General requirements for NGN
Y.NGN- FRM	Functional requirements and architecture of the NGN
Y.NGN-CONV	Next Generation Networks – Convergence scenarios
Y.NGN-MOB	Mobility management requirements and architecture for
Y.NGN-CMIP	NGN Customer manageable IP network
Y.NGN-MIG	Migration of networks to NGN
Y.PSTN-NGN	PSTN migration to NGN

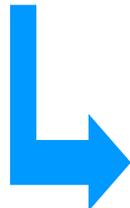
# JRG on NGN

## Deliverables on QoS for further study

<b>Deliverables</b>	<b>Title</b>
<b>Y.NGN-QoS</b>	<b>General aspects of QoS and network performance in the NGN</b>
<b>Y.e2eqos.1</b>	<b>Requirements and framework for end-to-end QoS architecture for NGN</b>
<b>Y.e2eqos.2</b>	<b>An end-to-end QoS architecture based on centralized resource control for IP networks supporting NGN services</b>
<b>Y.123.qos</b>	<b>A QOS ARCHITECTURE FOR ETHERNET-BASED IP ACCESS NETWORK</b>
<b>Y.ipaqos</b>	<b>A QoS Framework for IP based access networks</b>
<b>Y.NGN-NHNperf</b>	<b>Network performance of hybrid networks in NGN</b>

# NGN Focus Group

- ITU-T Director launched NGN Focus Group at June 2004
- Almost every two month meeting : 6, 7, 9, 11/2004 and 2, 4, 6/2005



- Functional & Nomadicity Architecture (base on IMS & non-IMS)
- QoS (include the xDSL Access)
- Security Capability (inc. Authentication)
- NGN Control and Signaling Capability
- Evolution from CGN to NGN

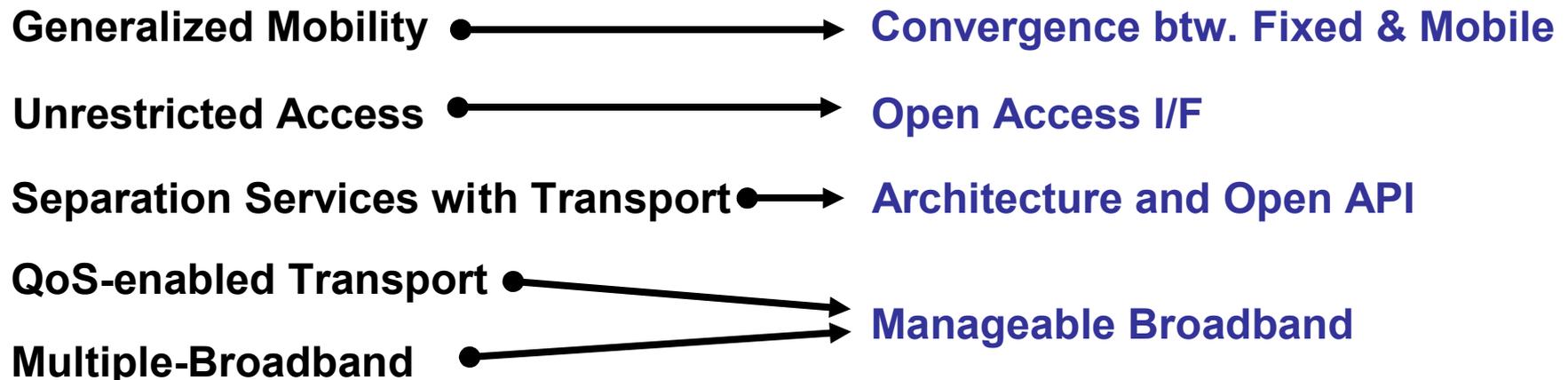
WG	Area	Deliverables
WG 1	SR (Service Requirements)	NGN Scope, Releases 1 / General Requirements, Service and Capability, Mobility Services and Capabilities
WG 2	FAM (Functional Architecture, and Mobility)	Req. and Architecture, Functional Req. for NGN Mobility, Functional Req. for Soft Router
WG 3	QoS (Quality of Services)	TR-123.qos, TR-msnniqos, TR-NGN.qos, TR-NGN.NHNperf, TR-e2eqos.1, TR-enet, TR-atmipa, TR-racs, TR-ipaqos
WG 4	CSC (Control & Signalling)	TRQ.IP QoS.SIG.CS1
WG 5	SeC (Security Capability)	NGN Security Framework
WG 6	Evol (Evolution)	Evolution of Networks to NGN, PSTN evolution to NGN
WG7	FPBN (Future Packet-based Network)	Future Packet Network requirements

# Definition & Features of NGN

Definition  
of NGN  
(Draft  
Rec.  
Y.2001)

A NGN is a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

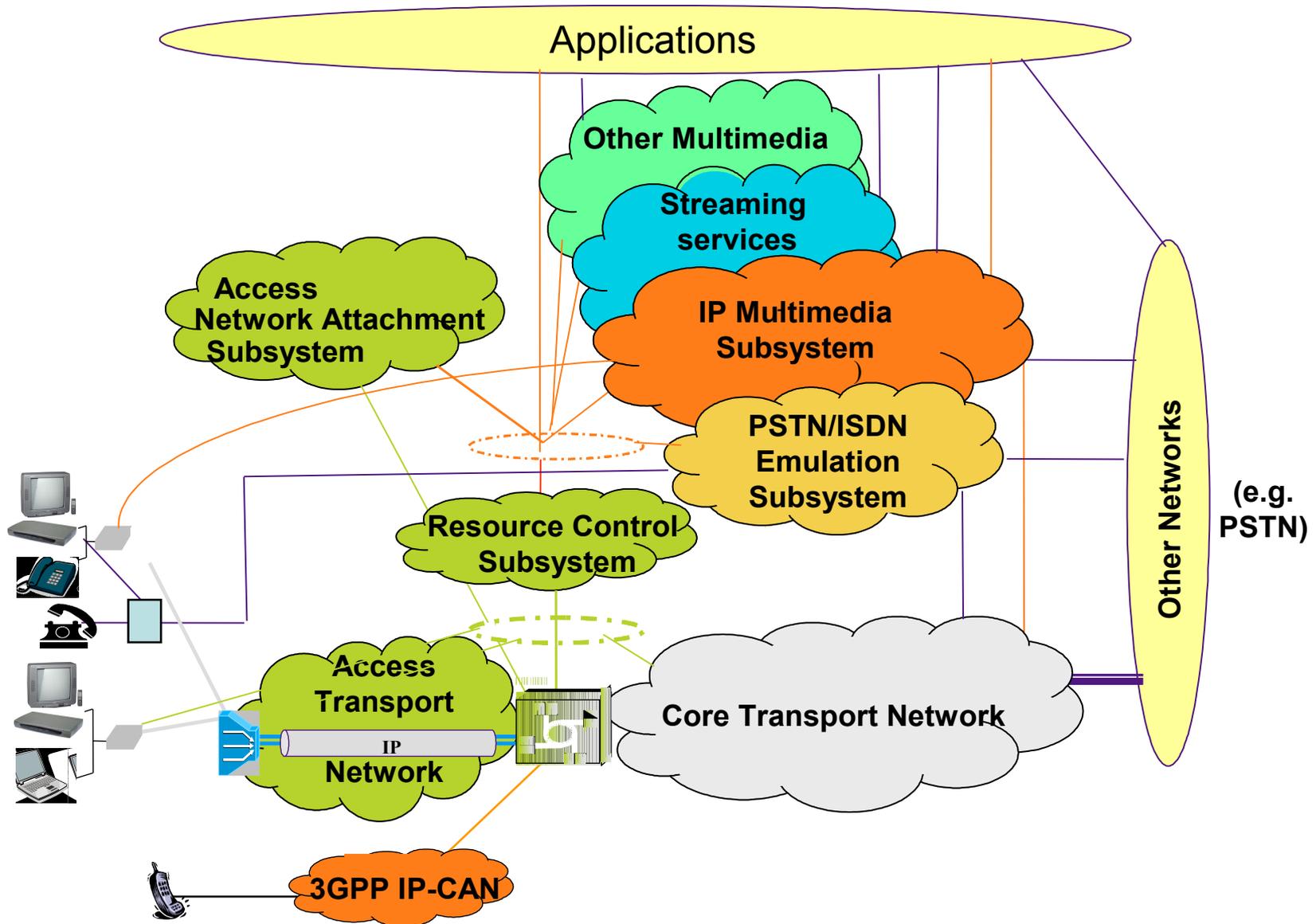
## Target Standards Area



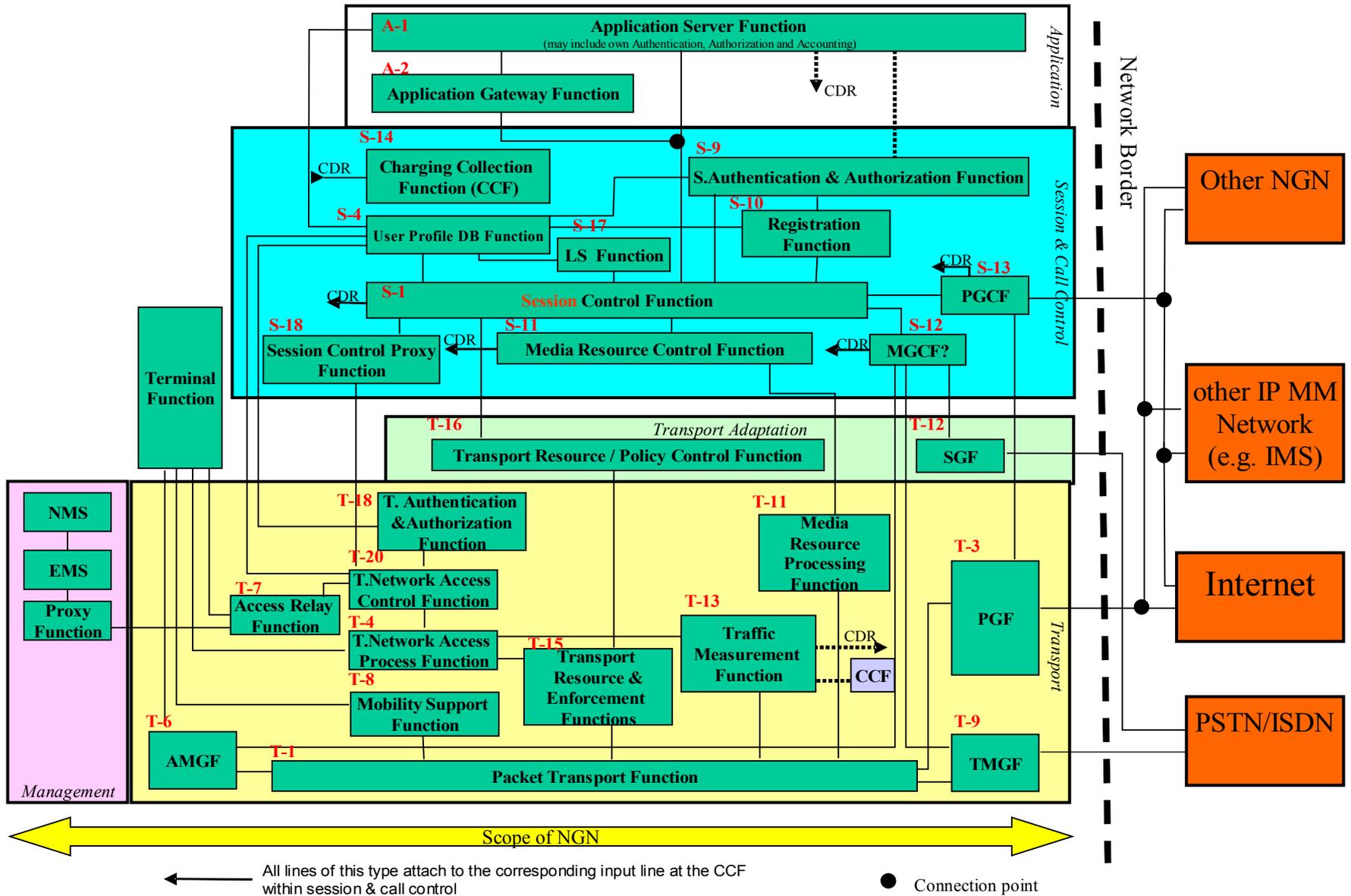
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- *Standardization for NGN*
- ***Functional Architecture of NGN***
- *Interfaces & Protocols*
- *Examples of Flow of Information in NGN*

# NGN Architectural Concept

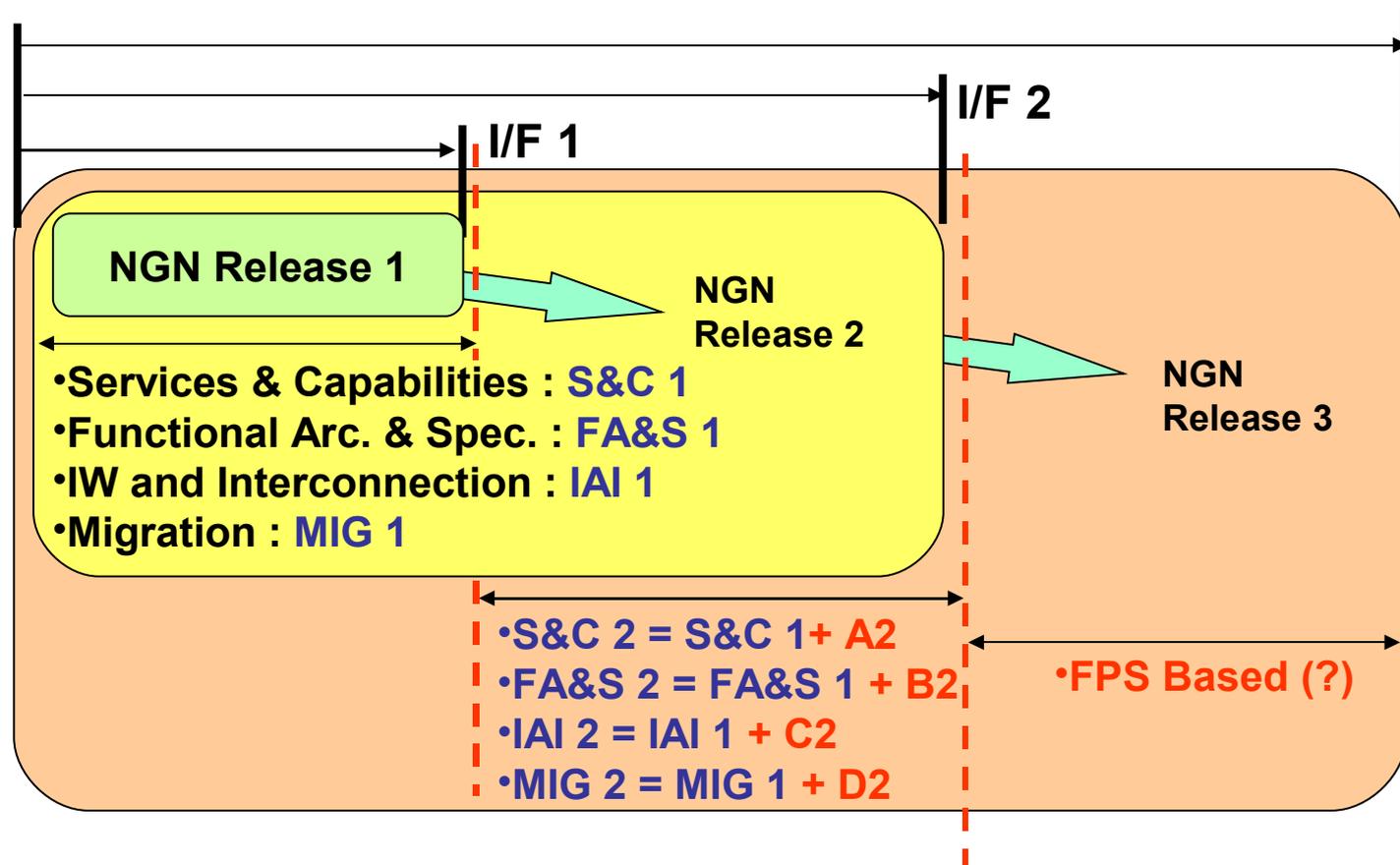


# Functional Architecture Model

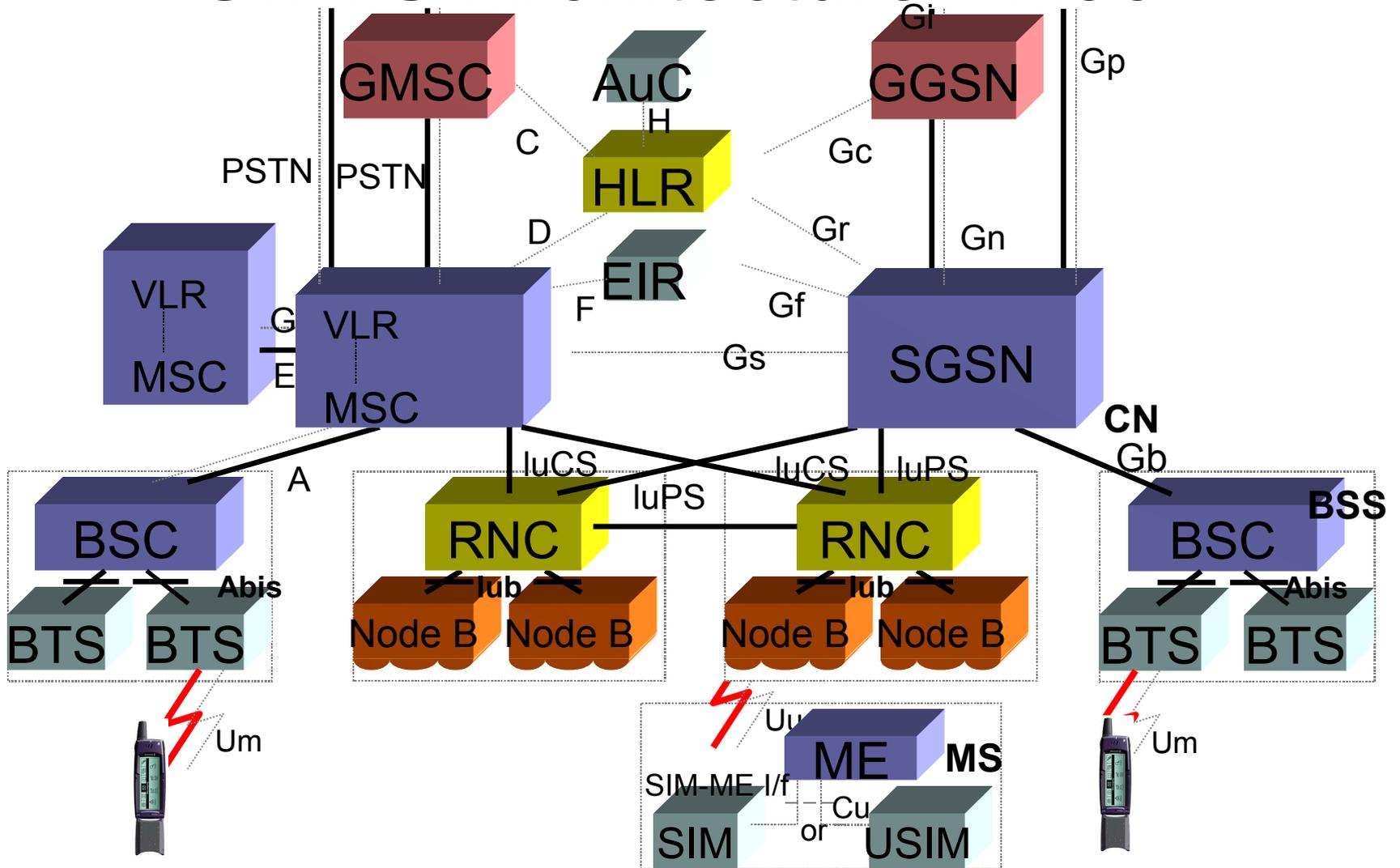


# Development of NGN Releases

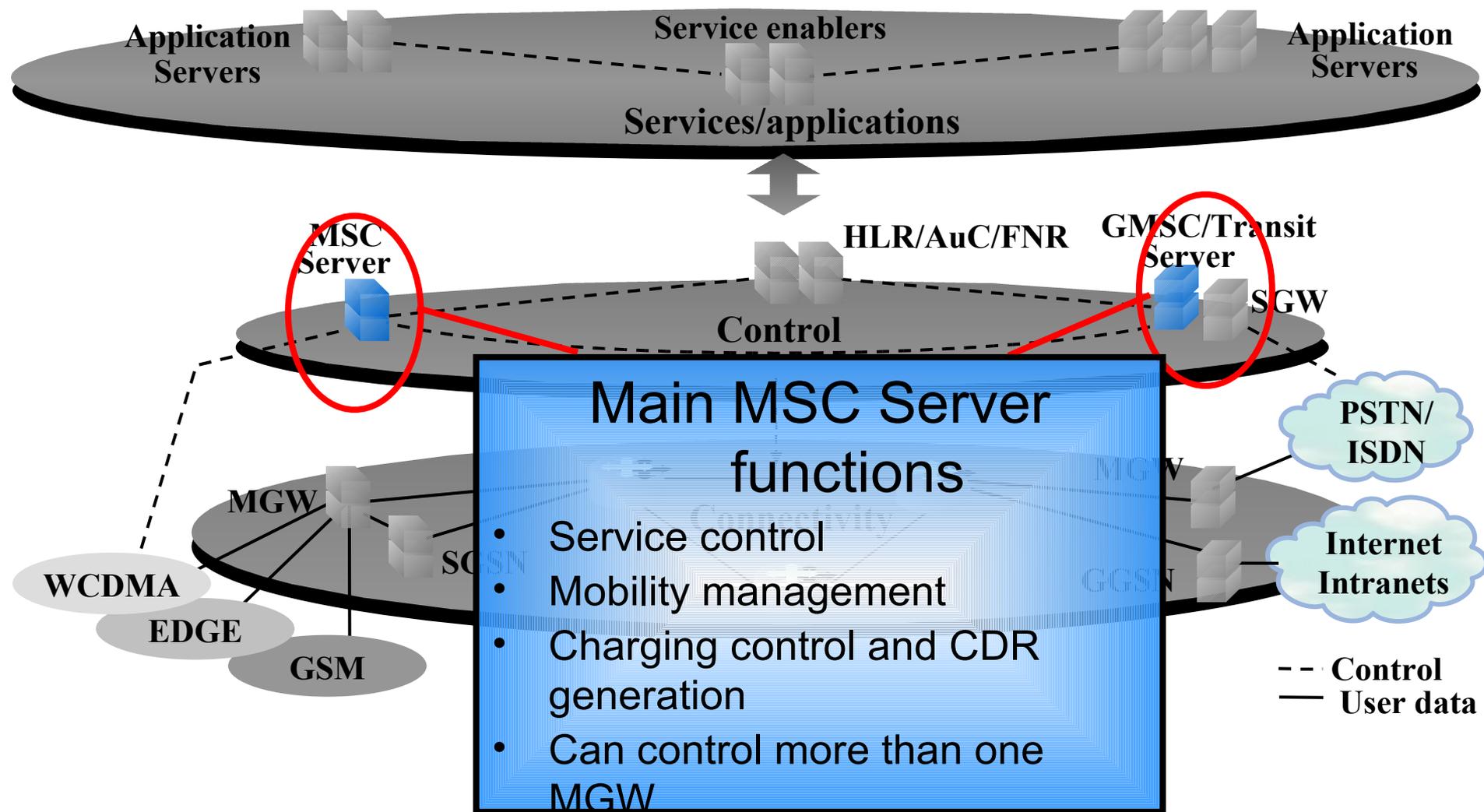
- Services and Capabilities (include Network and Control Capability)
- Architecture and their components
- Specifications for Interfaces, etc.



# UMTS Architecture - R99



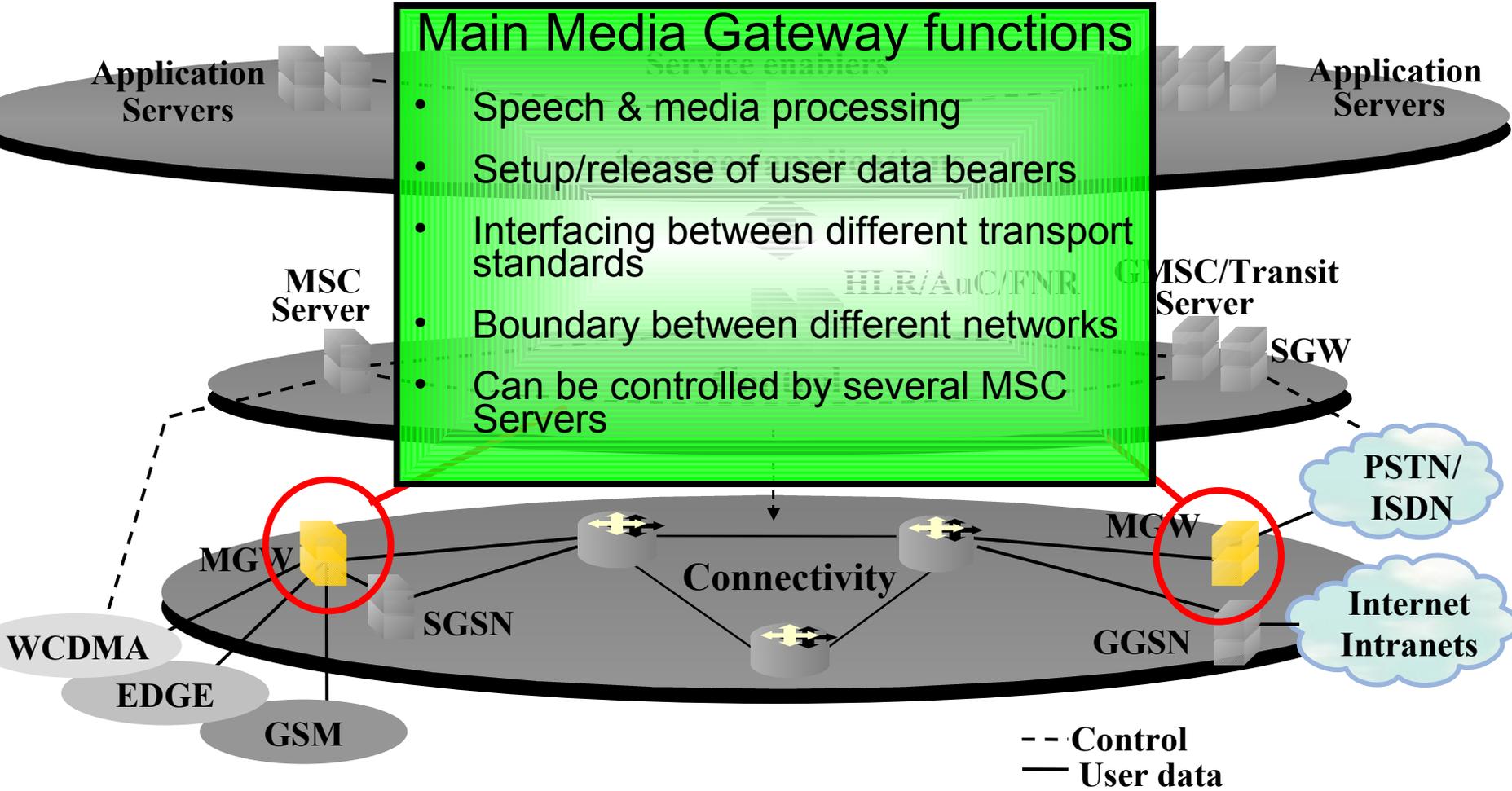
# MSC/GMSC Server:



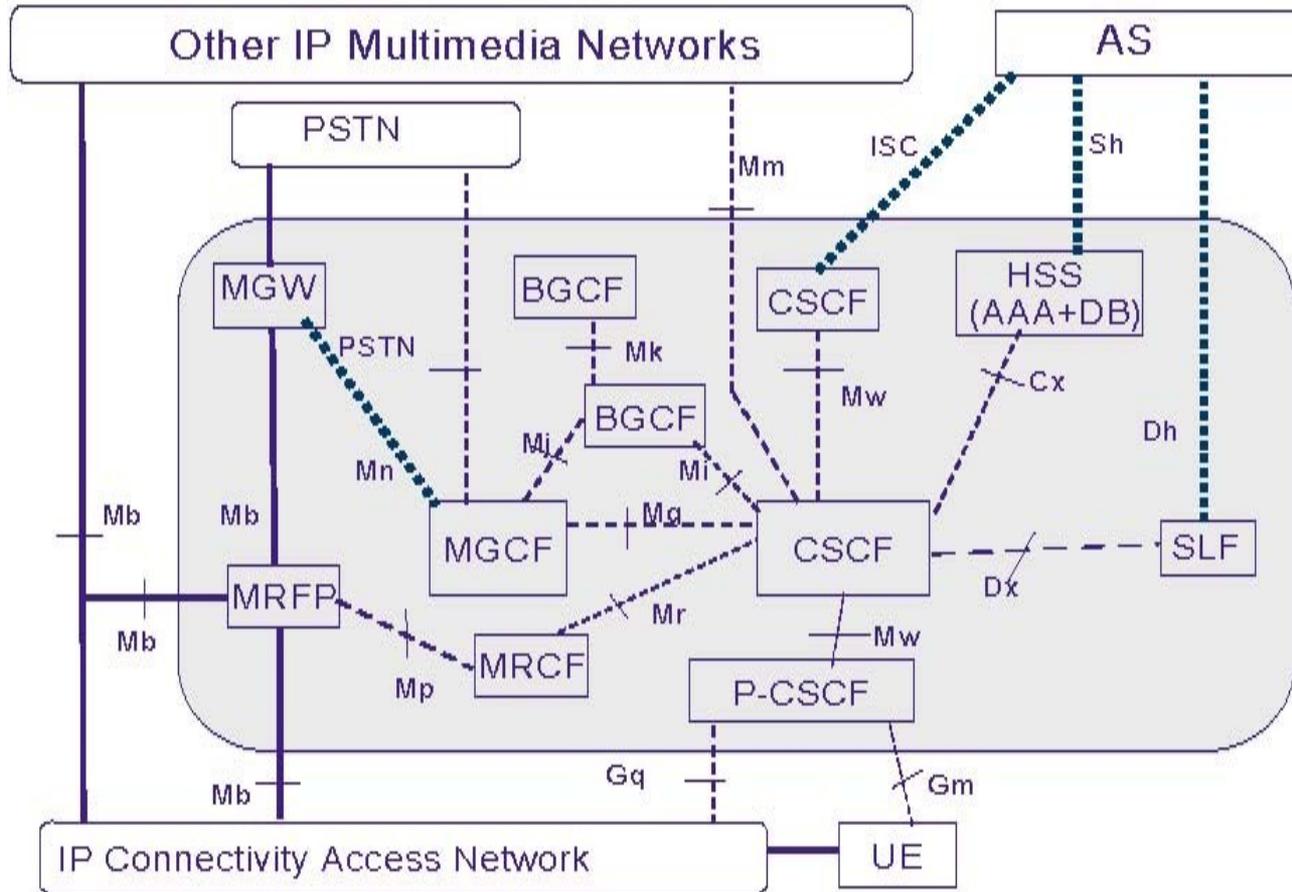
# Media Gateway:

## Main Media Gateway functions

- Speech & media processing
- Setup/release of user data bearers
- Interfacing between different transport standards
- Boundary between different networks
- Can be controlled by several MSC Servers



# IMS Architecture



# Agenda

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# ***Interface & Protocols Support required for***

- Multimedia domain call control
- QoS Control
- Charging
- Security
- Subscription profiles
- Inter-working with other networks (CS/PSTN)
- Allowing faster integration and deployment of IP multimedia services

# Protocols

- Open and standard Interface
- Increase the service capabilities
- Simplified network architecture
- Unified User data management
- Increase network reliability and flexibility
- Enhanced Charging functions
- Online charging and Offline charging
- Enhanced Security: Integrated security framework, based on IPSec and AKA
- QoS: Resource reservation
- Access Independence: Independent of the underlying IP connectivity network

# Highlights of protocols

- **Built on IETF Protocols**
- **SIP: SIP as the Single Call Control Protocol for IP Multimedia Services**
- **Diameter: AAA protocol**
- **XML: User Profile protocol**
- **COPS, ...**
- **Home network controls the services for a roaming user**
- **Service triggering point in Home Network**
- **Visit network can also provide local service to a roaming user**

# SIP (Session Initiation Protocol)

- IETF RFC3261: Internet standard
- SIP is an application-layer control (signaling) protocol for creating, modifying, and terminating sessions with one or more participants. These sessions include Internet telephone calls, multimedia distribution, and multimedia conferences.
- Server/Client mode
- Text based protocol
- UTF-8 charset
- Used with other IETF protocols to build a complete multimedia communication architecture
  - RTP (Real Time Transport)
  - RTSP (Real Time Streaming protocol)
  - MEGACO (Media Gateway Control Protocol)
  - SDP □ Session Description Protocol □

# SIP Basic functions

- SIP establishes and terminates multimedia communications based on following aspects:
  - User location □ determination of the end system to be used for communication
  - User availability □ determination of the willingness of the called party to engage in communications
  - User capabilities □ determination of the media and media parameters to be used
  - Session setup □ establishment of session parameters at both called and calling party, "ringing".
  - Session management □ including transfer and termination of sessions, modifying session parameters, and invoking services.

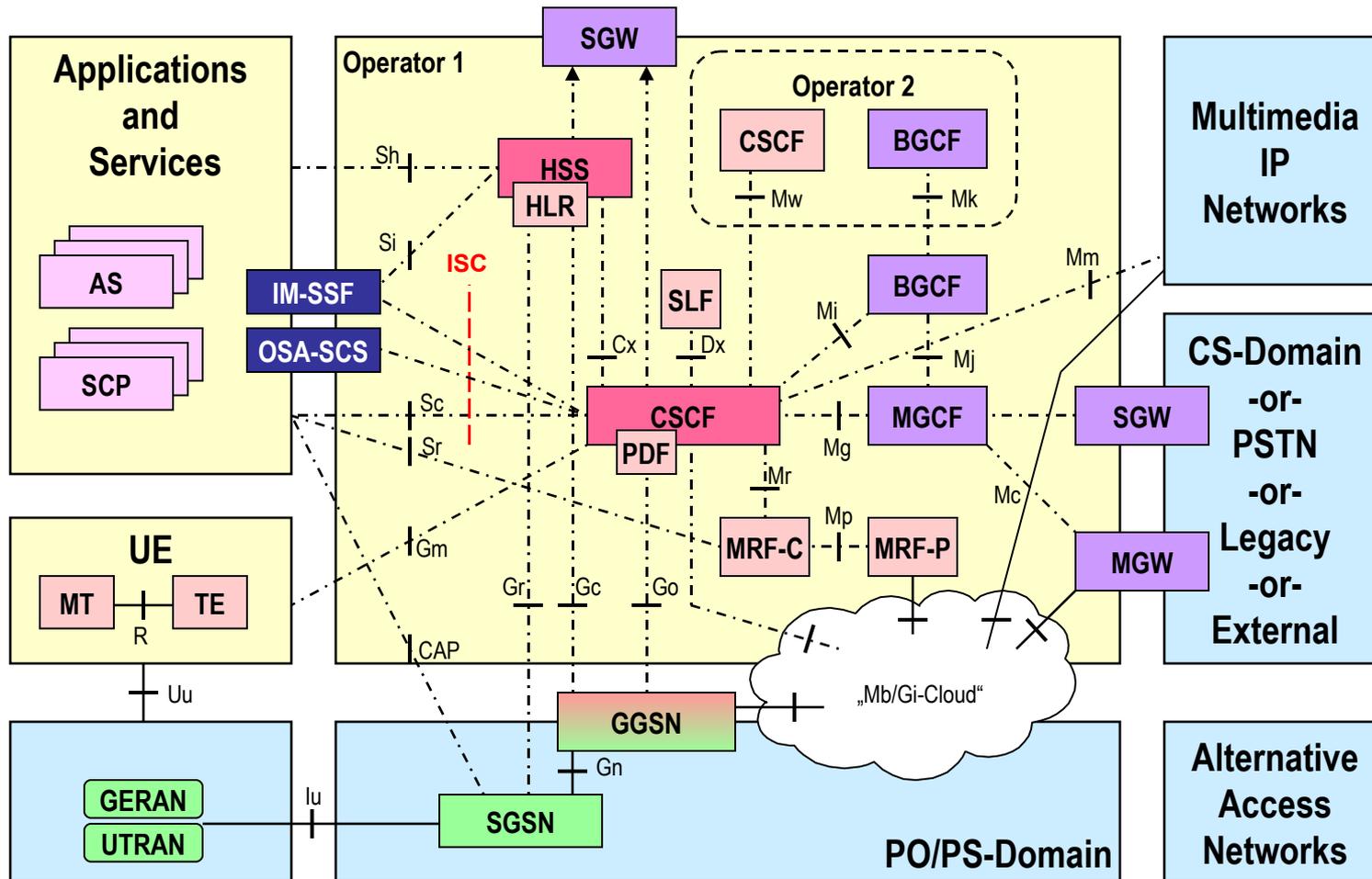
# Characteristics of SIP Messages

- **Basic SIP protocol defines only 6 methods**  
(Register, Invite, Ack, Bye, Cancel, Options)
- **Communication principal: Request – Response**
- **Syntax is similiar to known Internet protocols**  
(htmp, smtp, addressing, etc)
- **Example: INVITE message can include a message body being:**
  - SDP information
  - Plain Text
  - HTML Code
  - Link to Java applet
  - Any possible MIME Type (Image, Sound, Video-Clip,...)

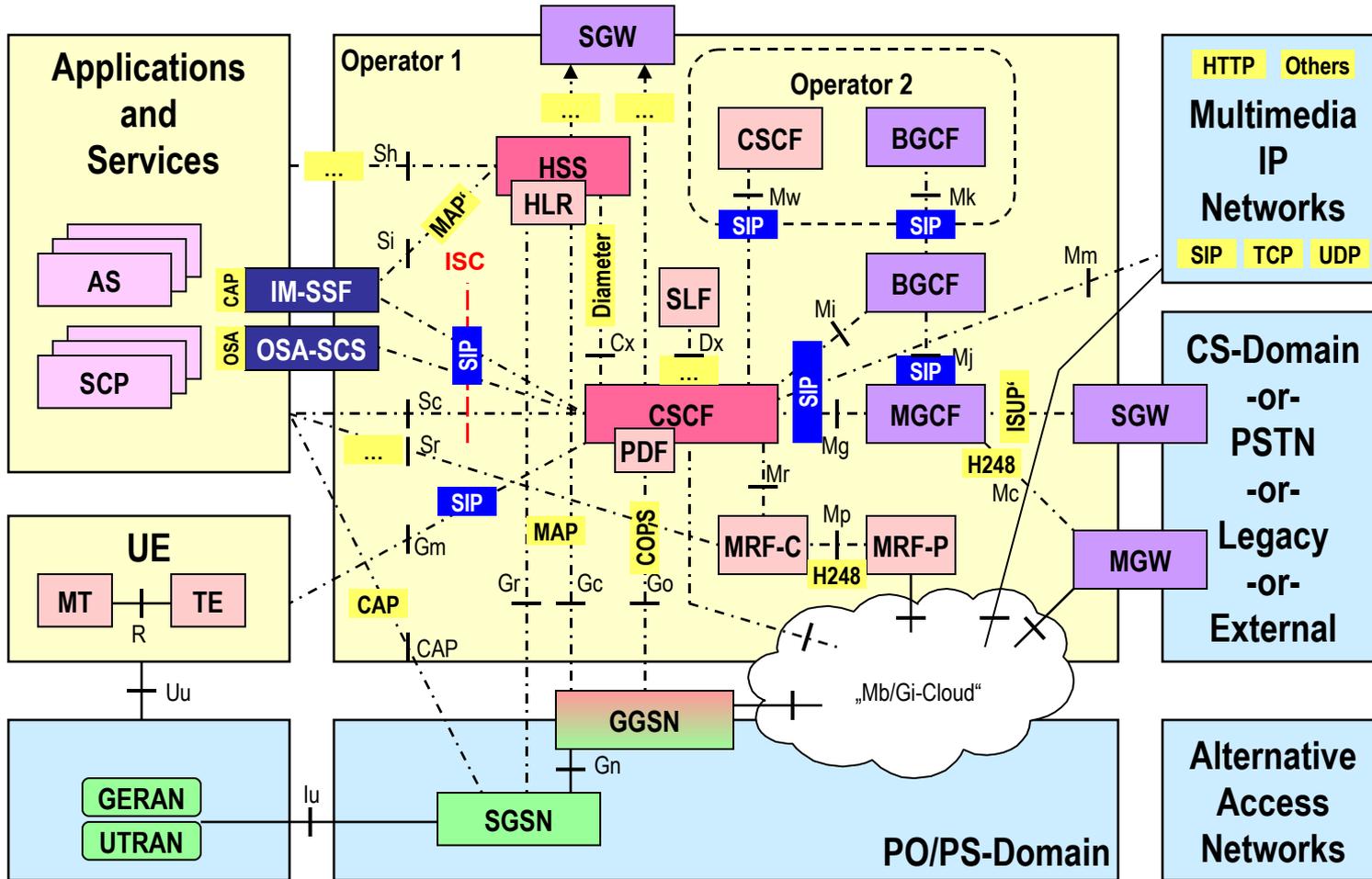
# SIP building blocks

- User Agent
- UAC: User Agent Clients
- UAS: User Agent Server
- Proxy Server
- Redirect Server
- Registrar Server

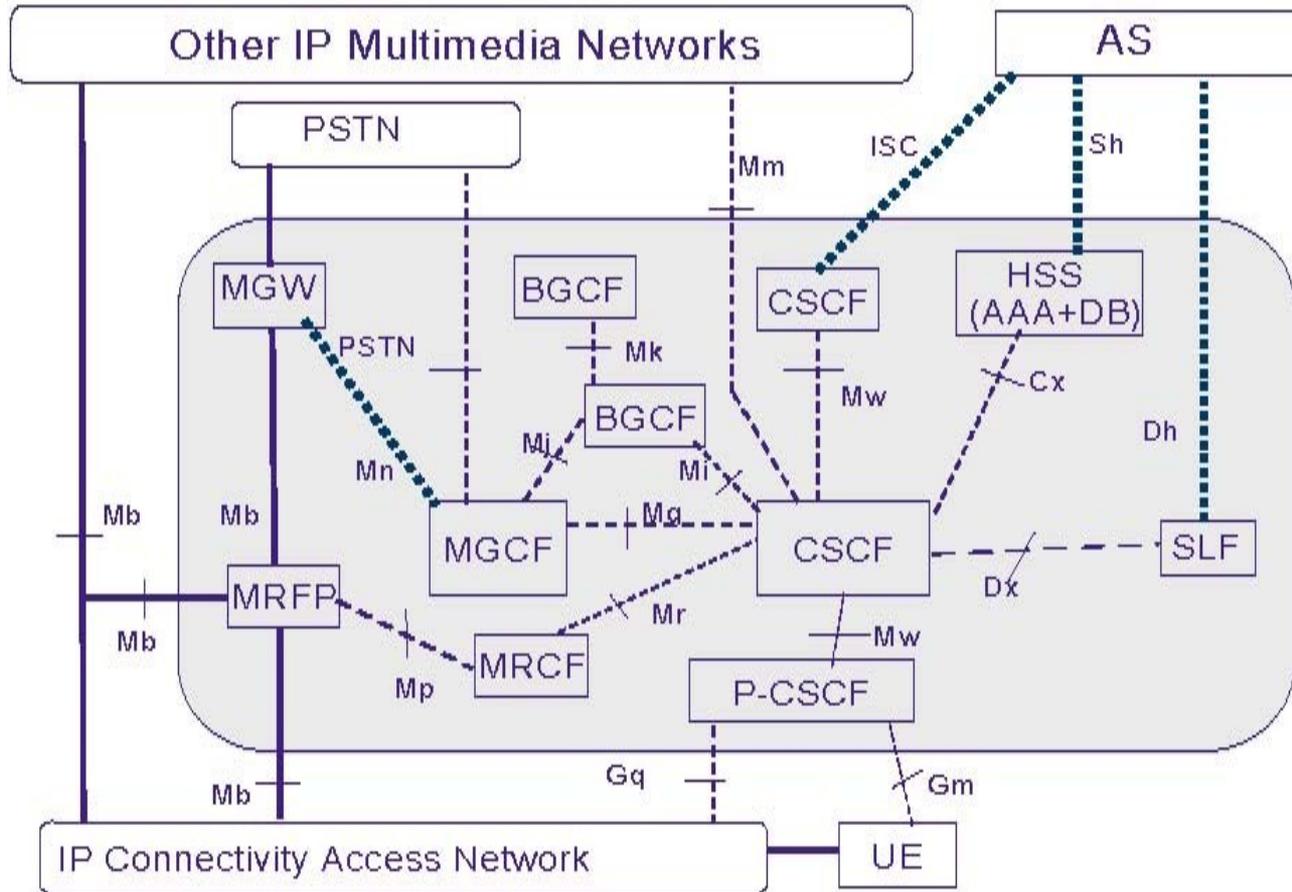
# Network Entities and Reference Points



# Network Entities and Protocols

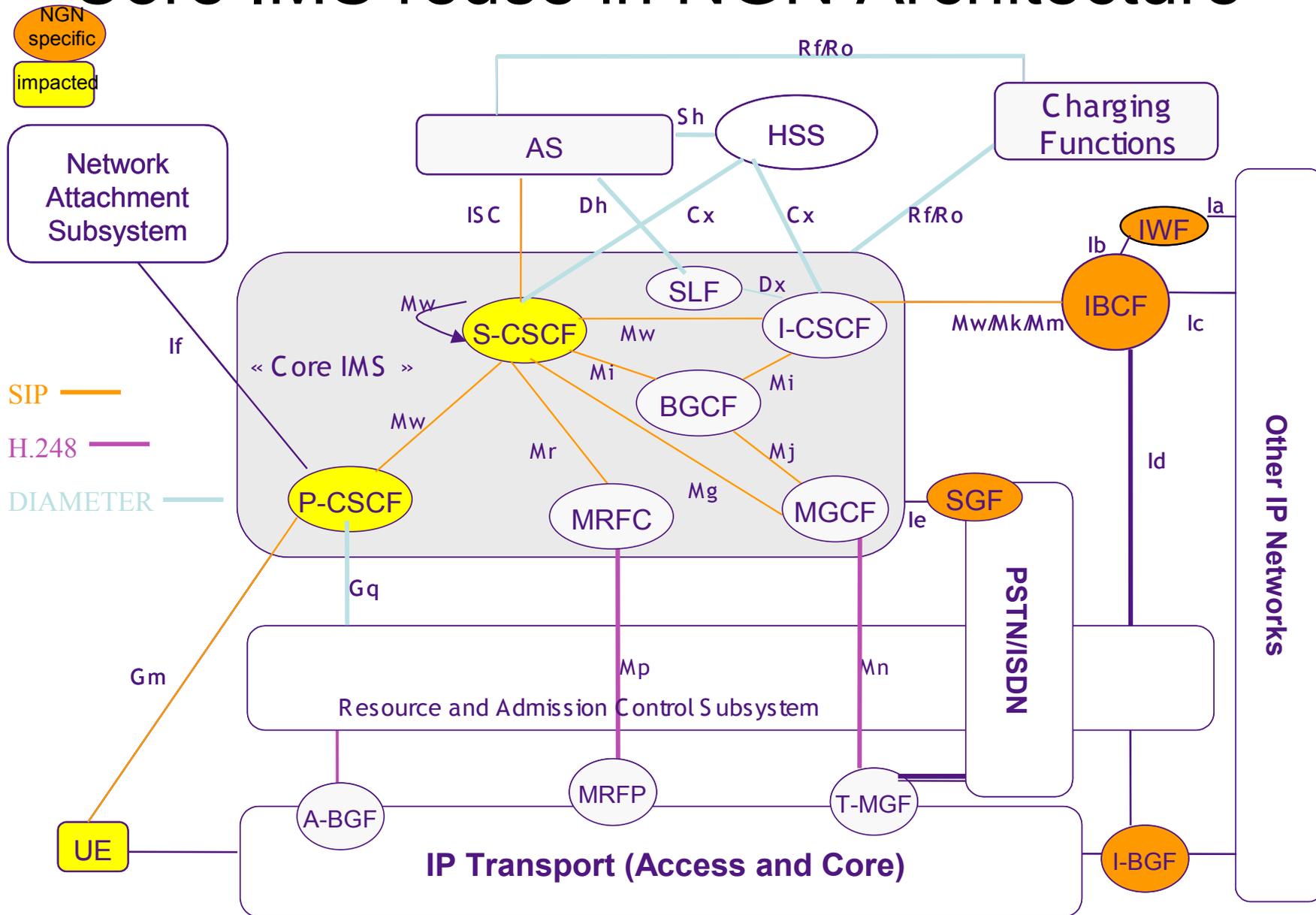


# IMS Architecture





# Core IMS reuse in NGN Architecture



# IMS Function Groups

- **IMS Core**
  - P/I/S-CSCF, SLF/HSS, BGCF, MRFP/MRFC
- **Service Network**
  - SIP AS, Parley Gateway, SCP
- **Inter-working Entities**
  - MGCF/MGW
- **IP-CAN: Provides the IP bearer to access to the IMS**
  - GPRS, UMTS, WLAN, xDSL
- **Charging Entities**
  - Offline charging
  - Online charging
- **IP Accessorial Entities**
  - DNS
  - Firewall
  - NAT
  - DHCP

# Network Entities

- CSCF (Call Session Control Function)
- PDF (Policy Decision Function)
- HSS (Home Subscriber Service)
- HLR (Home Location Register)
- SLF (Subscription Locator Function)
- MRF-C (Multimedia Resource Function - Controller)
- MRF-P (Multimedia Resource Function - Processor)
- BGCF (Breakout Gateway Control Function)
- MGCF (Median Gateway Control Function)
- MGW (Media Gateway)
- SGW (Signaling Gateway)
- AS (Application Server)
- SCP (Service Content Provider)
- IM-SSF (Service Switching Function)
- OSA-SCS (Service Capability Server)

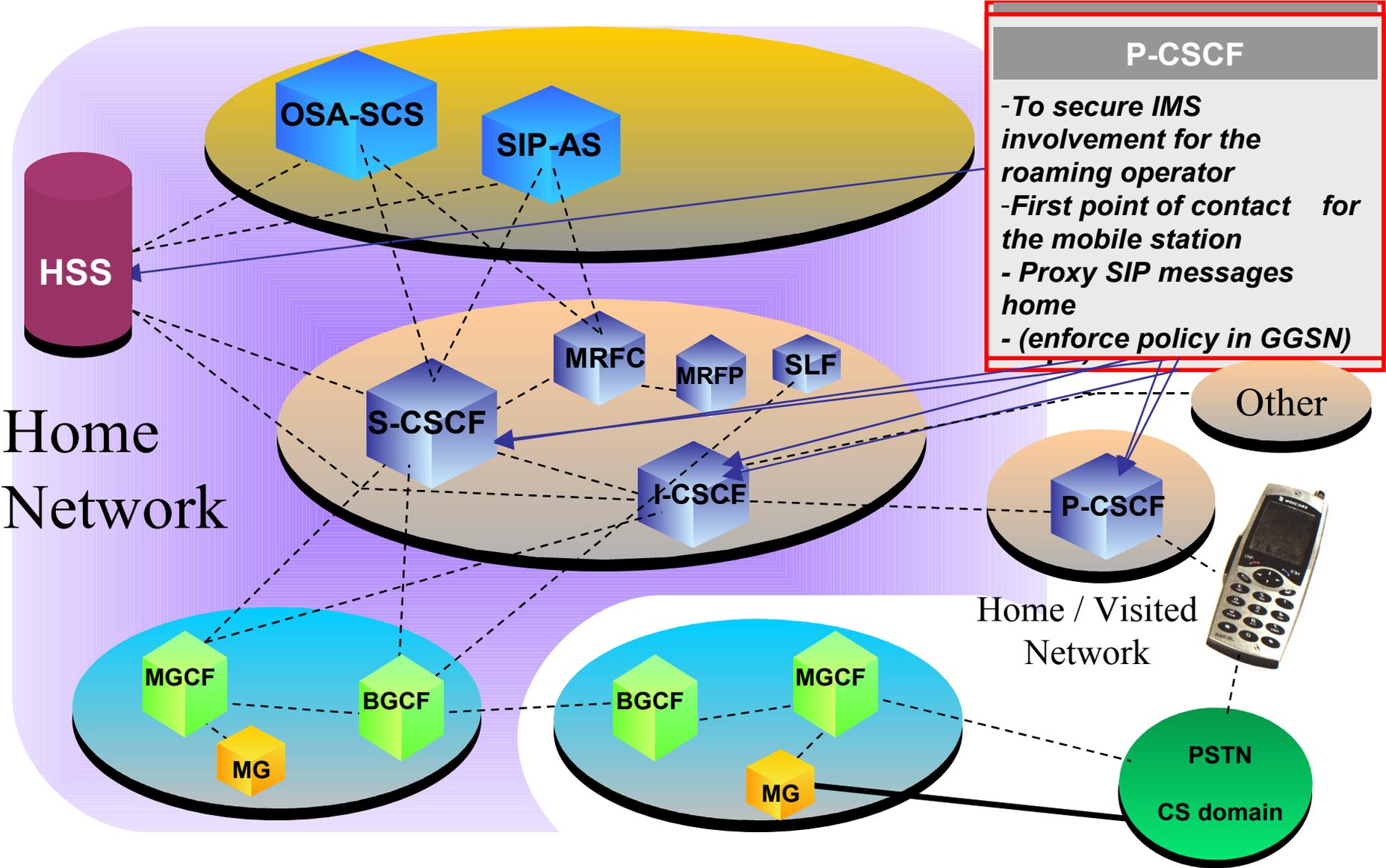
## Additionally:

- QoS Entities
- Charging Entities
- Security Entities
- Lawful Interception Entities
- Presence Service Entities
- Location Service Entities
- Push Service Entities
- OAM and NM Entities
- Firewalls, NAT, IPv4/v6, ...
- DNS, DHCP, TRIP, ...

# Single Session Control

- SIP is the single session control protocol used between the UE and the CSCF
- Gm: between UE and P-CSCF
- Mg: between MGCF and CSCF
- Mw: between CSCFs
- Mm: between CSCF and external IP networks
- Mi: between CSCF and BGCF
- Mj: between BGCF and MGCF
- Mk: between BGCF and BGCF

# Simplified 3GPP IMS Architecture



# CSCF (Call Session Control Function)

- CSCF: Manage SIP sessions
  - Coordinates with other network elements for session control, feature/service control and resource allocation.
- There are 3 types of CSCFs depending on their role:
  - S-CSCF (Serving CSCF): session control point for UE as an originator and terminator (home network).
  - I-CSCF (Interrogating CSCF): the contact point into the UE's home network for other networks.
  - P-CSCF (Proxy CSCF): the contact point into the IMS for the UE (home or visited network).

# Serving CSCF (S-CSCF)

- Functions:
  - Registration
  - behave as a Registrar as defined in RFC3261
  - Session control for the registered endpoint's sessions.
  - service logic is performed by an Application Server, not the S-CSCF
  - The Serving CSCF retrieves the subscriber profile from the HSS including AS filter criteria.
  - Behave as a Proxy Server
  - It accepts requests and services them internally or forwards them on, possibly after translation.
  - Behave as a User Agent
  - Terminate and independently generate SIP transactions.
  - Interaction with Services Platforms for the support of services
  - Charging and resource utilisation:
  - Generation of CDRs

# S-CSCF Routing Behaviors

- On behalf of an originating endpoint:
  - Obtain from DNS the address of the I-CSCF (or other IP endpoint) for the network operator serving the destination subscriber using the destination name of the terminating subscriber (e.g. dialed E.164 phone number or SIP URL). Send the SIP request or responses to the indicated I-CSCF.
  - If the destination name of the terminating subscriber is determined by DNS to be a PSTN address, then send the SIP request to the BGCF within the operator's network.
- On behalf of a destination endpoint:
  - Send the SIP request to a P-CSCF based on the registered location for registered subscribers.
  - Send or redirect the SIP request to an alternate endpoint for unregistered subscribers with call forwarding or similar services.

# Proxy CSCF (P-CSCF)

- Functions:
  - Serves as the initial point of contact for user terminal to network
  - Forward the SIP register request received from the UE to an I-CSCF
  - Forward SIP messages received from the UE to the SIP server (e.g. S-CSCF)
  - Forward the SIP request or response to the UE.
  - Insert public user identity for UE initiated requests
  - Maintain a Security Association between itself and each UE
  - Perform SIP message compression/decompression.
  - Authorization of bearer resources and QoS management.
  - Enforce the bearer resources as negotiated in the SDP

# Interrogating CSCF (I-CSCF)

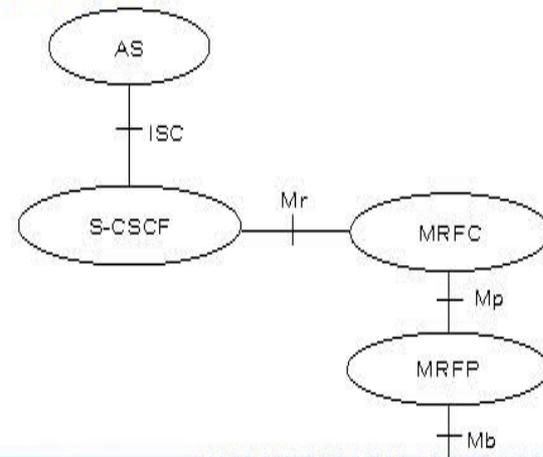
- Functions
  - Serves as the initial point of contact from other networks
  - Selects a S-CSCF for a user performing SIP registration
  - Routes SIP requests received from another network to the S-CSCF.
  - Query HSS for the Address of the S-CSCF.
  - If no S-CSCF is currently assigned (e.g., unregistered subscriber), then assign S-CSCF to handle the SIP request.
  - Performs a stateless SIP proxy function, Send a SIP request or response to:
    - S-CSCF in another operator's network.
    - MGCF for mobile termination call after processing INVITE.
    - I-CSCF in another operator's network (network hiding case).
    - THIG (optional): Topology Hiding Inter-network Gateway function to hide the configuration, capacity, and topology of the network from the outside

# Breakout Gateway Control Function (BGCF)

- Functions
  - Selects the network in which the interworking with the PSTN/CS Domain is to occur.
  - Selects the local MGCF in the network
  - Selects peer BGCF
  - IMS standards do not specify the criteria for the BGCF to use when selecting the PSTN/PLMN access point. Some possible factors include the following:
    - Current location of the calling UE.
    - Location of the PSTN/PLMN address.
    - Local policies and business agreements between the visited and home network (e.g. Minimize path distance, Least cost path).

# MRFC/MRFP

- Functions of MRFC (Media Resource Function Controller)
  - Control the media stream resources in the MRFP.
  - Interprets information coming from an AS and S-CSCF and control MRFP accordingly.
- Functions of MRFP(Media Resource Function Processor)
  - Control of the bearer on the Mb reference point.
  - Provides resources to be controlled by MRFC.
  - Mixing of incoming media streams
  - Media stream source
  - Media stream processing
  - Floor Control



# Home Subscriber Service (HSS)

- HSS:
  - The HSS supports IMS level Authentication, and Authorization.
  - Holds IMS subscription data, service profile, location information and authentication information...
  - Provides HLR function: CS and PS subscription data
  - Keeps track of currently assigned S-CSCF
  - Supports CSCF and AS access
  - Interface: Diameter (IMS), MAP(CS/PS)
- SLF:
  - Allocates HSS by SIP URI

# Media Gateway Control Function (MGCF)

- MGCF
  - Connecting point between IMS control layer and PSTN/ISDN network
  - It Controls IM-MGW by H.248 and performs media layer inter-working.
  - IMS side: communicates with I/S-CSCF and BGCF
  - PSTN/ISDN side: performs protocol conversion between SIP and BICC/ISUP.

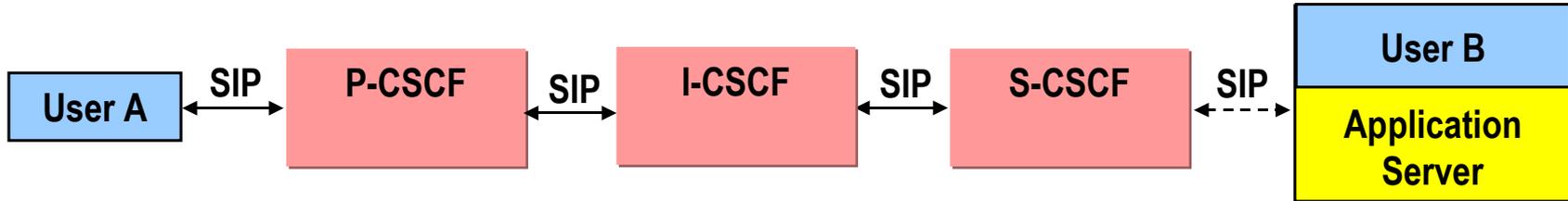
# IMS Media Gateway (IM-MGW)

- IM-MGW
  - Interacts with the MGCF for resource control
  - Terminates bearer channels from circuit switched network and media streams from packet network (e.g. RTP streams in an IP network).
  - Supports media conversion, bearer control, and payload processing (e.g. codec, echo canceller, conference bridge).
  - Detects events (i.e. bearer loss, DTMF digits, etc.) and notifies the MGCF.
  - May perform DiffServCode Point (DSCP) markings on the IP packets sent towards the UE.

# IMS Specifications

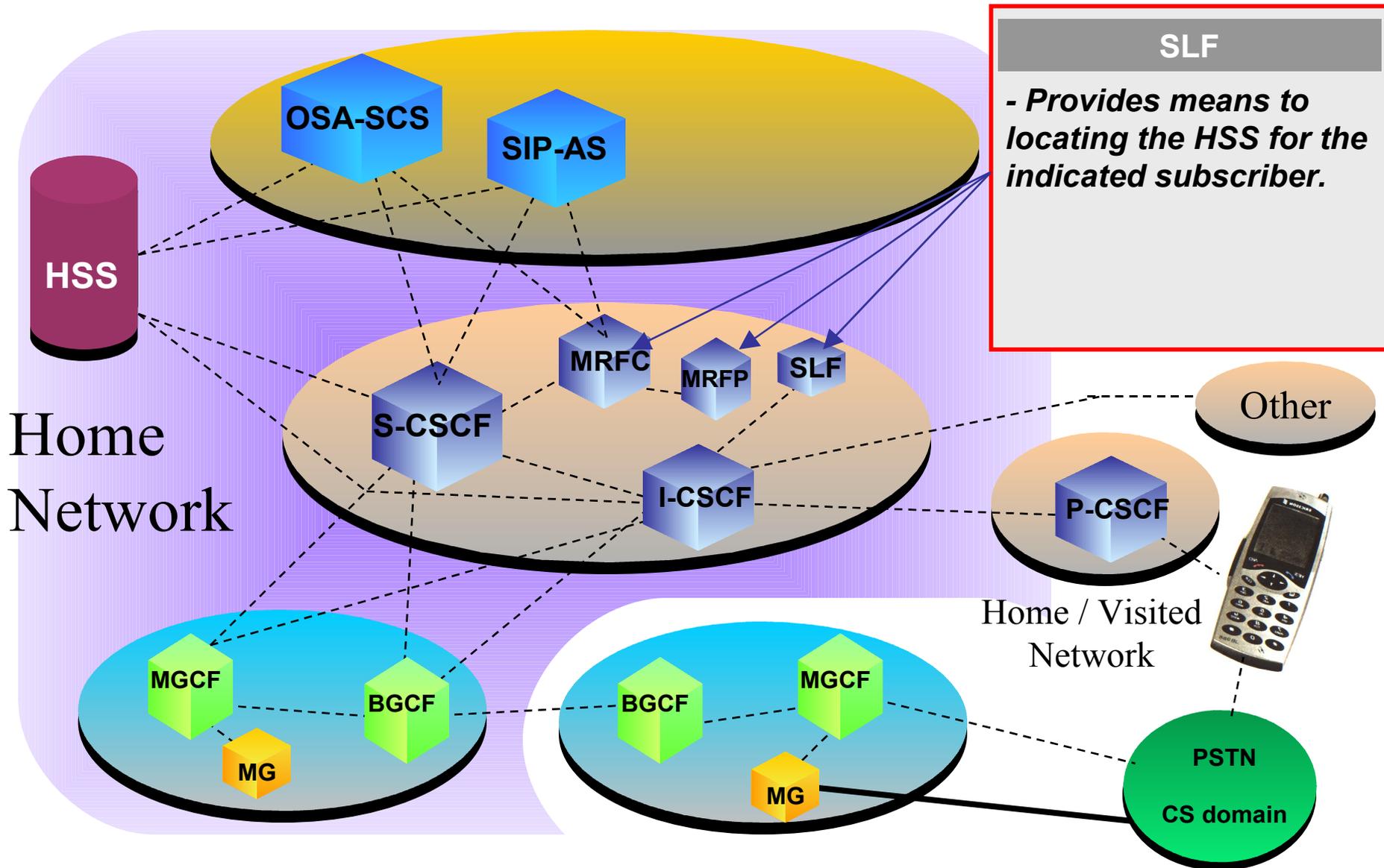
- 3GPP Specifications (Cont.)
- TS 22.228 □ Service requirements for the Internet Protocol (IP) multimedia core network subsystem (IMS); Stage 1
- TS 23.218 □ "IP Multimedia (IM) session handling; IM call model; Stage-2"
- TS 23.228 □ "IP Multimedia Subsystem (IMS); Stage 2"
- TS 24.228 □ Signaling flows for the IP multimedia call control based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3
- TS 24.229 □ "IP Multimedia Call Control Protocol based on SIP and SDP; Stage 3"
- TS 23.221 □ Architectural requirements

# Different Roles of the CSCF

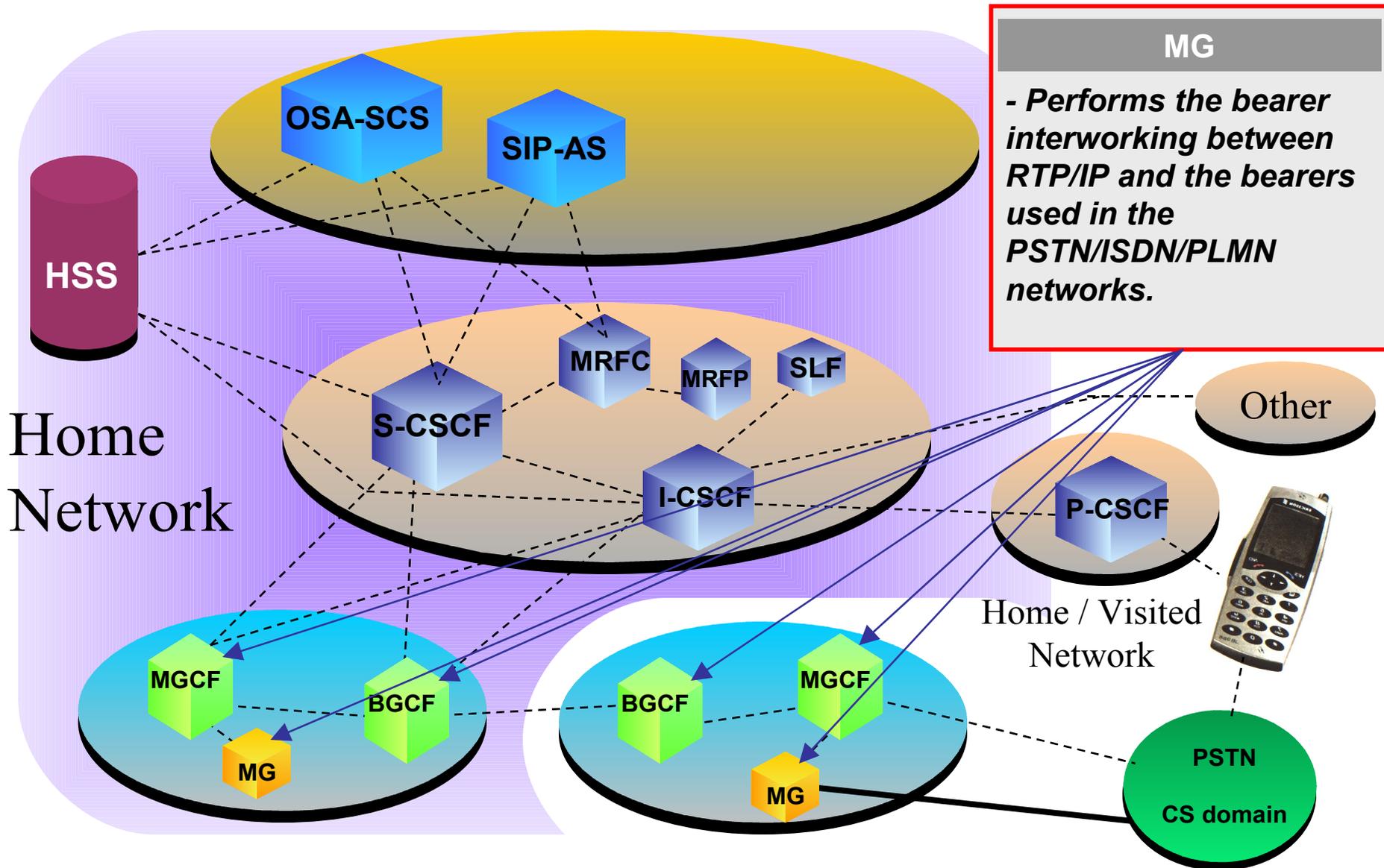


- The Proxy CSCF (**P-CSCF**) represents the first entry point for a mobile subscriber and determines the appropriate I-CSCF **in the caller's home network, based on the caller's home domain name.**
- **The responsible** Interrogating CSCF (**I-CSCF**) then selects the appropriate S-CSCF, **depending on the called party's location, the requested service and required service capabilities.**
- **Finally the** Serving CSCF (**S-CSCF**) establishes the connection to the called party (**via I-, S- and P-CSCF of B party's domain**) **respectively to the application server, which hosts the requested service.**

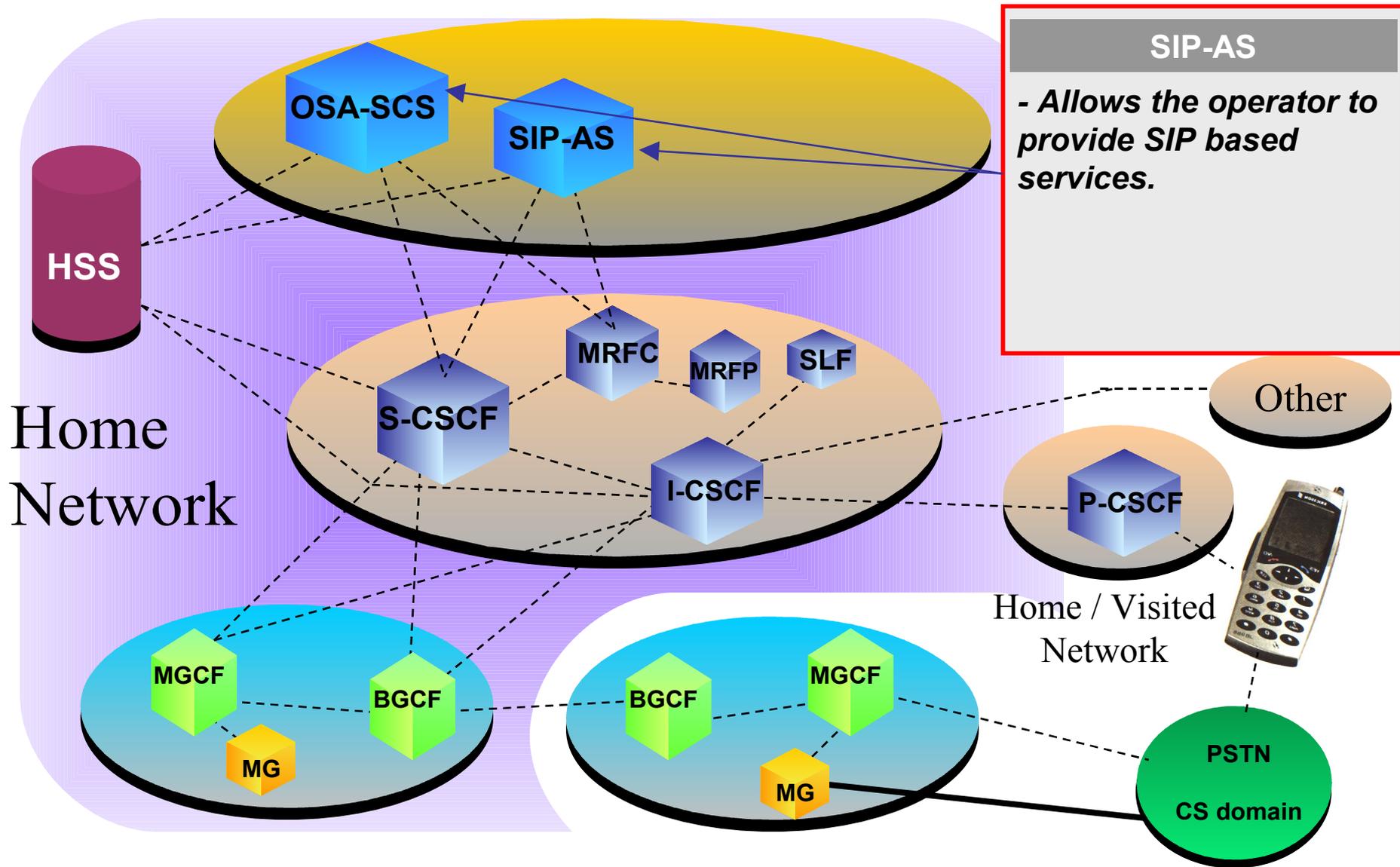
# Simplified 3GPP IMS Architecture



# Simplified 3GPP IMS Architecture



# Simplified 3GPP IMS Architecture



# ISC interface

- ISC (IMS Service Control Interface)
  - The ISC interface is between the S-CSCF and AS.
  - ISC is used to provide services residing in an AS.
  - S-CSCF to an AS in Home Network.
  - S-CSCF to an AS in External Network (e.g., Third Party or Visited)
  - From the perspective of the S-CSCF, The "SIP Application server", "OSA service capability server" and "IM-SSF" shall exhibit the same interface behaviour.
  - The ISC interface shall be able to convey charging information as per 3GPP TS 32.200 and TS 32.225.
  - The protocol to be used on ISC interface is SIP

# Highlights of ISC interface

- Introducing new services don't need to think about SIP routing, online and offline charging, register and security
- Services don't need to be standardized
- Have the capability of interoperating with Internet services
- Services based on IMS can be accessed through all kinds of visiting network, regardless of supporting IMS or not.

# Sh/Si Interface

- HSS to Service Platform Interface: Sh and Si
- Sh Interface is between the HSS and the "SIP AS" or the "OSA SCS"
- The Sh interface is an intra-operator interface.
- Responsible for transport
- Transparent data, e.g. service related data , user related information
- User related data stored in the HSS (e.g. user service related data, MSISDN, visited network capabilities, user location)
- Standardized data, e.g. for group lists, which can be accessed by different Application Servers
- The Si interface is between the HSS and the IM-SSF.
- It transports CAMEL subscription information including triggers for use by CAMEL based application services

# Application Server (AS)

- The Application Server provides service control for IMS.
- May be directly connected to S-CSCF or via OSA Gateway for 3rdparty security.
- Interacts with the HSS to obtain subscriber profile information.
- May support applications such as presence, conference control, online charging, etc.

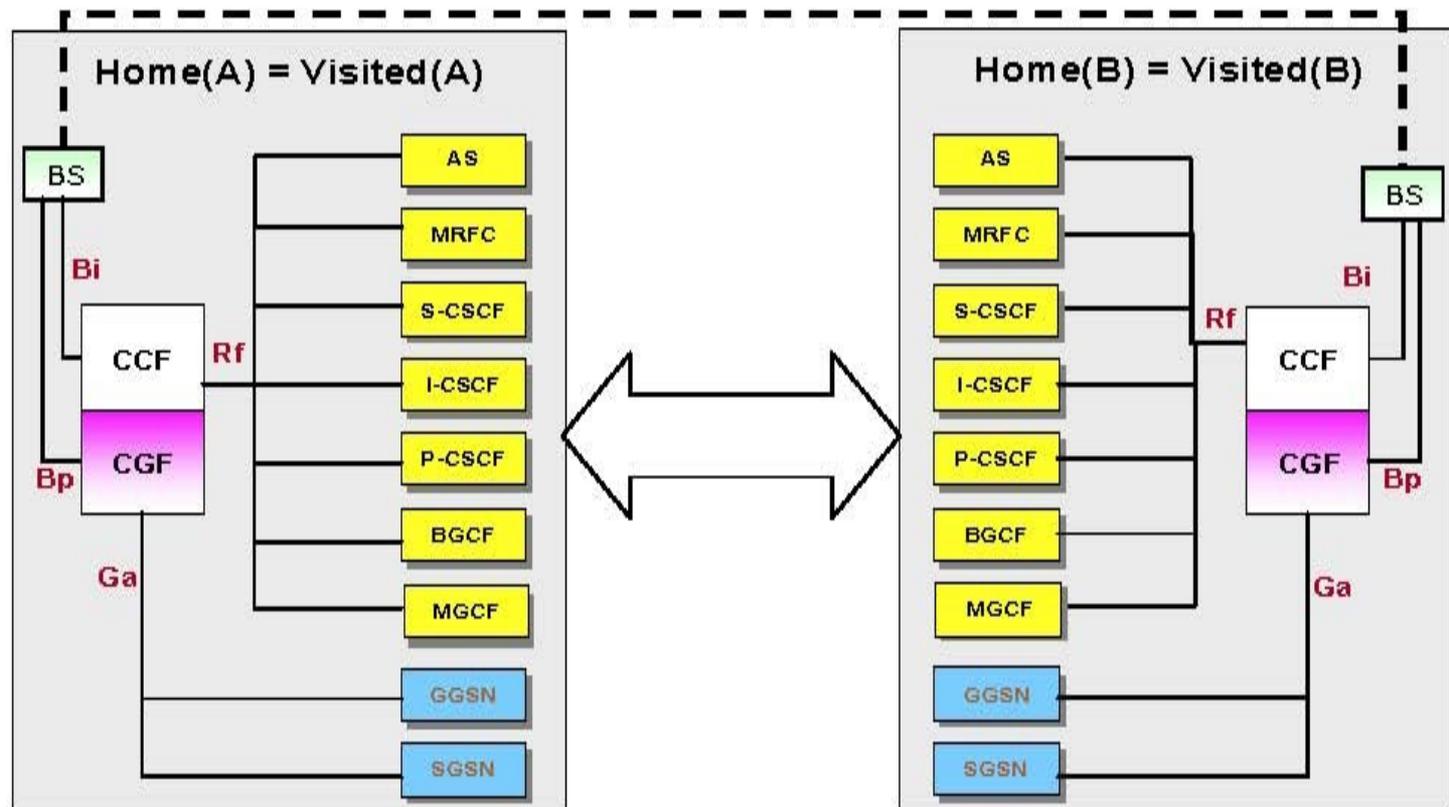
# Interaction of S-CSCF and AS

- S-CSCF uses Initial Filter Criteria to involve AS(s) as needed to provide services and features.
- The S-CSCF forwards messages to each AS in the order indicated by the Filter Criteria received from the HSS in the subscriber's service profile. After the last AS is contacted, then the message is sent on towards the intended destination.
- IMS defines Service Point Triggers (SPTs), points in the SIP signaling on which Initial Filter Criteria can be set:
- any initial known or unknown SIP method (e.g. REGISTER, INVITE, SUBSCRIBE, MESSAGE).
- presence or absence of any header or content of any header.
- direction of the request with respect to the served user.
- MO or MT to registered user or MT to unregistered user.
- session description information (i.e. SDP).

# Charging

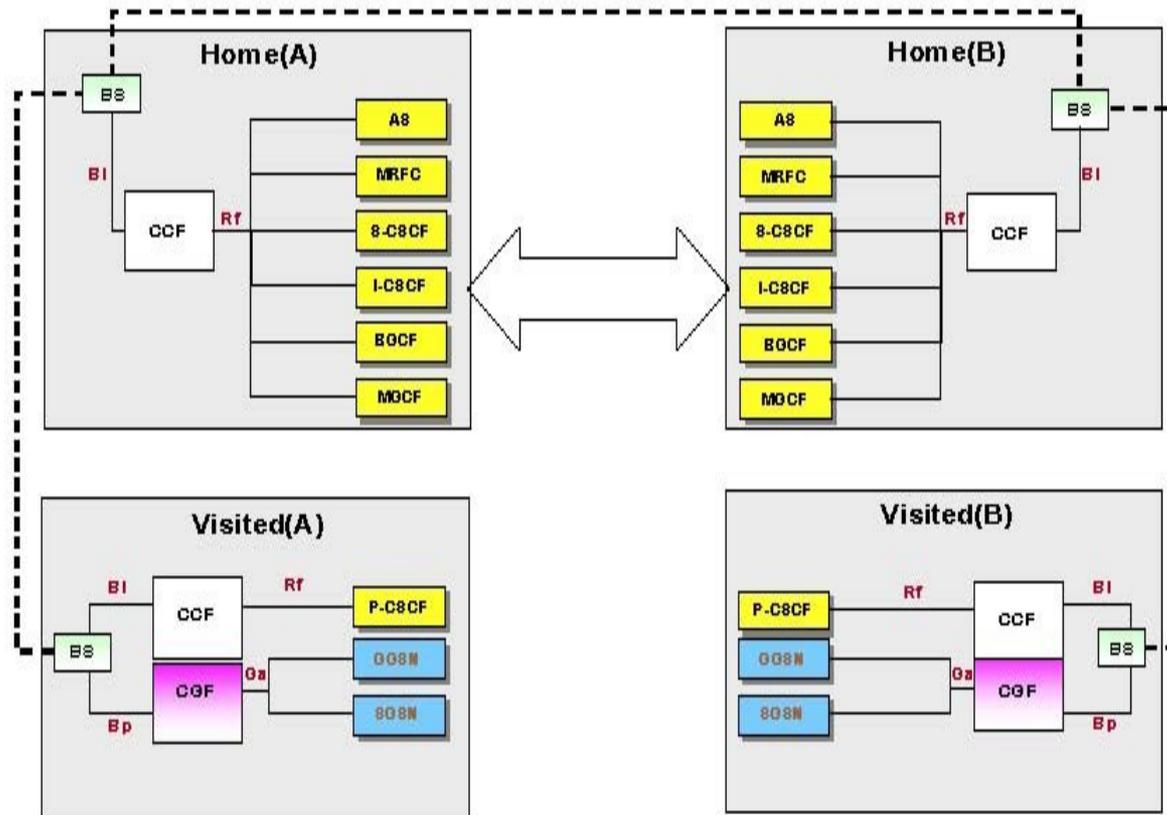
- Off-Line charging
- On-line charging
- Charging layers
  - Access/Transport Layer: Charging of usage of bearer resources (e.g. GPRS access services)
  - IP Multimedia/Session Layer: e.g. voice or video with a certain QoS, time based charging
  - Application/Content Layer -charging of services provided (e.g. games / info)

# Offline Charging Architecture



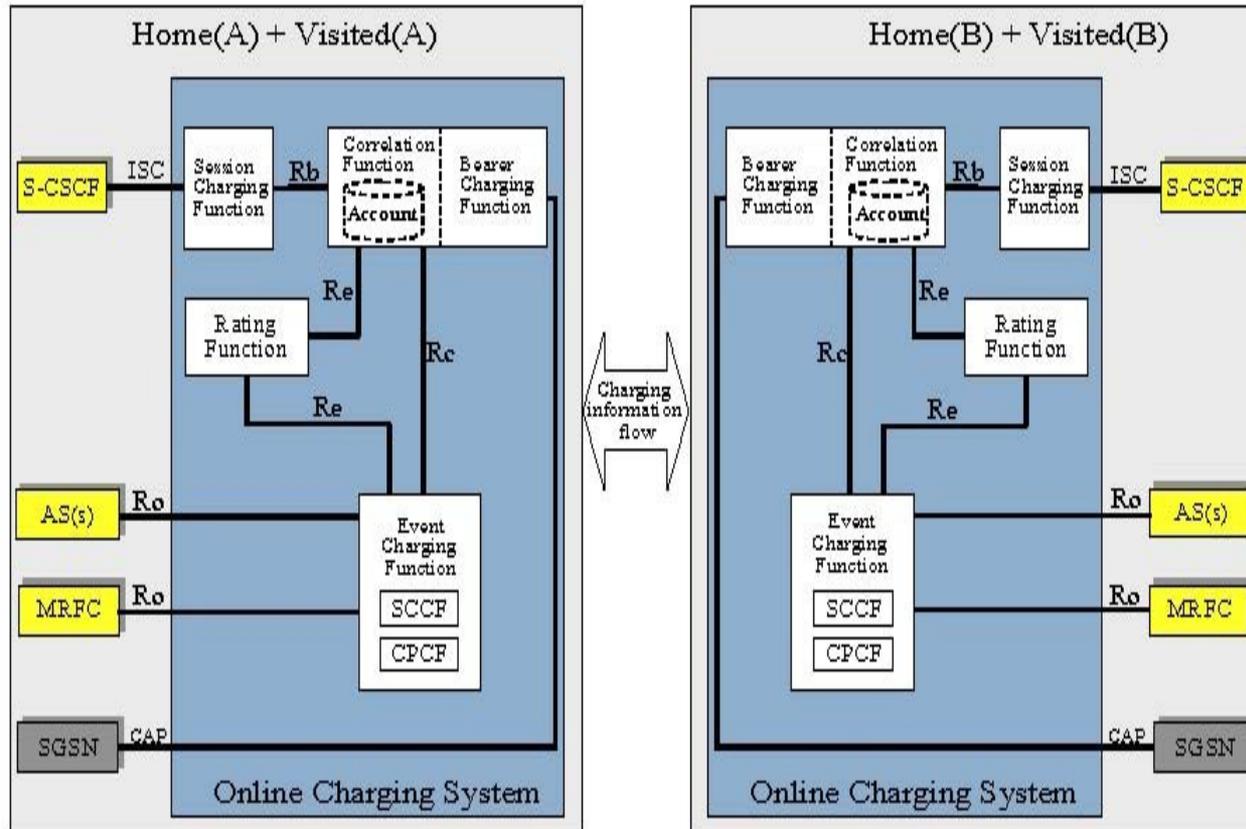
Offline IMS Charging architecture for non-roaming scenario

# Offline Charging Architecture



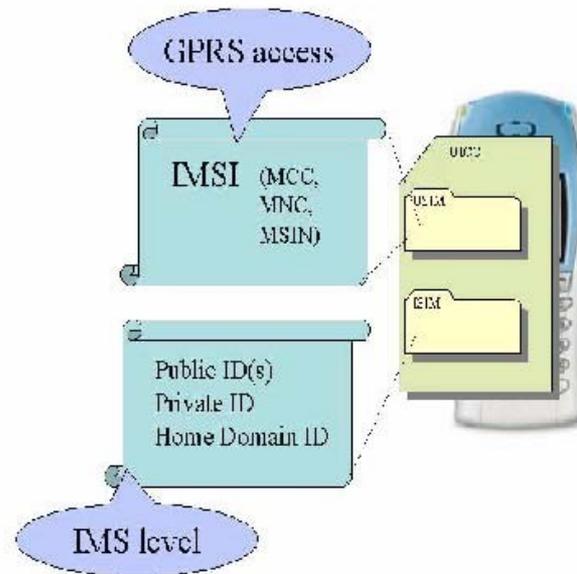
Offline IMS Charging architecture for roaming scenario

# Online Charging



Online IMS Charging architecture

# Relationship between UICC, USIM, ISIM



# Key identifiers of IMS

- The key identifier of the IMS Services Identity Module
- Home Domain ID: Provides the key way that a 3GPP IMS user routes their registration to their Home IMS Network.
- The Private Identity: Be used for authentication by the user's Home IMS Network
- The Public Identity: Be used for contactable by other users for IMS based services.

# Home Domain Name

- Be used to identify the home domain of the user
- If there is no ISIM application, Home domain name can be derived from the IMSI:
- Take the first 5 or 6 digits, depending on whether a 2 or 3 digit MNC is used and separate them into MCC and MNC
- Use the MCC and MNC derived in step 1 to create the "mnc<MNC>.mcc<MCC>.3gppnetwork.org" domain name
- Add the label "ims." to the beginning of the domain.

# Private User Identities

- Private Identity is not used for routing.
- The Private ID takes the format of a NAI: `username@realm`
- If there is no ISIM on the UICC, the Private ID is derived from the IMSI.
- use the whole string of digits of IMSI as the username part
- Realm is the home domain name

# Public User Identities

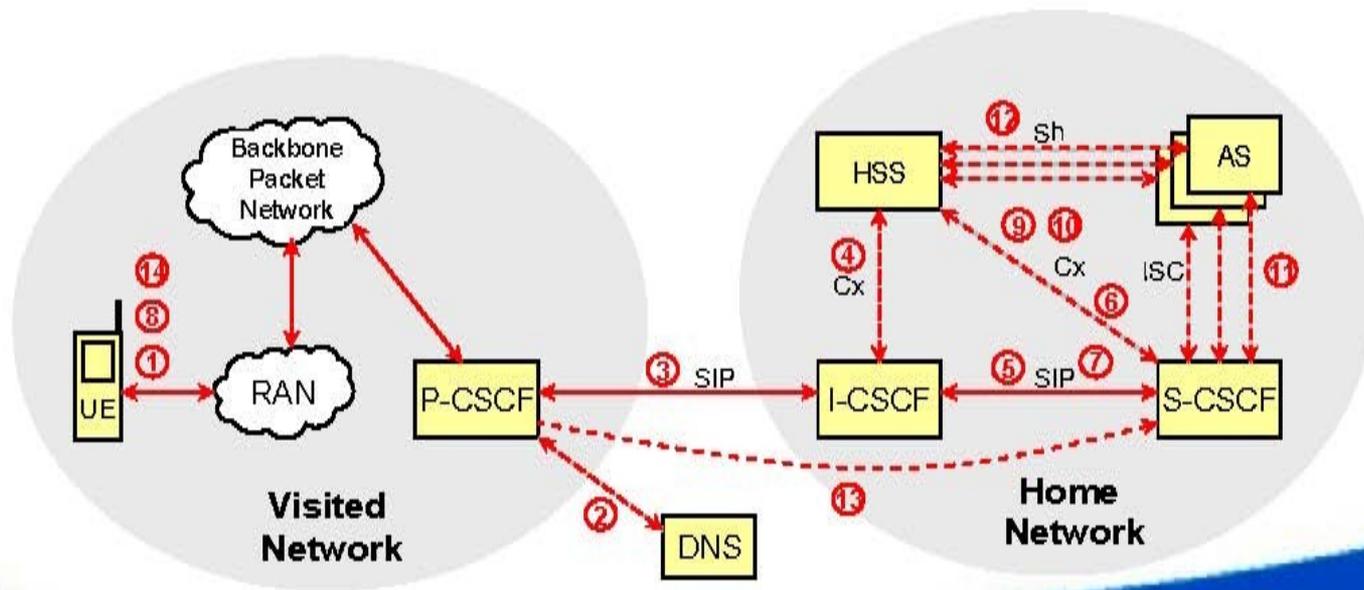
- The Public Identity is not used to authenticate the user during registration.
- Both Internet naming and Telecom numbering is supported: SIP URL, or a Tel URL.
- At least one IMPU is stored on the ISIM and can not be modified by the UE
- If the UICC does not contain an ISIM then a IMPU can be derived from the USIM's IMSI
- by pre-fixing 'SIP:' to the Private ID.

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- *Interfaces & Protocols*
- ***Examples of Flow of Information in NGN***

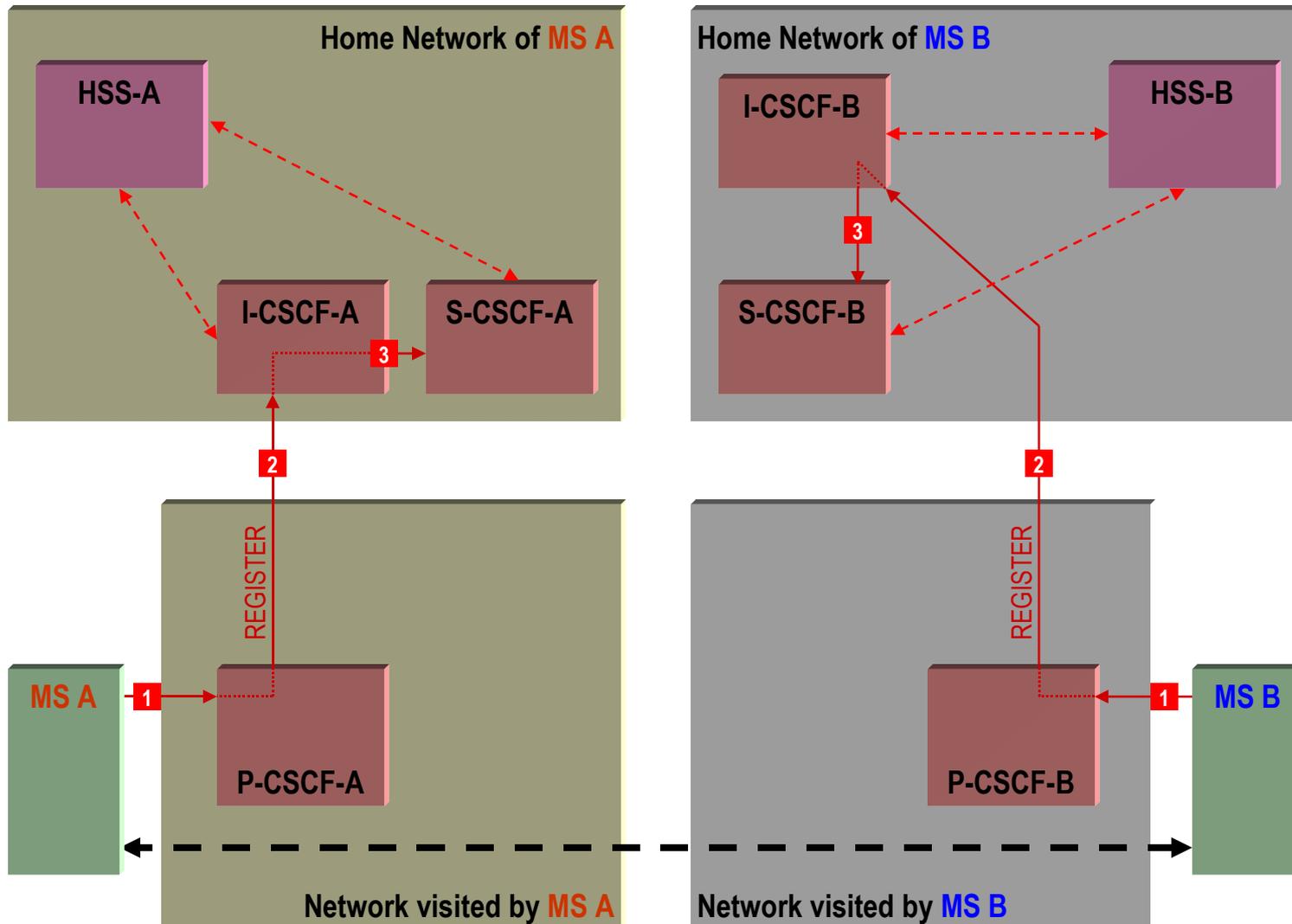
# Registration and Re-Registration

- ① UE sends the Register information flow to the proxy
- ② Query DNS to obtain routing information
- ③ Forward SIP REGISTER to Home Network
- ④ Retrieve information needed for S-CSCF Selection
- ⑤ Forward SIP REGISTER to S-CSCF
- ⑥ Retrieve and select Authentication Vector
- ⑦ Reject with Authentication Data
- ⑧ Re-initiate SIP Registration (steps 1 – 5)
- ⑨ Store S-CSCF Name
- ⑩ Retrieve Subscriber Profile and Filter Criteria
- ⑪ Register with AS(s) based on Filter Criteria
- ⑫ AS(s) retrieve Subscriber profile (if needed)
- ⑬ P-CSCF SUBSCRIBE, for de-registration
- ⑭ UE SUBSCRIBE, for de-registration



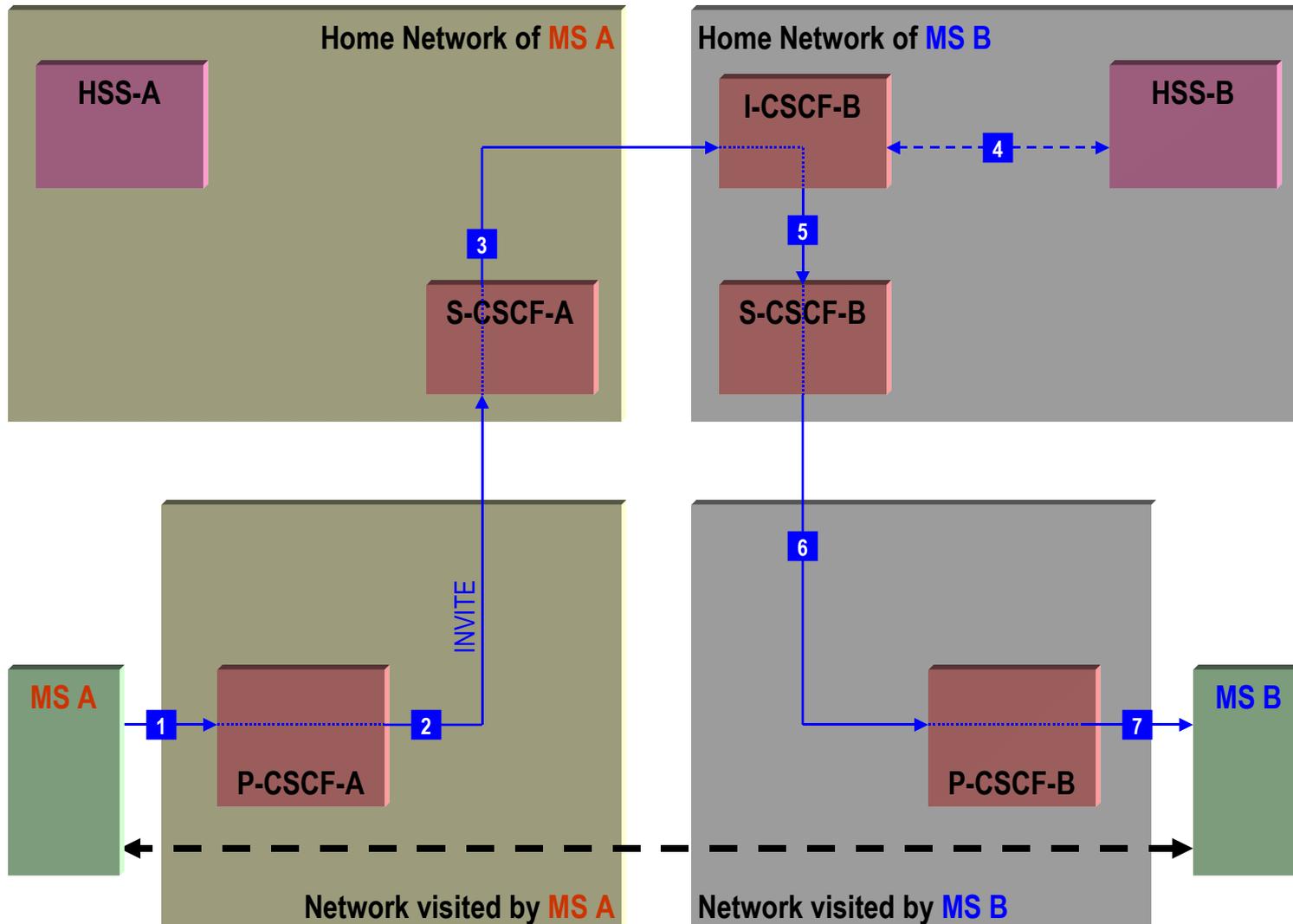
# Basic Message Flow

## Routing of Mobile-To-Mobile Calls - Registration



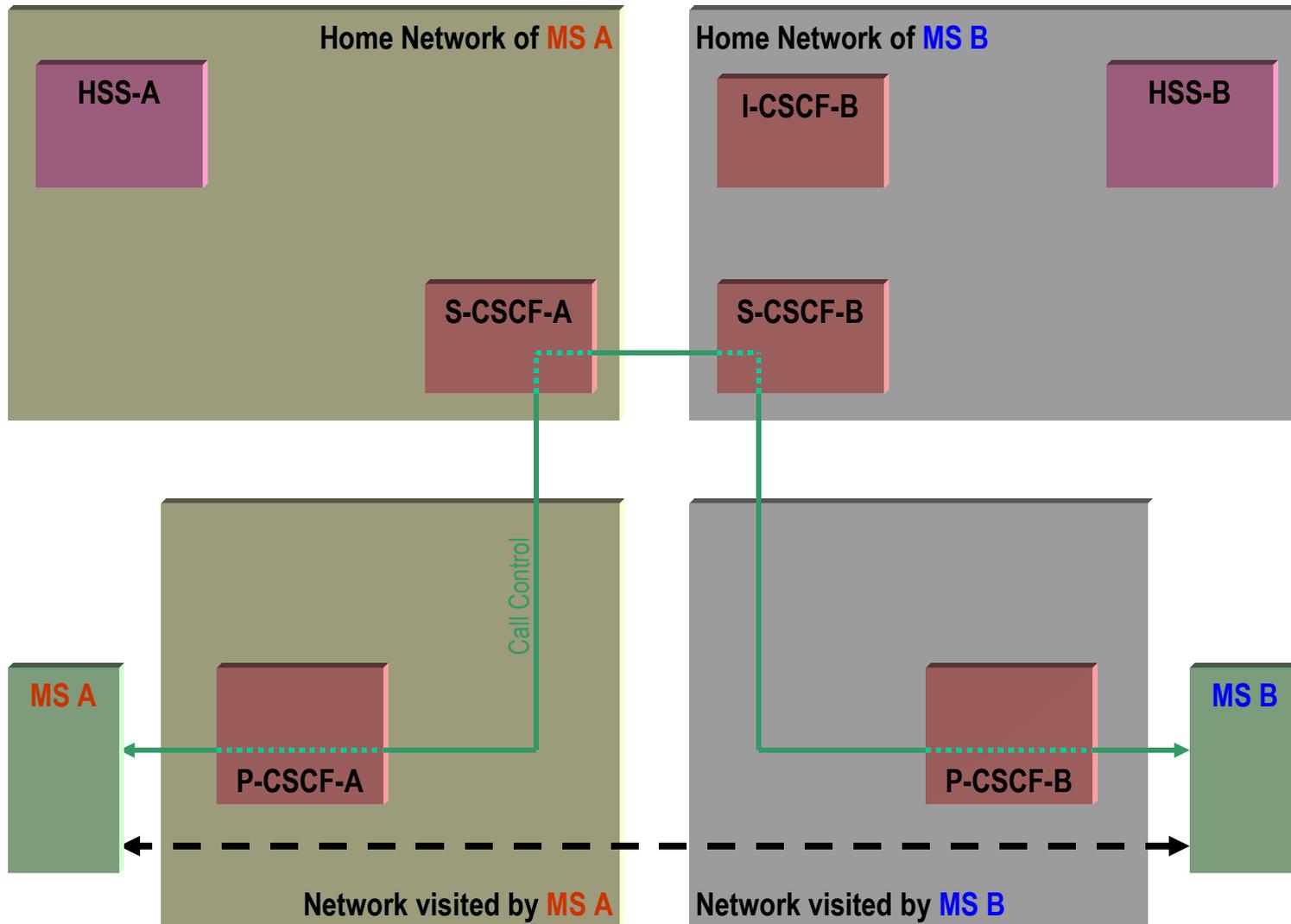
# Basic Message Flow

## Routing of Mobile-To-Mobile Calls - Session Initiation

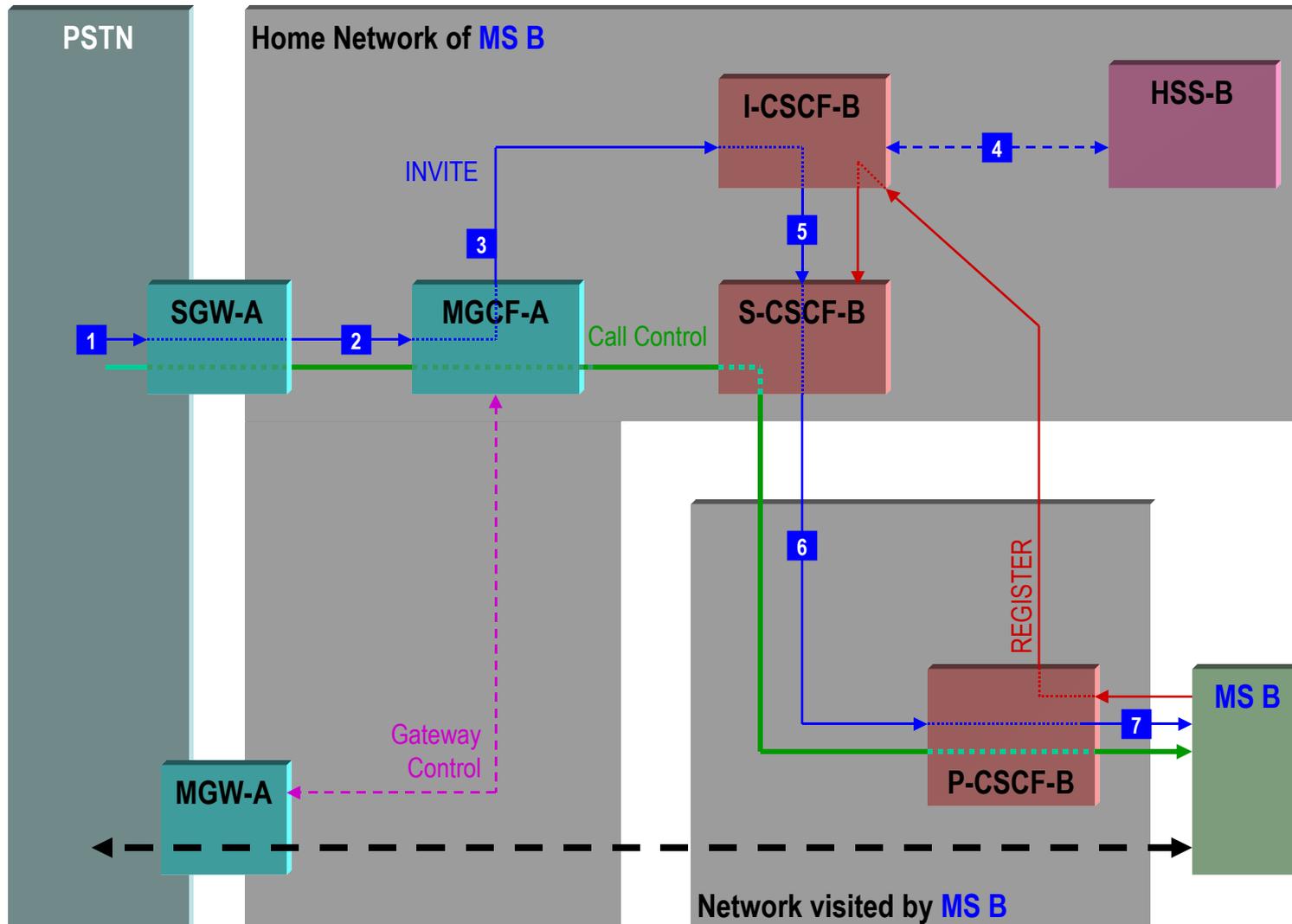


# Basic Message Flow

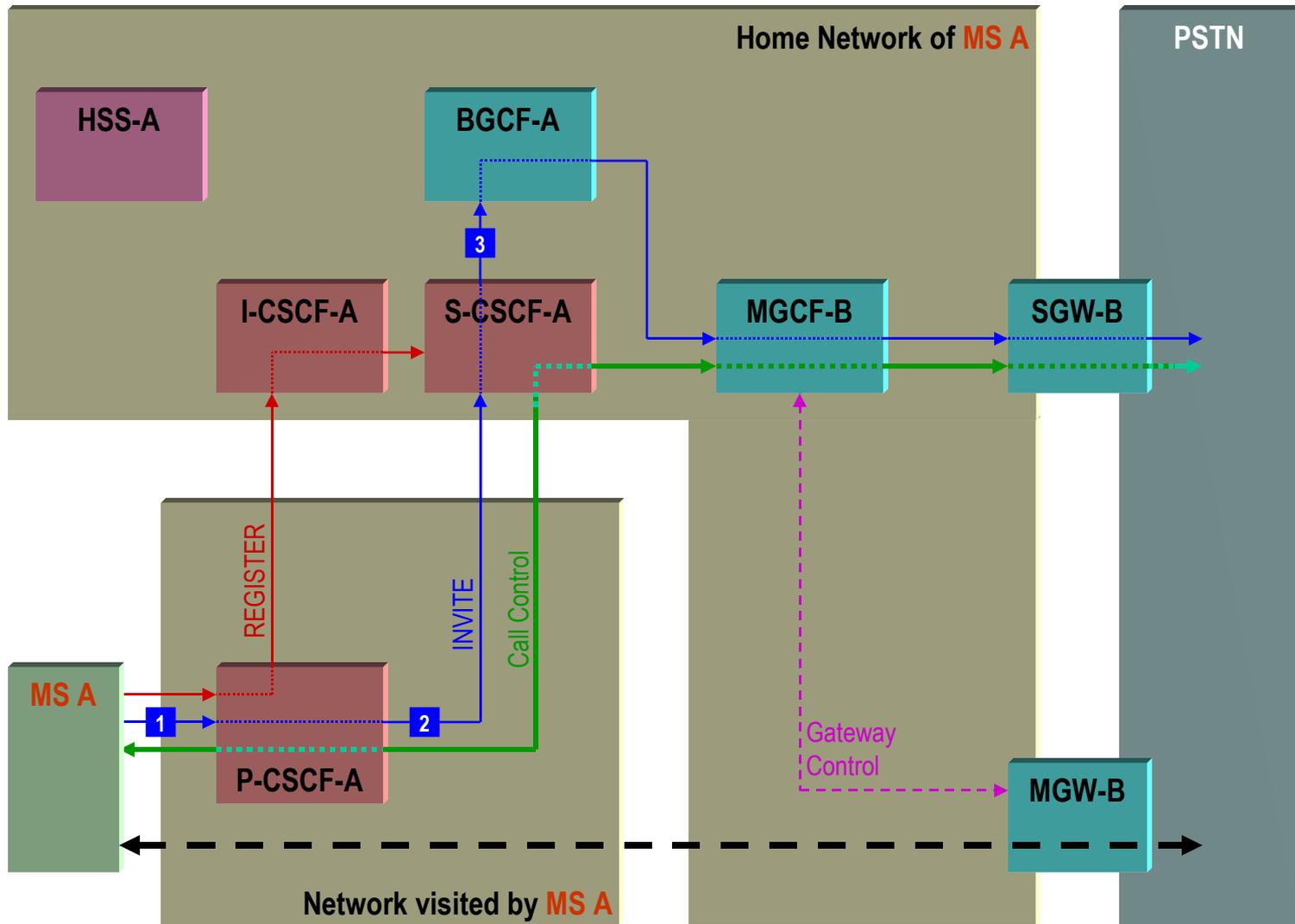
## Routing of Mobile-To-Mobile Calls - Call Control



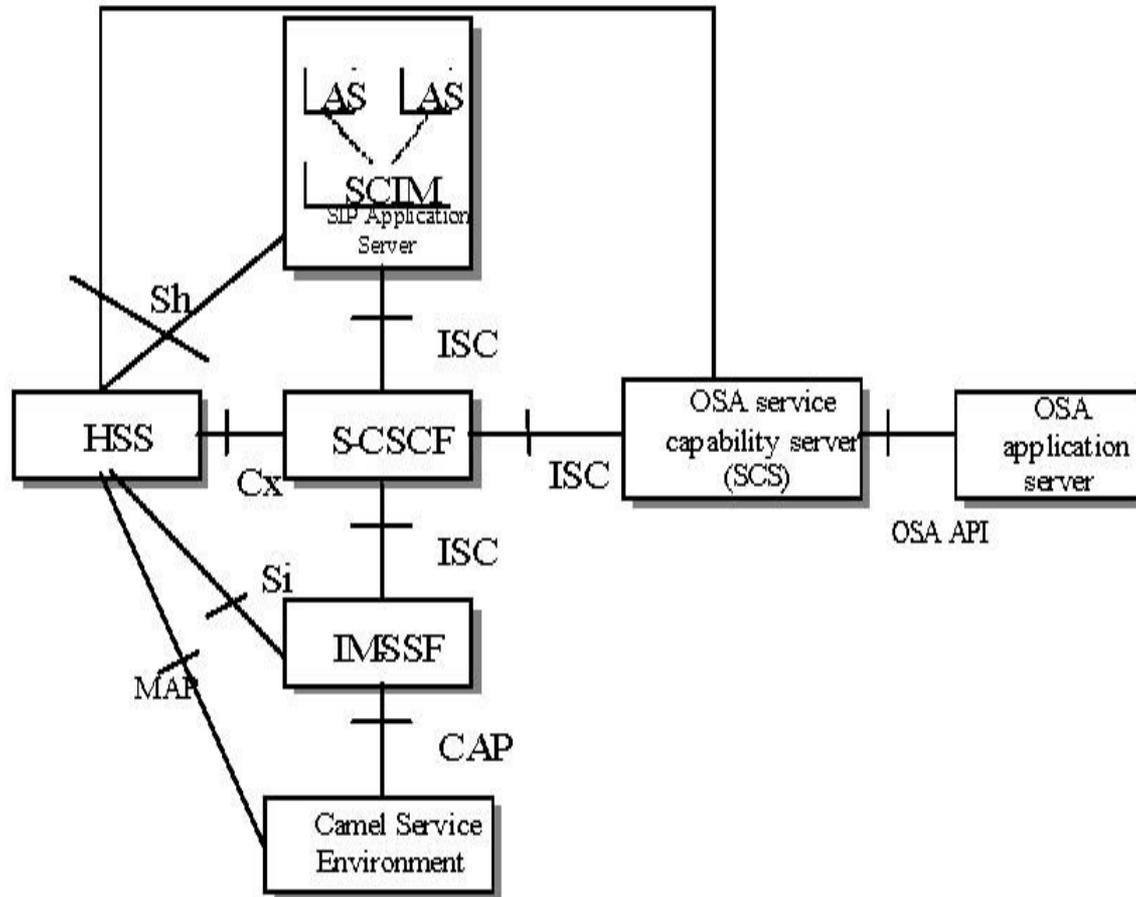
# Basic Message Flow Routing Calls from CS or PSTN



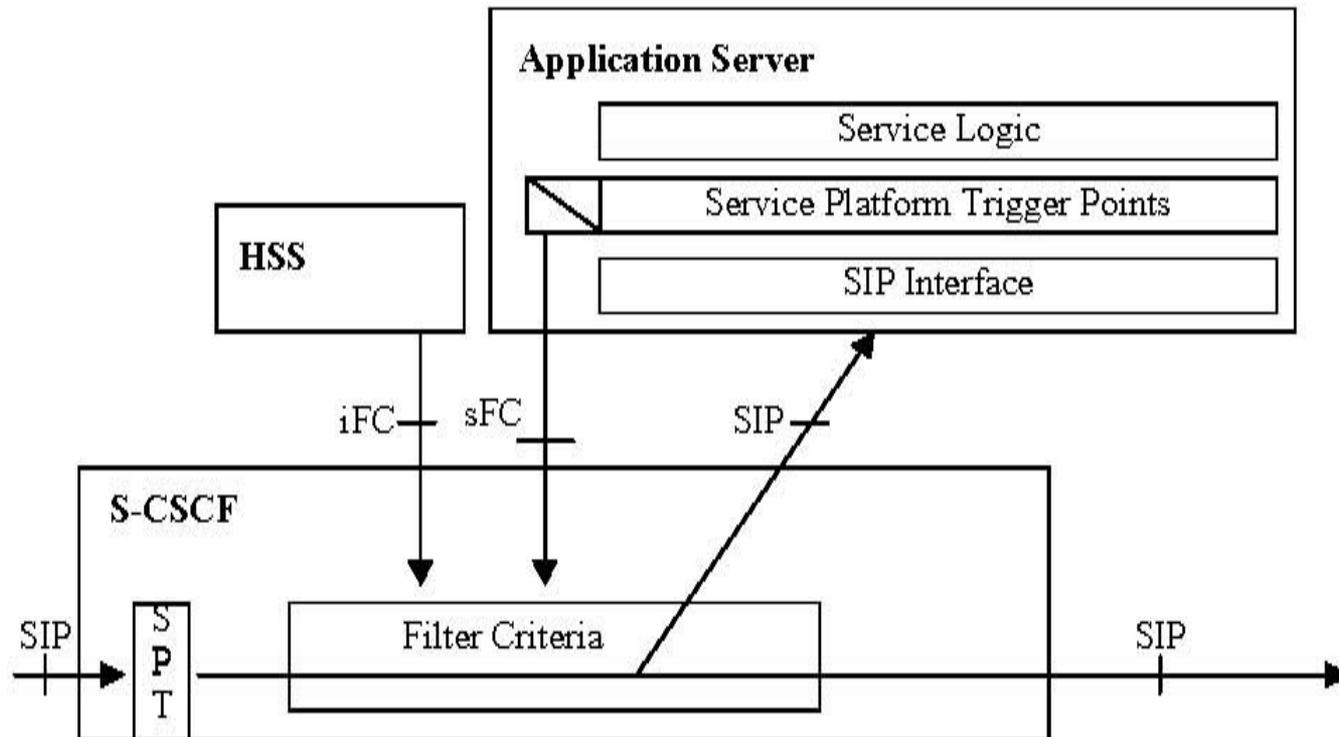
# Basic Message Flow Routing Calls to CS or PSTN



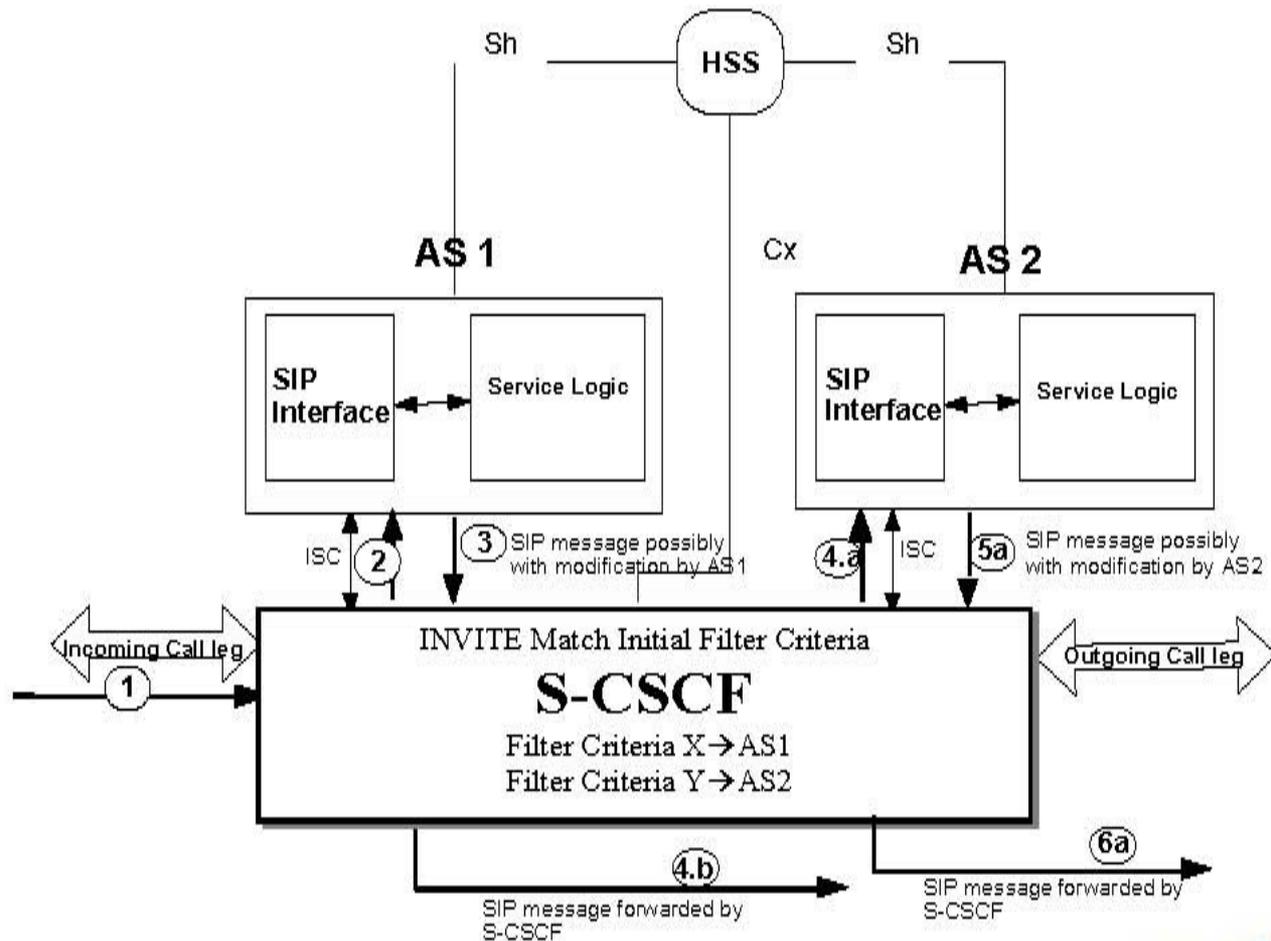
# IMS Service Architecture



# Service Triggering Mechanism



# iFC Triggering Procedure



**NGN : Nothing new, but upgrading, adding Value**

**Up-grading  
Current  
Infrastructure**



**Adding  
Value**



**Current Generation-Beach**



**Next Generation-Water Park**

# Back-Up Slides