



Services and applications in IMS

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Course Objectives:

- To learn the network architecture and basic principles of Services and applications in IMS
- To learn the key technology of IMS based voice service and short message service

Agenda





The main feature of IMS





- IMS is the product of the integration of communication technology and Internet technology
- Service solution without IMS is complex, vertical service deployment model
- Complete separation of service and control
- Rapid &flexibly deployment of new service
- All IP core network control architecture
- Convergence of multiple fixed / mobile access methods
- Seamless mobility and service continuity

Interaction between services:





IMS vs. integrated SIP architecture



IMS service ability





Basic service ability Advanced service ability

- Base SIP
- OSA-Parlay
- CAMEL

Service capability based on OSA



• Communication type services

- such as click on the dial, VOIP click on the fax, video call and other locations related emergency call, roadside assistant service, etc.;
- Message type services:
 - such as unified messaging, SMS, voice mail, E-Mail, multimedia messaging, chat, etc. ;
- Information type service
 - such as news, sports, tourism, finance, weather, yellow pages, ticketing and other various information query custom notification, and based on the position of the tracking to find friends;

• Payment type services

• such as e-commerce, mobile banking, online payment, instant ticket booking fees browsing, etc. ;

• Entertainment type services

- such as games, gambling, riddles, education, advertising, etc.;
- All kinds of service can be relatively independent, can also be organically combined, such as in query
 information according to the corresponding information payment service; another example, a variety
 of entertainment can be reflected by the different ways of news (short message, email) combines
 entertainment and news services.



OSA/Parlay APIs





• Framework

- Authentication
- Authorization
- discover
- Develop service protocol
- security

Service Capability Server

- Call control
- User location
- User state
- Message service
- User interaction
- Charging



registration

discovery

Agenda





IMS service structure







Interface

- SIP
- Diameter
- H.248







- ICS: IMS Centralized Services (3GPP TS23.292)
- ICS is suitable for the operators who will deploy IMS network and use IMS mechanism to control VoIP service;
- To CS and IMS dual operation operator, ICS can help them to
 - Keep service consistency and continuity
 - provide new service base IMS for users through CS access
 - Support evolution from the current network architecture (CS) to the target network architecture (IMS)
 - To protect the existing CS investment, reduce operating costs

ICS Scenario



ICS

-To provide IMS service capabilities to users through a variety of access types

-Typically, through CS access, the service is provided in IMS, while CS is only used as a media bearer



A: access through PS with VoIP capability

B: access through PS

C: access through PS without VoIP capability,CS served as bearer

ICS architecture







VCC



- VCC: Voice Call Continuity
- transfer the path of an existing voice call between a 3GPP CS system (GSM/UMTS) and IMS, and vice versa.

IMS user ID







Numbering and addressing -1



- Home network domain name
 - Identify IMS users home IMS network
 - Global Uniqueness
 - Stored in a smart card or terminal, or derived from the IMSI
 - the home network domain name format: ims.mnc(0xx).mcc(460).3gppnetwork.org。
- Private user ID (IMPI)
 - For user access IMS network registration, authentication and charging
 - Does not apply to addressing and routing
 - Uniqueness in IMS network
 - The use of the form of NAI, that is: username@ home network domain name

Numbering and addressing -2





- Public user identity(IMPU)
 - Users's communication identity, for the SIP message routing.
 - An IMS user can be assigned one or more public user identity
 - SIP URI "SIP: user@domain"
 - User: "SIP: 1234567@domain", "SIP: Alex @domain", "SIP: 1234567@domian, user=phone"
 - the user name is not allowed to repeat in the same IMS domain name inside
 - Domain uses home domain name
 - Tel URI is not for SIP message routing, need to be converted into the corresponding SIP URI in the IMS network for routing

Numbering and addressing -3





- Public service identifier(PSI)
 - Used to identify the services and groups owned by AS, can be static or dynamic
 - The public service identifier is stored in HSS, which is managed by an application server to manage the IP address assignment.
 - Format can be SIP URI or Tel URI
 - Public service identification can be a sure PSI can also be a wildcard PSI, such as "sip:chatlist*@example.com"

IMS user access







IMS session establishment







Interworking with CS/PSTN







IMS roaming



- By PCSCF users can access the IMS network anywhere;
- Can only use the home network S-CSCF ;
- Application platforms can be either home or visited.

Sketch map of roaming







Terminal and UICC -1



- IMS identity module (ISIM) is a UICC smart card applications, including a series of parameters:
 - Private user identity (IMPI):a private user ID is stored in ISIM ,that is allocated to the user, and one ISIM can only store one private user id.
 - Public user identity (IMPU): one or more public user ID stored in ISIM, the **for**mat can be Tel URI or SIP URI.
 - Home network domain name: for the search for home network address during the registration process, ISIM can only store one network domain name.
 - Other parameters for authentication, integrity, and key encryption for terminals and networks.
 - The above parameters are read-only data.

Terminal and UICC -2



- IMS terminal should support the following characteristics:
 - P-CSCF discovery.
 - Can use static configuration or dynamic way to get P-CSCF address.
 - IMS registration and authentication.
- When the IMS terminal uses the UICC card loaded with ISIM application to access the IMS network, the IMPI, IMPU and URI are used to create the SIP REGISTER request, which is stored in the ISIM, to complete the authentication process.
- When the IMS terminal uses the UICC without ISIM application to access the IMS network, the terminal should establish the temporary IMPI, the temporary IMPU and the URI according to the USIM stored IMSI, creates the SIP REGISTER request, in order to complete the authentication process.
- IPSec
- SIP sigcomp

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Voice service





- CS Voice service
- Basic service: AMR codec, from 4.75K to 12.2K, static&dynamic 。
- Supplementary service
- **PS Voice service (**VoIP)

- VOLTE: Providing voice services through LTE access IMS

- VoWiFi, RCS
- Internet voice (QQ Skype wechat)



Voice solutions in LTE network















SRVCC





 SRVCC: In the LTE network coverage area using IMS VoIP service, when the user reaches the LTE network coverage edge but with good 2G / 3G network coverage, under the control of EPC network, the user handover from the LTE to 2G / 3G network.

SRVCC architecture







LTE architecture







VoLTE Overall structure







LTE VOIP



Voice over IMS over EPC over LTE



VoLTE network entities -1





| Element name | Domain | function |
|--------------|----------------------|---|
| eNodeB | LTE RAN | VoLTE dedicated bearer , SRVCC |
| MME | EPC CN | SRVCC |
| S/P-GW | EPC CN | VoLTE dedicated bearer |
| PCRF | EPC CN | Rx |
| MSS/eMSS | R4 CN | SRVCC |
| MGCF | Interworking gateway | IMS/R4 voice interworking |
| IM-MGW | Interworking gateway | IMS/R4 voice interworking |
| I-SBC | IMS media | IMS interworking |
| BCF | IMS control | Control BGF, |
| BGF | IMS media | IMS media |
| P-CSCF | IMS control | IMS CN control access side |
| I/S-CSCF | IMS control | IMS CN control home domain |
| BGCF | IMS control | IMS routing capabilities for users to call other networks |
| DRA | IMS control | Provide Diameter interface (such as Cx/Dx/Sh/Rx) routing function |
| ENUM DNS | IMS control | Translate the E.164 number to IMS user's IMPU |

VoLTE network entities -2





| Element name | Domain | function |
|------------------|--------------------|---|
| TAS | IMS service domain | Supporting VoLTE voice and supplementary service |
| MRFC | IMS service domain | VoLTE voice recording server notification and mixing control function |
| MRFP | IMS service domain | Notice of record and mix media function in VoLTE voice server |
| IP-SM-GW | IMS service domain | Provide VoLTE and CS SMS interworking |
| IM-SSF(optional) | IMS service domain | Provide VoLTE and CS IN interworking |
| IMS-HSS BE | IMS data domain | Used to store IMS related user data |
| IMS-HSS FE | IMS data domain | Interface for providing HSS to CSCF or service servers |
| SCC-AS | IMS service domain | Service server providing SRVCC anchoring function |
| ATCF | IMS control domain | Provide eSRVCC control plane features |
| ATGW | IMS data domain | Provide eSRVCC media plane features |
| CG | IMS support domain | Provide IMS CDRintegration capabilities |
| OSS | IMS support domain | IMS network management |

APN and P-CSCF Discovery



• IMS APN

- The IMS application must use newly defined IMS APN
- The APN name must be "IMS", which is also the APN Network Identifier part of the full APN
- UE and network shall support the procedures for P-CSCF discovery via EPS



EPS Registration, Default bearer setup and VoLTE support discovery







IMS Registration and User Authentication

IMS Registration Procedure:



- the UE's Public Identity ("phone number", SIP-URI) is associated with its contact address (IP address)
- the UE is authenticated and authorized to use the IMS services
- the registration is regularly refreshed (typical refresh period: 1 2 hrs). This is denoted as "re-registration".





IMS Originating Call Setup





IMS Terminating Call Setup



 the UE (A-Party) in the PSTN or in another IMS network makes a call to UE (B-Party) in the IMS/LTE network.



Terminated Access Domain Selection (T-ADS)

•Terminals can be registered to IMS and MSS, for example at the same time , eg. the terminal moves from the LTE coverage area to CS, but in the IMS did not cancel the registration

• Need to select the correct domain, through the IMS (PS) or MSS (CS) to route the call to the VoLTE IMS called users



QoS for IMS services in the LTE access



Default- and Dedicated EPS bearers:

- Default EPS Bearer used e.g. for IMS signaling and internet traffic:
 - When the UE connects to a PDN in the initial attach, one *default* EPS bearer is established, remaining valid throughout the lifetime of the PDN connection.
 - Default EPS bearers are Non-Guaranteed-Bit-Rate (non-GBR) bearers
- Dedicated EPS Bearers used e.g. for the transport of the VoIP bearer traffic:
 - Dedicated EPS bearers (non-GBR or GBR) can be created for QoS differentiation purposes e.g. VoIP support.
 - the creation of a Dedicated EPS bearer is initiated by the network (and not by the UE).
 - the Default- and the Dedicated Bearer of the same APN share the same IP address.



QoS for IMS services in the LTE access



MMTel IMS vs CS supplementary services





| MMTel Supplementarys service in IR.92 | Respective supplementary services in HLR |
|---|--|
| Originating Identification Presentation | Calling Line Identity Presentation |
| Terminating Identification Presentation | Connected Line Identity Presentation |
| Originating Identification Restriction | Calling Line Identity Restriction |
| Terminating Identification Restriction | Connected Line Identity Restriction |
| Communication Forwarding Unconditional | Call Forwarding Unconditional |
| Communication Forwarding on not Logged in | Early CFNRc |
| Communication Forwarding on Busy | Call Forwarding Busy |
| Communication Forwarding on not Reachable | Late Call Forwarding not Reachable |
| Communication Forwarding on No Reply | Call Forwarding no Reply |
| Barring of All Incoming Calls | Barring of all Incoming Calls |
| Barring of All Outgoing Calls | Barring of all Outgoing Calls |
| Barring of Outgoing International Calls | Barring of Outgoing International Calls |
| Barring of Outgoing International Calls – ex Home Country | BOIC-exHC /BOIH |
| Barring of Incoming Calls - When Roaming | BAIC-Roam |
| Communication Hold | Call Hold |
| Message Waiting Indication | Voice Mail Indication |
| Communication Waiting | Call Waiting |
| Ad-Hoc Multi Party Conference | MPTY |

LTE voice roaming













CS routing emulation

CSFB for roaming

Basic IMS roaming

Charging correlation principles for IM CN subsystems (3GPP) Subscriber A call to subscriber B



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SMS Service Support in LTE

- two standard solutions have been defined:
 - **1.** SMS over SGs interface Solution:
 - includes the transparent SMS delivery as part of the NAS signaling over the LTE access.
 - the UE needs to use the Combined EPC/IMSI Attach procedure.
 - the IMS is not involved at all.
 - defined in 3GPP TS 23.272 (part of CSFB).
 - 2. SMS over IMS Solution:
 - includes the SMS delivery over IMS using the SIP Message request.
 - based on the IP-SM-GW
 - defined in 3GPP TS 23.204









SMS over IP







SMS interworking







SMS over SGs--MT SMS







CAICT&MTNet

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MTNet NV-IOT test architecture



MTNet VoLTE test event



Test environment

EPC/IMS of different vendors , simulating different

operators

LTE FDD \rightarrow WCDMA

TD-LTE→ GSM

Test scope

Each terminal / chip in a number of environments to complete the IOT test

Test result

Almost all of the terminal / chip passed all of test

cases.



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Thank you!

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