

IMS and SIP Signaling - VoLTE

Course Duration:

- 2 days.

Course Description:

- The course describes the voice over LTE capabilities with a special focus on IMS and the signaling protocol SIP / SDP.
- We will start with an overview on the IMS related architecture with special focus on the LTE Access network and 3GPP interworking with other RATs.
- We will then introduce the bearer concept and QoS architecture in LTE / SAE discussing the signaling for default and dedicated bearer setup, e.g. IMS triggered with the interaction with the policy functions (PCRFs).
- The purpose of the main architecture elements will be explained focusing in a sort of data sheet for each logical element. Other control entities, such as public, private and service identities, their relationship and use will be explained in detail in order to understand service routing capabilities.
- A central part will be an introduction to the signaling and media stream protocols, such as SIP / SDP, Diameter for policing and RTP / RTCP and their applicability for voice and other media transport in LTE.
- This protocol section will be completed with a review of the softswitch architecture as required by LTE for a roaming environment with voice support, introducing the architecture and functionality of Media Gateway Controllers and associated Media Gateways.
- We will then discuss in detail the alternatives for voice over LTE – with and without IMS support, such as SRVCC, CS Fallback and also quickly review other solutions such as VoLGA etc.
- Related scenarios and different use case for SRVCC and CS Fallback – including SMS transmission - will then conclude the course.

Pre-Requisites:

- The student must possess a sound understanding of network architectures in 3GPP. There is no particular knowledge required regarding IMS and SIP/SDP.
- We do recommend our webinar or web based training courses on LTE as preparation for the course in order to improve efficiency and comprehension.

Course Target:

- The student is enabled to understand particular voice requirements for LTE networks and is entitled to maintain and operate such networks.
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Some of your questions that will be answered:

- Why is IMS becoming an important function for LTE deployments supporting roaming voice subscribers?
- What are the main controlling entities for voice support in an IMS / LTE system environment?
- How are voice bearers identified and handled distinct from other services?
- How are sessions initiated and controlled, what is meant by a transaction, a SIP call and a SIP dialog?
- How are SIP transactions and dialogs identified? What are the most important header fields and their purpose?
- Where and for what purpose is Diameter protocol being used in a network deploying voice over LTE?
- Which mandatory codec types have to be supported for the media stream?
- How does a softswitch work and what are its main components and signaling interfaces?
- What is CS Fallback and when and where is it applicable? How is CSFB signaled / triggered?
- What is SRVCC and when and where is that applicable? How is this distinct from CSFB?
- How is SMS handled in an LTE voice environment and what are the alternatives for SMS here?

Who should attend this class?

- Design engineers who need to understand Voice over LTE protocols, features and interfaces.
- Anyone who need to understand the VoLTE terminology, features, interfaces and the applicability in future 3GPP networks.

Table of Contents:

IMS Architecture Overview

- **IMS in the overall Network Architecture**
- **The IMS in the 3GPP Architecture (Network Perspective)**
 - ⇒ And what is inside the IMS?
- **What is VoLTE?**
 - ⇒ VoIP
 - ⇒ VoLTE
 - ⇒ IP Multimedia Subsystem (IMS)
 - ⇒ Rich Communication Suite (RCS)
 - ⇒ MMTel
 - ⇒ VoLTE Network details in the context of LTE
 - ⇒ Control Plane / E-UTRAN – EPC
 - ⇒ User Plane E-UTRAN – EPC (S5/S8 GTP-based)
 - ⇒ SIP / SDP Transport Details
 - ⇒ The Mobile's Way to SIP Registration and SIP-Sessions

IMS with LTE

- **Attachment through E-UTRAN / new MME**
- **Bearer Concept & QoS-Architecture in SAE**
 - ⇒ SAE-Bearers, Classification and Policy Enforcement
 - ⇒ The QoS-Profile of the SAE-Bearer
 - QCI – QoS Class Identifier, GBR – Guaranteed Bit Rate, MBR – Maximum Bitrate, AMBR – Aggregate Maximum Bit Rate (APN-AMBR, UE-AMBR), QCI-Values and their Meanings, Mapping between Rel. 8 QoS and earlier Releases (QCI – QoS Class Identifier,)
- **Dedicated EPS Bearer Establishment**
 - ⇒ Network Initiated (IMS triggered during Call Establishment)
 - Initial Conditions, Detailed Description of PDN-GW & PCRF interworking
 - ⇒ Example for VoIP-IMS in LTE – S1-MME/UserPlane

Three EPS Bearers for a Voice Call?, Example for Traffic Flow Template (TFT) – QCI 5,
Example for Traffic Flow Template (TFT) – QCI 1

- **Security in LTE**

Architecture Internals and IMS Operation

- **Basic Architectural Elements**

- ⇒ Generic SIP-Network Architecture
- ⇒ Typical User Agents of the IMS
- ⇒ SIP Messaging between User Agents

- **IMS-related Identities**

- ⇒ Public User Identities
- ⇒ Private User Identities
- ⇒ Service Identities
- ⇒ Private User Identity (IMPI) / Public User Identity (IMPU)
Overview / the ISIM, Private User Identity (IMPI), Public User Identity (IMPU)
- ⇒ Details of Private User Identities (IMPI)
- ⇒ Details of Public User Identities (IMPU)
- ⇒ Use of Private and Public User Identities in REGISTER-Msgs.
Home Network Domain Name, Use of Private User Identity, Use of Public User Identity,
Use of Temporary Public User Identity
- ⇒ Relationship between Private and Public User Identities
- ⇒ Server Types (generic)
- ⇒ Special Server Types (generic)

- **IMS – the Detailed View**

- **P-CSCF – Tasks & Functions**

- ⇒ Typical Use Cases
Security Association Details
- ⇒ P-CSCF Interworking with the TrGW
- ⇒ Facts Sheet

- **I-CSCF – Tasks & Functions**

- **Typical I-CSCF Use Cases**

- ⇒ I-CSCF Involvement during UA Registration
- ⇒ I-CSCF Involvement during IMS-Incoming Transactions

⇒ Topology Hiding through the I-CSCF

⇒ Facts Sheet

- **S-CSCF – Tasks & Functions**

- **Typical Use Cases of the S-CSCF**

⇒ Registration Overview

⇒ Detailed IMS Registration
3rd Party Registration

⇒ Involvement during IMS-Originating Transactions

⇒ Involvement during IMS-Terminating Session

- **Service Architecture and Routing**

⇒ Routing Selection with Initial Filter Criteria

⇒ Example: Initial Filter Criteria and Trigger Point Configuration

⇒ IMS Routing Scenarios (Examples)

⇒ IMS Routing Scenarios (Examples) (cont'd)

⇒ Facts Sheet

- **BGCF – Tasks & Functions**

- **Use Case of the BGCF**

⇒ Facts Sheet

- **MGCF / MGW (IMS-MGW) – Tasks & Functions**

- **Typical Use Cases of the MGCF and the IMS-MGW**

⇒ Involvement during IMS-MOC towards PSTN or CS-Domain

⇒ Facts Sheet

⇒ Facts Sheet

- **MRF – Tasks & Functions**

- **Typical Use Case: Announcement Playing**

⇒ Facts Sheet

⇒ Facts Sheet

IMS Protocols and Messages

- **SIP and SDP**

, Session Establishment, Clarification of the Term “Session”, Session Modification, Session Release

- ⇒ Session Setup Example through SIP
- ⇒ Some SIP-Terminologies
Message Types, SIP-Methods, Response Types
- ⇒ SIP-Message Format
General Information, Request Messages, , Response Messages
- ⇒ Selected SIP Header Parameters
Example: SIP Logfile with Header and Routing Info
- ⇒ Transaction Identification (two UA's / no Proxies)
The Cseq Parameter , The Branch Parameter, Magic Cookie "z9hG4bK", Example:
Transaction Identification (Sequence Numbering (CSeq))
- ⇒ Dialog Identification (two Users / with or w/o Proxies)
Session Identification and Distinction
- ⇒ Session Description Protocol
- ⇒ The Offer / Answer Model
Example: SIP Logfile with SDP Parameter Definitions as Payload

- **Introduction to other important IMS-related Protocols**

- ⇒ Introduction to the DIAMETER Protocol
- ⇒ IMS-specific Amendments to DIAMETER Protocol
- ⇒ Architecture Overview
Overview of IMS Specific Messages

- **SIP Session Setup and Diameter Relation – Principles**

- **Review of RTP / SRTP / RTSP / RTCP**

- ⇒ Operational Overview of RTP and RTCP
SSRC (Synchronization Source / 32 bit), CSRC (Contributing Source / 32 bit), Timestamp Information
- ⇒ RTP / RTCP
- ⇒ Review of the RTP Header Format
Version, P-Bit (Padding), Ext-Bit (Header Extension), , CSRC-Count, M-Bit (Marker), Timestamp, Synchronization Source (SSRC), Contributing Source (CSRC), Extension Header, Payload Type, Sequence Number
- ⇒ IMS Mandatory Media for VoLTE Services – UE View
- ⇒ Tasks and Functions of RTCP
Quality Report Transfer, Session Control, CNAME <=> SSRC Binding
- ⇒ Example of an RTCP-Frame (Sender Report)
Gateway Architecture, Scope of H.248
- ⇒ Contexts and Terminations

Terminations, Contexts

- ⇒ The H.248 / MEGACO Command Set
Notify, Service Change, Add, Modify, Subtract, Move, Audit Value, Audit Capabilities,
Example of Media Gateway Operation through H.248
- ⇒ DNS-Queries in the IMS-Environment
- ⇒ ENUM
- ⇒ IPsec
IPsec in Tunnel Mode, The IPsec Authentication Header (Next Header (8 bit), Payload Length (8 bit), Reserved (16 bit), Security Parameters Index (SPI) (32 bit), Sequence Number (32 bit), Authentication Data (n bit)), The IPsec Encapsulated Security Payload (ESP) Header (Security Parameters Index (SPI) (32 bit), Sequence Number (32 bit), Payload Data (n bit), Padding (0 – 255 octets), Padding Length (8 bit), Next Header (8 bit), ESP Authentication Data (n bit))

Selected Services over IMS

- **VoLTE and the Alternatives**
 - ⇒ SRVCC
 - ⇒ CSFB
 - ⇒ SVLTE
 - ⇒ VoLGA
 - ⇒ FEMTO / PICO Cells
 - ⇒ Over The Top (OTT)
 - ⇒ IMS
 - ⇒ The Voice Evolution
 - ⇒ Circuit Switched Fallback (CSFB)
The SGs Interface, CSFB Procedures, Handover or Redirection, Delay Values, Call Setup Success Rate
- **Single Radio Voice Call Continuity (SRVCC)**
 - ⇒ SRVCC in Release 8
 - ⇒ Enhanced SRVCC
Architecture in case of IMS-based Voice Services (SRVCC)
- **IMS based VoLTE – A Brief Comparison**
- **IMS Centralized Services**
 - ⇒ Architecture for IMS Service Centralization and Continuity
SCC AS, UE (normal or enhanced for ICS), MSC Server (normal or enhancements for ICS), IMS registration via CS access
- **IMS MMTel Overview**

- **VoLTE – The Service Overview**

- ⇒ Generic IMS Functionality
- ⇒ SIP Registration
- ⇒ Authentication
- ⇒ Addressing
- ⇒ Call Establishment and Termination
- ⇒ Forking
- ⇒ Tracing of Signals
- ⇒ Use of Signaling Compression
- ⇒ Overview of IMS Supplementary Services
- ⇒ Overview
- ⇒ Supplementary Service Configuration
- ⇒ Ad Hoc Multi Party Conference
- ⇒ Communication waiting
- ⇒ Message Waiting Indication
- ⇒ Originating Identification Restriction
- ⇒ Terminating Identification Restriction
- ⇒ Communication Diversion
- ⇒ Communication Barring
- ⇒ Call Setup and SMS over IP Functionality
- ⇒ Call Setup Features
 - SIP Preconditions, Loss of PDN Connectivity, Loss of Media Bearer and Radio Connection, Voice Media, Multimedia
- ⇒ SMS Over IP
- ⇒ IMS Required Media Support
- ⇒ Codecs
- ⇒ RTP Profile
- ⇒ SDP Offer
- ⇒ Data Transport
- ⇒ RTCP
- ⇒ DTMF Events
- ⇒ Radio and Packet Core Feature Set

- ⇒ ROHC Profiles
- ⇒ LTE Radio Bearer Configurations
- ⇒ Bearer Management
- ⇒ P-CSCF Discovery
- ⇒ IMS Common Functionality
- ⇒ IP Version
- ⇒ Emergency Service
- ⇒ Domain Selection
- ⇒ Rich Communication Suite (RCS, RCS-e, Joyn)
- ⇒ Roaming Considerations
 - Interworking with PS CN, Target Voice Roaming Architecture
 - Access network specific signaling , Session Establishment Signaling – SIP / SDP ,
 - Diameter Signaling, Media Stream

- **SMS Handling**
 - The SMS Service