Voice over LTE
Telephony on the National Public Safety Broadband Network

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Agenda

- VoLTE Overview
- What is VoLTE
- VoLTE for FirstNet
Setting the scene for voice in the LTE era

A voice solution is needed for an LTE smartphone to connect to LTE network, otherwise it is connected to 2G/3G only – for voice and data.

The industry known options for voice are:

- Circuit switched fallback (CSFB)
- IMS based VoLTE (VoLTE)
- Simultaneous voice and data (SV-LTE)
Foreseen Voice over LTE Technology Evolution

Smartphone launch on LTE networks means that a voice solution must be implemented

- **SVLTE**: Dual radio terminals for CDMA /LTE operators
- **CSFB**: Voice over 2G/3G and data over LTE
- **VoLTE**: Secure voice quality
- **SRVCC**: Seamless voice continuity
- **VoLTE roaming**

**2012**
- Support for dual radio terminals
- CDMA / LTE operations
- VoLTE with QoS

**2013**
- CS Fallback to 2G/3G
- VoLTE with SRVCC

**2014**
- SMS over LTE connection
- Over the air configuration, prepaid information

**2015**
- VoLTE roaming
- Smartphone launch on LTE networks means that a voice solution must be implemented

**Terminals**
- SV-LTE
- CSFB
- VoLTE
- SRVCC

**Network Impact**
- Green indicates support
- Yellow indicates partial support
- Red indicates no support
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• VoLTE Overview

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VoLTE system architecture
The Obligatory Spaghetti Diagram

Call control signalling
User plane traffic
Other control signalling
What Is Needed for VoLTE

1. Circuit Switched Fallback (CSFB)
2. Single Radio Voice Call Continuity (SRVCC)
3. Rich Communications (RCS)
4. IMS Centralized Services (ICS)
5. Domain Selection (T-ADS)
6. Emergency Call (911)
7. Lawful Intercept (LI)
8. Roaming
9. Terminals

Assumed: LTE Network with QoS, Location and Charging
LTE Voice and Messaging Evolution

(Simplified for clarity, visited network and roaming not shown)

1. CSFB + SMS over SGs
2. VoLTE
3. SRVCC
4. RCS¹

Main drivers

**CS Fallback**
- Immediate voice solution for LTE
- Roaming before VoLTE roaming
- Emergency calls before IMS based VoLTE in place
- SMS over SGs before SMS o IP

**VoLTE**
- QoS for voice
- Based on all-IP network architecture
- Provides similar tools to fight OTT
- Improved voice spectral efficiency of LTE, short call setup time, short delays

**RCS**
- Richer service offering to attract users
- Alternative service offering to OTT
- Works with CSFB and VoLTE

¹ RCS can be introduced at any time, works with both CSFB and VoLTE
SRVCC in 3GPP

- SRVCC has been standardized in 3GPP Release 8 TS 23.216 to provide seamless continuity for UE handovers from E-UTRAN to UTRAN/GERAN.

3GPP Release 10 targets to enhance SRVCC performance in roaming cases.
3GPP Release 10 introduces two new functional entities for SRVCC: ATCF and ATGW.

ATCF Access Transfer Control Function
ATGW Access Transfer Gateway
Public Safety Broadband

- a simple interoperable extension to voice and SMS . . .

Future RCS-e services
- Image and video share (+voice)
- File transfer (+IM/chat)
- IM/chat
- Messages (SMS/MMS)
- Voice

New services to monetize market trends

Initial ‘joyn’ Service Set

Rich Call
Share the moment / See what I see

Instant messaging
Text chat

File transfer
Share files

Capability discovery
See your peers’ communications capabilities

RCS-e

RCS 5

RCS 5 is completely backward compatible with RCS-e V1.2 specifications and also includes features from RCS 4 and exciting new features such as IP video call, IP voice call and Geo-location exchange.

= new features (not part of RCS-e 1.2)
IMS Roaming / LTE Roaming Support and Evolution

- **3GPP VoLTE/IMS Roaming Alternatives**
  - the alternatives differ in:
    - Architecture: different network elements (P-CSCF, PCRF, PGW) are located in home- and visited networks.
    - Regulatory Service Support: ability to provide local support for IMS Emergency Calls and Lawful Interception.
    - Bearer Support: ability to support an optimized routing for the bearer.
  - today, operators typically have the GGSN/PDN-GW in the Home Network (= Alternative 3)
  - GSMA IR.92 “One Voice” recommends Alternative 1:
    - due to the flexibility to serve regulatory needs (LI, Emergency Calls) and to support optimized routing.
    - the roaming architecture however always also depends on the abilities of the roaming partners (who might not have an IMS at all).
GSMA IR.65
Operational Requirements for IMS Voice and Conversational Services

1. Routing of media for Voice & video over IMS when call originator is Roaming should be at least as optimal as that of current Circuit Switched (CS) domain.
2. The charging model for roaming used in CS domain shall be maintained in VoIMS.
3. Allow the HPMN to decide, based on service and commercial considerations & regulatory obligations, to enforce the routing of the traffic to itself (home routing).
VoLTE (IR.92) in terminals

Terminal industry trend is that VoIP (VoLTE IR.92) client will be integrated in a chipset – not in a terminal as an separate application.

VoLTE client (GSMA IR.92) run on the modem processor while the application processor can enter sleep mode. The same approach is used for CS voice.

Today VoIP (application) runs on top of OS in the application processor which is power hungry.

VoLTE (GSMA IR.92) calls are invisible to end user as those will be done same way as CS call – press the green button.

Voice clients (CS, CSFB, VoLTE, SRVCC) integrated in chipset.
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LTE Voice implementation depends on operator conditions

**Market situation**
- Capacity demand
- LTE spectrum
- Existing network
- Carrier Relations

**Coverage evolution**

**VoLTE implementation**
- IMS VoLTE
- IMS VoLTE with SRVCC
- CSFB / SVLTE *)

*) CSFB/SVLTE is the minimum as soon as Smartphones enter the LTE network
What Is Needed for VoLTE for FirstNet

1. Circuit Switched Fallback (CSFB)
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Assumed: LTE Network with QoS, Location and Charging

2G/3G Network Partner
2G/3G Network Partner
2G/3G Network Partner
Key Outbound Roaming Scenarios for a Firstnet VoLTE Subscriber (with an 1xCS, LTE, 2G/3G UE) roaming in a visited network:

1. visited network that supports: 1xCS
2. visited network that supports: 1xCS, LTE Data
3. visited network that supports: 1xCS, VoLTE/IMS
4. visited network that supports: 2G/3G CS/PS
5. visited network that supports: 2G/3G CS/PS, LTE Data
6. visited network that supports: 2G/3G CS/PS, VoLTE/IMS
S3 and Gs are used for ISR. S3 is also needed if PS-HO for CSFB is used. Legacy SGSN requires MME to support Gn/Gp interface. PLMN ID in LTE (PS) and 2/3G (CS) can be different.
MOC call flow from LTE to GERAN/UTRAN with redirection

RRC Connection Request

RRC Connection Setup

RRC Connection Setup Complete with Extended Service Request (MO CSFB)

S1-AP message with CSFB Indicator

Optional Measurement Report Solicitation

RRC Connection Release to GERAN or UTRAN

Location Area Update or Combined RA/LA Update (if LAI from radio is different than the one stored by the UE)

CS MO Call Establishment
MT call flow from LTE to GERAN/UTRAN with redirection

- **RRC Connection Request**
- **RRC Connection Setup Complete with Extended Service Request (MO CSFB)**
- **S1-AP message with CSFB and Emergency Indicators**
- **Optional Measurement Report Solicitation**
- **RRC Connection Release to GERAN or UTRAN**
- **Paging Response**
- **A/Iu-cs message with paging response**
- **Location Area Update or Combined RA/LA Update**
- **CS MT Call Establishment**
FirstNet LTE with eSRVCC to partner’s 2/3G

S3 is used for eSRVCC with PS HO procedure (optional). Legacy SGSN requires MME to support Gn/Gp interface.

Other VoLTE functional elements: PCC/S/P-GW/P-CSCF/ATCF…
High level flow for E-UTRAN SRVCC

VoLTE session ongoing

Measurement Reports

SRVCC Handover to UTRAN/GERAN required (CS or CS+PS)

Initiates SRVCC for voice component

CS handover preparation

IMS Service Continuity Procedure

To eUTRAN

Coordinates SRVCC and PS HO response

Handover CMD

Handover execution

PS HO response to MME (CS resources)

Request to partner’s 2/3G network via Sv interface
Thank you!