VoLTE Performance

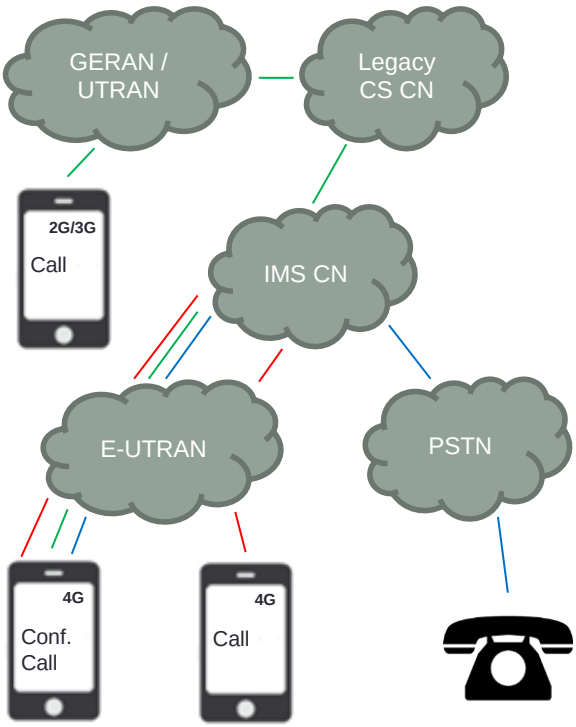
Introduction

Since 2010, the operators of commercial LTE networks have largely depended on legacy UMTS/GSM networks for widespread coverage and for the provision of speech services.

It has been essential for these operators to continue to provide what have been traditionally Circuit-Switched (CS) services for subscribers being served by LTE networks which are Packet-Switched (PS) only.

The interim solutions most operators deploy is twofold;

- **CS-fallback speech calls (CSFB)** where a device is re-directed to a Radio Access Technology (RAT) which supports CS Voice services i.e. UMTS or GSM.
- **SMS over SG** which allows SMS messages to be sent over the LTE SGs signaling link



The deployment of IP Multimedia Sub-system (IMS) core networks allow operators to continue to provide speech services over LTE without resorting to legacy solutions. The most important of these is *Voice-over-LTE*, or VoLTE.

End User Experience

VoLTE call setup times are much shorter compared with those made using CSFB, or even call made when on legacy technologies (UMTS or GSM).

VoLTE also has 'HD Voice' capability making calls sound better, more natural and a reduction in background artefacts like clicks, crackling or static.

If either of the improvements above are not experienced by a user then the perception of VoLTE could be a negative one, leading to a poor customer experience. It is important to test a new product thoroughly to ensure it meets the expectations of the VoLTE user.

Technical Aspects

- To make and receive VoLTE calls, an LTE device needs to be registered on the IMS Core Network (CN.)
  - The device requires a SIM provisioned for IMS services and its voice domain preference to be set to either *IMS PS Voice preferred* or *IMS PS Voice only*.
  - The activation of a **dedicated EPS bearer** with a Guaranteed Bit-Rate sufficient for the highest WB-AMR codec rate of 23.65 kbps is required in addition to the default EPS bearer activated during registration on the LTE network.
- Devices in a VoLTE call approaching the edge of LTE coverage are handed over from the IMS CN / LTE network to a CS CN / UMTS (or GSM) network using a feature called Single Radio Voice Call Continuity (SRVCC.)
  - The SIP session for the VoLTE call is terminated as soon as the device is instructed to handover to CS Radio Access Bearer (RAB) on a UMTS cell, or to a Traffic Channel (TCH) on a GSM cell.
  - The call to the remote end is simultaneously re-routed from the IMS CN to the CS CN.
- If both the device and the UMTS network support Voice-over-HSPA (VoHSPA), then the call will be handed over to HSPA PS RAB on the UMTS network but will remain routed through the IMS CN.
- It is possible for the call to be handed over back to the LTE network when a suitable cell is available.

Proposed Testing

An extensive set of tests need to be run by a terminal supporting VoLTE for GCF approval, which includes nearly all of those specified in section 51 of GSMA TS.11. IOTAS go beyond these requirements in testing the following aspects.

Performance

- VoLTE Call Setup (MO & MT)
- VoLTE Call Stability
- Default EPS Bearer Performance during VoLTE Call over Dedicated EPS Bearer

Functionality

- VoLTE-VoHSPA Inter-working
  - VoLTE -> VoHSPA handovers
  - VoLTE <- VoHSPA handovers
  - VoLTE + Default EPS Bearer <-> VoHSPA + PS RAB handovers
  - VoHSPA -> SRVCC (UMTS / GSM) handover
  - VoHSPA + PS RAB -> SRVCC UMTS CS/PS multi-call handover
  - VoHSPA + PS RAB -> SRVCC GSM DTM call

Proposed Conditions

The performance tests are run so that a Device Under Test (DUT) can be assessed against several typical user scenarios and in comparison with a reference / competitor device.

- VoLTE Call Setup, VoLTE Call Stability and Default EPS Bearer Performance
  - Static – in an area of good LTE coverage
  - Static – in an area of weak LTE coverage
  - Mobile – low speed, high multi-path fading in an urban environment with good LTE coverage
  - Mobile – high speed, low multi-path and high Doppler fading in a rural environment with variable LTE coverage
- VoLTE Call Stability only
  - Routes along the boundary of LTE coverage

The VoLTE-VoHSPA functionality tests are run where both the LTE and UMTS networks support these features by engineers from any of IOTAS' global test centers or affiliates.

Test Metrics

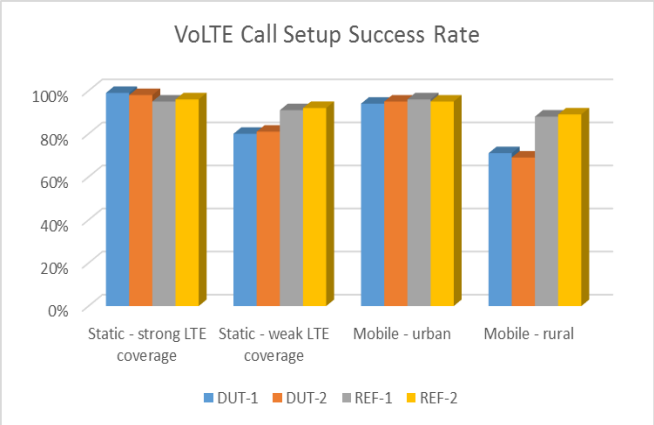
The captured logs are post-processed for performance data which is not immediately observable e.g. FTP / UDP bit rates, call setup success rates, etc.

- VoLTE Call Setup Time
  - Measured from time of RRC Connection Request message to SIP 180 Ringing message
- Speech Codec Rate Variations
  - Changes of rate in both transmit and receive directions
- VoLTE Call Drop Rate
  - Loss of RRC Connection
  - SIP BYE message received when neither party cleared down call
- VoLTE Call Handover Failures
  - RRC Connection Reestablishment messages
- VoLTE-SRVCC Call Handovers
  - Mobility from EUTRA Command messages

Test Reporting

The Key Performance Indicators (KPIs) will be summarized in a test report as follows:

- Bar Charts for each KPI and grouped according to environment e.g.



- Plots of locations for call drops or handover failures

