Product Introduction

VoLTE Test Solution

MD8475A
Signalling Tester
VoLTE Test Solution
- MD8475A Signalling Tester -

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Anritsu Corporation
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Market Background

- The first LTE services supporting 100 Mbps max. high-speed large capacity communications were rolled out in 2010 in N. Europe followed by service build-out in N. America and Asia.
- Connectivity with IP-based core networks must be maintained to support multimedia applications and ubiquitous networks using the packet domain. A key network design feature is assuring high data-rate throughputs at 100 Mbps as well as low latency.
- Starting with content-rich entertainment access and high-speed data downloads, IP conversion of fixed and mobile networks is helping drive the convergence of multimedia services leading to future genuine IP Multimedia-based systems.

<table>
<thead>
<tr>
<th>Technology</th>
<th>DL (Mbps)</th>
<th>UL (Mbps)</th>
<th>Standardization Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>W-CDMA</td>
<td>384</td>
<td>64</td>
<td>1999</td>
</tr>
<tr>
<td>HSDPA (R5)</td>
<td>14.4</td>
<td>384</td>
<td>2002</td>
</tr>
<tr>
<td>HSUPA (R6)</td>
<td>14.4</td>
<td>5.76</td>
<td>2005</td>
</tr>
<tr>
<td>HSPA+ (R7)</td>
<td>21</td>
<td>11.5</td>
<td>2007</td>
</tr>
<tr>
<td>LTE (R8)</td>
<td>100</td>
<td>50</td>
<td>2009</td>
</tr>
<tr>
<td>DC-HSDPA (R8)</td>
<td>42</td>
<td>11.5</td>
<td>2009</td>
</tr>
</tbody>
</table>
Voice Service Transition

- LTE systems do not support circuit switching of 2G/3G mobile phone systems. All LTE services use IP-based technologies.

- Voice communications supported by circuit switching up to 3G will be replaced by VoLTE (Voice over LTE). Offering voice communications using VoLTE will require core networks to use an IMS Server (IP Multimedia Subsystem Server) configuration.

- On the other hand, IMS Server configuration will require large investment costs in network infrastructure at introduction, rollout of voice communications using VoLTE will be done in stages. In concrete terms, 3G circuit switching technology will be used at the same time.

- Due to the differences between LTE and shared 2G/3G systems as well as the differences in services offered by operators, it will be necessary to use CS Fallback developed for 3GPP Rel. 8 and SV-LTE for connecting 2G/3G and LTE voice services while connected over LTE.
VoLTE Outline

- Centered on the ‘One Voice Initiative’ promoted by mobile carriers and communications equipment makers in November 2011, technology specifications called ‘One Voice; Voice over IMS profile’ have been gathered together to produce technical specifications for achieving voice and SMS services over LTE systems, generally called VoLTE. Currently, the GSMA (GSM Association) VoLTE Initiative promotes these specifications as ‘IMS Profile for Voice and SMS.’
- VoLTE (Voice over LTE) also called Voice over IMS Profile and IMS VoIP is the standard to support voice communications on IMS and controls communications using SIP (Session Initiation Protocol).
- The OTT (Over The Top) IP phone using software on LTE service is also available, but the bandwidth allocation priority is lower than VoLTE, which is secured by QoS control.

Sup Services

- Codecs
  - SIP
  - HTTP/XCAP
  - RTP/RTCP
  - TCP/IP – UDP/IP
  - Bearers/QoS RoHC
  - LTE with VoIP Optimizations

Mobile Device

Radio & Access Network

Servers (IMS)

*: Source: GSM Association IR.92 – IMS Profile for Voice and SMS
VoLTE – Example of IMS Registration Protocol Sequence

IMS registration required for IMS CN (core network) before using IMS service

<table>
<thead>
<tr>
<th>VoLTE UE</th>
<th>LTE / EPC</th>
<th>IMS CN</th>
</tr>
</thead>
<tbody>
<tr>
<td>VoLTE UE switched on.</td>
<td>RRC Connection establishment, Initial EPS Attach, Default EPS Bearer Context activation (IMS PDN)</td>
<td>EPC (Evolved Packet Core)</td>
</tr>
<tr>
<td></td>
<td>[Dynamic UE IP Address(es) Allocation]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unprotected client port</td>
<td>Unprotected server port 5060</td>
</tr>
<tr>
<td></td>
<td>Unprotected server port 5060</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Verify AUTN &amp; compute RES IPSec SA Establishment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IPSec SA Establishment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>port_uc</td>
<td>port_ps ; spi_ps</td>
</tr>
<tr>
<td></td>
<td>port_uc ; spi_uc</td>
<td>port_ps</td>
</tr>
<tr>
<td></td>
<td>REGISTER</td>
<td>200 OK (REGISTER)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-RRConnectionRelease</td>
</tr>
<tr>
<td></td>
<td>401 Unauthorized (Authentication Challenge)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sent to P-CSCF IP address</td>
<td></td>
</tr>
</tbody>
</table>
VoLTE Outline—Example of Protocol Sequence (Voice Call)

**VoLTE**

Protocol sequence for voice communications

1st SDP offer

1st SDP answer

2nd SDP offer

2nd SDP answer

Voice packets on RTP/UDP/IP

Stop voice call

BYE

Dedicated EPS Bearer Context Release

Network initiated Dedicated EPS Bearer for voice media on IMS PDN is added.

Dedicated EPS Bearer for voice media on IMS PDN is removed.
Looking at future commercial services, it seems likely that VoLTE terminals will become mainstream.

It is necessary to develop total function evaluation testing for commercial terminals, such as product QU, reduced feedback work burden, fault analysis, and subnormal and abnormal service verification, which is difficult on live networks. This requires a total test environment using a base station simulator supporting stable, high-reproducibility troubleshooting.

MD8475A and newly developed IMS Service function solve these problems.

VoLTE Testing
*IMS Procedures:
  - IMS Registration
  - VoLTE Call Establishment/Termination
*Error Scenarios
  - Reject Testing
  - Abnormal Testing

Lab

Integration Test
System Test
……

Live Network

Field Test

Feedback
MD8475A Signalling Tester

- The MD8475A is a multi-system base station simulator supporting the next-generation LTE standard as well as major 2G/3G communication systems worldwide.

- Its **SmartStudio** state-machine based GUI supports a wide range of commercial terminal test environments for general function tests, including multi-system LTE smartphone call processing, service verification, performance, and mobility tests, required increasingly by mobile R&D labs.

- It helps increase the efficiency of general function tests and reduce the number of post-verification bug fixes to improve the quality of commercial multi-system LTE smartphones.

### Key Features

- One unit supports LTE and 2G/3G/3.5G systems
  - LTE, W-CDMA/HSPA/HSPA Evo., GSM/(E)GPRS, CDMA2000 1X/1xEV-DO, TD-SCDMA*

- Supports simple operation without scenario
  - State-machine GUI: **SmartStudio**

- Provides total function tests for commercial mobile terminals, throughput evaluation (LTE 2x2 MIMO, Cat.3) and Interworking test environment

- Embedded Windows 7 supports end-to-end packet evaluation

*: Future Support
All-in One Multi-system Platform

- LTE system simulation for FDD and TDD (future)
- Multi-system platform
  - W-CDMA/HSPA/HSPA Evo
  - GSM/(E)GPRS
  - CDMA2000 1X/EV-DO
  - TD-SCDMA/HSPA
- Supports 100 Mbps throughput with 2x2 MIMO
- Easy operation with state-machine based GUI (SmartStudio)
- 2-cell IntraRAT/InterRAT platform
- Built-in PHY/IP layer throughput monitor
- Built-in PHY layer measure monitor
  - LTE: PHY/MAC(DL HARQ), PHY/MAC(UL HARQ), RLC(DTCH), PDCP(DTCH)
  - W-CDMA: Layer1 and Layer2
- RF power monitor for each channel
- Embedded Windows 7 OS for operation and application server
- Fading IO and GP-IB interface
Full Anritsu Solution Line-up for LTE Device Test Cycle

- **Platform R&D/Integration**
  - MD8430A Signalling Tester with RTD (L1/L2, Protocol Test)
  - MF6900A Fading Simulator
  - MS269xA Signal Analyzer
  - MD1230B Data Quality Analyzer

- **Commercial UE R&D**
  - MD8475A Signalling Tester (Functional Verification)

- **Conformance Test**
  - ME7873L RF Conformance Test System (RF CT)
  - MT8820C Radio Communication Analyzer
  - ME7834L Mobile Device Test Platform (Protocol CT, CAT)
  - MS2830A Signal Analyzer

- **Operator Acceptance Test**
  - MT8820C Radio Communication Analyzer
  - MF6900A Fading Simulator

- **Production / Repair**
  - MD8475A Signalling Tester (Functional Verification)
  - MT8860C WLAN Test Set

Discover What’s Possible™

MD8475A-E-L-2

Slide 11
MX847570A SmartStudio
Supports interactive test environment without scenarios

- Start bearers adaptively according to request from terminal
- Select any base-station parameter matching customer’s test environment
- One button terminal tests, such as voice call and packet communications
- Free SMS and MMS message sending/receiving and end-to-end packet service environment in combination with application server
- Supports complex two-cell tests, such as Handover and IntraRAT reselection/redirection without scenarios
- Full real-time communication status analysis toolkit supports easy fault troubleshooting, including throughput bottlenecks
Simple IMS Service Test Environment with Built-in Server

**IMS Service Function**

Built-in IMS Service function provides service test environment, such as VoLTE and SMS over IMS

- IMS Service function supports following environment:
  - CSCF (Call Session Control Function): Supports standard server function for VoLTE and SMS over IMS tests as well as voice data loopback function
  - DHCPv6 (Dynamic Host Configuration Protocol v6): Allocates IPv6 address and notifies DNS/SIP server address to network node
  - DNS (Domain Name Server): Operates as DNS cache server
  - NDP (Neighbor Discovery Protocol): Supports function to transmit RA (Router Advertisement) and regularly transmit RA to RS (Router Solicitation)

- Moreover, the extended CSCF option (MX847570A-080) supports subnormal and abnormal testing for VoLTE/SMS over IMS function.
## IMS Service Function (Outline List)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Function</th>
<th>Outline</th>
<th>Supported Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>VoLTE</td>
<td>SIP REGIST Test</td>
<td>Check Bind/Unbind behavior at CSCF server.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Mobile Originated Call Sequence Test</td>
<td>Check call-out sequence from UE.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Mobile Terminated Call Sequence Test</td>
<td>Check call-out sequence to UE.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Voice Call Loopback Test</td>
<td>Loopback UL voice data and DL and check voice at UE side.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Call Release Sequence Test (UE Release)</td>
<td>Check disconnect sequence from UE.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Call Release Sequence Test (Network Release)</td>
<td>Check disconnect sequence from network side.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Server (Network) No Response Test</td>
<td>Check behavior when no response due to fault at server or in network.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Server Error Occurrence Test</td>
<td>Check behavior when server error received due to fault at server.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Simulate the other party is talking</td>
<td>Check operation when other party talking.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Simulate the other party is not available</td>
<td>Check operation when other party not exists.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>No Response from the other party</td>
<td>Check operation when no response from other party.</td>
<td>✓</td>
</tr>
<tr>
<td>SMS over IMS</td>
<td>SMS Message Transmission Test</td>
<td>Check UE SMS message sending function.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>SMS Message Reception Test</td>
<td>Check UE SMS message receiving function.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Server (Network) No Response Test</td>
<td>Check behavior when no response due to fault at server or in network.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Server Error Occurrence Test</td>
<td>Check behavior when server error received due to fault at server.</td>
<td>✓</td>
</tr>
<tr>
<td>IPv6 addressing</td>
<td>IP Address Assignment Test (Router Advertisement)</td>
<td>Check IP address setting function when RA received.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>IP Address Assignment Test (DHCPv6)</td>
<td>Check IP address setting function allocated from DHCPv6.</td>
<td>✓</td>
</tr>
</tbody>
</table>

*1: MX847570A-080 is not required when two sets MX8475A are used as end-to-end VoLTE testing.
VoLTE Test Configuration Example—Voice Communications Test/Function Test

- Built-in IMS Service CSCF function supports VoLTE tests (AMR/W-AMR Codec) in loopback mode. Embedded PC saves space and supports simple environment configuration.
- Using two MD8475A supports VoLTE end-to-end tests between mobile terminals, supporting actual terminal benchmarking and evaluation.

![Diagram of VoLTE test configuration example](image)
VoLTE Subnormal and Abnormal Tests (Server Behavior)

MX847570A-080: Using extended CSCF option supports condition settings for VoLTE subnormal and abnormal tests (Server Behavior and Virtual UA’s Behavior)

**Ignore Request**
CSCF Service ignores all requests and simulates down server on real network or complete network shutdown

**Send Error Response**
CSCF Service sends any specified error response to all requests

Examples:
- 400 Bad Request
- 401 Unauthorized
- 402 Payment Required
- 403 Forbidden
- 404 Not Found
- 405 Method Not Allowed
  …etc.

- 491 Request Pending
- 493 Undecipherable
- 505 Version Not Supported
- 580 Precondition Failure
- 600 Busy Everywhere
- 606 Not Acceptable
  … etc.
VoLTE Subnormal and Abnormal Tests (Virtual UA Behavior)

- **Busy**
  - Virtual UA sends 486 Busy Here to Invite request. Simulates communications busy status.

- **Absence**
  - Virtual UA does not send 200 OK to Invite request. Simulates communications absence.

- **No Reply**
  - Virtual UA ignores all requests. Simulates no response to communications. 408 Request Timeout sent from server after specified time period.
LTE is a next-generation mobile technology offering the same high data speeds as optical networks to support rich-content distribution at the start, evolving to IMS-based services following network IP conversion.

Voice services will be offered over LTE using VoLTE technology with IMS servers in the future after using interim CS-Fallback and SV-LTE systems.

Anritsu has introduced the MD8475A for R&D into commercial LTE mobiles as well as for validating future VoLTE terminals with IMS functions.

Anritsu is proactively helping development of LTE service by offering test solutions to increase test efficiency as well as by supporting new LTE standards.