Signalling Tester MD8475A
Product Introduction

Signalling Tester
MD8475A
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Test Applications for Smartphone
Required Test Items in Smartphone

- **Battery Consumption**
  - Battery Performance Test
  - Power Control, Neighbor Cell configuration
  - High RF Level Accuracy, UL Power/ Frequency Meas.
  - CPC, Enhanced Cell FACH, Fast Dormancy, RRC Status Change, CDRX, TBS, BSR

- **Integration/ Regression Test**
  - Automation
  - SmartStudio Manager (LTE-FDD, LTE-TDD, W-CDMA/HSPA+, GSM/(E)GPRS, C2K/eHRPD, TD-SCDMA)

- **Data Communication**
  - Data Throughput Performance
  - LTE-FDD, LTE-TDD, W-CDMA/HSPA+, GSM/(E)GPRS, C2K/eHRPD, TD-SCDMA/SD-HSPA
  - External Packet Data, Throughput Test Result

- **Mobile Service**
  - Service Function Test
  - IMS Service: VoLTE, SMS over IMS, SRVCC, CSFB, RCS, ETWS (LTE, W-CDMA)
  - CMAS (LTE, W-CDMA, GSM, C2K)
  - Cellular/WLAN Interworking(ePDG, ANDSF, MAPCON etc.)

- **Basic Feature**
  - Radio Bearer/ Basic Feature
  - LTE-FDD, LTE-TDD, W-CDMA/HSPA+, GSM/(E)GPRS, C2K/eHRPD, TD-SCDMA/SD-HSPA
  - LTE/2G/3G InterRAT, LTE/2G/3G IntraRAT HO (incl. Measurement Based HO and CSFB)
  - SMS: SMS(over SGs)/MMS

- **LTE/3G/2G Multi-mode Smartphone**

- Target test application of MD8475A
MD8475A Concept
MD8475A Concept

*Reduce the customer’s evaluation cost, Remove the technical barrier for smartphone evaluation*

- **Easy to evaluate/ Needless to create scenarios**
  - Enables to evaluate by just GUI operation with SmartStudio
  - Supports not only normal test but also negative test and complex IMS test without SIP knowledge

- **4G to 2G/3G Multi-RAT test capability for any operator’s devices**
  - All Radio bearer and various 2cell test supported

- **Easy setup the Automation Test without high skill**
  - Creates the automation procedure with GUI sequencer
  - Integrated test configuration with UE control and other equipment
MD8475A Medium- and Long-term Concept

• A goal to reach for “Smartphone Tester”
  – Keep adding the test capability to GUI based State-Machine
  – Enhance Multi-RAT capability (LTE-CA, 3CC, Mobility etc.) to meet the TTM for Smartphone commercial device R&D

• Catch up advanced mobile service
  – Lead new upcoming mobile service and advanced service such as WLAN offloading.

• Realize Carrier Acceptance Test solution
  – Realize operator specific acceptance test solution for Smartphone applications and battery performance that will especially become of increasing importance for user experience in the market
MD8475A Overview
MD8475A Product Overview

- **LTE(FDD/TDD) system simulation**
- **Support 150Mbps with 2x2 MIMO / 300Mbps with LTE-CA 2CC MIMO** (2-box config.)
  / 450Mbps with LTE-CA 3CC MIMO (MD8475A + MD8430A BTM config.)
- **Multi-system capable platform**
  - W-CDMA/HSPA/HSPA evo/DC-HSDPA, GSM/GPRS/EGPRS
  - CDMA2000 1X/EV-DO, TD-SCDMA/HSPA
- **State-machine based GUI “SmartStudio”**
- **Multi-cell IntraRAT / InterRAT capable platform**
  - 2-cell IntraRAT: LTE 2-cell, W-CDMA 2-cell, GSM 2-cell, TDS 2-cell
  - 2-cell InterRAT: LTE/W, LTE/G, LTE-TDD/TDS, W/G, TDS/G
  - 3-cell LTE/LTE/LTE
  - 4-cell InterRAT: LTE/LTE, W/W using 2 boxes
  - CDMA2000 multi-sector / multi-carrier (*script only)
  - LTE-CDMA2000 (Hybrid mode) 2-box Interworking, Optimized HO
  - LTE-CDMA2000 single-box Interworking with 2RF
- **Built-in IMS service function**
  - State machined based CSCF server with supporting network servers
  - Synchronization with radio access network for QoS & mobility management
  - Configurable virtual user agents for end-to-end sessions, enhanced with RCS features
- **Built-in SMS/PWS (ETWS, CMAS) center**
- **Built-in PHY/IP layer throughput monitor**
- **Built-in PHY layer measure monitor**
- **UL RF power measurement** (LTE/W-CDMA/GSM)
- **BLER** (LTE/W-CDMA)
MD8475A Signalling Tester – Unique Features

Integrated IMS test environment with GUI operation
- IMS server is configured by GUI operation
- Highly integrated platform to realize effective troubleshooting (Wireless protocol and SIP messages)
- Advanced built-in IMS server and multi-RAT capability for SR-VCC type tests
- IMS/VoLTE supplementary service and abnormal testing for further application
- No external PC is required for IMS/VoLTE tests

Strong C2K and TDS capabilities for Multi-RAT
- Install all communication standards
- Various LTE/C2K interworking available such as SV-LTE, eCSFB, redirection/optimized handovers
- Leading TD-SCDMA market position and unique TD-LTE/TD-SCDMA InterRAT capability within 1-box
- Various CSFB combinations available
MD8475A Signalling Tester – Unique Features

Easy operation with State-machine GUI (SmartStudio)

- Interactive test environment without complicated test scripts
- Synchronize built-in IMS server
- Set various base station parameters according to user test environment
- Automatic call setting is performed according to DUT capability
- Unique graphical PWS center application available for CMAS/ETWS service
Basic Features

- Multi-RAT Applications
- LTE/C2K Interworking
- Cell Setting
- State Change/Reject
- RF Measurement
Multi-RAT

- Simple 2-cell handover simulation for commercial Smartphone & Data terminal devices
- MD8475A SmartStudio State-machine helps easy 2-cell test
- No complicated test script is required
  - Cell Selection & Reselection
  - Handover (Intra/Inter-RAT)
    - Redirection
    - Active HO (with or without Measurement)
  - CSFB / e1xCSFB
  - SR-VCC

Repeatable simulation cannot be realized on the actual Network or Base Stations
Multi-RAT – 2-cell Combinations

- MD8475A 2-cell test capability
  - SmartStudio supports all global commercial network combinations

<table>
<thead>
<tr>
<th>BTS2</th>
<th>BTS1</th>
<th>LTE(FDD/TDD)</th>
<th>W-CDMA</th>
<th>GSM</th>
<th>CDMA2000</th>
<th>TD-SCDMA</th>
<th>WLAN</th>
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<tbody>
<tr>
<td>LTE-FDD</td>
<td>✓</td>
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<td>CDMA2000</td>
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<td>✓</td>
<td>✓</td>
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</tbody>
</table>
# Reference sequence in TS36.523-1 Rel.11

## Section 13.4.3.1
### E-UTRA voice to UTRA CS voice / SRVCC
- **Procedure:**
- **To UTRAN(FDD):** Supported
- **To GERAN:** N/A
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.2
### E-UTRA PS voice + PS data to UTRA CS voice + PS data / SRVCC
- **Procedure:**
- **To UTRAN(FDD):** Supported*1
- **To GERAN:** N/A
- **Comment:** PS+PS to CS+PS(Multi-call HO)

## Section 13.4.3.3
### E-UTRA voice to GSM CS voice / SRVCC
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.4
### E-UTRA voice to UTRA CS voice / Unsuccessful case / Retry on old cell / SRVCC
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.5
### E-UTRA voice to GSM CS voice / Unsuccessful case / Retry on old cell / SRVCC
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.6
### E-UTRA PS voice + PS Data / HO cancelled / Notification procedure / SRVCC
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.7
### E-UTRA voice to UTRA CS voice / aSRVCC / MO call
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.8
### E-UTRA voice to UTRA CS voice / aSRVCC / MO call / Forked responses
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.9
### E-UTRA voice to UTRA CS voice / aSRVCC / MO call / SRVCC HO failure
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.10
### E-UTRA voice to UTRA CS voice / aSRVCC / MT call
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.11
### E-UTRA voice to UTRA CS voice / aSRVCC / MT call / SRVCC HO failure
- **Procedure:**
- **Comment:** PS to CS HO(Single call HO)

## Section 13.4.3.12
### E-UTRA voice to UTRA CS voice / aSRVCC / MT call / User answers in PS domain
- **Procedure:**
- **Comment:** ESM Notification procedure(to check re-Invite procedure)

## Section 13.4.3.13
### E-UTRA voice to UTRA CS voice / aSRVCC / MT call / User answers in PS domain / SRVCC HO cancelled
- **Procedure:**
- **Comment:** ESM Notification procedure(to check re-Invite procedure)

## Section 13.4.3.14
### E-UTRA PS voice + PS data to UTRA CS voice + PS data / aSRVCC / MO call
- **Procedure:**
- **Comment:** PS+PS to CS+PS(Multi-call HO)

## Section 13.4.3.15
### E-UTRA PS voice + PS data to UTRA CS voice + PS data / aSRVCC / MO call / SRVCC HO cancelled
- **Procedure:**
- **Comment:** PS+PS to CS+PS(Multi-call HO)

## Section 13.4.3.16
### E-UTRA PS voice + PS data to UTRA CS voice + PS data / aSRVCC / MT call
- **Procedure:**
- **Comment:** PS+PS to CS+PS(Multi-call HO)

## Section 13.4.3.17
### E-UTRA PS voice + PS data to UTRA CS voice + PS data / aSRVCC / MT call / SRVCC HO cancelled
- **Procedure:**
- **Comment:** PS+PS to CS+PS(Multi-call HO)

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*1) the feature is not verified with a commercial device.
LTE-C2K Interworking

- 2 solutions available for LTE/C2K interworking
  - User can choose LTE/C2K hybrid mode and/or simple test environment
  - Supports all LTE/C2K network conditions with 2-box configuration

**2-Box Solution**
- Master MD8475A can control to slave MD8475A

**Single-Box Solution**
- Configure LTE/C2K test environment within single platform

- LTE SISO
- CDMA2000 1xRTT (without eHRPD)
- LTE SISO
- CDMA2000 eHRPD (without CDMA2000 1xRTT)
# LTE-C2K Interworking

**LTE-C2K 1x/eHRPD hybrid simulation model**

<table>
<thead>
<tr>
<th>Service/Function</th>
<th>Single-box Solution*1</th>
<th>2-Box Solution</th>
<th>SourceBearer (State)</th>
<th>TargetBearer (State)</th>
<th>Procedure</th>
<th>Required function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Simultaneous Voice and LTE (SV-LTE)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Idle/Connected)</td>
<td>1xRTT (Idle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.</strong> Reselection (LTE -&gt; C2K 1X)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Idle)</td>
<td>1xRTT (Idle)</td>
<td>Reselection</td>
<td></td>
</tr>
<tr>
<td><strong>3.</strong> Reselection (C2K 1X -&gt; LTE)</td>
<td>Supported</td>
<td>Supported</td>
<td>1xRTT (Idle)</td>
<td>E-UTRA (Idle)</td>
<td>Reselection</td>
<td></td>
</tr>
<tr>
<td><strong>4.</strong> MO/MT Voice Call (Rel.8 1xCSFB)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Idle/Connected)</td>
<td>1xRTT (Connected)</td>
<td>Redirection</td>
<td></td>
</tr>
<tr>
<td><strong>5.</strong> MO/MT Voice Call (ECAM based e1xCSFB)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Idle/Connected)</td>
<td>1xRTT (Connected)</td>
<td>Redirection</td>
<td>SystemTime Sync Pre-Registration(S102)</td>
</tr>
<tr>
<td><strong>6.</strong> MO/MT Voice Call (UHDM based e1xCSFB)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Idle/Connected)</td>
<td>1xRTT (Connected)</td>
<td>Handover</td>
<td>SystemTime Sync Pre-Registration(S102)</td>
</tr>
<tr>
<td><strong>7.</strong> Non-Optimized Reselection (LTE -&gt; eHRPD)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Idle)</td>
<td>HRPD (Idle)</td>
<td>Reselection</td>
<td></td>
</tr>
<tr>
<td><strong>8.</strong> Non-Optimized Reselection (eHRPD -&gt; LTE)</td>
<td>Supported</td>
<td>Supported</td>
<td>HRPD (Idle)</td>
<td>E-UTRA (Idle)</td>
<td>Reselection</td>
<td></td>
</tr>
<tr>
<td><strong>9.</strong> Optimized Reselection (LTE -&gt; eHRPD)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Idle)</td>
<td>HRPD (Idle)</td>
<td>Reselection</td>
<td>SystemTime Sync Pre-Registration(S101) Cascade Port Connection</td>
</tr>
<tr>
<td><strong>10.</strong> Non-Optimized Redirection (LTE -&gt; eHRPD )</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Connected)</td>
<td>HRPD (Connected)</td>
<td>Redirection</td>
<td>Cascade Port Connection</td>
</tr>
<tr>
<td><strong>11.</strong> Optimized Redirection (LTE -&gt; eHRPD)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Connected)</td>
<td>HRPD (Connected)</td>
<td>Redirection</td>
<td>SystemTime Sync Pre-Registration(S101) Cascade Port Connection</td>
</tr>
<tr>
<td><strong>12.</strong> Optimized Handover (Data Call ) (LTE -&gt; eHRPD)</td>
<td>Supported</td>
<td>Supported</td>
<td>E-UTRA (Connected)</td>
<td>HRPD (Connected)</td>
<td>Handover</td>
<td>SystemTime Sync Pre-Registration(S101) Cascade Port Connection</td>
</tr>
</tbody>
</table>

*1: Single-box Solution does not support 1x/EVDO hybrid mode
Cell Setting

- SmartStudio has an internal database that can store up to 32 cell parameter profiles that can be selected to be used for setting up simulation for communicating to the UE.
  - Band, RF power, MCC, MNC, Access Class, etc.

- Neighbor Cell setting
  - Displays Neighbor cell parameters of communication system selected in Cell List.
  - Neighbor cell parameters can also be configured within a cell parameter profile for communicating the neighbor list to the UE during simulation.

  - LTE, WCDMA, GSM, 1x/EVDO, TD-SCDMA
LTE Cell Setting

- Easily profile Setting
  - MCC, MNC
  - NW Name
  - Cell ID, TAC
  - MMC

- T3402 Timer Testing
  - When a Combined Attach/TAU Request is accepted with “EPS only” using an EMM cause not previously listed, a maximum of 5 attempts shall be made, after which the device shall:
    - Start Timer T3402
    - Enter state EMM-REGISTERED.ATTEMPTING-TO-UPDATE-MM
    - When timer T3402 expires, the combined tracking area updating procedure indicating “combined TA/LA updating with IMSI attach” is triggered
RRC State Change

- Network simulator shall implement inactivity timer so RRC connection will be released when device has been inactive for certain period of time.
  - The duration of the inactivity time shall be adjustable.
  - Network simulator shall be able to re-establish connection (MO/MT) after the connection is released.

- Anritsu Response - Supported
  - W-CDMA
    - UTRAN Connected Mode
      - URA_PCH
      - CELL_PCH
      - CELL_DCH
      - CELL_FACH
    - Packet Preservation
      - Change to CELL_PCH
        - T1 fixed to 0 sec
      - Inactivity Timer
        - MD8475A SmartStudio Supports;
        - >T1=Change to CELL_PCH
          - [5 to 600 sec.]*
        - >T2 = 0 sec(fixed).

  - LTE/ TD-SCDMA
    - UTRAN Connected Mode
      - Packet Preservation
        - MD8475A SmartStudio Supports;
        - >Change to Idle Mode
          - [5 to 600 sec.]*
    - Idle Mode

*:0 is treated as Infinity.
RRC State Change (W-CDMA)

- Brand new triggers for the RRC State Change
  - Fast Dormancy & Measurement Report

**Inactivity timer**
When expiring Status Change Timer, the state transition is performed. (Inactivity timer)
- Cell DCH state
  - Can Select Cell FACH, Cell PCH or Idle to state transition.
- Cell FACH state
  - Can Select Cell PCH or Idle to state transition.
- Cell PCH state
  - Can Select Idle to state transition.

**Fast Dormancy**
When receiving a Signalling connection release message included in the IE "Signalling Connection Release Indication Cause", the state transition is performed.
- Cell DCH state
  - Can Select Cell FACH, Cell PCH or Idle to state transition.
- Cell FACH state
  - Can Select Cell PCH or Idle to state transition.
- Cell PCH state
  - Can Select Idle to state transition.

<Note>
- When selecting Cell PCH to state transition in Cell DCH state, cell state becomes "Cell DCH -> Cell FACH -> Cell PCH".

**Measurement report**
- Cell DCH state
  - If receiving event 4b in measurement report, cell state shifts to Cell FACH.
- Cell FACH state
  - If receiving event 4a in measurement report, cell state shifts to Cell DCH.

<Note>
- User can set the parameter of measurement control.
  (reporting threshold etc.)

**Anritsu spec**
When the communication request of the packet data (etc.) occurs, the state transition is performed.
- Cell FACH state
  - Cell state transits to Cell DCH.
- Cell PCH state
  - Cell state transits to "Cell PCH -> Cell FACH -> Cell DCH".
Reject Function (1/2)

- **Attach Reject**
  Setting specific messages when the terminal connects to the base station can be used to reject terminal connection requests.

- **APN Reject**
  Setting specific messages when the terminal connects to the network server can be used to reject terminal connection requests.
Reject Function (2/2)

- A semi-normal testing can be performed by easy setup.
  - UE Message Reject

  Setting to reject by the condition when MD8475A receives a specified message from UE.

Note: UE Trigger Information Condition can specify several conditions to one UE Message and it perform Accept or Reject or Ignore according to the setting.

  e.g. One Specified Message -> Condition A -> Reject
  -> Condition B -> Ignore
  -> Condition C -> Accept
RF Measurement*

Current measurement option can analyze Uplink RF power by useful GUI. This test environment is powerful tool for evaluating battery consumption of smartphone.

◆ Evaluation Procedure

- Starting SmartStudio
- Starting Simulation
- Starting RF Measurement
- Saving Measurement Results

MD8475A provides function to measure real air-link power which smartphone outputs under the communication.

*: Support system are LTE FDD/ W-CDMA/ GSM

Tx Specification
- Frequency range: 350MHz to 3600MHz
- Level range: -130 to -10dBm
- Level accuracy:
  ±1.0dB (≥-120dBm, 350MHz≤f ≤3000MHz, 20°C-30°C, Post-CAL)
  ±1.2dB (≥-120dBm, 3000MHz<f ≤3600MHz, 20°C-30°C, Post-CAL)

Rx Specification
- Frequency range: 350MHz to 3600MHz
- Maximum Input Level: 35dBm
- Level accuracy: (at implemented MX847506A)
  ±1.1dB (≥-120dBm, 350MHz≤f ≤3000MHz, 20°C-30°C, Post-CAL)
  ±1.3dB (≥-120dBm, 3000MHz<f ≤3600MHz, 20°C-30°C, Post-CAL)
- Linearity: (at implemented MX847506A)
  ±0.35dB (0to -40dB, ≥-50dBm)
  ±0.60dB (0to -40dB, ≥-55dBm)
Data Communication

- Packet Communication
- Throughput Performance
- LTE Carrier Aggregation
- WLAN Offload
Packet Communication

- Test Configuration
  - Evaluation using multiple application servers
    - SmartStudio can set up to 8 PDN*¹, making it easy to create a multi-application test for smartphone verification

Reference settings
- 8 default EPS Bearers
- 8 PDN Bearers
- Parameters (e.g. TFT Filter, QoS etc.) can be set flexibly during simulation

*¹: Only LTE supported
Data Communication – Throughput Performance

- Throughput test over the RF
  - Built-in Server PC (Windows 7)
  - Measure function
    - Throughput monitor
    - Counter
    - RF Monitor

✓ Throughput monitor
  Checks not only IP level but also MAC level with stable

✓ Counter
  Displays detailed information such as ACK/NAC, MCS

✓ RF monitor
  Displays frequencies and TRx power for each channel
Data Communication – Throughput Performance

- DC-HSDPA 42 Mbps Throughput Example
Data Communication - Throughput Performance

- Graphical tool available for easy troubleshooting
  - Data throughput test with InterRAT (e.g. LTE/HSPA+ handover)
2CC SISO & MIMO

- LTE FDD/TDD mode are supported
- Realize easy setup with GUI operation for commercial LTE-CA device verification

2CC SISO (Single-Box Solution)*

- Support functions
  - PHY/IP Throughput DL 150 Mbps/UL 50 Mbps
- Test applications
  - Simple packet connectivity tests with CA
- Operations
  - Single box support 2CC SISO

2CC 2x2 MIMO (2-Box Solution)*

- Support functions
  - RF Throughput DL 300 Mbps/UL 50 Mbps
  - IP Throughput DL 150 Mbps/UL 50 Mbps
- Test applications
  - Operator's device acceptance tests
  - Battery consumption tests
- Operations
  - Single GUI (SmartStudio on the master MD8475A) controls slave box also

* MX847550A-040 LTE Carrier Aggregation Option required
Easy GUI operation

- All set up is done by easy GUI operation
3CA Solution

Product Overview
- Combination of MD8475A (Master unit) and MD8430A BTM (Slave unit) supports 3CA & 2x2 MIMO testing environment (*1)
- Application/Function test can be performed under 3CA SISO/MIMO condition

Test Operation
Realizes totally same test operation as MD8475A single box!
- **SmartStudio** can control for both units from a single GUI
- **SmartStudio Manager** realizes automated testing environment

*LTE Carrier Aggregation Option (MX847550A-040) and LTE Carrier Aggregation DL3CCs Option (MX847550A-041) are required

(*1) The combination of MD8475A and MD8430A(ETM) is also possible
WLAN Offload Solution

• MD8475A SmartStudio will simulate EAP/ANDSF/ePDG functions for WLAN Offloading as one of advanced services

  • MX847570A-070  WLAN Offload Basic Option
  • MX847570A-071  ePDG Option
  • MX847570A-072  ANDSF Option

• Provide the following server environment (refer to 3GPP architecture model);
  • 3GPP AAA Server (EAP-SIM/AKA/RADIUS)
  • Operators IP Services (ANDSF)
  • ePDG

• Test Applications
  • Connectivity Test (EAP-SIM/AKA Authentication, ePDG)
  • Mobility Test between LTE Cellular and WLAN (ANDSF)
  • Throughput Performance Test (WLAN and Cellular)
WLAN Offload Solution Configuration

Package Solution for WLAN Offload

- **Note:** For ePDG, due to the switching method of downlink data, it might be on an external PC.
- This solution needs to use commercial WLAN-AP.
  (Recommended model: CISCO AIR-SAP2602E-x-K9)

EAP authentication for Trusted non-3GPP Access
IP sec tunneling for Untrusted non-3GPP Access
ANDSF policy derivative

1. EAP authentication for Trusted non-3GPP Access
2. IPsec tunneling for Untrusted non-3GPP Access
3. ANDSF policy derivative
LTE -> WLAN Handover Sequence

Priority Setting: The UE is set the preference for WLAN connection.

The UE sends and receives the U-Plane packets via the 3GPP Bearer.

LTE-> WLAN HO
The UE sends the U-Plane packets via the IPsec tunnel.

1. IKE_SA_INIT request (HDR, SAi(IKE_SA), KEi, Ni, N, N)
2. IKE_SA_INIT response (HDR, SAr(IKE_SA), KEr, Nr, N, N)
3. IKE_AUTH request (HDR, IDi(User ID), CP(CFG_REQUEST)=(INTERNAL_IPv4ADDRESS), SAi(CHILD_SA), TSi, TSr, N)
4. IKE_AUTH response (HDR, IDr(ePDG ID), AUTH, EAP-request(AKA-Challenge))
5. IKE_AUTH request (HDR, EAP-Response(AKA-Challenge))
6. IKE_AUTH response (HDR, EAP-Success)
7. IKE_AUTH request (HDR, AUTH)
8. IKE_AUTH response (HDR, AUTH, CP(CFG_REPLY)=(INTERNAL_IPv4ADDRESS), SAr(CHILD_SA), TSi, TSr, N, N)

LTE -> WLAN Handover Sequence

Priority Setting: The UE is set the preference for WLAN connection.

The UE sends and receives the U-Plane packets via the 3GPP Bearer.

LTE-> WLAN HO
The UE sends the U-Plane packets via the IPsec tunnel.

IPsec tunnel

Handover

3GPP Bearer

802.11 Association

DHCP Discover/Request

DHCP Offer/Ack

(1) IKE_SA_INIT request (HDR, SAi(IKE_SA), KEi, Ni, N, N)
(2) IKE_SA_INIT response (HDR, SAr(IKE_SA), KEr, Nr, N, N)
(3) IKE_AUTH request (HDR, IDi(User ID), CP(CFG_REQUEST)=(INTERNAL_IPv4ADDRESS), SAi(CHILD_SA), TSi, TSr, N)
(4) IKE_AUTH response (HDR, IDr(ePDG ID), AUTH, EAP-request(AKA-Challenge))
(5) IKE_AUTH request (HDR, EAP-Response(AKA-Challenge))
(6) IKE_AUTH response (HDR, EAP-Success)
(7) IKE_AUTH request (HDR, AUTH)
(8) IKE_AUTH response (HDR, AUTH, CP(CFG_REPLY)=(INTERNAL_IPv4ADDRESS), SAr(CHILD_SA), TSi, TSr, N, N)
**ANDSF Overview**

The ANDSF supports the Pull model and Push model.

- Select the MO to be sent to the UE from the server. 
  > Refer to “Parameter Settings (IPv4/IPv6)”.

- Perform some operations to send a request MO message if necessary.

- Check the UE behavior if it is changed according to the received MO (Policy). e.g. The UE holds the 3GPP connection or performs handover to WLAN.

- > Refer to “Connecting to LTE”.

- > Refer to “Requesting MO (Sending Request Message)”.

- > Refer to “Requesting MO (Receiving Response Message)”. 

**Diagram:**

1. UE
2. ANDSF Server
3. **OMA-DM Alert**
4. **HTTP POST**
5. **OMA-DM Status**
6. **HTTP RESPONSE**
7. **Requests MO**
8. **MO Delivery**
9. **Checks UE behavior**

- Turns on Attach LTE
- Performs some operations

- Selects MO
# Function Details (EAP-SIM/EAP-AKA, ANDSF)

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
</table>
| **EAP-SIM/EAP-AKA** | Communication protocols  
|                  | RADIUS (Remote Authentication Dial In User Service)/UDP/IPv4/IPv6/and Ether  
|                  | Authentication  
|                  | EAP-AKA (RFC 4187), EAP-SIM (RFC 4186)  
|                  | Vector generation algorithm  
|                  | Test algorithm defined in 3GPP TS 34.108  
|                  | and conversion functions (c2, c3) in 3GPP TS 33.102  
|                  | MILENAGE algorithm defined in 3GPP TS 35.205 |
| **ANDSF**        | Communication protocols  
|                  | TLS (Transport Layer Security) 1.0/1.1/1.2  
|                  | Models  
|                  | Pull model (3GPP TS 24.302 6.8.2.2.3)  
|                  | Push model (3GPP TS 24.302 6.8.2.2.2)  
|                  | Notification message push  
|                  | WAP Push |

WLAN Offload
## Function Details (ePDG)

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communication protocols</strong></td>
<td>IPv4 / IPv6 / ESP (3GPP TS 33.234 6.6)</td>
</tr>
<tr>
<td><strong>IKE</strong></td>
<td>IKEv2 (RFC 5996) RSA Digital Signature(X.509)</td>
</tr>
<tr>
<td><strong>Authentication</strong></td>
<td>EAP-AKA (RFC 4187)</td>
</tr>
<tr>
<td><strong>Vector generation algorithm</strong></td>
<td>Test algorithm defined in 3GPP TS 34.108 MILENAGE algorithm defined in 3GPP TS 35.205</td>
</tr>
<tr>
<td><strong>Security algorithm</strong></td>
<td>AES-CBC-128, AES-CBC-256, AES-CTR-128, 3DES, DES, NULL for encryption HMAC-SHA1-96, HMAC-MD5-96, AES-XCBC-96 for integrity</td>
</tr>
<tr>
<td><strong>Diffie-Hellman Group</strong></td>
<td>Group1(768bit), Group2(1024bit), Group5(1536bit), Group14(2048bit)</td>
</tr>
<tr>
<td><strong>ESN support</strong></td>
<td>Extended Sequence Numbers 0</td>
</tr>
</tbody>
</table>
WLAN Calling

- Environment using MD8475A

1. Select WLAN as the route to call
2. Connect to Security Gateway using IPsec
3. Access to SIP server
4. Call via WLAN

Cellular Network
- IMS
- PDN Gateway
- LTE BS
- UE

Non Cellular Network
- Security Gateway (ePDG)
- WLAN AP
- Virtual UE
- IMS
- LTE BS
- ePDG
- PDN Gateway
- MD8475A

WLAN Offload

Anritsu envision: ensure
WLAN Calling Sequence

Priority Setting: The UE is set the preference for WLAN connection.

1. 802.11 Association
2. DHCP Discover/Request
3. DHCP Offer/Ack
   - IKE_SA_INIT request (HDR, SAi(IKE_SA), KEi, Ni, N, N)
   - IKE_SA_INIT response (HDR, SAr(IKE_SA), KEr, Nr, N, N)
   - IKE_AUTH request (HDR, IDi(User ID), CP(CFG_REQUEST)=INTERNAL_IPv4ADDRESS, P-CSCF_IP4_ADDRESS, SAi(CHILD_SA), TSi, TSr, N)
   - IKE_AUTH response (HDR, IDr(ePDG ID), AUTH, EAP-request(AKA-Challenge))
   - IKE_AUTH request (HDR, EAP-Response(AKA-Challenge))
   - IKE_AUTH response (HDR, EAP-Success)
   - IKE_AUTH request (HDR, AUTH)
   - IKE_AUTH response (HDR, AUTH, CP(CFG_REPLY)=INTERNAL_IPv4ADDRESS, P-CSCF_IP4_ADDRESS, SAr(CHILD_SA), TSi, TSr, N, N)

IPsec tunnel

SIP REGISTER
SIP 200 OK

Perform Voice Call etc. connecting to the IMS Services via IPsec tunnel

- UE
- 3GPP
- WLAN AP
- ePDG/AAA
- IMS Services
Mobile Services

- VoLTE/SMS Applications
- RoHC on LTE
- IMS Enhancement
- RCS (Rich Communication Suite)
- PWS (Public Warning System)
- VoLTE Emergency Call
Comprehensive Functional Test Environment IMS Service

- **Key Unique Points**
  - **Ease of use**
    - SmartStudio GUI allows users to set and configure the IMS test easy
    - No complicated test scripts are required for IMS setting
  - **Comprehensive IMS Test**
    - Supports a lot of tests including irregular tests and supplementary service
    - PSAP of Add-in Service has functions to emergency test and loop back voice data
  - **Analysis and Debug**
    - Wireshark and Signalling protocol logging can be checked simultaneously
  - **Built-in Servers**
    - IMS and relevant application server can be installed within single platform
    - No external server required then realize small-footprint environment
  - **Multi-RAT Expandability**
    - Enough expandability for SR-VCC tests

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**VoLTE/SMS Applications**

- VoLTE Device
  - IMS Server
    - CSCF/ DHCP/ DNS
    - NDP / XCAP, IPsec
    - SMS over IMS
    - IMS Supplementary service
    - IMS Conference Call
    - RCS
    - LTE RoHC
VoLTE Functional Test

- Functional test on VoLTE
  - Built-in SIP Server & P-CSCF configures loopback and E2E VoLTE test with small-footprint environment

**Functionality test environment (Loopback Case)**

**Functionality test environment (End - End)**
VoLTE Functional Test – Abnormal Server Condition

• Subnormal & Abnormal test conditions
  – Server behavior *
  • Supports a lot of causes without complicated test scripts

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.

Mobile Terminal
Invite
Mobile Terminal
Invite

Mobile Terminal
CSCF
Register
CSCF
Error Response

CSCF Information Window

* Extended CSCF option (MX847570A-080) required
VoLTE Functional Test – Various Virtual UA Behavior

• Virtual UA’s Behavior *
  – Supports various UA behavior without complicated test scripts

![Virtual UA's Behavior](image)

**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 is sent from server after specified time period.

*Extended CSCF option (MX847570A-080) required*
Message Service Test – SMS over IMS / SGSN

• Built-in SMS Centre support both procedures
  – SMS over SGSN: Sending/Receiving SMS over SGSN
  – SMS over IMS: Sending/Receiving SMS over IP
• SIP registration
RoHC on LTE - Reducing the IP packet overhead

- **What’s RoHC?**
  This is an algorithm of header compression to improve efficiency to transfer IP packet. Noisy propagation environment is one of the characteristics of wireless network. In such an environment, there is sometimes significant packet loss. RoHC was developed to resolve such problem.

**ID --------- Profile**
- 0x0000: No compression (LTE)/Uncompressed (UMTS)
- 0x0001: RTP/UDP/IP
- 0x0002: UDP/IP
- 0x0003: ESP/IP
- 0x0004: IP

Supported by MX847550A-060
VoLTE Functional Test – Supplementary Service

VoLTE Supplementary Services
- In IMS architecture, supplementary services are also needed like CS service (Call Forwarding, Call Hold/Resume, Connected Line Identification Presentation/Restriction, etc)
- Supports various simulation service defined in 3GPP by GUI simple operation

IMS Supplementary Service option (MX847570A-081) offers following SS for IMS clients

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>PSTN/ISDN simulation service</th>
<th>PSTN/ISDN supplementary service</th>
<th>Support</th>
<th>Reference Spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFU</td>
<td>Communication Forwarding Unconditional</td>
<td>Call Forwarding Unconditional</td>
<td>Yes</td>
<td>TS24.604</td>
</tr>
<tr>
<td>CFB</td>
<td>Communication Forwarding on Busy user</td>
<td>Call Forwarding Busy</td>
<td>Yes</td>
<td>TS24.604</td>
</tr>
<tr>
<td>CFNR</td>
<td>Communication Forwarding on No Reply</td>
<td>Call Forwarding No Reply</td>
<td>Yes</td>
<td>TS24.604</td>
</tr>
<tr>
<td>OIP</td>
<td>Originating Identification Presentation</td>
<td>Calling Line Identification Presentation</td>
<td>Yes</td>
<td>TS24.607</td>
</tr>
<tr>
<td>OIR</td>
<td>Originating Identification Restriction</td>
<td>Calling Line Identification Restriction</td>
<td>Yes</td>
<td>TS24.607</td>
</tr>
<tr>
<td>TIP</td>
<td>Terminating Identification Presentation</td>
<td>Connected Line Identification Presentation</td>
<td>Yes</td>
<td>TS24.608</td>
</tr>
<tr>
<td>TIR</td>
<td>Terminating Identification Restriction</td>
<td>Connected Line Identification Restriction</td>
<td>Yes</td>
<td>TS24.608</td>
</tr>
<tr>
<td>CW</td>
<td>Communication Waiting</td>
<td>Call Waiting</td>
<td>Yes</td>
<td>TS24.615</td>
</tr>
<tr>
<td>HOLD</td>
<td>Communication Hold</td>
<td>Call Hold</td>
<td>Yes</td>
<td>TS24.610</td>
</tr>
<tr>
<td>MWI</td>
<td>Message Waiting Indication</td>
<td>Message Waiting Indication</td>
<td>Yes</td>
<td>TS24.606</td>
</tr>
<tr>
<td>CB</td>
<td>Communication Barring</td>
<td>Call Barring</td>
<td>Yes</td>
<td>TS24.611</td>
</tr>
</tbody>
</table>
VoLTE Functional Test – Conference Call

• VoLTE Conference Call*
  – Supports various conference call relevant functions with GUI operation of IMS server (Event message, generation of meeting, reservation, participation, etc.)

Comparison of 3GPP TS24.605

<table>
<thead>
<tr>
<th>Item</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5.2.1.1 User joining a conference</td>
<td>✓</td>
</tr>
<tr>
<td>4.5.2.1.2 User inviting another user to a conference</td>
<td>✓</td>
</tr>
<tr>
<td>4.5.2.1.3 User leaving a conference</td>
<td>✓</td>
</tr>
<tr>
<td>4.5.2.1.4 User creating a conference</td>
<td>✓</td>
</tr>
<tr>
<td>4.5.2.1.5 Subscription for the conference event package</td>
<td>✓</td>
</tr>
<tr>
<td>4.5.2.2.1 Conference focus</td>
<td>✓</td>
</tr>
<tr>
<td>4.5.2.2.2 Conference notification service</td>
<td>✓</td>
</tr>
<tr>
<td>4.5.2.7 Actions at the destination UE</td>
<td>✓</td>
</tr>
<tr>
<td>4.6.1 Communication HOLD (HOLD)</td>
<td>✓</td>
</tr>
<tr>
<td>4.6.3 Terminating Identification Restriction (TIR)</td>
<td>✓</td>
</tr>
<tr>
<td>4.6.5 Originating Identification Restriction (OIR)</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Need IMS Supplementary Service option (MX847570A-081)
### IMS/IPsec Function Table

- Follow IMS fundamental technologies to support smartphone IMS verifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authentication method</td>
<td>HTTP Digest Authentication Using AKAv1</td>
</tr>
<tr>
<td></td>
<td>HTTP Digest Authentication Using AKAv2</td>
</tr>
<tr>
<td></td>
<td>Comparing RES with XRES</td>
</tr>
<tr>
<td></td>
<td>Comparing RES with XRES when AUTS parameter is present</td>
</tr>
<tr>
<td>Transport protocol</td>
<td>UDP</td>
</tr>
<tr>
<td></td>
<td>TCP</td>
</tr>
<tr>
<td>Verification of Security header</td>
<td>Security-verify header</td>
</tr>
<tr>
<td>Integrity algorithm</td>
<td>HMAC-SHA1-96</td>
</tr>
<tr>
<td></td>
<td>HMAC-MD5-96</td>
</tr>
<tr>
<td>Encryption algorithm</td>
<td>NULL</td>
</tr>
<tr>
<td></td>
<td>AES-CBC-128bit</td>
</tr>
<tr>
<td></td>
<td>3DES-CBC</td>
</tr>
<tr>
<td>Logging feature</td>
<td>Logging key information (Sequence Number, Nonce etc.)</td>
</tr>
<tr>
<td></td>
<td>Logging decrypted data at reception</td>
</tr>
<tr>
<td>Removing Security Association</td>
<td></td>
</tr>
</tbody>
</table>
Multiple P-CSCF (1/2)

- What is “Multiple P-CSCF” function?
  - A network operator sometimes provision multiple P-CSCFs to disperse network load, and the network provides the IP addresses of multiple P-CSCFs in this case.
  - UE sometimes shows an incorrect behaviour to access to a P-CSCF. So whether UE accesses to a correct P-CSCF is a significant key point of verification on PDN connectivity establishment.
  - Anritsu provides:
    - a function to set IP addresses of up to 3 P-CSCFs.
    - a function to set accept/ignore UE’s access to P-CSCFs.
  - Due to the functions above, the user can confirm:
    - if UE can access to the correct P-CSCF
    - how UE behaves when it can’t get any response from a P-CSCF
  - Anritsu provides a large benefit to customers through creating abnormal procedure easily.
Multiple P-CSCF (2/2)

Example of a specific use case for Multiple P-CSCF

The IP addresses of multiple P-CSCFs are notified to UE by network.

Set “Ignore” for SIP:REGISTER/INVITE

The user can confirm if UE switches to P-CSCF2 when it can’t connect to P-CSCF1.
GBA Authentication Option (1/3)

What is “GBA”?

- The 3GPP defined the GAA (Generic Authentication Architecture) as the framework for various peer authentication methods within the NGN world, in particular for Internet-based services.

- Within the GAA, the Generic Bootstrapping Architecture (GBA) defines the functions that are required to authenticate a client to a Web-based service using his 3G subscription.

  ✓ The points of GBA:
  - An authentication method for Internet-based service
  - To reuse of 3GPP authentication (ISIM)
  - A HTTP-based authentication

- Internet access is explosively growing, and the access is mainly done by smartphone nowadays. The conventional authentication methods for the Internet are showing their weakness compared with GBA. So network operators are faced with a subject to improve the security.

*GBA Authentication Option (MX847570A-084) is required*
GBA Authentication Option (2/3)

- Functions and Interfaces on GBA network

**[Process]**
1. When the UE accesses the Internet without going through the home network,
2. UE authenticates with the SIM information.

**Diagram:***
- HSS: Home Subscriber Server
- BSF: Bootstrapping Server Function
- NAF: Network Application Function

*GBA Authentication Option (MX847570A-084) is required*
Anritsu provides the following environments:

- An authentication procedure and several kinds of setting parameter to emulate GBA operation
- GBA procedure combined with XCAP-based service
  - e.g., authentication when UE gets its capability from XCAP server after SIP registration.

*GBA Authentication Option (MX847570A-084) is required*
IMS Early Media Option

- VoLTE Early Media function*
  - Supports Early Media sequence of IMS with GUI operation of IMS server
  - Supports Customized Alerting Tone (CAT) by Network Ring Back Tone (NRBT) test environment*

* IMS Early Media Option (MX847570A-085) required
**IMS Script Basic Option**

- Provides the scripting environment for a CSCF server and Virtual UA within SmartStudio.
- Scripts can be created using a ladder sequence, supporting high flexibility and scalability.
- The Smartphone vendor can easily configure both a test environment;
  - for the leading edge of operator services
  - for various tests such as subnormal and abnormal test conditions
- Call processing of LTE is by using the SmartStudio, the user can focus on function of IMS development and evaluation.

**Strength:**
High flexibility and scalability

**Weakness:**
Need to prepare the Call processing scenario related to each IMS test case for network simulator

*IMS Script Basic Option (MX847570A-060) is required*
IMS Script Basic Option

**Property area:**
Set the network parameter like server address

**Script area:**
Supports to edit and execute a sequence message between UE and CSCF

**Sample Script:**
Prepare the following type of scripts (with or without AUTH)
- Registration
- Voice(VoLTE) MO
- Voice(VoLTE) MT
- SMS(over IMS) send
- SMS(over IMS) receive

*IMS Script Basic Option (MX847570A-060) is required*
RCS (Rich Communication Suite)

- Supports the enhancement messaging service will be adopted by carriers worldwide

RCS features:
- **Enhancement messaging**
  Instant Messaging, 1to1 chat, group chat
- **Contents sharing**
  File Transfer, Contents sharing
- **Communication**
  IR.92 VoLTE, IR.94 Video
- **Enhanced Address Book**
  Social Presence Information
- **Geolocation**

MD8475A/SmartStudio:
- Built-in IMS server supports RCS
- Up to 5 Virtual UAs(user agents)

* MX847570A-083 RCS Basic Option required
RCS Option enhancement

1 to 1 Chat (CPM)
- 1 to 1 Chat (CPM): Chat session over CPM
- MO/MT Chat support
- Chat message logging
- Support for store and forward (message is sent at getting online)

Group Chat
- Upgrade from 1 to 1 Chat to Group Chat
- Support for 5 Virtual UAs on SmartStudio side
- Chat session: based on CPM protocol
- Chat message logging in one window for 1 to 1 Chat and Group Chat
- Support for store and forward (message is sent at getting online)

File Transfer
- Image file transfer: 5 extensions support: jpeg/jpg, bmp, gif, png
  - Other file format: transferred as binary
- File transfer support during 1 to 1/Group Chat
- Real time display of image file when received on Virtual UA
- Transfer status display (Transfer progress)
- Support for store and forward (message is sent at getting online)

Standalone Messaging

Content sharing
- Content Sharing during/without a voice call
- Share Video during a call in the multi device environment
- Share an Image during a call
## Comparison of RCS 5.1 Service

<table>
<thead>
<tr>
<th>Item</th>
<th>Support</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration &amp; Registration</td>
<td>✓</td>
<td>Support only HTTP(S) base</td>
</tr>
<tr>
<td>Capability discovery</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Standalone messaging</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>1-to-1 Chat</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Group Chat</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>File Transfer</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Content sharing</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Social Presence Information</td>
<td>✓ (1)</td>
<td>(1) Geolocation service is not supported.</td>
</tr>
<tr>
<td>IP Voice Call</td>
<td>✓</td>
<td>Support only IR.92 base Interaction with CS voice is not supported.</td>
</tr>
<tr>
<td>IP Video Call (IR.94)</td>
<td>✓</td>
<td>Support only IR.94 base</td>
</tr>
<tr>
<td>Geolocation services</td>
<td></td>
<td>Under planning</td>
</tr>
</tbody>
</table>

* MX847570A-083 RCS Basic Option required
VoLTE Emergency Call

- VoLTE Emergency Call function
  - Supports VoLTE Emergency Call* with GUI operation of IMS service and Simulation parameter setting, Cell parameter setting.

IMS service

Simulation parameter setting

Cell parameter setting

---

* For Video Call, MX847570A-080 Extended CSCF Option required
# IMS Function Summary (1/2)

## General

<table>
<thead>
<tr>
<th>Section</th>
<th>Function</th>
<th>Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>SIP REGIST Test</strong></td>
<td>Function for verifying CSCF server Bind/Unbind operation</td>
</tr>
<tr>
<td></td>
<td><strong>Ipsec</strong></td>
<td>Function for on/off at IPsec (3DES, AES).</td>
</tr>
<tr>
<td></td>
<td><strong>DNS Server</strong></td>
<td>Function for resolving address using DNS</td>
</tr>
<tr>
<td></td>
<td><strong>NTP Server</strong></td>
<td>Function for synchronizing time using NTP</td>
</tr>
<tr>
<td></td>
<td><strong>PSAP Server</strong></td>
<td>Function for looping-back voice for IMS Emergency</td>
</tr>
<tr>
<td></td>
<td><strong>X-CAP Server</strong></td>
<td>Function for verifying service using XML file</td>
</tr>
<tr>
<td></td>
<td><strong>No Server (Network) Response Test</strong></td>
<td>Function for verifying operation when no response due to error at server or network</td>
</tr>
<tr>
<td></td>
<td><strong>Server Error Test</strong></td>
<td>Function for verifying operation when error response received from server when error at server</td>
</tr>
<tr>
<td></td>
<td><strong>GBA</strong></td>
<td>Function for verifying GBA Authentication</td>
</tr>
<tr>
<td></td>
<td><strong>Early Media</strong></td>
<td>Function for verifying Customized Alerting Tone(CAT) and supported by Network Ring Back Tone(NRBT) test environment</td>
</tr>
<tr>
<td></td>
<td><strong>IMS Script</strong></td>
<td>Function for testing special SIP sequence flexibly according to operator’s test condition or abnormal test requirement</td>
</tr>
</tbody>
</table>

## VoLTE/VT

<table>
<thead>
<tr>
<th>Section</th>
<th>Function</th>
<th>Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Calling Sequence Test</strong></td>
<td>Function for verifying call sequence from UE</td>
</tr>
<tr>
<td></td>
<td><strong>Incoming (Answering) Call Sequence Test</strong></td>
<td>Function for verifying call sequence to UE</td>
</tr>
<tr>
<td></td>
<td><strong>Voice Loopback Test</strong></td>
<td>Function for looping-back and sending uplink voice data to verify call at UE side</td>
</tr>
<tr>
<td></td>
<td><strong>Disconnection (from UE) Sequence Test</strong></td>
<td>Function for verifying disconnection sequence from UE</td>
</tr>
<tr>
<td></td>
<td><strong>Disconnection (from NW) Sequence Test</strong></td>
<td>Function for verifying disconnection sequence from network</td>
</tr>
<tr>
<td></td>
<td><strong>Called Party Busy Test</strong></td>
<td>Function for verifying operation when called party busy</td>
</tr>
<tr>
<td></td>
<td><strong>Called Party Not Found Test</strong></td>
<td>Function for verifying operation when called party not found</td>
</tr>
<tr>
<td></td>
<td><strong>Called Party No Responses Test</strong></td>
<td>Function for verifying operation when no response from called party</td>
</tr>
<tr>
<td></td>
<td><strong>Codec Selection Tx</strong></td>
<td>Function for confirming VoLTE/VT traffic with any codec; also performs loopback</td>
</tr>
<tr>
<td></td>
<td><strong>VoLTE/VT Upgrade/Downgrade</strong></td>
<td>Switches VoLTE/VT during call</td>
</tr>
<tr>
<td></td>
<td><strong>Call ID Display/Block</strong></td>
<td>TS 24.607 Verifies IMS test terminal call ID display ON/OFF</td>
</tr>
<tr>
<td></td>
<td><strong>Incoming Call ID Display/Block</strong></td>
<td>TS 24.608 Verifies IMS test terminal incoming call ID display ON/OFF</td>
</tr>
<tr>
<td></td>
<td><strong>Call Forwarding, Holding, Catchphone</strong></td>
<td>Function for simulating TS 24.604, TS24.610, TS 24.615 call forwarding, call holding, and catchphone functions</td>
</tr>
<tr>
<td></td>
<td><strong>VoLTE Conference Environment</strong></td>
<td>Function for verifying TS.24.605 VoLTE Conference related tests (Event message, HOLD, etc.)</td>
</tr>
<tr>
<td></td>
<td><strong>Message Waiting Indication</strong></td>
<td>Function for notifying users of voice mail services about arriving voice mail</td>
</tr>
</tbody>
</table>

### Required Option

<table>
<thead>
<tr>
<th>Required Option</th>
<th>MX847 570A</th>
<th>MX847 570A-080</th>
<th>MX847 570A-081</th>
<th>MX847 570A-083</th>
<th>MX847 570A-084</th>
<th>MX847 570A-085</th>
<th>MX847 570A-060</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>✓</strong></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## IMS Function Summary (2/2)

<table>
<thead>
<tr>
<th>Section</th>
<th>Function</th>
<th>Outline</th>
<th>MX8475 70A</th>
<th>MX8475 70A-080</th>
<th>MX8475 70A-081</th>
<th>MX8475 70A-083</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RCS</strong></td>
<td>Configuration</td>
<td>Function for creating and updating UE configuration data using XML file</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Presence</td>
<td>Function for configuring from UE using XML file</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Standalone Messaging</td>
<td>Function for sending and receiving Instant Message using XML file</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>RCS Address Book</td>
<td>Function for registering and saving UE contacts using RCS</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 to 1 Chat</td>
<td>Function for 1 to 1 chat</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group Chat</td>
<td>Function for multi party chat (Maximum 5 users)</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>File Transfer</td>
<td>Function for sending and receiving same files between chat user</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Content Sharing</td>
<td>Function for sharing a video or an image during voice call/without voice call</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SMS over IMS</strong></td>
<td>SMS Message Send Test</td>
<td>Function for verifying UE SMS message sending</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SMS Message Receive Test</td>
<td>Function for verifying UE SMS message receiving</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IPv6 Addressing</strong></td>
<td>IP Address Allocation and Test (RA)</td>
<td>Function for verifying IP address setting at RA receipt</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP Address Allocation and Test (DHCPv6)</td>
<td>Function for verifying IP address setting allocated from DHCPv6 server</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VoLTE Emergency Call</strong></td>
<td>VoLTE Emergency Call (Voice)</td>
<td>Function for verifying IP VoLTE Emergency Call</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This option is unnecessary when a separate network-side terminal is available.
Message Service Test – Public Warning System

- Public Warning System (PWS) Message test
  - Earthquake Tsunami Warning System (ETWS) on LTE/WCDMA
    - Primary Notification
    - Secondary Notification
  - Commercial Mobile Alert Service (CMAS) on LTE/W-CDMA/CDMA2000/GSM
Automated Test Solution

- Automation Framework Overview
- Regression Test
- Battery Consumption
- IP Tester Control Library
- Smartphone Control Platform
- SSM Test Configuration
MD8475A Automated Test Solution Overview

Validate UE functionality during development cycle to reduce TTM
- Minimize field/drive testing, characterize performance, test applications

**Highlights:**

- **Multi-technology/multi-cell signaling scenarios**
  - cost effective, small footprint solution

- **State machine driven**
  - straightforward parameters with no script design

- **Create automated test sequences**
  - join multiple scenarios for drive test simulation

- **Automate once**
  - Re-use your configuration across Anritsu automated solutions

**Types of Tests**

- **Signaling:** Basic, IRAT Handovers, CSFB, VoLTE-IMS
- **Performance:** data throughput, data efficiency
- **Applications:** Video streaming, web browsing, RCS

**Technologies**

- LTE(FDD/TDD), W-CDMA/HSPA/HSPA evo/DC-HSDPA
- GSM/GPRS/EGPRS
- CDMA2000 1X/EV-DO
- TD-SCDMA/HSPA
Product Description; MX847503A SmartStudio Manager

• Product Attributes
  – Ease of use, without requiring in depth knowledge of 3GPP protocols
    • Intuitive graphical user interface to expedite creation and execution of test cases
  – Evaluates application behavior under different network conditions
    • Simulate different QoS, data throughput and mobility scenarios
  – Captures logs and reports results to application developer
    • Provides protocol log of message sequence for analysis
Product Description; MX847503A SmartStudio Manager

• Customer Values
  – Contribute to configure turn key solution to meet short customer’s verification cycle
  – Various Sample Test Sequences are included.
  – Create automation Test Sequence easy based on sample Test Sequences
  – Expandability for external equipment control such as power supply, W-LAN AP to allows users to configure various types of automated environment easy for Smartphone user experience verification
  – Realize “24/7” automated tests

• Sample Test Sequences
  – UE Function Test – 89 Test Sequences Available
    • Registration/ Service/ SMS/ CMAS/ ETWS/ Cell Barred/ Emergency/ WLAN
  – Mobility Test - 52 Test Sequences Available
    • Selection/ Reselection/ Redirection/ Handover/ SRVCC
  – GSMA TS09 Test – 23 Test Sequences Available
    • Stand-by Test/ Talk Time Test/ Browsing/ FTP Download
Test Application Examples

• Software Regression Test
  – Mobility Test
  – Stress Test
• Battery Consumption Test
• Device Thermal Test
• Data Throughput Test
Software Regression Test

- Type of software testing to find new software bugs and check if existing functions and new functions work without any problem after enhancement
- Simple automated test environment allows users to reduce software development cycle

Sample Test Sequences
- Registration
- Service
- PWS
- Cell Barred
- CS Emergency
- Stress test
- Tput testing
- Mobility
- etc.
Battery Consumption

• GSMA TS.09 Battery Life Measurement test solution

– Features:
  • GSMA TS.09 compliance
  • Easy parameter setup & operation
  • UE Control
  • Automated Test System used Ethernet remote control

*Customer supplied

Better battery life performance is a key point of differentiation to win for the Chipset and Smartphone manufacturers
# Battery Consumption Test Sequence List

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Radio system</th>
<th>File Name</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand-by test</td>
<td>G</td>
<td>TS09_GSM_StandbyTime.test</td>
<td>Current measurement test while UE is in Idle mode in GSM cell</td>
</tr>
<tr>
<td>Stand-by test</td>
<td>G</td>
<td>TS09_G_StandbyTime.test</td>
<td>Current measurement test while UE is in Idle mode in GSM/GPRS cell</td>
</tr>
<tr>
<td>Stand-by test</td>
<td>W</td>
<td>TS09_W_StandbyTest.test</td>
<td>Current measurement test while UE is in Idle mode in W-CDMA cell</td>
</tr>
<tr>
<td>Stand-by test</td>
<td>G-W</td>
<td>TS09_GSM_W_StandbyTime.test</td>
<td>Current measurement test while UE is in Idle mode in GSM cell with W-CDMA neighbour cells information</td>
</tr>
<tr>
<td>Stand-by test</td>
<td>G-W</td>
<td>TS09_G_W_StandbyTime.test</td>
<td>Current measurement test while UE is in Idle mode in GSM/CPRS cell with W-CDMA neighbour cells information</td>
</tr>
<tr>
<td>Stand-by test</td>
<td>W-G</td>
<td>TS09_W_G_StandbyTime.test</td>
<td>Current measurement test while UE is in Idle mode in W-CDMA cell with GSM/GPRS neighbour cells information</td>
</tr>
<tr>
<td>Stand-by test</td>
<td>L</td>
<td>TS09_L_StandbyTime.test</td>
<td>Current measurement test while UE is in Idle mode in LTE cell</td>
</tr>
<tr>
<td>MOMR: Talk time Test</td>
<td>G</td>
<td>TS09_GSM_TalkTime_MO_MR.test</td>
<td>Current measurement test while UE is in voice communication in GSM cell (UE origination, UE release)</td>
</tr>
<tr>
<td>MTNR: Talk time Test</td>
<td>G</td>
<td>TS09_GSM_TalkTime_MT_NR.test</td>
<td>Current measurement test while UE is in voice communication in GSM cell (UE termination, NW release)</td>
</tr>
<tr>
<td>MOMR: Talk time Test</td>
<td>W</td>
<td>TS09_W_TalkTime_MO_MR.test</td>
<td>Current measurement test while UE is in voice communication in W-CDMA cell (UE origination, UE release)</td>
</tr>
<tr>
<td>MTNR: Talk time Test</td>
<td>W</td>
<td>TS09_W_TalkTime_MT_NR.test</td>
<td>Current measurement test while UE is in voice communication in W-CDMA cell (UE termination, NW release)</td>
</tr>
<tr>
<td>Packet Switch Transfer Test</td>
<td>G</td>
<td>TS09_GPRS_PacketSwitchedTransfer.test</td>
<td>Current measurement test while UE is in packet communication in GSM/GPRS cell</td>
</tr>
<tr>
<td>Packet Switch Transfer Test</td>
<td>W</td>
<td>TS09_W_PacketSwitchedTransfer.test</td>
<td>Current measurement test while UE is in packet communication in W-CDMA cell</td>
</tr>
<tr>
<td>Packet Switch Transfer Test (Download)</td>
<td>L</td>
<td>TS09_L_PacketSwitchedTransfer_FileDownload.test</td>
<td>Current measurement test while UE is in packet communication in LTE cell (FTP download)</td>
</tr>
<tr>
<td>Packet Switch Transfer Test (Upload)</td>
<td>L</td>
<td>TS09_L_PacketSwitchedTransfer_FileUpload.test</td>
<td>Current measurement test while UE is in packet communication in LTE cell (FTP upload)</td>
</tr>
<tr>
<td>Packet Switch Transfer Test (Down/Upload)</td>
<td>L</td>
<td>TS09_L_PacketSwitchedTransfer_ParallerFileDlUl.test</td>
<td>Current measurement test while UE is in packet communication in LTE cell (FTP download, FTP upload)</td>
</tr>
<tr>
<td>Browsing Test</td>
<td>W</td>
<td>TS09_W_HTMLBrowsing.test</td>
<td>Current measurement test while UE is in packet communication in W-CDMA cell (HTML Browsing)</td>
</tr>
<tr>
<td>Browsing Test (Full Web Browsers)</td>
<td>W</td>
<td>TS09_W_HTMLBrowsing_Full.test</td>
<td>Current measurement test while UE is in packet communication in W-CDMA cell (HTML Browsing)</td>
</tr>
<tr>
<td>Streaming Content Test (Video)</td>
<td>L</td>
<td>TS09_L_StreamingContent_Video.test</td>
<td>Current measurement test while UE is in packet communication in LTE cell (Video Streaming)</td>
</tr>
<tr>
<td>Streaming Content Test (Audio)</td>
<td>L</td>
<td>TS09_L_StreamingContent_Audio.test</td>
<td>Current measurement test while UE is in packet communication in LTE cell (Audio Streaming)</td>
</tr>
<tr>
<td>Video Telephony Test</td>
<td>W</td>
<td>TS09_W_VideoTelephony.test</td>
<td>Current measurement test while UE is in packet communication in LTE cell (Audio Streaming)</td>
</tr>
<tr>
<td>FTP Download Test</td>
<td>W</td>
<td>TS09_W_FTPDownload.test</td>
<td>Current measurement test while UE is in Video call in W-CDMA cell</td>
</tr>
<tr>
<td>FTP Download Test</td>
<td>G</td>
<td>TS09_GPRS_FTPDownload.test</td>
<td>Current measurement test while UE is in packet communication in W-CDMA cell (FTP Download)</td>
</tr>
</tbody>
</table>
IP Tester Control Library (1/2)

What is “IP Tester Control Library”?

- People enjoy many kinds of benefits by using the Internet and the access is operated by their smartphone.
- Nowadays smartphone should offer not only easy operation but also its stability for the Internet access to the people. This is a key for UE development.
- IXIA IxChariot has been a highly well-received tool for IP network testing.
- IP Tester Control Library is a collection of procedures used to control the IXIA IxChariot remotely.
- Anritsu provides the following features with this library:
  - automating IP throughput testing
  - an integrated solution for testing 3GPP and 3GPP2 wireless protocols as well as IP performance measurement and analysis
- Due to the functions above, the user can perform:
  - UE’s performance under high IP throughput testing condition
  - UE’s stability by repeated procedures under automated testing environment
- Anritsu provides a large benefit to customers through creating this automated measurement environment easily.

*IP Tester Control Library (MX847503A-901) is required*
IP Tester Control Library (2/2)

- Setup with SmartStudio Manager

*IP Tester Control Library (MX847503A-901) is required*
Smartphone Control Platform

- Anritsu provides the following features with this environment:
  - Editor for recording UE’s behaviour and creating a script for UE automation control
  - Invoking the script by automated test engine of SmartStudio Manager
  - Supported OS: Android

- Due to the functions above, the user can do:
  - UE’s regression testing before its release
  - UE’s stability testing by repeated procedures under automated testing environment easily
  - Reuse and modify the existing scripts for other test script easily
Architecture

- Logical architecture

Interaction between UE and GUI to record UE's behaviour via ADB

Remote control of UE according to a called script

GUI to create a script

Script creation part

Store the created script on this GUI

Remote Execution

Script repository

Calling a script

Script execution part
IMS VoLTE Calling

Test configuration to make sure IMS VoLTE calling with application operation via ADB

Test Case Example
1. Register to LTE network
2. Make SIP registration
3. Make VoLTE MO call from UE via ADB
4. Receive VoLTE call at IMS server
5. Check the UE status (by using “Get CSCF Status” procedure)
6. End call by UE side
**SMS/PWS**

Test configuration to make sure continuous SMS/PWS testing with automation framework

**Test Case Example**
1. Register to LTE network
2. Send SMS or Cell Broadcast /CMAS/ETWS from network side
MMS Testing
Test configuration to make sure MMS testing with application operation via ADB and 3\textsuperscript{rd}-party server

**Test Case Example**
1. Register to LTE network
2. Send MMS contents to MMS server
3. Automatically send the binary SMS to SMSC
4. Send the binary SMS to UE
5. UE automatically retrieves the MMS contents from server
Web Browsing / Video Streaming

Test configuration to make sure web browsing with application operation via ADB

**Test Case Example**
1. Register to LTE network
2. Control UE via ADB command
3. Make web browsing from UE side
4. End call by UE side
FTP/ Iperf for Data Throughput Test

Test configuration to make sure web browsing with application operation via ADB

**Test Case Example**
1. Register to LTE network
2. Execute Iperf or FTP server through dedicated .bat file
3. Control UE via ADB command
4. Perform the FTP/UDP/TCP data throughput
5. End call by UE side
WLAN Offload

Test Case Example
1. Register to LTE network
2. Packet call over LTE via ADB
3. Control SmartStudio (LTE), WLAN AP and external WLAN OL application by SSM
4. Perform WLAN OL
5. End call by UE side

SmartStudio Manager
Smartphone Control Platform

Ethernet

WLAN AP
MD8475A
USB

Call Proc A

Ether 1