Mobile Terminal Service Quality and Call Connectivity Tests during Handover

Following the sudden worldwide expansion in 2/2.5G GSM/GPRS/EGPRS, rollout of next-generation 3/3.5G W-CDMA/HSDPA/HSUPA mobile communication standards is starting in earnest. This complex mixture of 2/2.5/3/3.5G mobile networks increases the need for assured service quality and call connectivity as mobile terminals move between base-station cells. Moreover, the general testing and verification phase of mobile terminals requires effective solutions for performing service quality, call connectivity and stability tests at handover between cells, while field tests must assure roaming services between multiple carriers in different countries.

Key Multi-cell Network Simulator Applications

- Verify mobile terminal service quality and call connectivity at handover
- Verify roaming services between national carriers
- Perform pre-verification before field tests
- Perform comprehensive verification at integration tests of UMTS terminals
- Evaluate throughout performance at switching between cells supporting different data rates, as well as mobile terminal user interface (UI)
- Verify call connectivity by simulating various carrier networks

Anritsu’s MX847016A Multi-cell Network Simulator (MNS) simulates an interactive 2-cell environment for W-CDMA/HSDPA/HSUPA, and GSM/GPRS/EGPRS mobile networks with an easy-to-use graphical user interface (GUI) for setting the network parameters to test mobile handover and cell selection/reselection functions. Installing the MX847016A option in one MD8470A offers a personal benchtop environment for verifying handover and cell selection/reselection functions in a 2-cell environment emulating most of the world’s main mobile communication standards. Service quality, call connectivity, stability, etc., during handover are all easy to verify with high repeatability using this cost-effective test solution.

MX847016A
Multi-cell Network Simulator
Simulates Interactive 2-cell Environment
MX847016A Multi-cell Network Simulator (MNS)

The MNS software application runs on the MD8470A to simulate an interactive 2-cell environment. Since the bearer starts in response to requests from the mobile terminal connected to the MD8470A, call processing for each service type is achieved easily in a 2-cell environment. Tests of handover as the mobile terminal moves between cells as well cell selection and reselection to register with a suitable cell can be performed. The GUI-based operations set various network and communication parameters flexibly using system configuration settings for two base stations, cell parameter settings for up to 10 cells and test condition settings for cell switching.

Features

Small Footprint Platform Supporting World Networks
One MD8470A with this software supports a 2-cell test environment for the GSM/GPRS/EGPRS and W-CDMA/HSDPA/HSUPA communication standards worldwide. Even foreign services and bearers can be tested easily at the benchtop. Verifying mobile terminal operation during handover between cells at the early development stage helps cut field test workloads and post-installation troubleshooting.

Stable, Reproducible Test Environment
Unlike live networks that are influenced by various external factors, the MD8470A is a stable, high-reproducibility test environment. Specifying each communications condition and cell switching parameter allows users to easily verify service quality, call connectivity, and stability during handover between cells at any timing. The MNS offers a stable test environment with high reproducibility and allows users to test subscribers' mobile terminal operations easily. Moreover, protocol logs saved during testing help with later debugging.

Easy Handover and Roaming Simulation
Various network parameters for target cells, such as MCC/MNC/LAC/RAC, bands, communication standards, and data rate, can be set freely by GUI operations. Call connectivity tests at handover between cells as well as roaming tests between national carriers are simulated to troubleshoot mobile terminal problems easily without needing to write complex test scripts. Simplified system settings help support high-efficiency testing.
Cell Selection, Reselection & Handover Tests

The MNS performs cell selection, reselection and handover tests. In addition to roaming verifications when moving between different national carriers, the MNS can also verify the quality of high-speed packet-based multimedia services by installing the MX847010A-01 EGPRS Software, MX847010A-11 HSDPA Software, and MX847010A-12 HSUPA Software options. Since one MD8470A with these software options closely emulates the real service environment, it greatly improves work efficiency at pre-verification of field tests.

Flexible Network Parameter Settings

Cell Parameter Settings for up to 10 Cells

Using the MNS, network parameters can be specified for up to 10 cells (Cell A to Cell J) that can be pre-set as Non-Camping Cells during testing to perform handover and cell reselection. The MNS supports mobile terminal operation verifications at switching to the specified cell. Also, it can be applied to verify measurement of throughput performance according to changes in packet data rate and to evaluate the mobile terminal user interface by performing handover between Cell A: Rel. 5 (Cat. 8) to Cell B: Rel. 5 (Cat. 6) to Cell C: Rel. 99 as an example.

W-CDMA/HSDPA/HSUPA (2-Cell)

- Cell Selection
- Cell Reselection
- Handover
  - Soft Handover
  - Inter-frequency Hard Handover
  - Intra-frequency Hard Handover
  - Voice Call (AMR: Handset, Loopback)
  - Video Call (Loopback)
  - Packet Call (DL384k/UL64k to DL7.2M/UL2.0M)
  - Multi-call (Voice + Packet, Video + Packet)

GSM/GPRS/EGPRS (2-Cell)

- Cell Selection
- Cell Reselection
- Inter-frequency Hard Handover
  - Voice Call (EFR/FR/HR*/AMR: Handset, Loopback)
  - Packet Call (GPRS, EGPRS)
  - FR/HR only support Loopback

W-CDMA/HSDPA/HSUPA, GSM/GPRS/EGPRS (2-Cell/InterRAT)

- Cell Selection
- Inter-system Cell Reselection
- Inter-system Handover
  - Voice Call (W-CDMA ⇔ GSM)
  - Packet Call (W-CDMA/HSDPA/HSUPA ⇔ GSM/GPRS/EGPRS)
  - Voice call only support Loopback

Test Condition Settings at Cell Switching

The MNS Test Parameter Editor function makes it easy to select test types and set cell switching conditions for each test. The simple GUI allows users to configure various condition settings such as power control for Camping Cell/Non-Camping Cell, measurement control for Hard/Soft Handover, and barred cell status and registration timeout setting for Cell Selection/Reselection.
**About Cell Selection Test**

When a mobile terminal is switched on, it selects a suitable cell using the PLMN, barred conditions, downlink signal level, etc., of each cell and then tests registration with that cell. The test for confirming that the mobile terminal selects a suitable cell is called the Cell Selection Test.

**Cell Selection Test**

The MNS allows users to configure various conditions such as a suitable cell where registration should be performed, downlink power level, barred cell status for each cell as BTS1 and BTS2. This supports simple verification of whether a suitable cell is selected at registration after power-on.

**Registration Timeout Setting**

The wait time of the message (W-CDMA; RRC Connection Request, GSM: CHANNEL REQUEST) sent by the mobile terminal can be specified from 30 to 120 s when registration is performed for the cell selection/reselection test.

**About Cell Reselection Test**

If the mobile terminal cannot use the service after completing registration, it may sometimes change the suitable cell depending on the barred conditions and downlink signal level of each cell. In this case, the mobile terminal reselects a suitable cell based on the E-PLMN List, and PLMN, barred conditions and downlink signal level of each cell and then tests registration again with that new cell. The test for confirming that the mobile terminal reselects a suitable cell is called the Cell Reselection Test.

**Cell Reselection Test**

After registration is completed, the power [dBm] when the downlink signal starts, the final targeted power [dBm], the power change steps [dB] and the power step change period [s] as well as the barred cell status can all be set for each cell of BTS1 and BTS2. This supports simple verification of whether a suitable cell is reselected after registration.

Furthermore, since cell parameters including MCC/MNC/LAC/RAC and Band can be preset for up to 10 cells (Cell A to Cell J), a test environment that emulates roaming between national carriers is easily configured. Using the MNS to perform effective debugging before field tests helps to cut post-installation troubleshooting workloads.
Handover Test

About Handover Test

When a mobile terminal is using a service, it sometimes switches to another cell depending on changes in the downlink signal level. The mobile terminal reselects the suitable cell using the downlink signal level and tries to continue the service while switching to the new cell according to instructions from the network. The test for confirming that the mobile terminal can maintain service while switching between cells is called the Handover Test.

Handover Reliability Test

The MNS tests whether the call connection (voice call, video call, packet call, multi-call) can be maintained in an environment where handover occurs repeatedly. Switching between pre-set cells is performed according to the cell parameters so the mobile terminal call connection reliability and stability can be tested efficiently, helping debugging before field tests and lightening post-installation troubleshooting workloads.

Setting Non-Camping Cell Parameters during Testing

The Details Setting Field is used to display and edit the network parameters and test settings for each selected cell. The MCC/MNC/LAC/RAC and Band, packet data rate, Power Control, and Measurement Control settings can all be easily changed during testing to increase test work efficiency.

Remote Control Interface

The MNS supports remote control using the dedicated functions of the MX847010A external control library (RmtSvcLib.dll), making it easy to configure an automated test system by calling the API from external applications.

Network Service Selection Test

The MNS can be used to test whether the mobile terminal switches as intended when performing network service selection during voice call, packet call, and multi-calling. In addition, the throughput performance at switching to a cell supporting a different packet rate can be tested along with evaluation of the mobile terminal user interface.

(Examples)
- Switching to different packet rate cell during multi-call (HSDPA/3.6M + Voice → W-CDMA/384k + Voice)
- Switching to different voice codec cell during GSM voice call (GSM/AMR → GSM/EFR)
- Switching to W-CDMA cell during HSDPA packet call
- Switching to EGPRS cell during HSDPA packet call

Target Cell Selection using Pull-down Menu

Voice Calling

3G

3.5G

W-CDMA

W-CDMA/HSDPA

W-CDMA

Voice Calling

Video Streaming

3.5G

2.5G

3.5G

Cell A: HSDPA(Cat.8)

Cell B: GPRS/EGPRS

Cell C: HSDPA(Cat.6)

L1/L2 Measurement

IP Performance Monitor
## Main Functions

### MX847016A Multi-cell Network Simulator (MNS)

<table>
<thead>
<tr>
<th>Supported Bearers</th>
<th>W-CDMA/HSDPA/HSUPA</th>
<th>Voice (MO/MT), Packet data (MO), PPP [built-in server] packet data (MO), Video [Loopback] (MO/MT), Multi-call (Voice(Packet), Video+Packet)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Simulation Model</strong></td>
<td>W-CDMA/W-CDMA</td>
<td>Voice (MO/MT), Packet data (MO)</td>
</tr>
<tr>
<td></td>
<td>W01-W01, W03-W03: Cell Selection/Reselection, Hard Handover, Soft Handover</td>
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<tr>
<td></td>
<td>GSM/GSM</td>
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<tr>
<td></td>
<td>G01-G01: Cell Selection/Reselection, Hard Handover</td>
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<tr>
<td></td>
<td>W-CDMA/GSM</td>
<td></td>
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<tr>
<td></td>
<td>W01-G01: Cell Selection/Reselection, Hard Handover</td>
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</tr>
<tr>
<td><strong>Common</strong></td>
<td>Security: ON/OFF/Fake</td>
<td></td>
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<tr>
<td></td>
<td>Handset: Handset or Loopback</td>
<td></td>
</tr>
<tr>
<td><strong>IP Address</strong></td>
<td>Client IP address, Server IP address, Router connection setting</td>
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</tr>
<tr>
<td><strong>USIM</strong></td>
<td>USIM Parameter: Test USIM MODE, K, RAND, AUTN, IK</td>
<td></td>
</tr>
<tr>
<td><strong>Simulation Parameter Setup</strong></td>
<td>W-CDMA</td>
<td>Communications standard: W-CDMA or GSM/GPRS</td>
</tr>
<tr>
<td></td>
<td>MCC/MNC/Equivalent PLMN Group/LAC/RAC</td>
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<tr>
<td></td>
<td>Initial DL Ref. Power: –120 to –20 dBm</td>
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<tr>
<td></td>
<td>Initial UL Ref. Power: –40 to +30 dBm</td>
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<tr>
<td><strong>Cell Parameter Setup</strong></td>
<td>Band: I, II, III, IV, V, VI, VII, VIII, IX, X, Not specified</td>
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<tr>
<td></td>
<td>Channel: DL/UL</td>
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<td></td>
<td>NMO: Combined Attach, Not Combined Attach</td>
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<td></td>
<td>Packet Window Size: DL/UL</td>
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<td>Packet Rate: DL384k/UL64k, DLHS-Auto/UL384k, DL1.8M/UL384k, DL3.6M/UL384k, DL7.2M/UL384k, DLHS-Auto/ULHS-Auto, DL1.6M/UL1.46M, DL1.8M/UL2.0M, DL3.6M/UL1.46M, DL7.2M/UL2.0M</td>
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<tr>
<td></td>
<td>Primary Scrambling Code: 0 to 511</td>
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<tr>
<td><strong>GSM</strong></td>
<td>Band: GSM450, GSM480, GSM850, P-GSM900, E-GSM900, R-GSM900, DC1800, PCS1900 ARFCN (CCH, TCH)</td>
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<tr>
<td><strong>GPRS</strong></td>
<td>NCC: 0 to 7</td>
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<tr>
<td><strong>EGPRS</strong></td>
<td>BCC: 0 to 7</td>
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<tr>
<td><strong>Power Control</strong></td>
<td>Test start downlink power: –120 to –20 dBm (Camping Cell, Non-Camping Cell)</td>
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<td></td>
<td>Test end downlink power: –120 to –20 dBm (Camping Cell, Non-Camping Cell)</td>
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<td></td>
<td>Power change step cycle: 1 to 30 s (Camping Cell, Non-Camping Cell)</td>
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<tr>
<td><strong>Measurement (Hard HO/Soft HO tests only)</strong></td>
<td>Measurement Control: ON or OFF</td>
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<td>Event Parameters: W-CDMA 2-Cell Hard Handover</td>
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<td>Intra Frequency: Event Type, Reporting Constant, Hysteresian</td>
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<td>Inter Frequency: Event Type, Threshold (own), Threshold (other), Hysteresis</td>
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<td></td>
<td>Event Parameters: W-CDMA 2-Cell Soft Handover</td>
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<td>Intra Frequency: Event Type, Reporting Constant, Hysteresian</td>
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<td></td>
<td>Event Parameters: GSM 2-Cell Handover</td>
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<td>Threshold: Own, Other</td>
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<td>Event Parameters: W-CDMA/GSM InterRAT Handover</td>
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<td></td>
<td>Event Parameters (W-CDMA): Event Type, Threshold (own), Threshold (other), Hysteresis</td>
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<tr>
<td></td>
<td>Event Parameters (GSM): Own, Other</td>
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1: MX847010A-11: HSDPA Software option separately required
2: MX847010A-12: HSUPA Software option separately required
3: MX847010A-01: EGPRS Software option separately required
### Configurations

**MX847016A Multi-cell Network Simulator**

The MNS software simulates interactive base station operations for a 2-cell W-CDMA/W-CDMA, GSM/GSM, and W-CDMA/GSM environment to support cell selection, cell reselection and handover tests for each service. The easy-to-use GUI supports simple setting of network parameters without needing to create complex test scripts.

<table>
<thead>
<tr>
<th>Test Configuration</th>
<th>Option/Unit/Software</th>
<th>MD8470A</th>
<th>MD8470A-02</th>
<th>MU847010A</th>
<th>MU847020B</th>
<th>MU847020BA</th>
<th>MU847020BA</th>
<th>MU847010A</th>
<th>MU847010A</th>
<th>MU847010A-01</th>
<th>MU847010A-11</th>
<th>MU847010A-12</th>
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<th>Mx847011A</th>
<th>Mx847012A</th>
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<tbody>
<tr>
<td>W-CDMA/W-CDMA</td>
<td>W-CDMA 2-Cell</td>
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<td>GSM/GSM</td>
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<tr>
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<tr>
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</tbody>
</table>

Note: Optional (Ciphering tests are simulated by C-scenario.)

* The MX847015A Energy Management Test Simulator, MX847015A-01 Parallel Phone Test Software for ETS, MX847016A Multi-cell Network Simulator, and related hardware options are also offered as the "Wireless Test Suite" package. For more details, contact your local sales.

Refer to the MX847015A catalog for details about the MX847015A and MX847015A-01.

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Specifications are subject to change without notice.