Product Introduction

MX847016A Multi-cell Network Simulator

MD8470A
Signalling Tester

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MX847016A Multi-cell Network Simulator

Product Introduction

Mobile Terminal Service Quality and
Call Connectivity Tests during Handover

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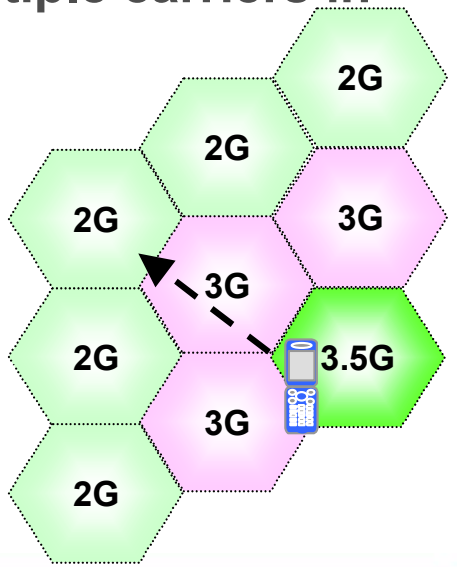
October 2008
Ver 1.00

Background

- 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 phone 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 phones 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.

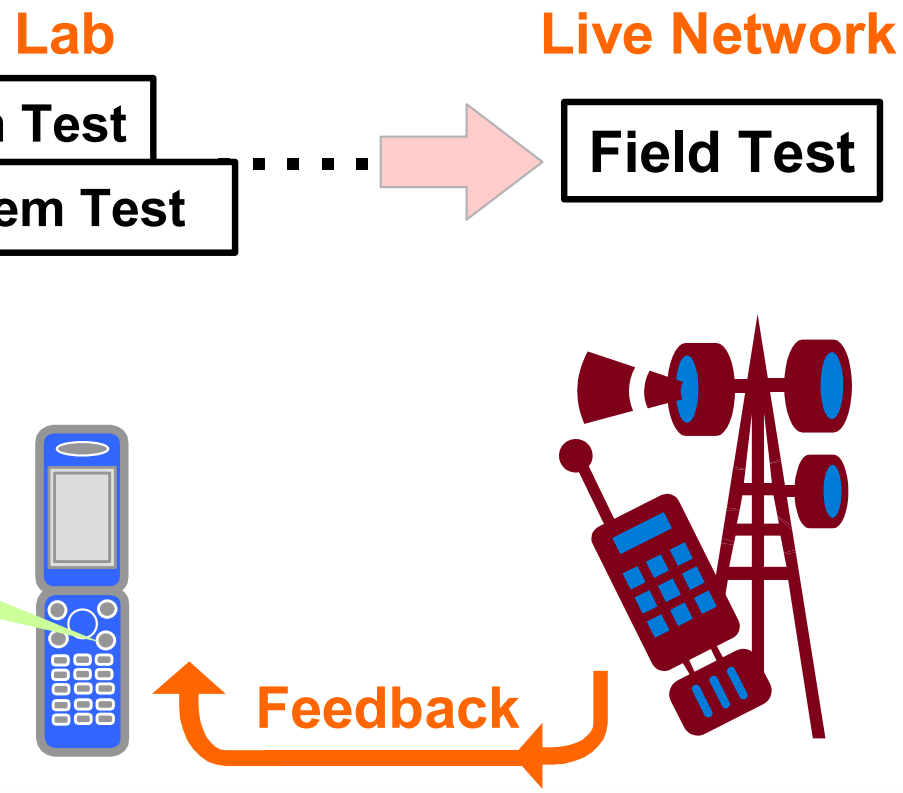
- **A test environment is needed to simulate various cell conditions for maintaining service quality under different network conditions.**



Test Environment

- Verification for all UE functions before field test must be required in order to improve product quality, decrease feedback workload to previous processes, conduct troubleshooting and verify services otherwise difficult to test on a live network etc.
- In this case, a BTS simulator is a stable verification environment for all UE functions with high repeatability and an effective troubleshooting tool. **However it is not easy to create a test environment for multi-cell.**

-Telephony service (voice, video, data)
-Supplementary service
-Service interruption
-Multi call (voice, video, packet, SMS)
-Semi-normal test, Abnormal test
-Service repetition (continuous call, SMS)
-Data throughput test
-Regression test
-Call connectivity and stability
-Battery life test / Thermal test
-Handover reliability
-System determination (roaming) reliability
-Cell selection / reselection test etc.



Current Test Environment Issues

UE verification related to handover and cell selection/reselection

Global Network Support

- The rollout of 3.5G mobile communications services is creating mixed 2G/2.5G/3G/3.5G networks, requiring a desktop worldwide verification environment.

Live Network Verification Costs

- Field testing of live networks incurs large costs for travel, etc., and sometimes repeated extended trips for debugging.

Difficult Fault Reproducibility at Cell Switching in Field Tests

- Changing external factors make field verification of high stability and reproducibility difficult. Moreover, service verification at handover is difficult under changing communications conditions.

Solve Mobile Terminal Verification Problems

The MX847016A Multi-cell Network Simulator solves these problems!

Supports Major World Communication Standards

- The new MX847016A software for the MD8470A supports a lab desktop two-cell test environment for the world's GSM/GPRS/EGPRS and W-CDMA/HSDPA/HSUPA communication bearers.

Early Fault Detection

- Early desktop fault detection cuts testing using live network and feedback costs and time, supporting faster roll-out.

High Stability/Reproducibility Test Environment

- Service quality, connection reliability/stability verifications, etc., at any handover timing are verified easily by setting cell handover conditions.

Benefits of MD8470A

- The burdens of field tests to check overall operation from Layer 1 to terminal application software, as well as terminal integration and system tests are cut by verifying service quality, connectivity at handover, and roaming, etc., under various network conditions in the lab.

MD8470A
—MX847016A Multi-cell Network Simulator

Cut Fault and Verification Process

Integration Test

System Test

Field Test

Application Software

RF Protocol (Layer 2, 3)

RF (Layer 1)

Feedback

Cut Verification Cost !!

Lab

Cut Debugging

Live Network

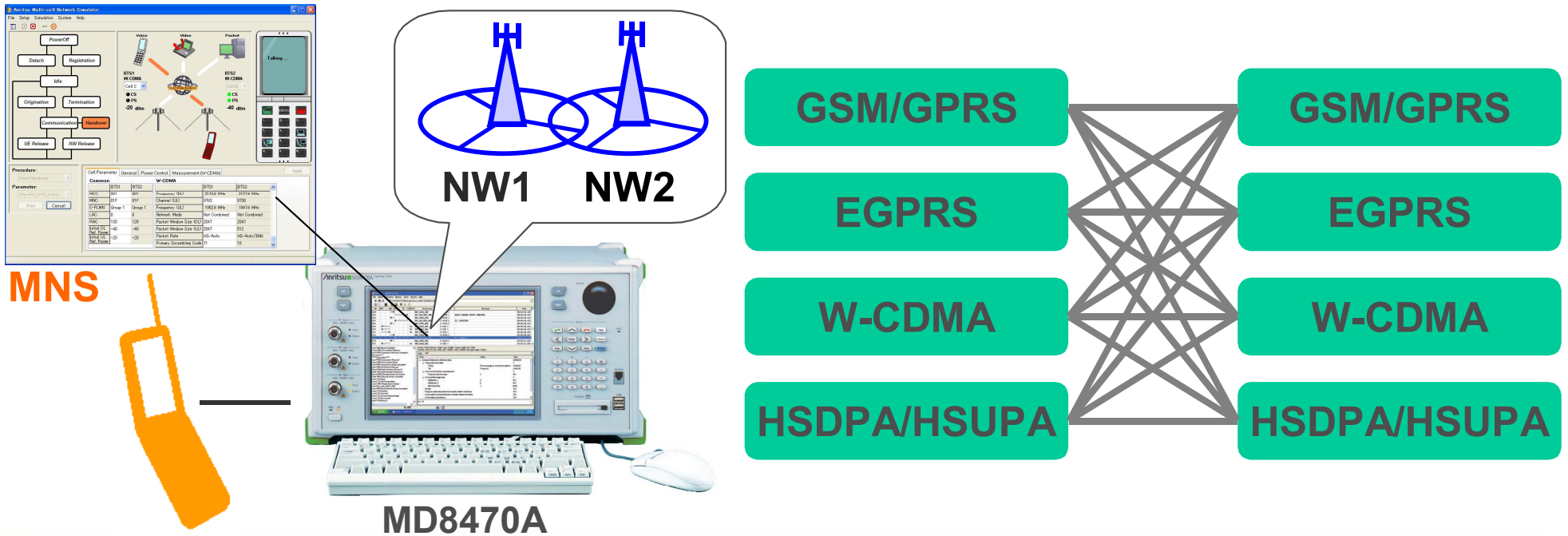
Development Phase

Evaluation Phase

MX847016A Multi-cell Network Simulator
Product Overview

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. The bearer starts in response to requests from the mobile terminal connected to the MD8470A.
  - Supports system parameter configuration and network simulation capability required for handover / roaming tests.
  - Handover, cell selection / reselection tests on GSM/GPRS⇔GSM/GPRS, GSM/GPRS⇔W-CDMA and W-CDMA⇔W-CDMA can be supported on a single MD8470A.



Practicable Handover and Cell selection/reselection Tests

W-CDMA/HSPA⇔W-CDMA/HSPA (2Cell)

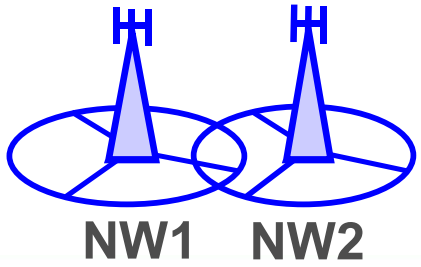
- **Cell Selection / Reselection**
- **Soft Handover**
  - **Voice Call** (AMR(12.2k) Handset、Loopback)
  - **Video Call** (Loopback)
  - **Packet Call** (DL384k/UL64k to DL7.2M/UL2.0M)
  - **Multi-Call** (Voice + Packet, Video＋Packet)
- **Inter-frequency Hard Handover**
  - **Voice Call** (AMR(12.2k): Handset、Loopback)
  - **Video Call** (Loopback)
  - **Packet Call** (DL384k/UL64k to DL7.2M/UL2.0M)
  - **Multi-Call** (Voice + Packet, Video＋Packet)
- **Intra-frequency Hard Handover**
  - **Voice Call** (AMR(12.2k): Handset、Loopback)
  - **Video Call** (Loopback)
  - **Packet Call** (DL384k/UL64k to DL7.2M/UL2.0M)
  - **Multi-Call** (Voice + Packet, Video＋Packet)

GSM/(E)GPRS⇔GSM/(E)GPRS (2Cell)

- **Cell Selection / Reselection**
- **Inter-frequency Hard Handover**
  - **Voice Call**
    (EFR/FR*/HR*/AMR(12.2k): Handset、Loopback)
    *FR/HR only support Loopback
  - **Packet Call** (GPRS, EGPRS)

W-CDMA/HSPA⇔GSM/(E)GPRS (2Cell)

- **Cell Selection / Reselection**
- **Inter-System Handover (InterRAT)**
  - **Voice Call*** (W-CDMA ⇔ GSM)
    *Voice call only supports Loopback
  - **Packet Call**
    (W-CDMA/HSPA ⇔ GSM/(E)GPRS)



Handover/Roaming Test Examples

Multi-cell Network Simulator (MNS) supports the following tests:

Handover Reliability Test

Verifies whether call connection status (voice call, packet, video call, multi-call) during handover can be repeated continuously

(Examples) Repetition of handover while in voice communications status
Repetition of handover while in W-CDMA multi-call status

Network Service Selection Test

Verifies whether service switched to intended state when mobile switches network while in voice call, packet, video call and multi-call communications status

(Examples) Switching to different packet rate cell during multi-call
Switching to different voice codec cell during GSM voice call (GSM/AMR ➔ GSM/EFR)

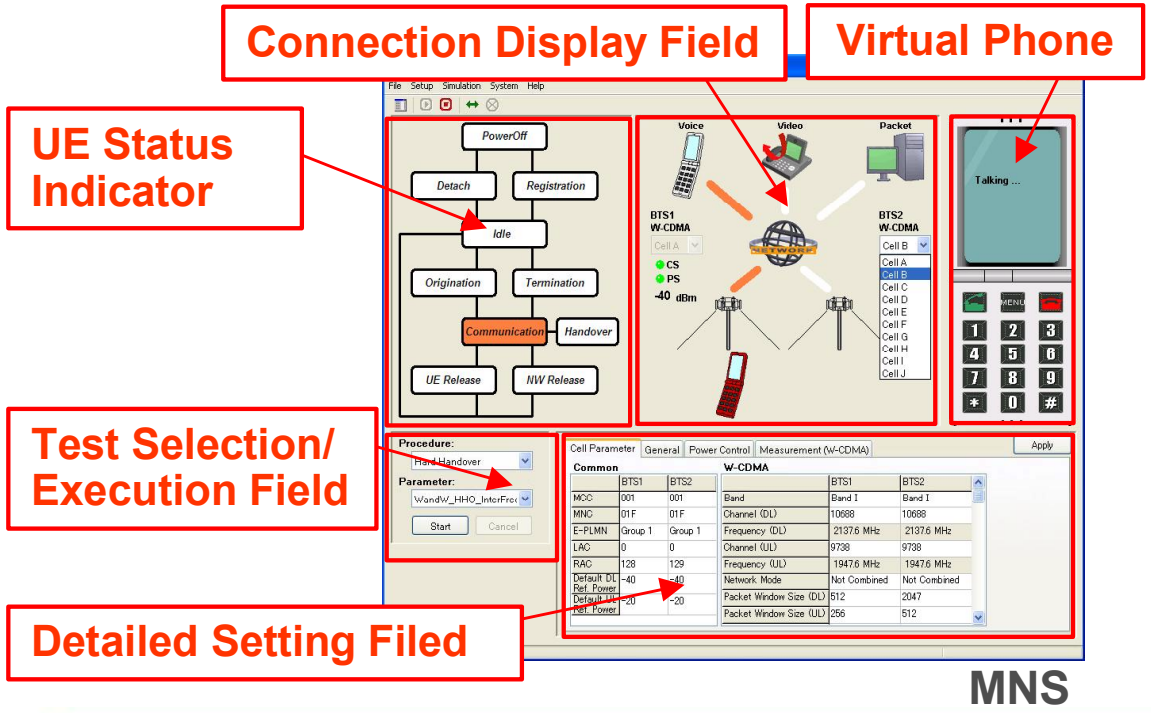
Cell Selection/Reselection Test

Verifies whether optimum cell selected according to cell selection/ reselection status set at mobile

MX847016A Multi-cell Network Simulator
User Interface

MNS User Interface (1/4)

- MNS Main Screen
  - Simulates interactive base station operation and supports call origination/ release for voice, video, and packet calls from mobile and network side in two-cell test environment
  - Displays call connections on three screens (UE Status Indicator, Network Status Indicator and Virtual Phone).
  - Supports efficient testing by editing/setting non-camping cell parameters in “Detailed Setting Field” during communications.



MNS

Supported Bearers

- W-CDMA/HSDPA/HSUPA
  - Voice (MO/MT)
    - —AMR (12.2k)
  - Packet (MO) (IP/PPP)
    - —DL 384k/UL 64k to DL 7.2M/UL 2.0M
  - Video [Loopback] (MO/MT)
  - Multi-call
    - —Voice + packet, Video + packet
- GSM/GPRS/EGPRS
  - Voice (MO/MT)
    - —EFR/FR*/HR*/AMR(12.2k)
    - *Loopback only
  - Packet (MO)
    - —Multi-slot Class 12

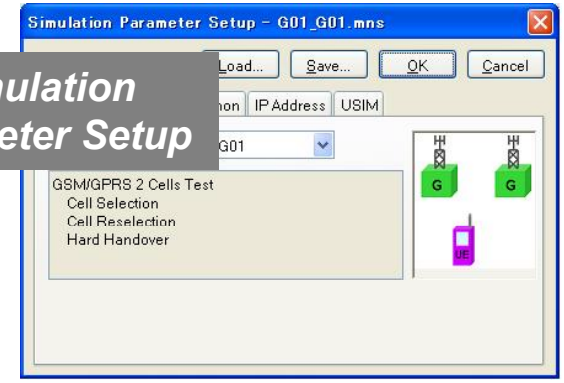
MNS User Interface (2/4)

- **Parameter Setting Screen**
  The MNS sets three types of network parameters.

Simulation Parameter Setup

Set basic system for 2BTS

- Simulation Model Setting: W-W, G-G, W-G
- Handset/Loopback Setting
- UE/Server IP Address and Router Setting
- USIM Parameter Setting, etc.

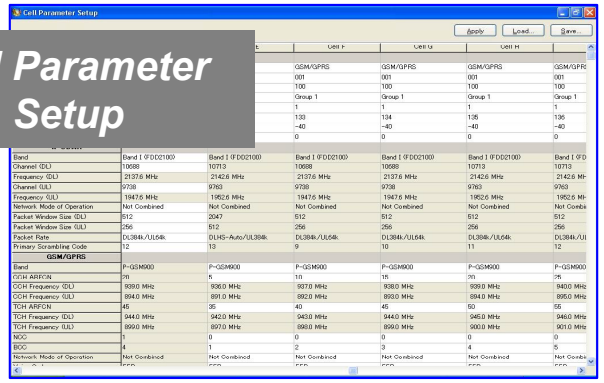


Simulation Parameter Setup

Cell Parameter Setup

Set up to 10 cell parameters

- Communication Standards, MCC/MNC/LAC/RAC Setting
- W-CDMA Band/Channel Setting
- W-CDMA/HSPA Packet Rate Setting (to DL 7.2M/UL 2.0M)
- W-CDMA Primary Scrambling Code Setting
- GSM Band/ARFCN Setting
- GSM Voice Codec Setting (EFR/HR*/FR*/AMR) *: Loopback
- Slot, GPRS CS, EGPRS MCS Setting, etc.

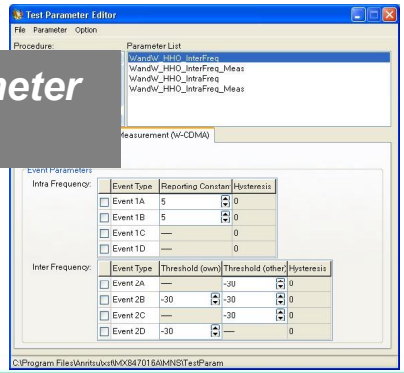


Cell Parameter Setup

Test Parameter Editor

Set test conditions at cell handover

- Suitable Cell Setting
- Cell Regulation Setting
- Cell Power Setting
- Measurement Control Setting, etc.



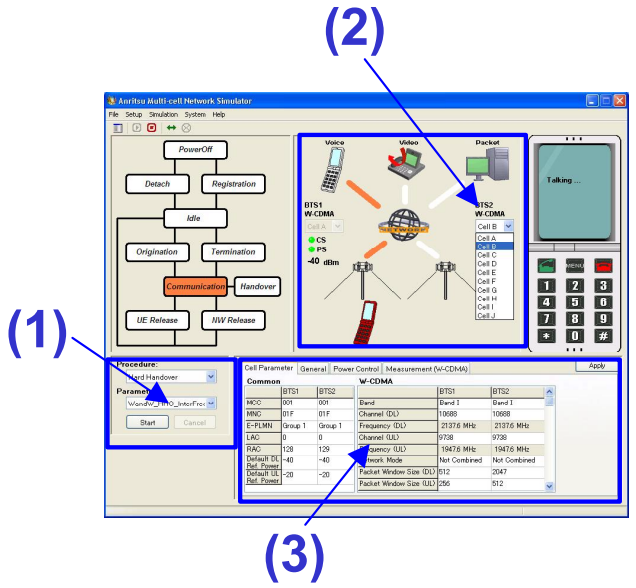
Test Parameter Editor

MNS User Interface (3/4)

- **Execute Simulation**

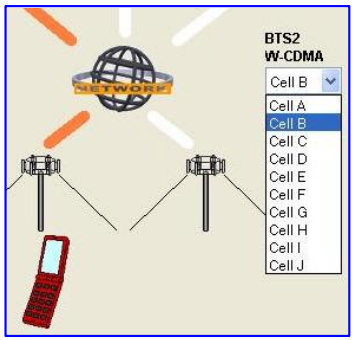
(1) Test Selection/Execution

- **Select test parameters for procedures and test conditions and execute tests.**
  - At UE Power Off: Cell Selection Test
  - At UE Idle: Cell Reselection Test
  - At UE Communication:
    Handover, Hard Handover and Soft Handover Tests



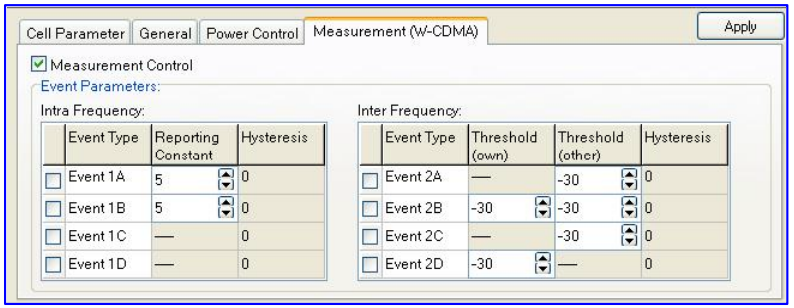
(2) Select Cell to Use

- **Select cells set by cell parameter setup in the Connection Display field. Select the BTS 1 and BTS 2 cells for cell tests from a pull-down menu.**
- **Non-camping cell is also selected and changed from a pull-down menu during simulation.**



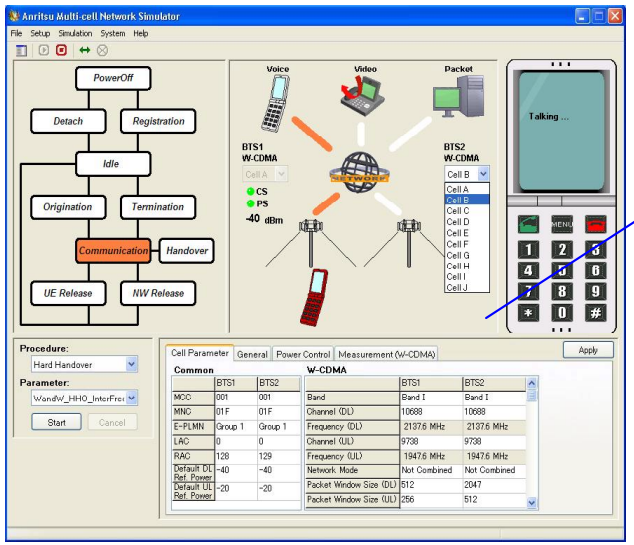
(3) Editing/Setting Test Details

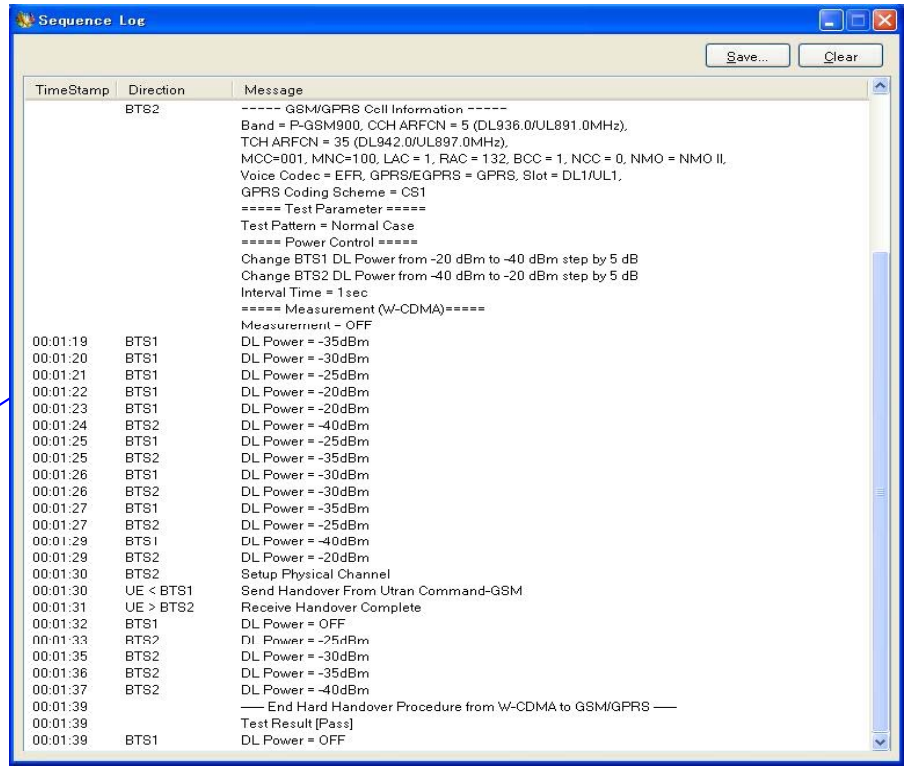
- **Display each cell parameter selected in the Connection Display field and set the test parameters.**
- **NW parameters (MCC/MNC/LAC/RAC, Band, Rate, etc.) for non-camping cell and each test condition (Power Control, Measurement Control, etc.) can be changed during simulation.**



MNS User Interface (4/4)

- Sequence Log
  - Display and save cell-test conditions as sequence data at simulation.
  - Display test results (Pass/Fail) in real time at the end of major protocol sequences, elapsed time and some setting contents.





Sequence Log

MNS Configurable Parameters (1/3)

Simulation Parameter Setup

- **Following network parameters can be configured for W-CDMA and GSM network simulation**

Simulation Parameter Setup	Parameter	Description
Simulation Model	W01-W01, W03-W03, G01-G01, W01-G01	Simulation standards setting
Common	Security	Security method setting (ON, OFF, Fake)
	Handset	Handset, Loopback
IP Address	UE Address	UE IP address setting
	DNS Server Address	Server IP address setting
	Router	Router setting (Enable, Disable)
	Default Gateway Address	Router IP address setting
	Subnetmask	Router subnetmask setting
USIM	Test USIM Mode	Selectable method of designation about RAND,AUTN,IK for authentication (ON, OFF)
	K	Security Key (K) setting
	RAND	Random Number (RAND) setting
	AUTN	Authentication Number setting
	IK	Integrity Key (IK) setting

MNS Configurable Parameters (2/3)

Cell Parameter Setup

Cell Parameter Setup	Parameter	Description
Common	Standard	Communication standards setting (W-CDMA, GSM/GPRS)
	MCC	Mobile Country Code setting
	MNC	Mobile Network Code setting
	Equivalent PLMN Group	Group1, Group2
	LAC	Location Area Code setting (0 ~ 65535)
	RAC	Routing Area Code setting (0 ~ 255)
	Initial DL Ref. Power	Initial DL refernce power setting (-120dBm to -20dBm)
	Initial UL Ref. Power	Initial UL refernce power setting (-40dBm to 30dBm)
W-CDMA	Band	Band Ⅰ, Band Ⅱ, BandⅢ, BandⅣ, Band Ⅴ, BandⅥ, BandⅦ, Band Ⅷ, BandⅨ, BandⅩ, Not Specified
	Channel (DL)	DL channel No setting
	Frequency (DL)	DL frequency display
	Channel (UL)	UL channel No setting
	Frequency (UL)	UL frequency display
	Network Mode of Operation	Resistration type setting (Combined, Not Combined)
	Packet Window Size (DL)	Packet Window Size setting (1 to 2047)
	Packet Window Size (UL)	Packet Window Size setting (1 to 2047)
	Packet Rate	DL384/UL64, DL1.8M/UL384k, DL1.8M/UL1.46M, DL1.8M/UL2.0M, DL3.6M/UL384k, DL3.6M/UL1.46M, DL3.6M/UL2.0M, DL7.2M/UL384k, DL7.2M/UL1.46M, DL7.2M/UL2.0M, DL HS-Auto/UL384k.
	Primary Scrambling Code	Primary Scrambling Code setting (0～511)
GSM/GPRS	Band	GSM450, GSM480, GSM850, P-GSM900, E-GSM900, R-GSM900, DCS1800, PCS1900
	CCH ARFCN	CCH ARFCN setting
	CCH Frequency (DL)	CCH DL frequency display
	CCH Frequency (UL)	CCH UL frequency display
	TCH ARFCN	TCH ARFCN setting
	TCH Frequency (DL)	TCH DL frequency display
	TCH Frequency (UL)	TCH UL frequency display
	NCC	NCC setting (0 to 7)
	BCC	BCC setting (0 to 7)
	Network Mode of Operation	Resistration type setting (Combined, Not Combined)
	Voice Codec	EFR, FR(Loopback), HR(Loopback), AMR
	Slot	DL1/UL1, DL2/UL1, DL3/UL1, DL4/UL1, DL1/UL2, DL2/UL2, DL3/UL2, DL1/UL3, DL2/UL3, DL1/UL4
	GSM/GPRS	GPRS, EGPRS, NO_GPRS
	Coding Scheme	CS1, CS2, CS3, CS4
	Modulation And Coding Scheme (DL)	MCS1,MCS2,MCS3,MCS4,MCS5,MCS6,MCS7,MCS8,MCS9
	Modulation And Coding Scheme (UL)	MCS1,MCS2,MCS3,MCS4,MCS5,MCS6,MCS7,MCS8,MCS9

MNS Configurable Parameters (3/3)

Test Parameter Editor

Test Parameter Editor	Parameter	Description
General	Suitable Cell	BTS1 or BTS2 (Only when Selection testing)
	Cell Barred States	"BTS1 is Barred Cell" or "BTS2 is Barred Cell" (Only when Selection/Reselection testing)
	Result of Handover	"Success" or "Failure" (Only when Hard HO/Soft HO testing)
	Timeout settings	Reception timeout setting for resistration (30 to 120s) (Only when Selection/Reselection testing)
Power Control	Camping Cell	DL power setting at simulation start (-120 to -20dBm)
		DL power setting at simulation finish (-120 to -20dBm) (Only when Reselection/Hard HO/Soft HO testing)
		Change step of power from simulation start to finish (1 to 100dB) (Only when Reselection/Hard HO/Soft HO testing)
		Period for change step of power (1 to 30s) (Only when Reselection/Hard HO/Soft HO testing)
	Non-Camping Cell	DL power setting at simulation start (-120 to -20dBm)
		DL power setting at simulation finish (-120 to -20dBm) (Only when Reselection/Hard HO/Soft HO testing)
		Change step of power from simulation start to finish (1 to 100dB) (Only when Reselection/Hard HO/Soft HO testing)
		Period for change step of power (1 to 30s) (Only when Reselection/Hard HO/Soft HO testing)
Measurement (W-CDMA/W-CDMA) (Only when Hard HO/Soft HO testing)	Measurement Control	ON, OFF
	Event Parameters (Intra Frequency)	Event Type, Reporting Constant, Hysteresis
	Event Parameters (Inter Frequency)	Event Type, Threshold (own), Threshold (other), Hysteresis
Measurement (GSM/GSM) (Only when Hard HO testing)	Measurement Control	ON, OFF
	Threshold	Own (0 to 63), Other (0 to 63)
Measurement (W-CDMA/GSM) (Only when Hard HO testing)	Measurement Control	ON, OFF
	Event Parameters (W-CDMA)	Event Type, Threshold (own), Threshold (other), Hysteresis
	Threshold (GSM)	Own (0 to 63), Other (0 to 63)

Test Examples
Cell Selection / Reselection Tests

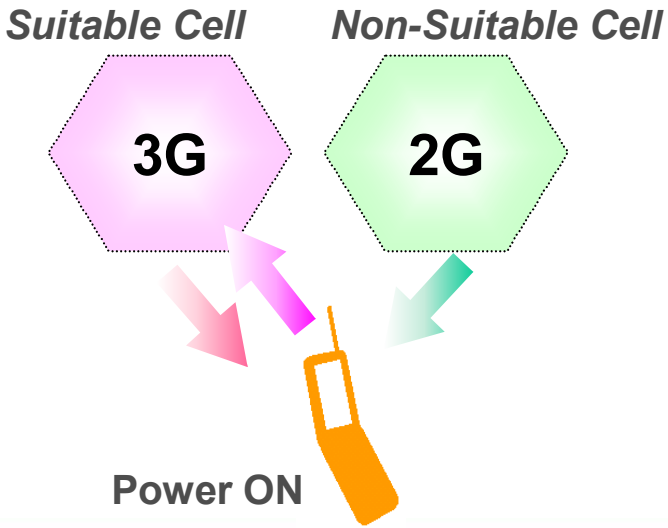
Cell Selection Test

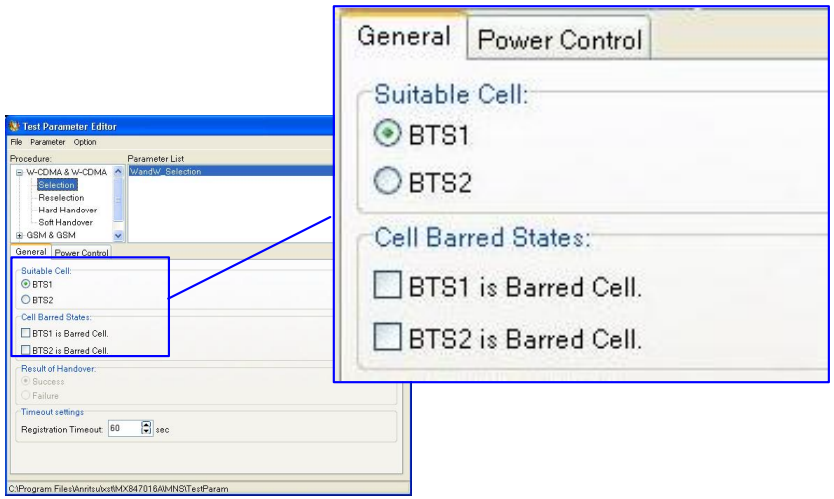
About Cell Selection

- When a mobile terminal is switched on, it selects a suitable cell using the PLMN, barred conditions, downlink signal level, etc., of each cell.

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.





Test Parameter Editor

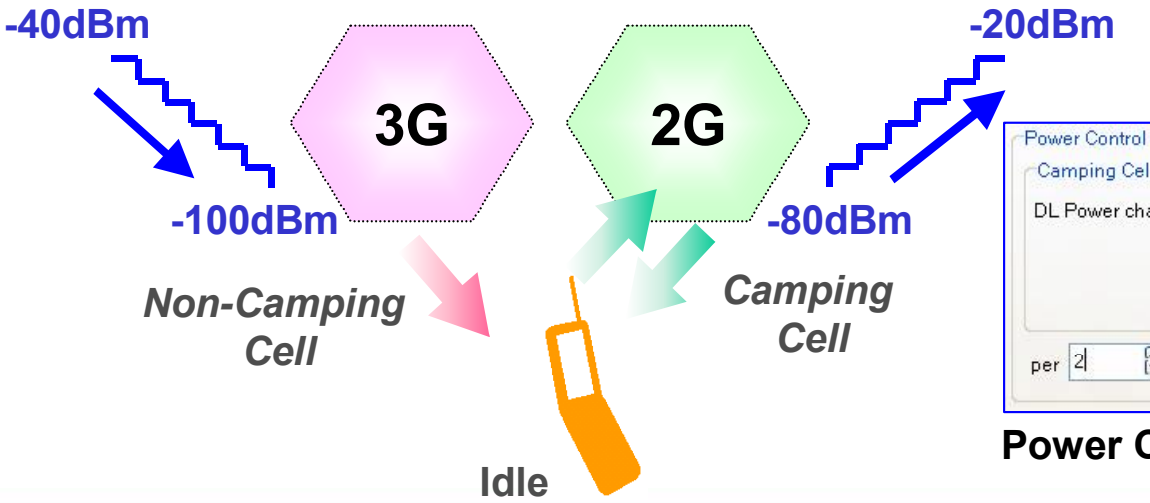
Cell Reselection Test

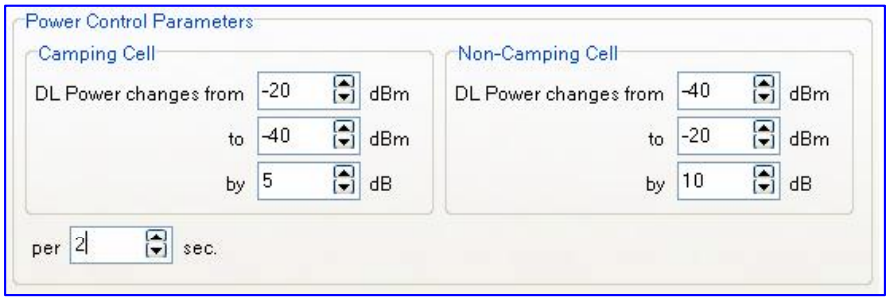
About Cell Reselection

- 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 reselects a suitable cell based on the E-PLMN List, and PLMN, barred conditions and downlink signal level of each cell.

Cell Reselection Test

- After registration is completed, the power when the downlink signal starts, the final targeted power, the power change steps and the power step change period 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.



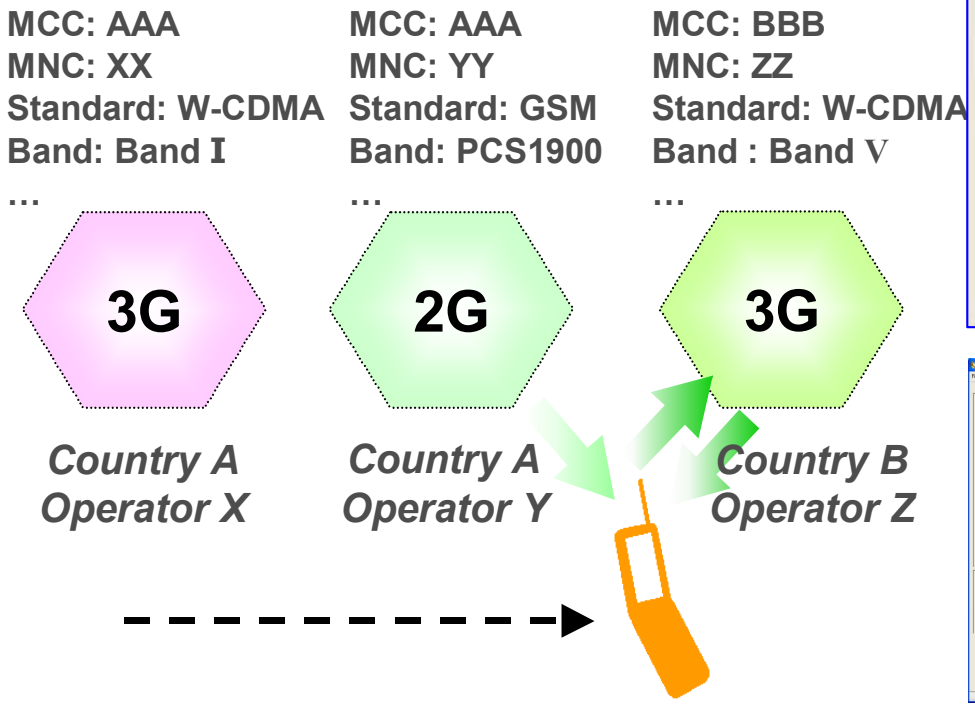


Power Control Parameters

Application Example: Roaming Test

Roaming Test

- 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.



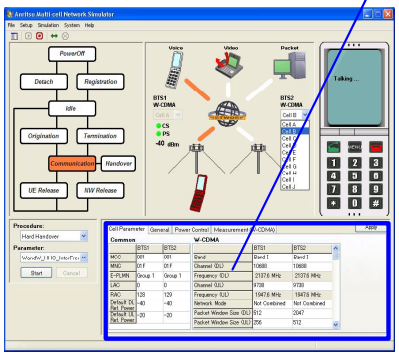
Cell Parameter | General | Power Control | Measurement (W-CDMA)

Common

	BTS1	BTS2
MCC	001	001
MNC	01F	01F
E-PLMN	Group 1	Group 1
LAC	0	0
RAC	128	129
Default DL Ref. Power	-40	-40
Default UL Ref. Power	-20	-20

W-CDMA

	BTS1	BTS2
Band	Band I	Band I
Channel (DL)	10688	10688
Frequency (DL)	2137.6 MHz	2137.6 MHz
Channel (UL)	9738	9738
Frequency (UL)	1947.6 MHz	1947.6 MHz
Network Mode	Not Combined	Not Combined
Packet Window Size (DL)	512	2047
Packet Window Size (UL)	256	512



Detailed Setting Field

- Non-camping cell parameters can be changed in the Detailed Setting Field of MNS.

Test Examples
Handover Tests

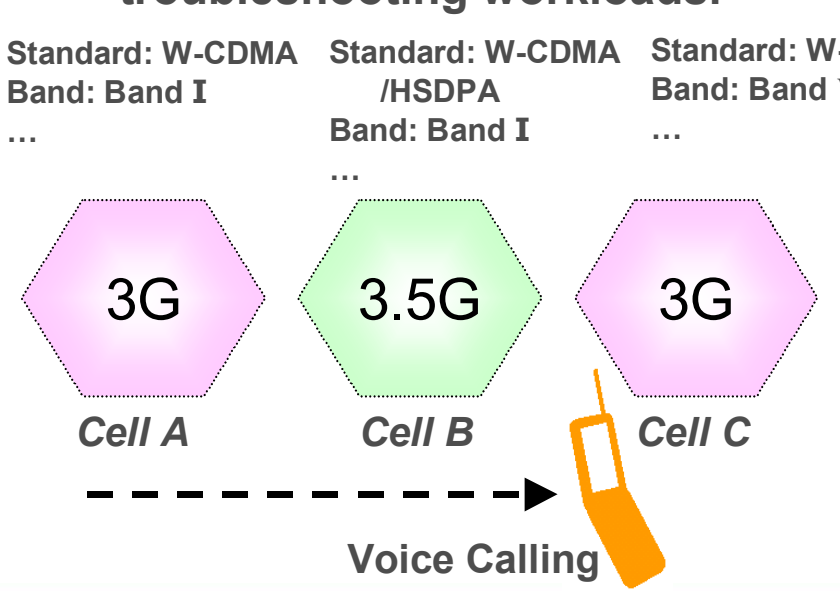
Handover Reliability Test

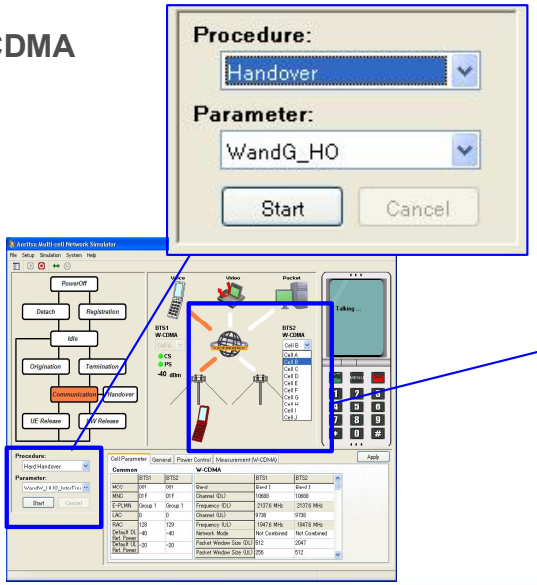
About Handover

- When a mobile terminal is using a service, it sometimes switches to another cell depending on changes in the downlink signal level. The mobile 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.

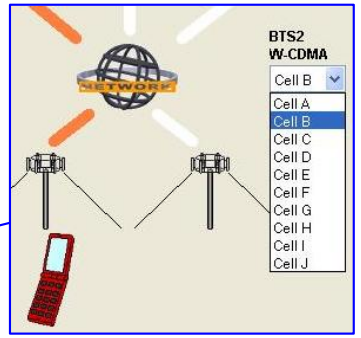
Handover Reliability Test

- 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 call connection reliability and stability can be tested efficiently, helping debugging before field tests and lightening post-installation troubleshooting workloads.





Test Selection/Execution



Target cell selection using pull-down menu

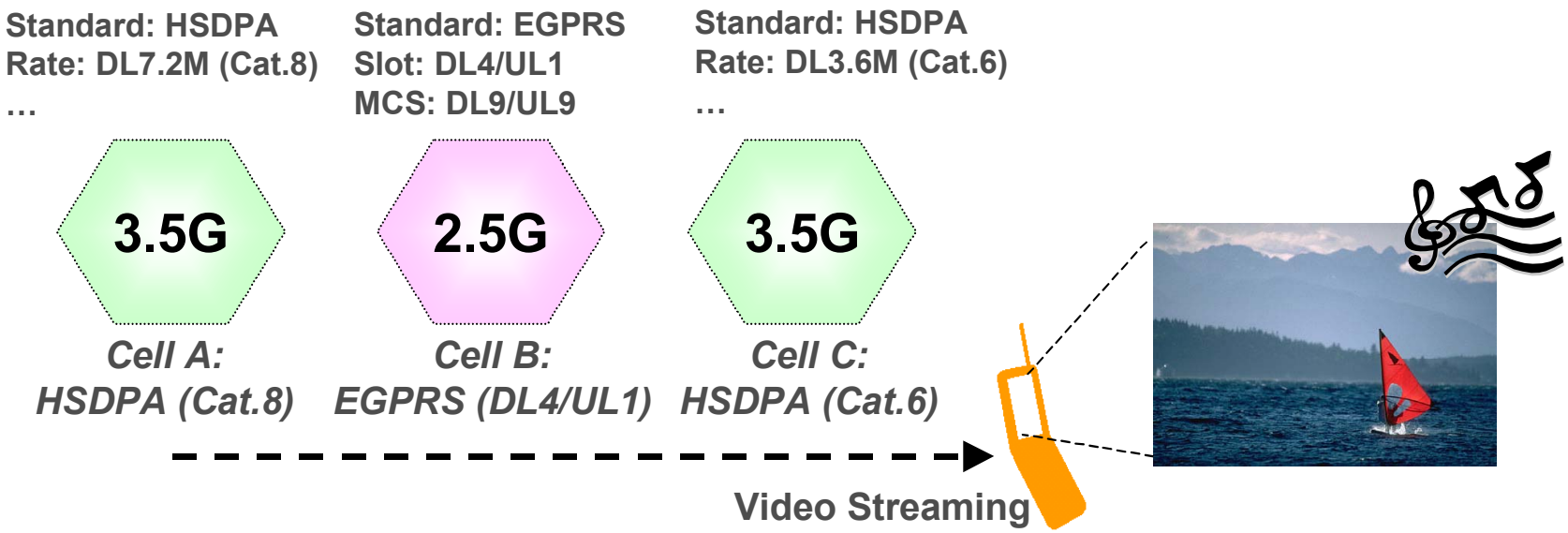
Network Service Selection Test

Network Service Selection Test

- The MNS can be used to test whether the mobile switches as intended when performing network service selection during voice call, packet call, and multi-calling.

<Examples>

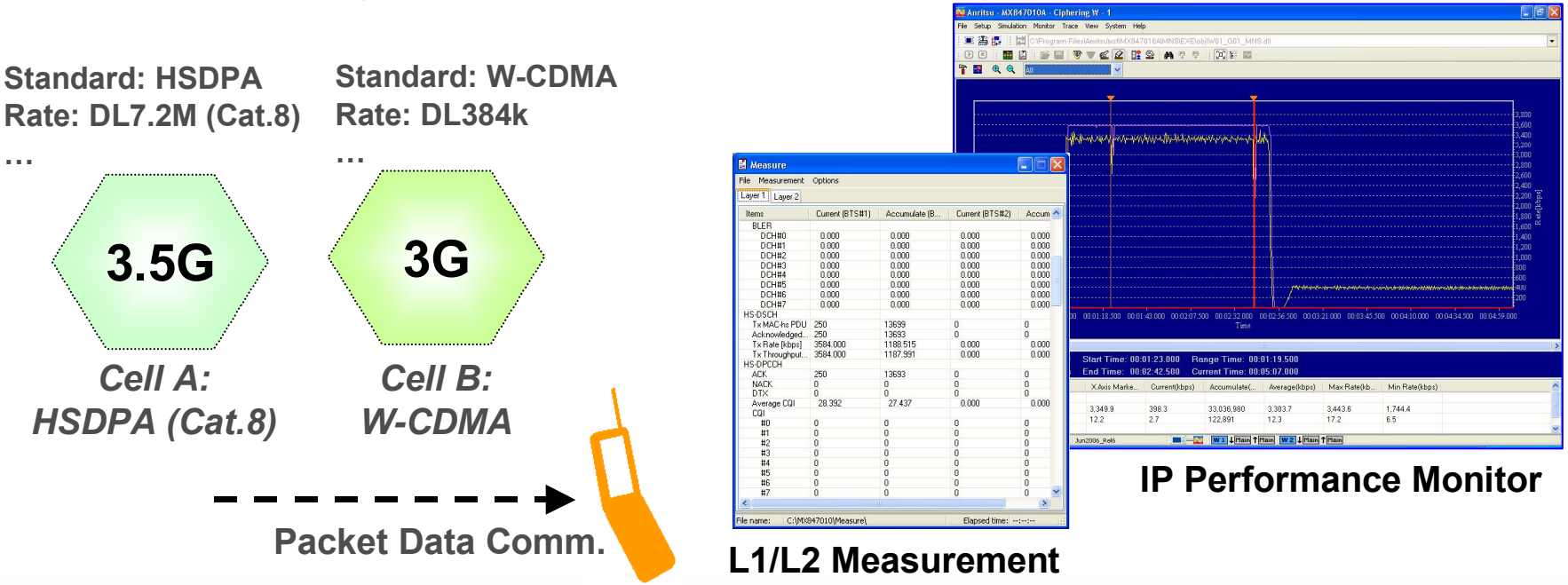
- ✓ Switching to different packet rate cell during multi-call
- ✓ Switching to different voice codec cell during GSM voice call (GSM/AMR ➔ GSM/EFR)
- ✓ Switching to EGPRS cell during HSDPA packet call etc.



Application Example: Throughput Performance Verification

Throughput Performance Verification at Handover

- The throughput performance at switching to a cell supporting a different packet rate can be tested using “IP Throughput Monitor” along with evaluation of the terminal user interface.
- In addition, measured values indicating the performance of Layer 1 and Layer 2 communications can be displayed using the Measure function. The throughput of Layer 1 and Layer 2 can be monitored in real time during testing, and functions for displaying ACK, NACK, DTX, and CQI values are built-in. Use in combination with the IP Performance Monitor function supports efficient troubleshooting and fault isolation when testing data communications.

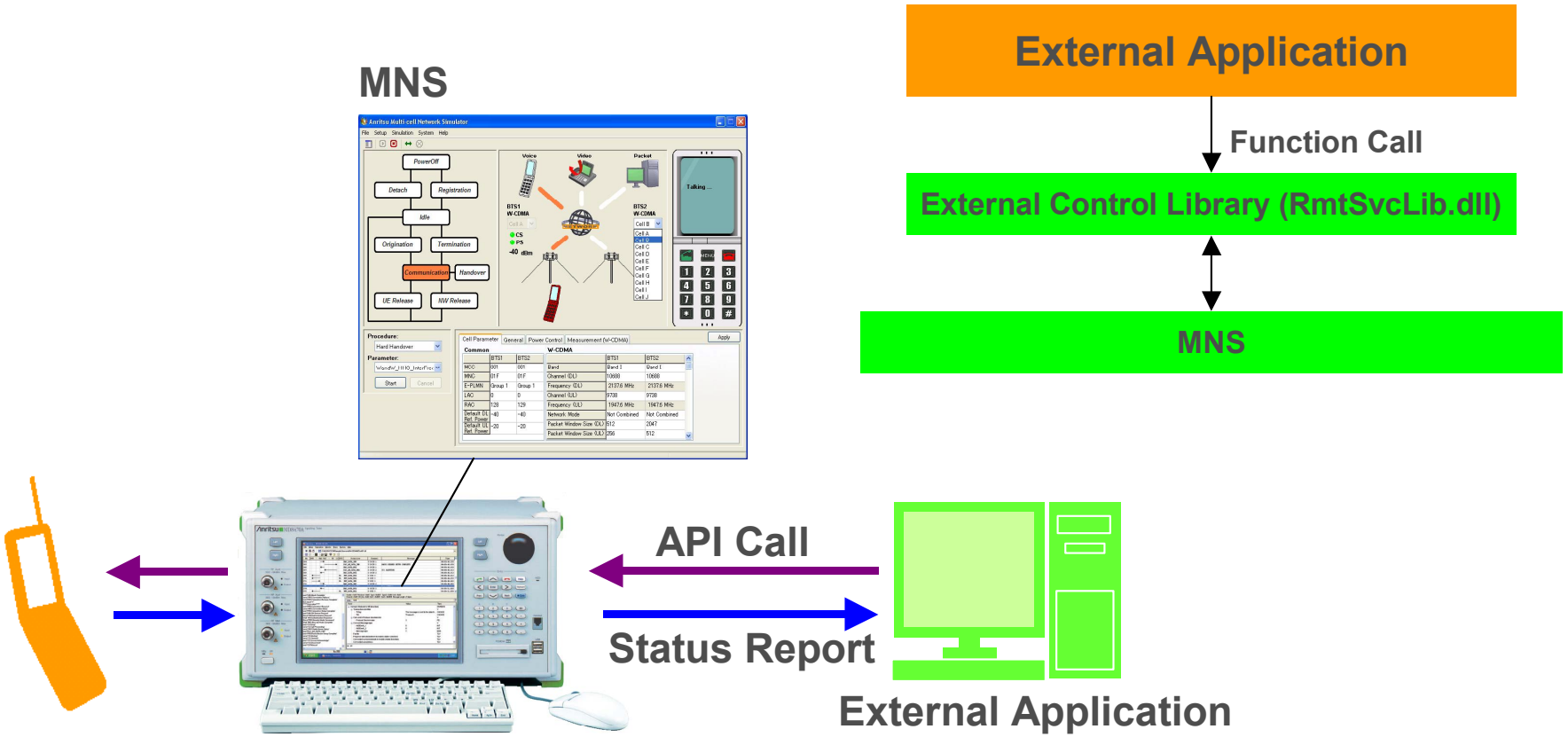


External Control Interface

MNS External Control Interface

Application for Automated Test Environment

- 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.



Ordering Information

Ordering Information

Configurations

Test Configuration	Option/Unit/Software	MD8470A	MD8470A-02	MU847010B	MU847010B	MU847020B	MU847020B	MX847010A	MX847016A	MX847010A-01	MX847010A-11	MX847010A-12	MX847010A-20	MX847011A	MX847021A	Remarks
W-CDMA/W-CDMA (Intra-system)	W-CDMA 2-Cell Test Configuration	v	v	v	v			v	v				v	v*1		
	W-CDMA/HSDPA/HSUPA 2-Cell Test Configuration	v	v	v	v			v	v		v	v	v	v*1		
GSM/GSM (Intra-system)	GSM/GPRS 2-Cell Test Configuration	v	v			v	v	v	v				v		v*1	
	GSM/GPRS/EGPRS 2-Cell Test Configuration	v	v			v	v	v	v	v			v		v*1	
W-CDMA/GSM (InterRAT)	W-CDMA<=>GSM/GPRS InterRAT Test Configuration	v	v	v		v		v	v				v	v*1	v*1	
	W-CDMA/HSDPA/HSUPA<=>GSM/GPRS/EGPRS InterRAT Test Configuration	v	v	v		v		v	v	v	v	v	v	v*1	v*1	
W-CDMA/W-CDMA, GSM/GSM, W-CDMA/GSM	W-CDMA 2 Cell, GSM/GPRS 2 Cell, W-CDMA<=>GSM/GPRS InterRAT Test Configuration	v	v	v	v	v	v	v	v				v	v*1	v*1	
	W-CDMA/HSDPA/HSUPA 2 Cell, GSM/GPRS/EGPRS 2 Cell, W-CDMA/HSDPA/HSUPA<=>GSM/GPRS/EGPRS InterRAT Test Configuration	v	v	v	v	v	v	v	v	v	v	v	v	v*1	v*1	

*1: Optional (Ciphering tests are simulated by C-scenario)

Wireless Test Suite Package

- **The MX847015A Energy Management Test Simulator, MX847015A-01 Parallel Phone Test Software, 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 separate catalog for details about the MX847015A and MX847015A-01.)**

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Specifications are subject to change without notice.

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Printed on Recycled Paper

No. MX847016A-E-L-1-(1.00) 公知 Printed in Japan 2008-10 PSD