Introduction of WiBro Network Management
Contents

1. WiBro Technologies
2. WiBro Market Deploy
3. WiBro Business Model
4. WiBro Product
5. WiBro Network Management
6. WiBro System Manager
7. WiBro Network Management Issues
WiBro Technologies
Standardization Status (System)

IEEE 802.16e Standardization Roadmap (by IEEE)

- Issue 802.16e/D5
  - Sep. 2004
- Issue 802.16e/D6
  - Feb. 2005
- Issue 802.16e/D7
  - April. 2005
- Standard Ratification
  - Dec. 2005 (Completed)

Mobile WiMAX Roadmap

- Mobile WiMAX Profile Approved
  - 1Q. 2006
- Certification Start (Wave1)
  - 4Q. 2006
- Certified Products In the market
  - Dec. 2006

Mobile WiMAX Management (NetMan)

- 802.16f for Fixed MIB
  - 2006
- 802.16i for Mobility MIB
  - 2007
- 802.16i for Mobility MIB
  - 2008

- Wave2 certification will be starting from 3Q 2007 including MIMO/BF
- WiBro = The service name of Mobile WiMAX using 802.16e in Korea
WiBro Market Deploy
Market Deploy (Domestic)

- **Pre-commercial service (Mar ~ May ‘06)**
  - 1\textsuperscript{st} Stage (Mar.’06) : 3 Hot Zone in Seoul (Friendly user)
  - 2\textsuperscript{nd} Stage (May.’06) : 2 more residential area in Seoul

- **Commercial service**
  - June ‘06 : Commercial deployment of 5 regions in Seoul
  - 4Q. ‘06 : Network Expansion through Seoul (incl. Subway)
  - 2Q. ’07 : Satellite City

- **Pre-commercial service (May ‘06)**
  - May. ’06: 2 Hot Zone (Campus area) in Seoul

- **Commercial Service**
  - June ’06: 6 Hot Zone (Campus area) in Seoul
  - 4Q. ‘06 : Network Expansion through Seoul
Market Deploy (Global)

- **Europe**
  - TI (’06.2, Olympics)
  - H1 (’07.1Q Commercial)

- **Korea**
  - KT (’06.3, Pre-Commercial)
  - SKT (’06.5, Pre-Commercial)

- **North America**
  - Sprint (’07.3Q, Commercial)
  - Arianlink (’06.3Q, Trial)

- **Asia Pacific**
  - KDDI (’05.4 Trial)

- **South America**
  - TVA (’06.5 Trial)
  - Omnivision (’06.4Q - Commercial)

- **Other Asian countries**
  - Sprint
  - Arianlink

- **Other**
  - Lotus
  - Sprint
  - Arianlink
WiBro Business Model
Services

Messaging & Communication
- Personal Broadband
- Personal Communication
- PTA
  - PTT (Push to talk - 1: N telephony)
  - PTD (Push to Data - send data during PTT)
  - PTV (Push to Video - 1: N Video telephony)

Multimedia
- AOD / MOD / VOD
- MBS (Multicast Broadcast)
- Personal Broadcast
- Interactive Gaming

LBS
- Telematics
  - Traffic Info.
  - Location search
- LoBlog
  - LBS + Blog

Public Safety and Works
- Emergency
- Surveillance
- Security
- Public Works

“Anytime, Anywhere and Any devices”
Business Model

Model I
Suburban Black Spots
Fixed Broadband
External Antenna

Model II
Urban Residence/Office
Nomadic Broadband
CPE, Laptop

Model III
City/Nationwide
Portable Broadband
Laptop, PDA

802.16e
Biz. range

Service Migration

Model IV
City/Nationwide
Mobile Broadband
PDA, Phone

Model V
Campus Network
Appl.-customized device
(Laptop, PDA, Phone)

Broadband Internet Access
Converged Personal Mobile Broadband
WiBro Product
WiBro Product Roadmap

RAS

U-RAS Standard
(3/6/12 Tx Ant)
- RAS Standard
  - '05.12 (Lab Trial)
  - 3FA/3Sec
  - MIMO/BF Ready

U-RAS Mini
(3 Tx Ant)
- U-RAS Mini
  - '06.3Q
  - 1FA/3Sec;

U-RAS Micro
(4 Tx Ant)
- U-RAS Micro
  - 1FA Omni; MIMO/BF

MIMO / Interference Canceller Development

ACR

ACR Standard
- '05.4Q
- Mobility/Handover Management

ACR Campus
- ACR Standard
  - 150 RAS max.

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WiBro Network Management
WiBro Network Architecture

- IMS: IP Multimedia Subsystem
- MGW: Media Gateway
- HA: Home Agent
- HSS: Home Subscriber Server
- EMS: Element Management System

- RAS: Radio Access Station
- ACR: Access Control Router
- WSM: WiBro System Manager
## WiBro Network Management Systems

### EMS Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Coverage</th>
<th>Status</th>
<th>Main Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMS</td>
<td>IMS, MGW, TGW, WGW</td>
<td>Ready</td>
<td>IMS Core Network Elements Management</td>
</tr>
<tr>
<td>Router</td>
<td>Core Router</td>
<td>Ready</td>
<td>IP Core Network (Core Router) Management</td>
</tr>
<tr>
<td>Access</td>
<td>ACR/RAS</td>
<td>Ready</td>
<td>ACR/RAS Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FA/Sector Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Neighbor List, Paging Group Management</td>
</tr>
<tr>
<td>CPE</td>
<td>Fixed Mode CPE</td>
<td>Ready</td>
<td>Auto-Configuration (TR-069 Based)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RDL (Remote DownLoad)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fault Management</td>
</tr>
</tbody>
</table>

### OSS/Additional Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Coverage</th>
<th>Status</th>
<th>Main Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMS</td>
<td>WiBro Network</td>
<td>Planned</td>
<td>WiBro Network Management System</td>
</tr>
<tr>
<td>WiBro App. Server</td>
<td>Inventory Server</td>
<td>Ing</td>
<td>Serial Number Mgmt.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hardware Spec Mgmt.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Repair History Mgmt.</td>
</tr>
<tr>
<td></td>
<td>Image Server</td>
<td>Ing</td>
<td>Centralized S/W Library</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S/W Version Mgmt. (Verify, Compare)</td>
</tr>
<tr>
<td></td>
<td>PM Server</td>
<td>Ing</td>
<td>Data Mining for Performance Information</td>
</tr>
<tr>
<td></td>
<td>Optimizing Server</td>
<td>Planned</td>
<td>WiBro Network Design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RF Parameter Tuning</td>
</tr>
</tbody>
</table>

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WiBro System Manager (WSM)
WSM Specification

- Web Based EMS (HTML & Applet based UI)
- Multi NE, Multi Version Management
  - Multi Version
- High Compatibility
  - Full Java Based Server/Client
  - OS Independency (Unix, Linux, Windows)
- XML Based Message Definition
- XML Based Policy Definition
- SNMP Based WiBro System (ACR, RAS) Interface

- Client-Server Architecture
- Distributed Server Deployment Support
  - Independent App. Server Deployment by Manager and Manager Group
- High Capability, Availability, Continuity Support
  - Easy to Expansion of Capability
  - Server Redundancy Support
- Various OSS (Operating Support System) Interface
  - SOAP(XML, WSDL), SNMP, CORBA, HTTP, Etc.
WSM Software Architecture

UIsS
- CM
- FM
- PM
- GM
- CLI
- ...
- OSS

UISFss
- Web Server
  - Web Page Library
  - Applet/Servlet /JSP

UI Server
- US_MGR
- US_EVENT

MFss
- CM
- FM
- PLD
- GM
- PM

DBss
- Java API
- DBMS
- DB

NIss
- NI_SNMP
- NI_INIT
- NI_FTP
# WSM Function Overview

<table>
<thead>
<tr>
<th>Category</th>
<th>Main Functions</th>
</tr>
</thead>
</table>
| **Configuration** | Control Network, System and Service Configuration  
Network Topology, ACR/RAS/FA/Sector Grow/Degrow, PLD Manager, Rack Viewer, GUI  
Command Line Interface, Software Package Manager, NE S/W Version Manager,  
On-line Upgrade Manager, Etc. |
| **Fault**   | Manage Network, System and Service Related Fault Data  
Real-Time Alarm Monitoring, Alarm History, Alarm Statistic, Trouble Ticketing, Etc. |
| **Performance** | Collect and Analysis Performance Data  
Periodical Data Collection, Real-time Monitoring, Customizable PM Manager, Etc. |
| **Security** | Access Control for WSM  
User Manager, Network Group Manager, IP Control Manager, Etc. |
| **Mobility** | Control configuration for mobility  
Neighbor List Manager, Paging Group/Zone Manager, MBS Zone Manager, Etc. |
| **Subscriber** | Support subscriber service information  
Call Trace, Call Fault Report Manager, Etc. |
Configuration Management

PLD Based Management

- PLD (Programmable Loading Data)
- Pre-Configuration and Post-Loading
- Loading Configuration Data in the Initial Time
  - No Data in NE before Loading
  - Centralized Data Management
  - Reliable Data Management
  - Simplified Hardware Design
- Create/Modify NE Configuration by Controlling PLD
  - Design ACR, RAS Configuration
  - Design FA/Sector
- Intelligent PLD Audit
- Automatic PLD Backup and Restore
- PLD Manager
  - Raw Level PLD Editor
  - Provide Easy GUI to Control PLD
  - PLD Verify/Compare
  - PLD Conversion in Version Upgrade

Software Manager

PLD DB

Create NE

Create PLD

PLD

Audit/Compare/Verify PLD

Loaded

Created NE

PLD Editor

Provide Easy GUI

PLD Verify/Compare

PLD Conversion

Version Upgrade
Configuration Management

Software Manager

- Loading S/W in the Initial Time
  - No S/W in NE before Loading
  - Centralized S/W Library (One Source)
  - Simplified Hardware Design
- Automatic S/W Backup and Restore
  - Reliable S/W Maintenance
  - Reducing Malfunction by S/W Crash
- Package Manager
  - Package Maintenance/Verify/Compare
  - Patch Maintenance/Verify/Compare
  - Multi NE/Multi Version Package Mgmt.
- On-line Upgrade Manager
  - Centralized On-line S/W Upgrade
  - Upgrade Multi-Site in the Same Time
  - Automatic Verify of Upgrade Result
- S/W Diagnostic Manager
  - S/W Validate Diagnostic
  - Compare S/W among NEs
  - Verify S/W Version
  - Detecting Mismatch of S/W Version
Fault Management

<table>
<thead>
<tr>
<th>Category</th>
<th>Faults</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF</td>
<td>LNA, ANT, RF Power, FEP Fault/Fail, Etc.</td>
</tr>
<tr>
<td>Hardware</td>
<td>Processor Down/Abnormal, Board Malfunction, Power, Equip Status, Etc.</td>
</tr>
<tr>
<td>Software</td>
<td>Processor Down/Abnormal, Software Function Fail, Etc.</td>
</tr>
<tr>
<td>Link</td>
<td>RAS-ACR Link, Port, Etc.</td>
</tr>
<tr>
<td>Call</td>
<td>Call Overload, Call Fail, Etc.</td>
</tr>
<tr>
<td>Etc</td>
<td>EMS Alarms, Etc.</td>
</tr>
</tbody>
</table>
Performance Management

Performance Manager

- Full Support of General PM Functions
  - Realtime PM Data Monitoring
  - PM Threshold Control
  - PM Inhibit Control
  - PM Collection Period Control
- Guaranteed PM Data Collection
  - Long Term Re-Collection Skim for Lost or Damaged Data
  - PM Data Validation Check Support
  - High Speed Raw Data Processing Algorithm
- Customizable User Interface
  - GUI Format Customizing
  - PM Parameter Customizing
  - KPI Customizing
  - Numerical Formula Editor
  - Statistics/Analysis Customizing
  - Report Viewer Customizing
# Performance Management

## Performance Data Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Statistics</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL SETUP/RELEASE</td>
<td>NETWORK ENTRY, SERVICE FLOW, SECURITY, DEREGISTRATION</td>
<td>Call Quality Analysis Factors</td>
</tr>
<tr>
<td>HANOVER</td>
<td>INTER-SECTOR HHO, INTER-RAS HHO, INTER-ACR HHO, INTER-SECTOR FA HHO, INTER-RAS FA HHO, INTER-ACR FA HHO</td>
<td></td>
</tr>
<tr>
<td>ACR DOWNLINK TRAFFIC</td>
<td>DOWNLINK TOTAL, ARQ, NON-ARQ, PHS</td>
<td>Traffic Analysis Factors</td>
</tr>
<tr>
<td>ACR UPLINK TRAFFIC</td>
<td>UPLINK TRAFFIC for CPE, ARQ, NON-ARQ, PHS</td>
<td></td>
</tr>
<tr>
<td>RAS DOWNLINK TRAFFIC</td>
<td>DOWNLINKE TRAFFIC from ACR DOWNLINKE TO SS</td>
<td></td>
</tr>
<tr>
<td>RAS UPLINK TRAFFIC</td>
<td>UPLINK TRAFFIC to ACR UPLINK TRAFFIC from SS</td>
<td></td>
</tr>
<tr>
<td>IP ALLOCATION/RELEASE</td>
<td>DHCPv4, IPv4 ALLOCATION</td>
<td></td>
</tr>
<tr>
<td>IDLE MODE</td>
<td>LOCATION UPDATE, PAGING, IDLE USER COUNT</td>
<td></td>
</tr>
<tr>
<td>DIAMETER</td>
<td>ACCOUNTING, AUTHENTICATION, PEER</td>
<td></td>
</tr>
<tr>
<td>COPS</td>
<td>TCP CONNECTION, COPS SESSION, ASC COPS MESSAGE</td>
<td></td>
</tr>
<tr>
<td>RESOURCE</td>
<td>USER MANAGEMENT, CID</td>
<td></td>
</tr>
</tbody>
</table>
Mobility Management

- Provide Management Functions for Mobility Parameters
- Neighbor List Management
  - SubCell based Incoming/Outcoming Neighbor Control
  - Automatic Distribution of Neighbor Info. on the Contiguous Network
  - Neighbor Display based on GPS data
  - GUI Supported Neighbor Control
- Paging Group/Zone Management
  - Paging Parameter Control
  - Automatic Distribution of Paging Group/Zone Info. on the Entire Network
  - GUI Supported Paging Info. Control
- MBS Zone Management
  - In Progress
Subscriber Management

Subscriber Manager

- **Call Manager**
  - Real-Time Call Tracing by Subscribers
    - Signaling Flow among Each Point, Traffic Information, RF Resource Information
  - Provide Subscriber Detail Information
  - RAS RF Report
    - CID Info : B-CID, P-CID, DL T-CID, UL T-CID
    - DL RF Quality : CQI Values
    - UL RF Quality : burst error rate, max tx power, current tx power, headroom, CINR, number of allocated slots
  - Traffic Report
    - Tx/Rx Throughput, RAS-Core Rx/Tx Packet Count, CPE-RAS Rx/Tx Packet Count, System/CPE ARQ Info

- **Call Drop Report Manager**
  - Collection of Call Drop Data
    - Entry Info., Handover Info., Authentication Info., Message Info., Etc...
    - Call Drop Location, Call Drop Reason, Call Drop Time, Etc...
  - Statistic of Call Drop Data
    - By RAS, MAC, NAID, Fail Reason, Detail Location
  - Analysis of Call Drop Data
    - Knowledge Based Analysis
    - Detecting Problem Reason
    - Isolating of Problems
    - Providing Guideline of Problems
Northbound Interface

OSS Integration

- Separated OSS Interface Block and Protocol Support Block
- No Dependency by Using Unified Interface between OSS Block and Protocol Support Block
- XML Based OSS Info/Message Define
- Pluggable Option Modules for Specific OSS Functions
- Easy to implement new OSS Function
- Easy to Change protocol and Add new protocol
- Various Interface Support
  - HTTP
  - SOAP
  - SNMP
  - XML
  - Etc.

OSS Integration Diagram

- Mgmt. Blocks
- WSM Message Format
- OSS Interface
- OSS Message Formats
  - HTTP
  - SOAP
  - SNMP
  - XML

XML Documents

- < OSS Info >
  - ID: 00001
  - ALIAS: A-Telecom
  - INTERFACE: SNMPOPTION: #1

- < Messages >
  - ID: 00001
    - MsgName: DIS-SW-INFO
    - MsgName: DIS-HA-INFO
    - MsgName: DIS-RAID-INFO

- OSS#1
- OSS#2
- OSS#3

XML Based OSS Info/Message Define

Pluggable Option Modules for Specific OSS Functions

Easy to implement new OSS Function

Easy to Change protocol and Add new protocol

Various Interface Support

- HTTP
- SOAP
- SNMP
- XML
- Etc.
WiBro Network
Optional Management System
AceMAN-Inventory Server

- **Inventory Data Management**
  - Inventory Info Management of Multi WSM
  - Software Version Information
    - Firmware Version
    - App S/W Version
  - Hardware Information
    - Serial Number, Spec
  - Fault/Repair Information
  - Inventory Report Generation

### Inventory Server

<table>
<thead>
<tr>
<th>CI</th>
<th>Serial Num</th>
<th>Type</th>
<th>Fault Count</th>
<th>Repair Count</th>
<th>.....</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSM#1/RAS#1/Bd#1</td>
<td>111EBQ2234A</td>
<td>CH Board</td>
<td>3</td>
<td>1</td>
<td>.....</td>
</tr>
<tr>
<td>WSM#1/RAS#1/Bd#1</td>
<td>211EBQ2234A</td>
<td>CH Board</td>
<td>0</td>
<td>1</td>
<td>.....</td>
</tr>
<tr>
<td>WSM#1/RAS#1/Bd#1</td>
<td>331EBQ2234A</td>
<td>CH Board</td>
<td>1</td>
<td>1</td>
<td>.....</td>
</tr>
<tr>
<td>WSM#1/RAS#1/Bd#1</td>
<td>111AQQ2234A</td>
<td>CH Board</td>
<td>WSM#1/RAS#1/Bd#1</td>
<td>2006.08.01</td>
<td>Changed</td>
</tr>
<tr>
<td>WSM#1/RAS#1/Bd#1</td>
<td>111EBQ2777A</td>
<td>CH Board</td>
<td>WSM#1/RAS#1/Bd#1</td>
<td>2006.08.01</td>
<td>Repaired</td>
</tr>
</tbody>
</table>

### Repair Info

<table>
<thead>
<tr>
<th>CI</th>
<th>CPU</th>
<th>Memory</th>
<th>HDD</th>
<th>.....</th>
<th>Repair Time</th>
<th>Repair Type</th>
<th>Reason</th>
<th>.....</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSM#1</td>
<td>1.5 Ghz X 2</td>
<td>4 GB</td>
<td>250 GB</td>
<td></td>
<td>2006.08.01</td>
<td>Repaired</td>
<td>Chip</td>
<td></td>
</tr>
<tr>
<td>WSM#2</td>
<td>1.5 Ghz X 2</td>
<td>8 GBCH Board</td>
<td>246 GB</td>
<td></td>
<td>2006.08.01</td>
<td>Changed</td>
<td>Etc</td>
<td></td>
</tr>
<tr>
<td>WSM#3</td>
<td>1.5 Ghz X 2</td>
<td>8 GB</td>
<td>146 GB</td>
<td></td>
<td>2006.08.01</td>
<td>Changed</td>
<td>Etc</td>
<td></td>
</tr>
</tbody>
</table>
AceMan-Image Server

- On-line and Centralized Software Management
  - ACR/RAS Image/PLD Loading Control
  - Including Software Management Function of WSM
  - Multi WSM Site Management

- Software Upgrade
  - Manual/Automatic Software Upgrade for All NEs in the WSM Area
  - ACR/RAS/WSM Software Upgrade
  - Scheduling / Planning S/W Upgrade
  - Generating Report for Upgrade Result

- Software Verify/Compare/Diagnostic
  - Manual/Automatic Detecting S/W Validation Info
  - Generating S/W Status Report

- Reliable Software Package Maintenance
  - Centralized Software Library
  - Automatic Package Backup/Restore
  - Package Validation Management
  - ACR/RAS Firmware Package
  - ACR/RAS Application Package
  - WSM Package
  - PLD Master Copy
WiBro Network Management Issues
## Progressing WSM Issues

<table>
<thead>
<tr>
<th>Issues</th>
<th>Contents</th>
</tr>
</thead>
</table>
| Internetworking among WSMs            | - The main feature of WiBro is supporting Mobility.  
- Mobility Parameters have to be controlled in the same time to whole network elements.  
- WSM internetworking for Mobility Parameter sharing is not exist.  
- WSM could communicate among other WSMs which have a relation for Mobility Parameters. |
| IPv6 Support                          | - IPv6 is preparing to adapt in practical site.  
- IPv6 has to be used to give each CPE unique address.  
- IPv6 Management Functions have to be applied to WSM                                                                          |
| VoIP Management Support               | - WiBro will be supporting Voice Service.  
- WSM has to support Voice Quality Management Functions                                                                                       |
| QoS Management                        | - WSM also has to support more practical and various QoS Management Functions                                                                                           |
| CPE Management                        | - Mobile CPE and Fixed CPE Management Issues  
- CPE Performance/Fault Management  
- CPE Auto Configuration / Remote Download Management                                                                                  |
Thank You