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WiBro – 2.3GHz Mobile WiMAX:

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Part 1.

THE TRENDS
Service Convergence

Telecommunication
- Voice
- Internet
- VOD
- IP-TV
- Mobile services
- Interactive TV
- DMB

Broadcasting
- Cable TV
- Satellite TV
- TV

Entertainment
- Game
- Music
- M-Bank

Financial Services
- M-Bank

Mobility

Personalization

Interactivity

BGL/SNU 2007
What Should be the Future System?

Two-way, high-data rate, user-participated, mobile, broadband, triple services

Should be Mobile, Broadband IP-based system
Part 2.

Mobile WiMAX/WiBro
WLAN (IEEE 802.11 series)
- Support very high data rate but limited coverage and mobility not supported

Cellular (cdma2000 1X, 1xEV-DO, WCDMA)
- Support large coverage and fast mobility but data rate is low and too expensive
WiMAX intends to Lift the Limits

- **Mobile WiMAX/WiBro (IEEE 802.16)**
  - Support very high data rate
  - Support large coverage (MAN)
  - Support high QoS (though IP based)
  - Support fast mobility
  - Low service charge
What is WiMAX?

**Mobile WiMAX**

*IEEE 802.16 Standards*

- **Mobile WiMAX**, 802.16e Standards
- **WiBro**, 2.3 GHz based mobile WiMAX

**Mobility**
- Vehicle speed (120 km/h)
- Good performance while on the move

**IP**
- Compatible with Internet world
- Diverse terminal types (PC/PMP/PDA/Phones..)

**Broadband**
- ~10 MHz Bandwidth
- 19/5Mbps Datarate
- Broadband uploading capability
WiMAX Frequency in the Globe

Unification of global spectrum mask
- WiMAX Forum (SMSG) is defining requirements for spectrum mask
- To be finished before Wave.2 certification

Europe
2.5GHz – UMTS reserved (ECRSC)
Movement towards “Technology Neutral”

EUROPE (3.5GHz)
- France
- Germany
- Belgium
- Portugal
- Austria
- Norway
- Greece
- Malta
- Luxembourg
- Spain
- Denmark
- U.K.
- Ireland
- Netherlands

- Poland
- Hungry
- Czech Rep.
- Slovakia
- Slovenia
- Latvia
- Romania

Russia (2.5/3.5GHz)
Korea (2.3GHz)
Japan (2.5GHz)
Hong Kong (3.5GHz)
Thailand (2.3GHz/3.5GHz)
Malaysia (2.3GHz/3.5GHz)
Vietnam (2.3/2.5GHz)
Indonesia (3.5GHz)
Singapore (2.3/2.5GHz)
Australia (2.3GHz)
New Zealand (2.3GHz/3.5GHz)

Canada (2.3/2.5GHz)
US (2.3/2.5GHz, Allocated)
Mexico (3.5GHz)
Venezuela (2.5GHz/3.5GHz)
Columbia (3.5GHz)
Brazil (2.5GHz/3.5GHz)
Peru (3.5GHz)
Chile (3.5GHz)
Uruguay (3.5GHz)
Argentina (3.5GHz)

* SMSG : Spectrum Mask Sub Group
Part 3.

Mobile WiMAX/WiBro System Overview
## Mobile WiMAX/WiBro Features

<table>
<thead>
<tr>
<th>Major System Parameters</th>
<th>Radio Access Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duplexing</strong></td>
<td><strong>Frequency Reuse Factor</strong></td>
</tr>
<tr>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td><strong>Multiple Access</strong></td>
<td><strong>Mobility</strong></td>
</tr>
<tr>
<td>OFDMA</td>
<td></td>
</tr>
<tr>
<td><strong>Channel BW</strong></td>
<td><strong>Service Coverage</strong></td>
</tr>
<tr>
<td>5/7/8.75/10 MHz</td>
<td></td>
</tr>
<tr>
<td><strong>Spectral Efficiency</strong></td>
<td><strong>Max. DL / UL = 6 / 2</strong></td>
</tr>
<tr>
<td>[bps/Hz/cell(sect.)]</td>
<td></td>
</tr>
<tr>
<td><strong>Handoff</strong></td>
<td><strong>150 ms</strong></td>
</tr>
<tr>
<td><strong>Peak Throughput</strong></td>
<td><strong>DL / UL = 19 / 5 Mbps</strong></td>
</tr>
</tbody>
</table>
WiBro PHY – Features

- High spectral efficiency support
  - TDD
    - Minimize guard band
  - 10MHz BW/OFDMA
    - Minimize multi-path interference
  - High modulation order (QPSK, 16QAM, 64QAM) & enhanced channel coding (convolutional turbo code)

- Full coverage support
  - Cellular operation with frequency reuse factor 1
    - High spectral efficiency & easy cell planning
    - Minimize interference using diversity subchannel
    - Compensate low SINR at cell edge using low rate coding
  - Fast handover with mobile IP
WiBro PHY – Features (cont’d)

- Performance enhancement considering mobility
  - H-ARQ
    - FEC and ARQ
  - Band selection AMC & diversity subchannel
    - For slowly moving users: allocate band selection AMC subchannels which have high channel quality
    - For fast moving users: allocate diversity subchannels
  - Support mobility
    - Short OFDM symbol
    - Pilot structure supporting channel estimation while moving
  - Support fast access during handover
    - Short frame length
    - Non-contention based control channel access
WiBro PHY – Features (cont’d)

- Flexible resource allocation
  - TDD: asymmetric DL / UL allocation
  - Subchannel-level multiuser scheduling
- Power saving mechanisms
  - Sleep mode
  - Idle mode
- Advanced optional features
  - Smart antenna support
  - Space-time code/Spatial multiplexing support
WiBro MAC – Features

- Flexible BW allocation
  - On frame basis
- Flexible QoS provisioning
  - UGS, rtPS, ertPS, nrtPS, BE
- Efficient MAC PDU construction
  - Variable size MAC PDU
  - Fragmentation, packing, concatenation
  - Support header suppression
- Energy-saving
  - Sleep & idle mode
- Handover
  - Hard & soft handover
- Multicast and Broadcast Services
- Security support
Part 4.

WiBro/Mobile WiMAX Standardization
IEEE 802.16 Standards

- **802.16-2004**
  - Basic specifications of the air interface
- **802.16e-2005**
  - Mobility amendment + corrigenda (so called Cor1)
- **Cor2-2006 (under development)**
  - 802.16e Corrigenda
- **Other active projects**
  - 802.16g Management Plane Procedures & Services
  - 802.16h License-Exempt Coexistence
  - 802.16i  Mobile MIB
  - 802.16j Relay Task Group
  - 802.16k - 802.16 Bridging
  - 802.16m - Advanced Air Interface

http://ieee802.org/16/
WiMAX Forum

Goal
➢ To promote and certify compatibility and interoperability of IEEE 802.16 products

Principles
➢ Support IEEE 802.16 standard
➢ Propose and promote access profiles for their IEEE 802.16 standard
➢ Certify interoperability levels both in network and the cell
➢ Achieve global acceptance
➢ Promote use of broadband wireless access overall

Facts
➢ Industry-led, non-profit organization
➢ Established in June 2001
➢ 430 member companies (as of March 2007)
➢ http://www.wimaxforum.org
Part 5.

WiBro/Mobile WiMAX System Development
WiBro Network Architecture

NMS: Network Management System
CMS: Contents Management System
PMS: Product Management System
VCC: Voice Call Continuity
MSC: Mobile Switching Center
IMS: IP Multimedia Subsystem
RAS: Radio Access Station (BS)
ACR: Access Control Router
AAA: Authentication, Authorization and Accounting
WiBro System by Samsung Electronics

Standard Type 2 RAS

- **Capacity**: 3Carrier/3Sector with MIMO (2x2)/ BF(4-Path)
- **Modem**: Soft-Modem, ASIC Modem ('08. 2Q)
- **Output power**: 20W@ antenna port
- **Frequency**: 2.3GHz/8.75MHz
- **Main feature**
  - Rack mounted type
  - Indoor/Outdoor
  - Protection: Main processor, GPSR, Link card, RAS card
  - ASN Profile A-like

All products, dates, plans and features are preliminary and subject to change without notice.
WiBro System by Samsung Electronics

- **Capacity**
  - ✓ Throughput: 3.6 Gbps
  - ✓ 150 RAS (1C/3S RAS, 8MB/Sector)
- **Feature**
  - ✓ Mobility / Handover Management
  - ✓ 802.16e High MAC / ARQ
  - ✓ IP routing
  - ✓ AAA interface
- **Backhaul interface**: FE, GE
- **ASN Profile A-like**: Available Now
- **ASN Profile C**: '07.2Q

All products, dates, plans and features are preliminary and subject to change without notice.
WiBro Terminal by Samsung Electronics

SPH-M8100

- Mobile WiMAX MITs
- Duplexing Mode: OFDMA, TDD
- Frequency: 2.3 GHz / 8.75 MHz
- CDMA EV-DO (1900MHz PCS) & Mobile WiMAX: Voice & Data Call Support
- Main Features
  - Display: 65k color WVGA TFT (2.8", 240 x 320)
  - OS: Window Mobile 5.0 Pocket PC
  - IMS: VoIP, Video Telephony, Push-to-All
  - Dual Camera 2M + 0.3M pixels
  - Terrestrial DMB, TV - Out

All products, dates, plans and features are preliminary and subject to change without notice.
WiBro Terminal by Samsung Electronics

SPH-P9000

- Mobile WiMAX Deluxe MITs
- Duplexing Mode: OFDMA, TDD
- Frequency: 2.3 GHz / 8.75 MHz
- CDMA EV-DO (1900MHz PCS) & Mobile WiMAX: Voice & Data Call Support
- Main Features
  - Display: 65k color WVGA TFT (5”, 800 x 480)
  - OS: Windows XP
  - IMS: Video Telephony
  - 1.3 Megapixel Camera
  - Bluetooth Connectivity
Part 6.

WiBro/Mobile WiMAX Deployment
Global Deployment of Mobile WiMAX

- Sprint/Nextel ('07.4Q Pre-Commercial)
- Arialink ('07.4Q)
- TVA ('07.2Q)
- Omnivision ('07.1Q)
- KDDI ('05.4, Trial)
- KT ('06.6)
- SKT ('06.6)
- TI ('06.2, Olympics)
- Bayanat ('07.3Q)
- Etisalat ('06.4Q, Trial)
Service Rollout Plan - KT

- **2005.1** License issued
- **2005.9** Testbed built
- **2005.11** APEC Demo.
- **2006.4** Large Scale trial
- **2006.6** Soft-Commercial Service (5 regions)
- **2007.4** Full-Commercial Service (Seoul and Vicinity)
- **2008~** Network upgrade & Coverage expansion

- **Coverage:** Seoul and vicinity (encompassing 12 million people, 25% of total population)
- **Terminal**
  - PCMCIA
  - USB dongle
  - Smart phone, PMP
  - Embedded laptop, UMPC
### Commercial WiBro Service by KT

**Target Services:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicator</td>
<td>SMS, MMS, Email, Text chatting</td>
</tr>
<tr>
<td>Hot Clip</td>
<td>Personalized portal (e.g. News, Sports, etc.)</td>
</tr>
<tr>
<td>mLog</td>
<td>Motion picture uploading</td>
</tr>
<tr>
<td>Multiboard</td>
<td>Multimedia conference</td>
</tr>
<tr>
<td>Internet</td>
<td>Internet surfing</td>
</tr>
</tbody>
</table>
## Commercial WiBro Service by KT

### Service Charge

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Service Charge (Korean Won)</th>
<th>Served Data (Mbytes)</th>
<th>Add. Charge (Won/MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saver</td>
<td>6,000</td>
<td>500</td>
<td>25</td>
</tr>
<tr>
<td>Basic</td>
<td>7,500</td>
<td>800</td>
<td>12</td>
</tr>
<tr>
<td>Special</td>
<td>9,000</td>
<td>1,500</td>
<td>10</td>
</tr>
<tr>
<td>Free</td>
<td>16,000</td>
<td>unlimited</td>
<td>0</td>
</tr>
</tbody>
</table>