Mobile WiMAX Directions

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Presentation Overview

WiMAX Forum Overview

Mobility in WiMAX Forum
- Market adoption of 802.16e/Mobile WiMAX
- Performance comparison – WiMAX and 3G
- Mobile Network Architecture
- Productization of Mobile WiMAX – Plugfests, certifications

Advances in 802.16
- Introduction of 802.16 to ITU-R
- 802.16m - Next generation mobile 802.16
- 802.16j – Multihop Relay technology for 802.16
- Other activities in 802.16

Summary
WiMAX Forum Working Groups

Shankar, AT&T

Tom Tofigh, AT&T
Howard Liu, Disney
Prakash, Intel

TWG: Wonil Roh– Samsung
Vladimir Yanover- Alvarion

Ed Agis, Intel

Tim Hewitt, British Telecom

Mo Shakouri, Alvarion

Hyung Kim, Mary Clark
• The WiMAX Forum is dedicated to promote technical flexibility as a spectrum policy
• Find current status of spectrum licensing and regulatory information on a global basis
Mobile WiMAX Certification Roadmap

Release 1.0 Wave 1
Mandatory testing:
Key functionality, including OFDMA, QoS, power control, AES and PKMv2, handoff support, H-ARQ, and header compression

Release 1.0 Wave 2
Mandatory testing:
Additional tests on handovers, QoS and power saving, IPv6
Base station
Optional modules:
MIMO
Beamforming
Ethernet IO
MBS
Mobile station
Mandatory testing:
MIMO
Beamforming
MBS
Optional:
Ethernet IO

Certified products announced
1Q07 2Q07 3Q07 4Q07 1Q08 2Q08 3Q08 4Q08
Roaming: agreements, rating, billing and settlement

WiMAX Forum Contribution: We are working with global roaming experts to identify and leverage best practices in place today. Lessons learned from the deployment of roaming in CDMA and GSM will be incorporated into this process to enable and encourage rapid roaming deployment. Deliverables include:

- Technical Roaming Guideline
- Roaming Process Flow
- Roaming Agreement template
- Billing Exchange Format
- Method of Roaming Brokerage

Creating the Roaming Eco-System
Network Interoperability for WiMAX is Next Step – move near roaming

- Interoperability between different network elements across vendors implementations
- Network Level Interoperability of User Devices across WiMAX network implementations
  - This is complementary to currently planned MACPHY certification testing in CWG.

**WHY NWIOT?**

**NWIOT to Operators**
- Economy of Scale
- Lower initial CapEx and Low Cost of Expansion
- Higher Roaming Revenue
- Access to Retail Distribution Channels

**NWIOT to Vendors**
- More Market Opportunities
- Economy of Scale
- Focus on Strengths
- Room for Innovation and differentiation

**NWIOT to End Users**
- Global Roaming
- Lower Cost of Service
- Consistent User Experience

![Diagram showing network element interoperability and user device testing](image-url)
WiMAX Intellectual Property Rights

- Dispersed distribution of ownership of US patents*
- No single company has a dominant IPR position.

1550 patents are distributed among 330 companies

Of the 23 Companies that hold more than 10 Patents...
74% are WiMAX Forum members, representing 82% of the patents held in concentrations of 11 or more patents per company

* Based on independent survey of relevant and potentially relevant patents/applications for United States

Source: Schwegman, Lundberg, Woessner & Kluth
More Than 250 Operator Trials and Deployments in 65+ countries!

Source: Intel, the WiMAX Forum

* Other names and brands may be claimed as the property of others
Mobility in WiMAX Forum
WiMAX Adoption by the market

- Korea with the WiBro
  - Commercial service in Seoul, coverage area being increased

- WiMAX adopted by major US operators – Sprint and Clearwire
  - Commercial deployment in 2008

- KDDI and NTT in Japan are trialing 802.16e

- Taiwan is pushing for 802.16e in M-Taiwan project
WiMAX and 3G: Throughput Comparison

- WiMAX provides much better throughput than EVDO and HSxPA
- 3G-LTE only technology which may be a real match to WiMAX
  - But…not available at least until 2010/2011
  - Does not provide an EVOLUTIONARY path from existing 3G networks
  - A wholly new network and requires entirely new devices
Two Plugfests have already taken place (6/06, 9/06), next one 2/07
- About 20 companies in last Plugfest (vs. 9 in the first)
- Major achievement: interoperability among multiple vendors demonstrated

Supporting 3 BW profiles and two frequency bands
- 5 MHz, 8.75 MHz and 10 MHz bandwidths
- 2.3-2.4 GHz and 2.5-2.7 GHz frequency bands

Demonstrated different chip manufacturers (multiple station vendors) and delivery of video streaming to multiple subscriber stations
Certification of 802.16e equipment

- **Certification efforts ongoing**
  - Validation of Wave 1 test equipment started 11/06

- **Wave 1 features:**
  - Basic 802.16e-2005 air protocol

- **Wave 2 main features:**
  - MIMO
  - Adaptive antennas

Minimum Configuration for Mobile WiMAX Wave 2
Next Generation Technologies in 802.16
Introducing WiMAX into IMT-2000

- WiMAX Forum and IEEE802.16 are working to make IEEE802.16 one of the Radio Access Technologies acceptable in IMT-2000
  - IMT-2000 is under the auspices of ITU-R
  - Currently defines 5 radio access technologies

- Purpose – get access to spectrum

- Strategy – Add 802.16e as a 6th technology of IMT-2000 under the name “IP-OFDMA”
Levelling the Playing Field for Spectrum: Entry into the world of “IMT”

An entry process and criteria exist for “new” IMT-2000 air interface technologies (Standards), but as written they are somewhat restrictive (ITU-R Circular Letters 47 & 95).

By definition, there are no entry options here for new technologies like WiMAX.

IMT-Advanced is not yet defined, so there are, as yet, no entry processes or criteria.

Existing
IMT-2000
CDMA2000-1x, W-CDMA etc.

Evolution of
Existing IMT-2000
EV-DO HSDPA etc.

IMT-Advanced
(formerly “systems beyond IMT-2000”)
??
100Mbit/s mobile 1GBit/s Nomadic
## Existing radio interfaces in IMT-2000

### ITU-R WP 8F (IMT-2000): the terrestrial radio interfaces

*(Recommendation ITU-R M.1457)*

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Common Names</th>
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<tbody>
<tr>
<td>IMT-2000 CDMA direct spread</td>
<td>UTRA FDD</td>
</tr>
<tr>
<td></td>
<td>WCDMA</td>
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<td></td>
<td>UMTS</td>
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<td>IMT-2000 CDMA multi-carrier</td>
<td>CDMA2000 1x and 3x</td>
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<td>CDMA2000 1xEV-DO</td>
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<td>CDMA2000 1xEV-DV</td>
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<td>IMT-2000 CDMA TDD (time-code)</td>
<td>UTRA TDD 3.84 Mchip/s high chip rate</td>
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<tr>
<td></td>
<td>UTRA TDD 1.28 Mchip/s low chip rate</td>
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<tr>
<td></td>
<td>(TD-SCDMA)</td>
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<td></td>
<td>UMTS</td>
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<td>IMT-2000 TDMA single-carrier</td>
<td>UWC-136</td>
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<td></td>
<td>EDGE</td>
</tr>
<tr>
<td>IMT-2000 FDMA/TDMA (frequency-time)</td>
<td>DECT</td>
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Continuation project named 802.16m:

- Be capable of meeting the requirements of IMT-Advanced
  - 1 Gb/s stationary, 100 Mb/s mobile
- Be backwards compatible to 802.16e
  - 802.16e CPEs will work with 802.16m BSs
  - 802.16e BSs will be able to operate in 802.16m network
- Provides confidence to operators that 802.16 technology is future proof
- Provides security for current investments
Other activities in 802.16

- **Corrigenda 2 for 802.16e-2005**
  - Correcting errors and inconsistencies in 802.16e-2005 standard
  - Substantial preparatory work by WiMAX Forum members

- **802.16h – Coexistence in license-exempt bands**
  - Chaired by Mariana Goldhamer from Alvarion
  - First draft released

- **802.16g – NetMan**
  - Goes to Sponsor Ballot
Summary

- Mobile WiMAX is gaining momentum
- Adoption by major Operators
- Equipment is maturing and nearing availability
- 802.16 is starting work on the next generation

Alvarion believes that Mobile WiMAX will become a major technology in the next generation

- Equipment demonstrated in WiMAX Plugfests
- Invest heavily in Smart Antenna and Advanced Networking technologies
Thank you