IEEE 802.16/WiMAX Broadband Wireless Access

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IEEE802.16 Relay TG Chair

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Agenda

- IEEE 802.16
  - Recent Topics in IEEE 802.16
- WiMAX Forum
- Development Examples
  - WiBRO in Korea
  - KDDI's Mobile WiMAX Trial in Osaka, Japan
- Conclusions

IEEE 802.16 Working Group

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IEEE

IEEE 802

IEEE-SA:
Standards Association, Institute of Electrical & Electronics Engineers, Inc.

IEEE 802 LAN/MAN Standards Committee

Examples of Active Working Group:

- 802.3 Ethernet (wired)
- 802.11 WLAN
- 802.15 Wireless PAN
- 802.16 Wireless MAN
- 802.20 Mobile BWA
- 802.21 Media Independent Handoff

IEEE 802 Features

- Global
- Open
- Industry Driven
- Individual Members
- 75% votes to pass

IEEE 802.16 Broadband Wireless Access Standards (Wireless Metropolitan Area Network)

WG Chair: Dr. Roger B. Marks (NIST, USA)

- est. in 1999
- Meet every other month

Task Group and other activities:

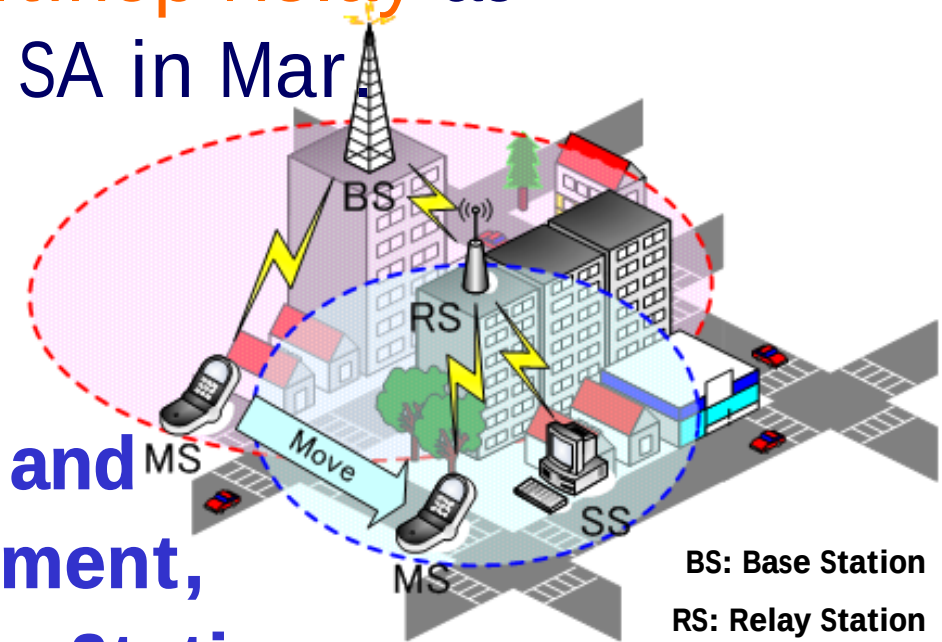
- Network Management (NetMan) TG
  - P802.16g, P802.16i, P802.16k
- License-Exempt TG
  - to draft P802.16h
- Conformance TG
- Maintenance TG
- Liaison: ITU-R WP8A, 8F, 9B, etc.,
- New: Relay TG to start P802.16j

Recent Topics in IEEE 802.16 WG

- IEEE802.16e-2005 (mobile) published on 28 Feb. 2006 (incl. 16-2004/Cor1.)
- New Relay TG to start from Session #43 in May, to discuss Multihop Relay as authorized by IEEE SA in Mar.

Multihop Relay:

- **To gain:**
  - **Coverage Extension, and**
  - **Throughput Enhancement,**
- **by introducing the Relay Stations.**



WiMAX Forum

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WiMAX FORUM

- President & Chairman: Ron Resnick (Intel)
- Industry-led, non-profit corp. found in 2001, 350+ companies participating
- formed to certify compatibility and inter-operability of Broadband Wireless Products based on IEEE 802.16.

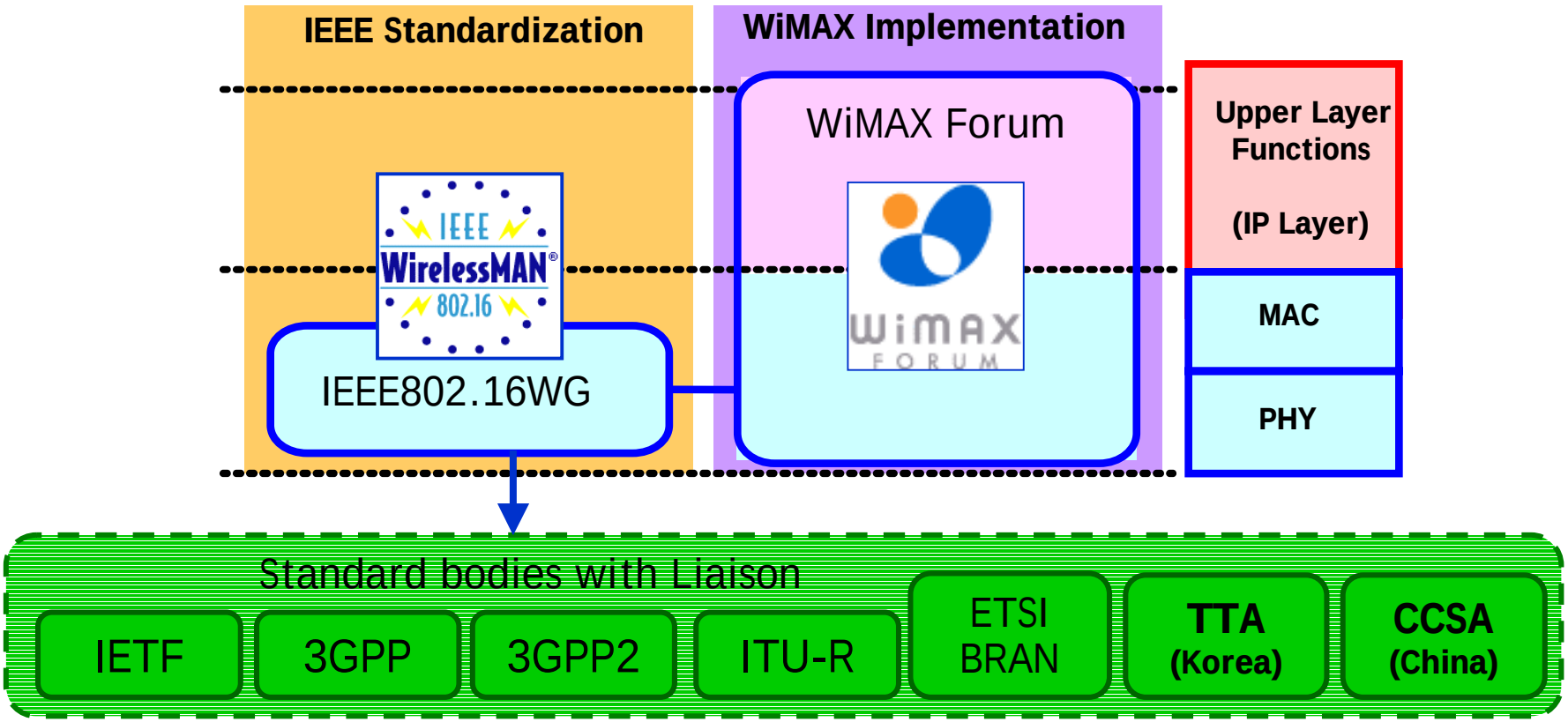
Forum Organization

WiMAX Forum Board

- **Marketing WG** · Build preference for WiMAX certified products worldwide
- **Regulatory WG**
  · Regional&Global band plan · ITU harmonization
- **Service Provider WG**
  · Operator Requirements · System Performance
- **Network WG**
  · Create higher level networking specifications
- **Technical WG** — Mobile Task Group (Profile)
  · Conformance and interoperability specifications
- **Certification WG**
  · Test Labs · Certified program
- **Application WG**
  · Demonstrate best practice solutions

Relation between IEEE 802.16 and WiMAX Forum

802.16 covers PHY and MAC while WiMAX covers the whole



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IEEE 802.16e Transmission Characteristics

Spectral Efficiency Target: 1.5bit/s/Hz or more

Item	Specifications
Frequency	< 6GHz e.g., 2.3GHz(Korea), 2.5GHz(USA), 3.5GHz(EU)
Channel Bandwidth	1.25 - 20 MHz (e.g., 5/10/20 MHz)
Access Method / Duplex Mode	OFDMA (FFT128, 512, 1024, 2048), OFDM (FFT256) / FDD, TDD
Modulation Scheme	BPSK, QPSK, 16QAM, 64QAM
Channel Coding	Convolutional Code, Convolutional Turbo Code, Optional: LDPC and Block Turbo Code
Frame Length	2.5 ~ 20ms (e.g., 5ms)
Transmission Rate	*Defined with Channel Bandwidth, Modulation, Coding Rate, and Tx/Rx Antenna Config.
Mobile Support	Inter-BS Handover (Hard Handoff, etc.)
Cell Radius	Metropolitan Area: ~1km, Rural Area ~5km
Frequency Reuse Factor	1 - 3

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WiMAX Usage Models

Technology Evolution

Fixed → Nomadic/Portable → Mobile

802.16-2004

Fixed Outdoor

Backhaul

ACCESS

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Nomadicity/ Portability

Fixed Indoor

Enterprise Campus Piconet

METROZONE

802.16e

MOBILITY

802.16 Technology enables diverse usage models from fixed to mobile

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Service Providers (mobile WiMAX)

- **Korea**
  - KT: APEC WiBro demo last Nov. Will start pre-commercial service in April and commercial one in June
  - SKT: Will start commercial service in June
- **Japan**
  - KDDI: Executed Osaka mobile WiMAX trial and demo
  - NTT DoCoMo: Will start mobile WiMAX trial in Tokyo
  - Vodafone KK, Yozan, etc
- **Taiwan**
  - FiTEL: 2.5GHz, Considering several vendors for mobile WiMAX service
- **China**
  - CNC: Will start mobile WiMAX trial and plan to its demo during BJ Olympics
- **US**
  - Sprint-Nextel: Co-work with Samsung & Motorola for mobile WiMAX trial
- **Europe**
  - Telecom Italia: Executed mobile WiMAX demo during Torino winter Olympics
    - And more over the world…

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WiBRO Development Status in Korea

- **WiBro: Wireless Broadband access service**
- **fully compliant with IEEE 802.16e OFDMA (Mobile WiMAX)**
- **Key Requirement:**
  - Cell Edge transfer rate : DL 512 kbps/ UL 128kbps
  - Channel bandwidth : 9MHz
  - Inter-Operator Roaming should be required
  - Frequency Reuse Factor is '1'
  - Duplex = TDD & Tx/Rx Time Slot Synchronization

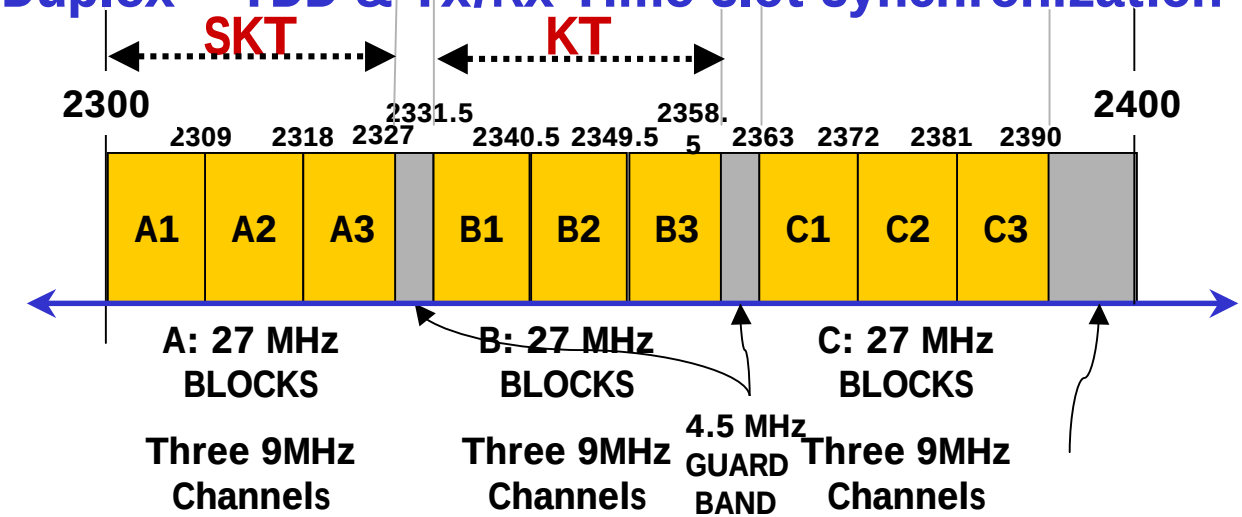


Fig. WiBRO Frequency Allocation in Korea

Contribution: Dr. JaeWeon Cho, Samsung Electronics

WiBRO Development Status

2003 — Start the Co-development

Start the WiBro Co-development

2004 — Prototype development

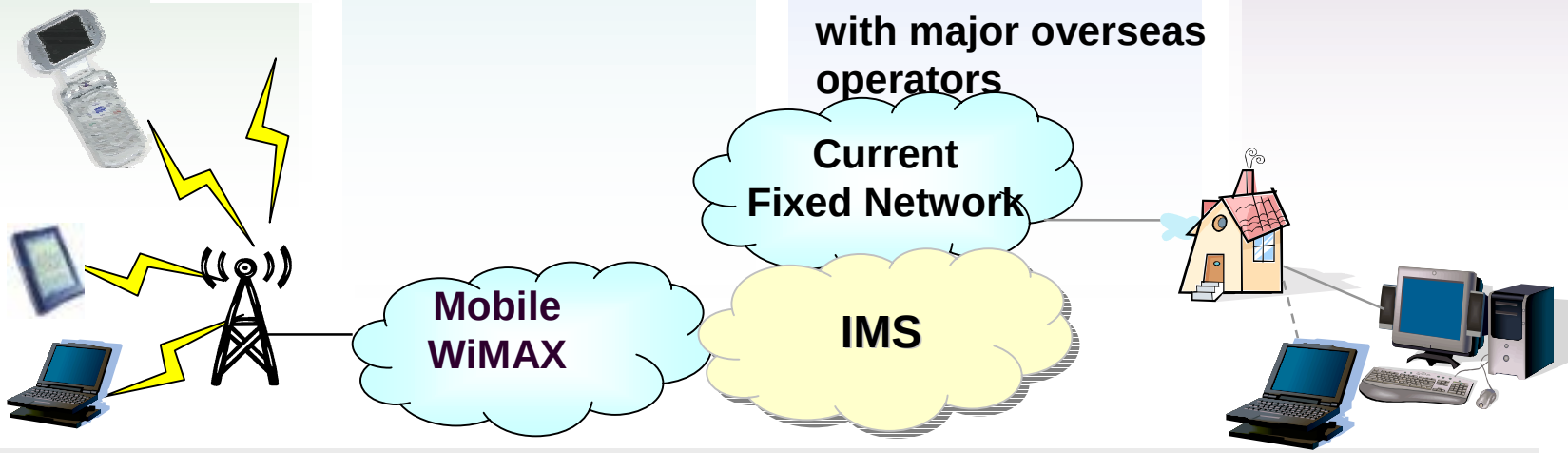
- 1st Call Demo (Nov. '04)

2005 — Trial Service

- APEC Demonstration (Nov.)
- Mobile WiMAX trials with major overseas operators

2006 — Commercial Service

- The world 1st commercial service



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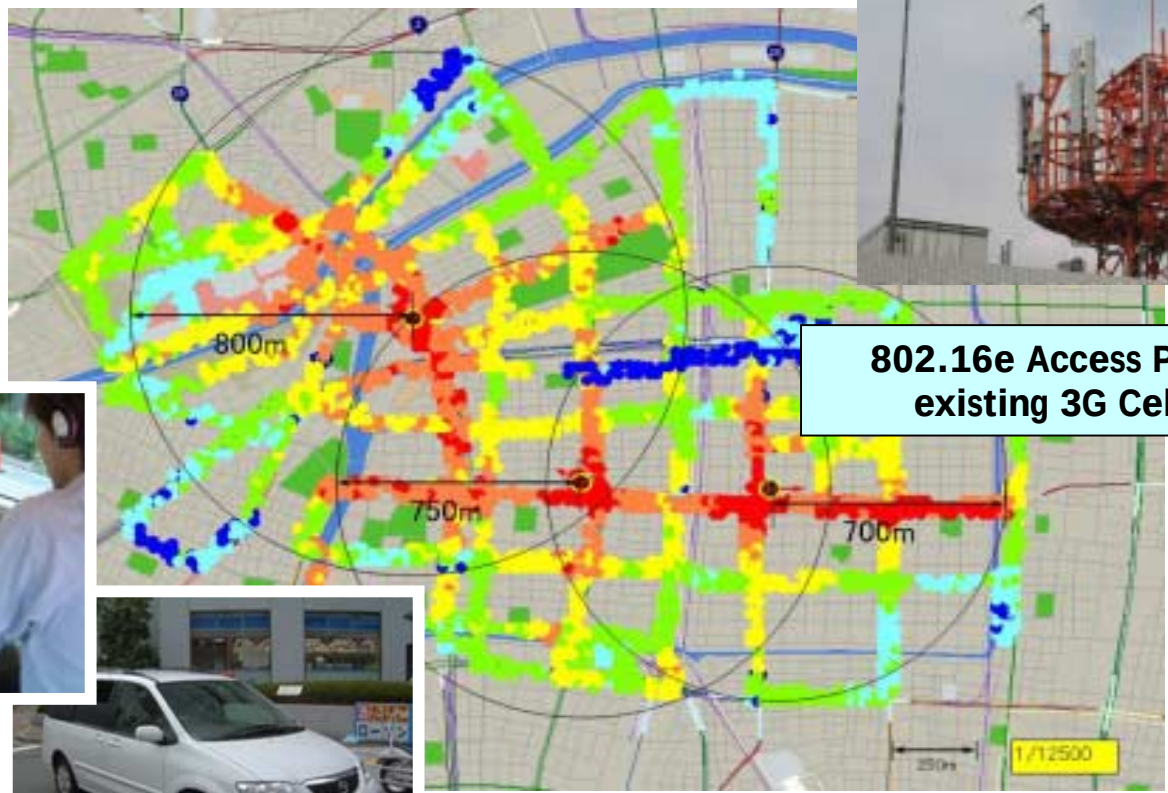
KDDI Osaka Trial on Mobile WiMAX

- KDDI developed IEEE 802.16e-based Mobile WiMAX system and has conducted its field trial in Osaka, Japan since Jul. 2005.
- Mobile WiMAX, capable of broadband transmission even on the move at 120 km/h, is expected to be a part of Overlay system, complement to the 3rd Gen. Cellular System.
- Its characteristics, from the fundamental propagation to the applications such as video streaming, successfully confirmed through the trials.

KDDI Osaka Trial on Mobile WiMAX

Field Trial and its Result Example



802.16e Access Point collocated with existing 3G Cellular Base Station

Trial using Test Terminal on-board the vehicle

Received Signal Strength around the Three Access Points in Osaka

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Conlcusions

- Activities at IEEE 802.16WG/WiMAX Forum introduced,
- Some examples shown indicating 802.16/WiMAX networks are coming,
- Field trials have indicated its feasibility, while depicting further study items,
- global harmonization required to promote it as global standard (i.e., such as equipment/system interoperability, common frequency band allocation, etc.)