



WiMAX Overview

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Outline

- The Opportunity
- IEEE802.16
- Certification profiles
- Spectrum regulation
- WiMAX Forum Overview
- Mobile WiMAX
- Mobile WiMAX network architecture
- IPv6 support in Mobile WiMAX

WiMAX is addressing mobile broadband Internet access

	“Integrated Services Digital Network”	“Digital Subscriber Line”
fixed	POTS, ISDN (B-ISDN, ATM)	xDSL, Cable
mobile	GSM (GPRS / EDGE) UMTS / HSDPA	<div style="display: flex; align-items: center; justify-content: center;"> <div style="background-color: #008080; color: white; padding: 5px; text-align: center;">IEEE802.16-2004 IEEE802.16e</div> <div style="margin: 0 10px;">→</div> <div style="background-color: #fff9c4; padding: 5px; text-align: center;">Wi-Fi</div> </div> <div style="background-color: #ffcc00; color: white; padding: 10px; text-align: center; margin-top: 10px;">WiMAX</div>

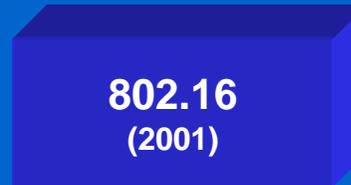
- End-to-end Quality of Service
- Hard realtime (voice)
Defined traffic classes
- End-to-end service delivery
 - Voice, SMS, Gaming, Infotainment
- Precise accounting, charging and billing

- Best effort, Class of Service enabled
- Interactive (http, mail)
Streaming, downloads
- Access to the plain Internet
 - Common web applications, e-mail
- Usage classes, flat-rate

The Evolution of WiMAX

Parallel effort in Korea
“WiBro”

July '04
Korea Govt
Decision
Converges
“WiBro” w/ 802.16e



Fixed wireless broadband
Air Interface: 10 – 66 GHz



802.16 Amendment
Fixed wireless broadband
MAC & PHY: 2 - 11 GHz



802.16 Rev PAR for 802.16, 802.16a
Fixed wireless broadband System
Profiles, Errata for 2 - 11 GHz
(Formerly 802.16REVd)



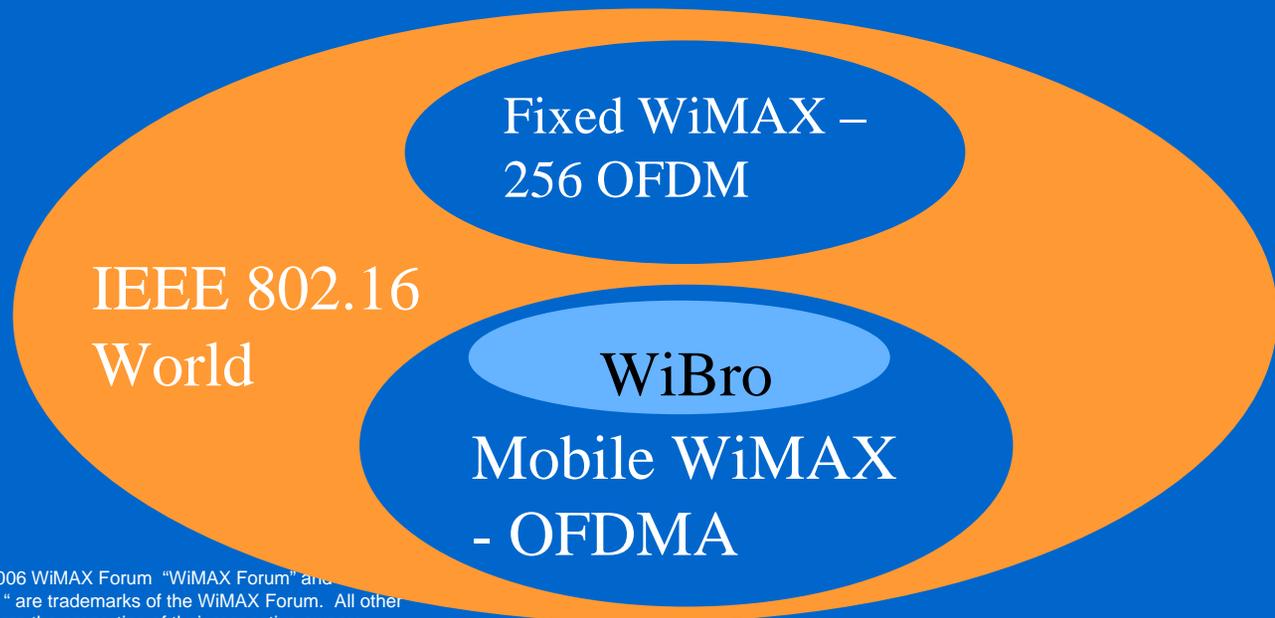
Changes to 802.16e ratified that
allowed for a unified profile completed



802.16 Amendment for Combined
Fixed and Mobile wireless broadband
at vehicular speeds in Licensed bands
from 2-6 GHz

WiMAX and IEEE 802.16

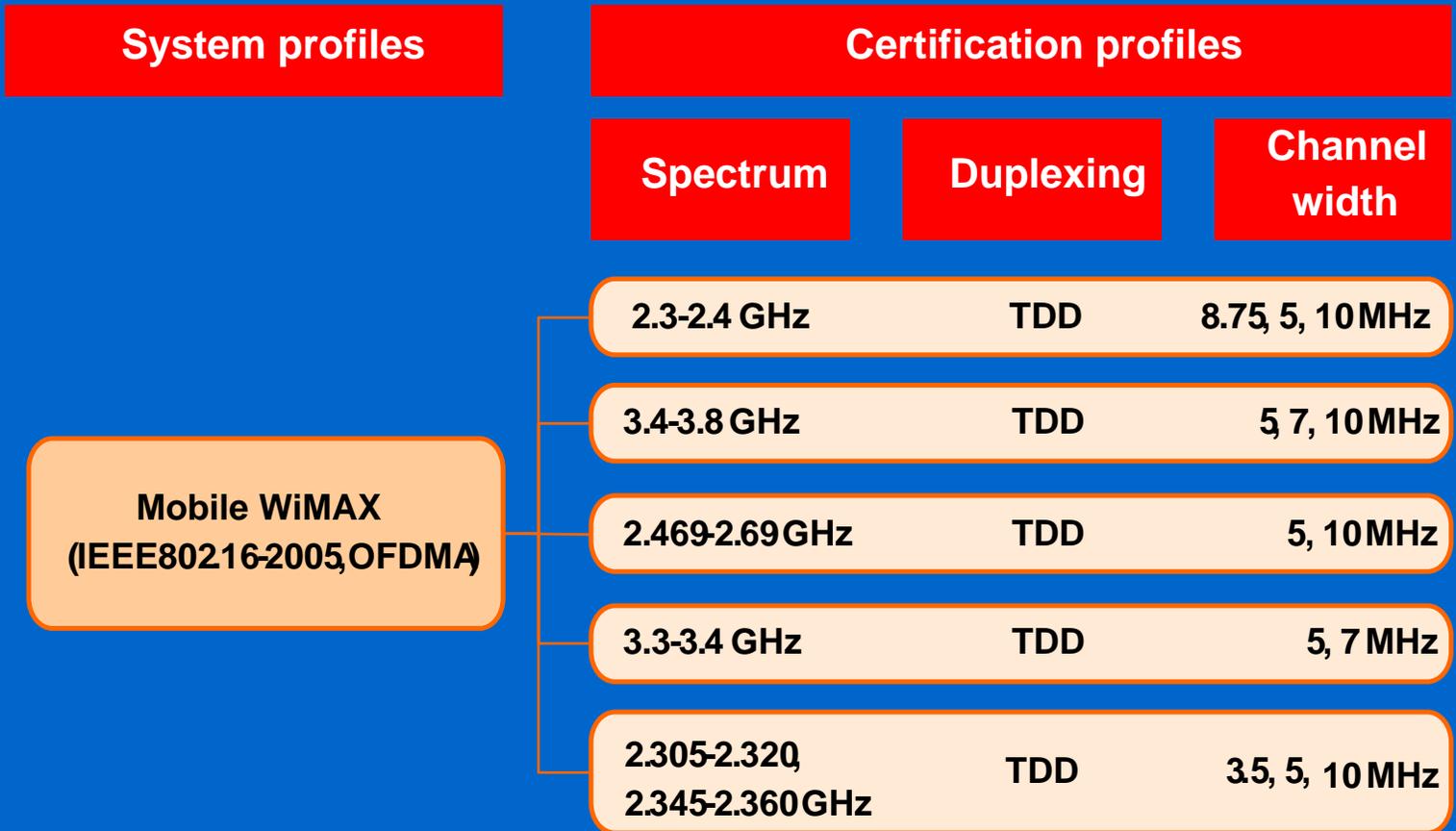
- WiMAX is a subset of IEEE 802.16
 - No new features can be added
- Mandatory features in 802.16 are mandatory in WiMAX, if included
- Optional features in 802.16 may be optional, mandatory or not included



WiMAX System Profiles: Fixed and Mobile WiMAX

	Fixed WiMAX (IEEE 802.16-2004)	Mobile WiMAX (IEEE 802.16e-2005)
Multiplexing	OFDM	OFDMA
FFT size	256	512, 1024
Duplexing mode	TDD, FDD, HFDD	TDD
Modulation	BPSK, QPSK, 16-QAM, 64-QAM	QPSK, 16-QAM, 64-QAM (optional uplink)
Channel bandwidth	3.5, 7, 10 MHz	5, 7, 8.75, 10 MHz
Frequency bands	2 GHz – 11 GHz	2.3-2.4 GHz 2.5-2.7 GHz 3.3-3.4 GHz

Mobile WiMAX Proposed Certification Profiles



Spectrum Regulation

WiMAX Forum is working diligently with governments around the world to ensure economical and efficient use of spectrum for creation of true, open markets and delivery of cost-effective broadband to citizens

- WF advocates that governments remain technology neutral when allocating spectrum
- Focus on 5.8G, 3.5G, 2.5G and <1GHz
- 20-30MHz of Spectrum per Operator

Spectrum Considerations

**5.8
GHz**

- High antenna gains
- Highest building penetration loss
- Good for fixed & Backhaul applications
- Not suitable for mobile applications

**3.3-3.6
GHz**

- High antenna gains (fixed)
- Higher building penetration and path loss
- Good for fixed applications
- Some Portable/mobile applications

**2.3-2.7
GHz**

- Considerable spectrum available
- Good antenna gains (fixed)
- Moderate building penetration and path loss
- Good for fixed or mobile applications

<1 GHz

- Less spectrum available
- Low antenna gains
- Low building penetration loss
- Very good for mobile and rural applications

WiMAX Forum

- Deliver a trusted certification process
- Develop a specification for a high performance end-to-end IP network architecture supporting stationary, portable, and mobile users
- Evangelize business model, including favorable IPR policy
- Foster a thriving ecosystem
- Promote and accelerate WiMAX deployments to achieve global wireless broadband market leadership

WiMAX Forum Realities

- WiMAX Delivering on its Promise
 - Certified Fixed WiMAX products in Q1'2006
 - Multiple 3.5GHz TDD and FDD products during '06
- WiMAX is Getting Market Acceptance
 - 120+ operators trialing and deploying WiMAX
 - WiMAX Forum membership growth accelerating >350
- WiMAX Fast Forward
 - Mobile WiMAX Certification lab on track to open in Q3'2006 (TTA/Cetecom)
 - Spectrum: 2.3-2.7GHz, 3.3-3.8GHz, 5GHz, <2GHz (3.5/5/7/10 MHz channel bandwidth)
 - Personal broadband terminals globally '07-'08

The WiMAX Forum Membership Continues to Grow!

368 WiMAX Forum Member Companies

-  85 Ecosystem/Applications/Content
-  136 Service Providers
-  71 System Vendors
-  78 Silicon/Component Suppliers

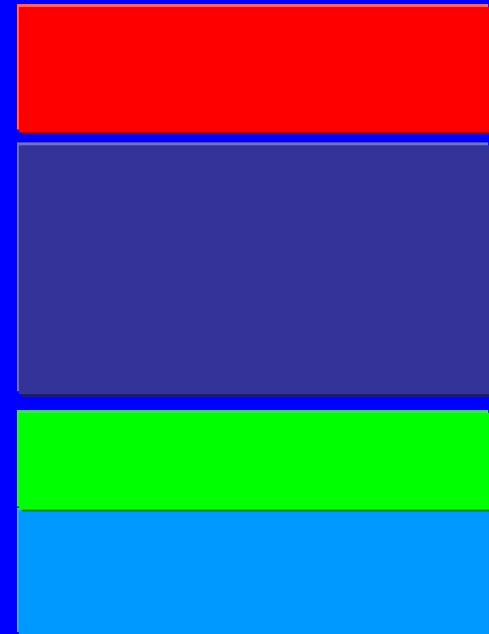
368



46



Spring 2004



Today

Mobile WiMAX = Personal Broadband

- Do for the Internet what Cellular did for voice
 - 1985: voice at home, voice at work
 - 1995: cellular voice everywhere
 - 2005: Internet at home, Internet at work (broadband)
 - 2010+: Internet everywhere

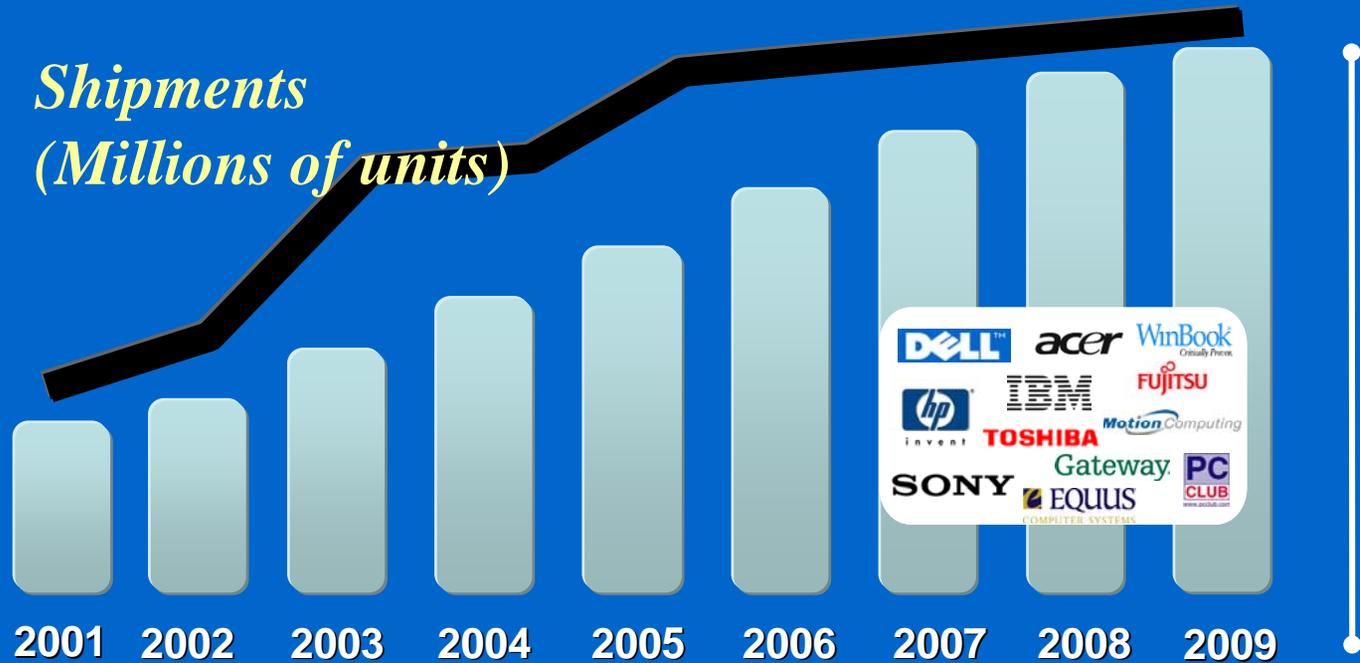
- *27% of the 160M PC's sold in '04 were laptops*
- *05 milestone >50% of US PCs are laptops*
- *90% of new laptops are WiFi ready*
- *US Broadband penetration 43% Jan04*

**Affordable multi-Mbps Personal Broadband
Everywhere**

Zero Cost CPE!

100 M

*Shipments
(Millions of units)*



By 2008:

**70 million
notebooks
shipped
Annually
With WiFi**

**350
thousand
Hotspots
World-wide**

**700 million
WiFi
users**

0%

Replicate with WiMAX... & Build Handset Presence

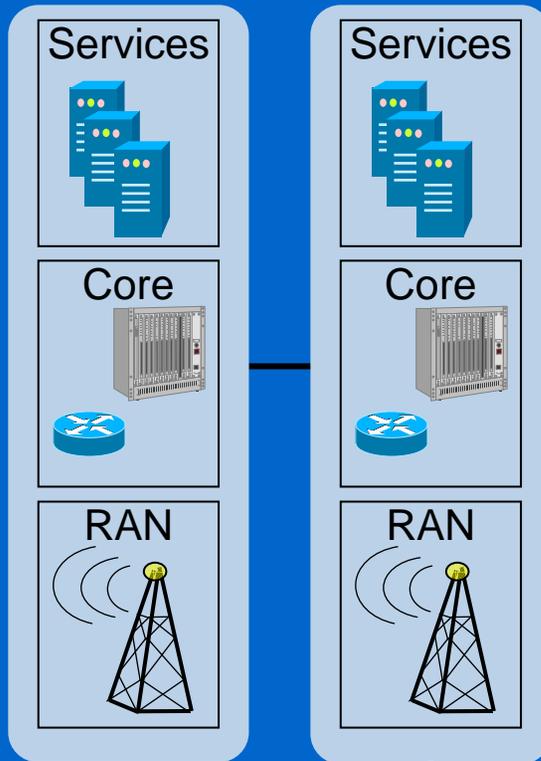
Sources: Allied Business Intelligence, Inc Q4'03, Pyramid Research Report Nov '03, In-Stat/MDR, Jan '04

Mobile WiMAX Attributes

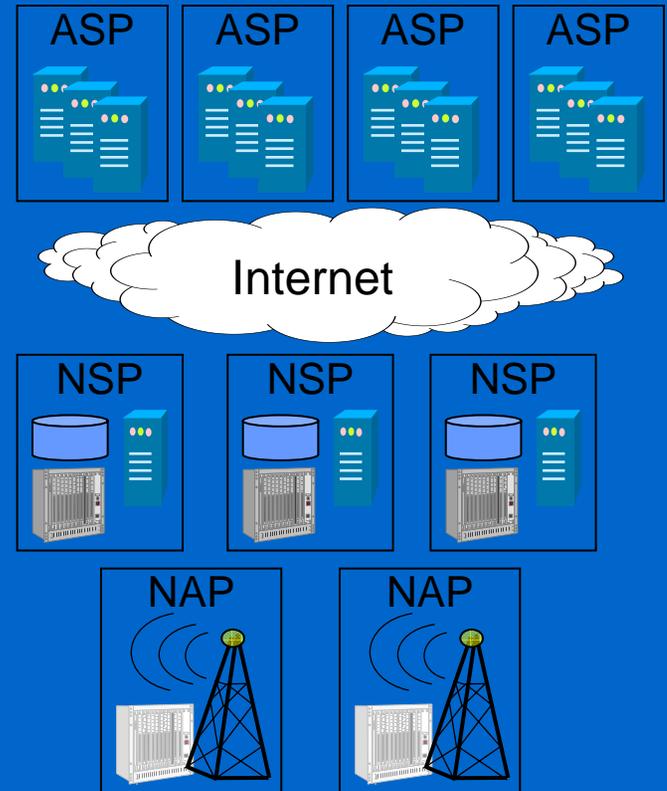
- High tolerance to multipath and self-interference
- Scalable channel bandwidth
- Spectrally-efficient TDD
- Adaptive Modulation and Coding (AMC)
- Hybrid automatic repeat request (H-ARQ)
- Superior Quality of Service (QoS)
- Frequency-selective scheduling
- Mobility management
 - Mobile station power conservation
 - BW-efficient hand-off
- Multicast and Broadcast Service
- Fractional frequency reuse
- Support for smart antenna systems
- All-IP end-to-end network

WiMAX operator value chain

Classical MNO



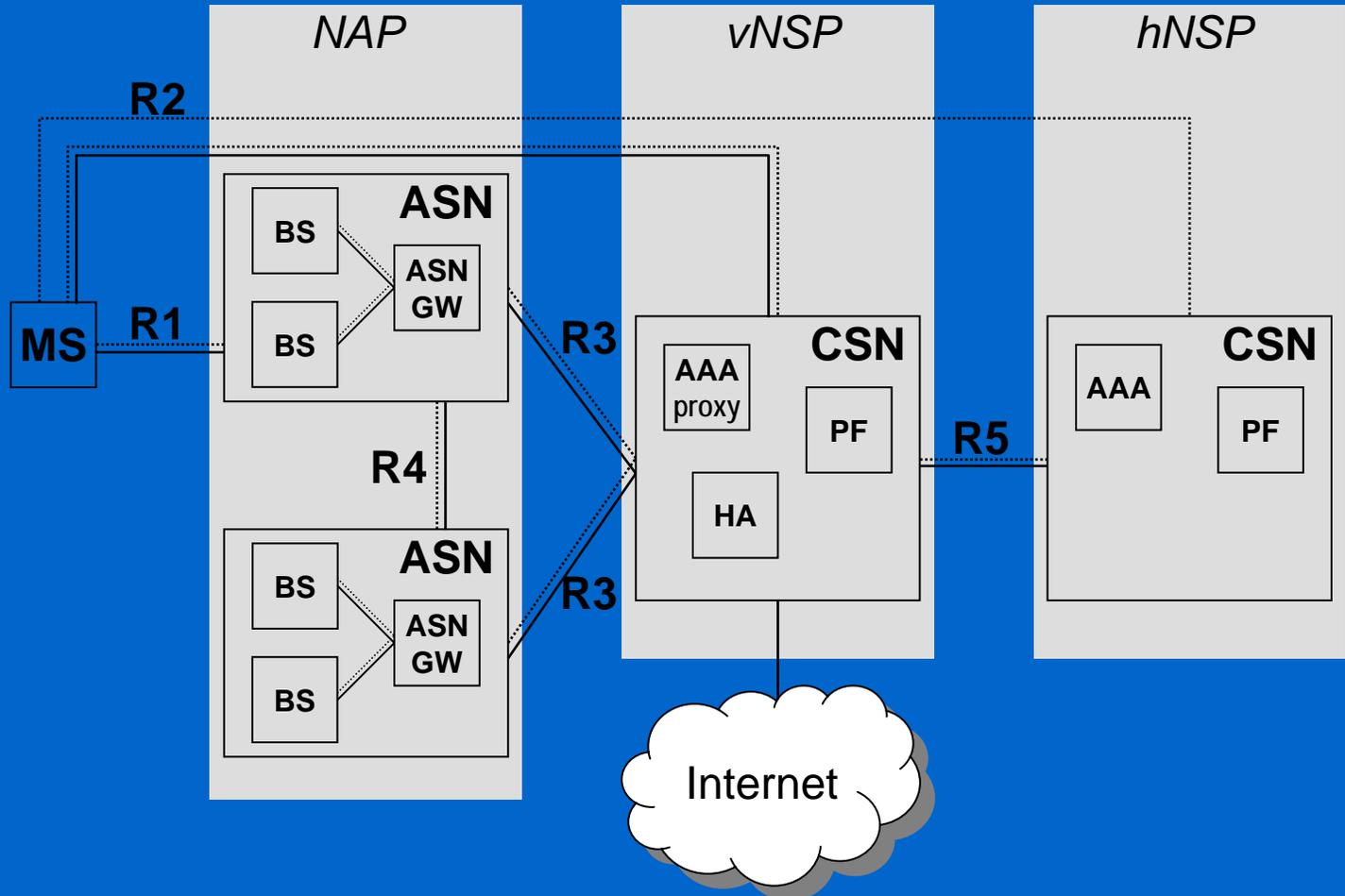
WiMAX



Network Operator Relationships

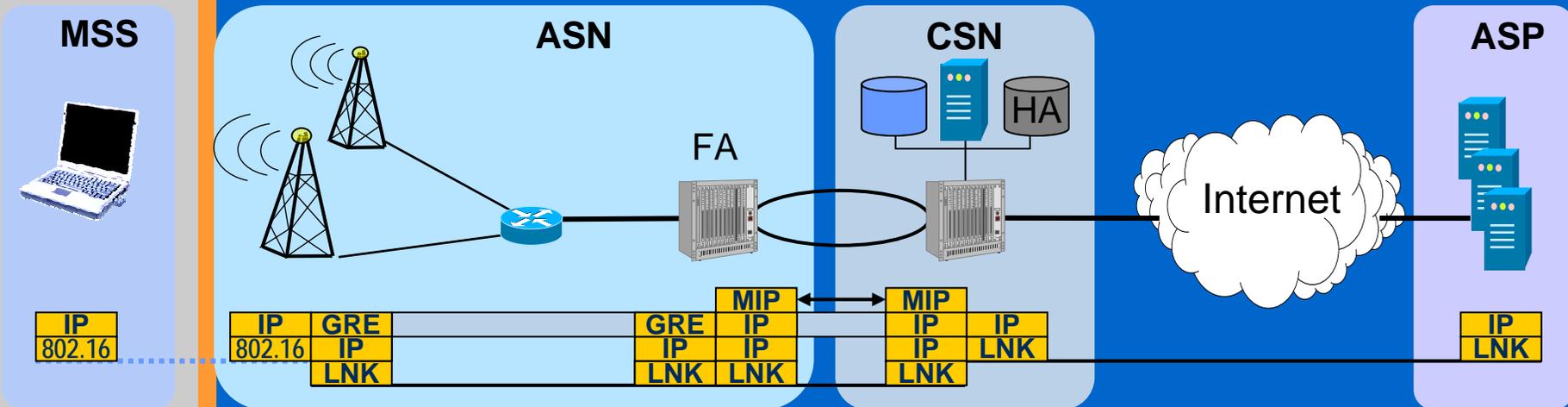
- Network Access Provider (NAP)
 - A business entity that provides WiMAX radio access to one or more WiMAX NSPs. A NAP implements this by one or more Access Service Networks (ASN)
- Network Service Provider (NSP)
 - A business entity that provides IP connectivity and services to WiMAX subscribers.
 - An NSP may also establish roaming agreements with other NSPs and contractual agreements with third-party application providers.
- Application Service Provider(ASP)
 - Provides value added services, Layer 3+ (e.g. email, web services, corporate access, VoIP, ...)
 - Provides and manages applications on top of IP

WiMAX Network Reference Model (roaming case, HA in vNSP)

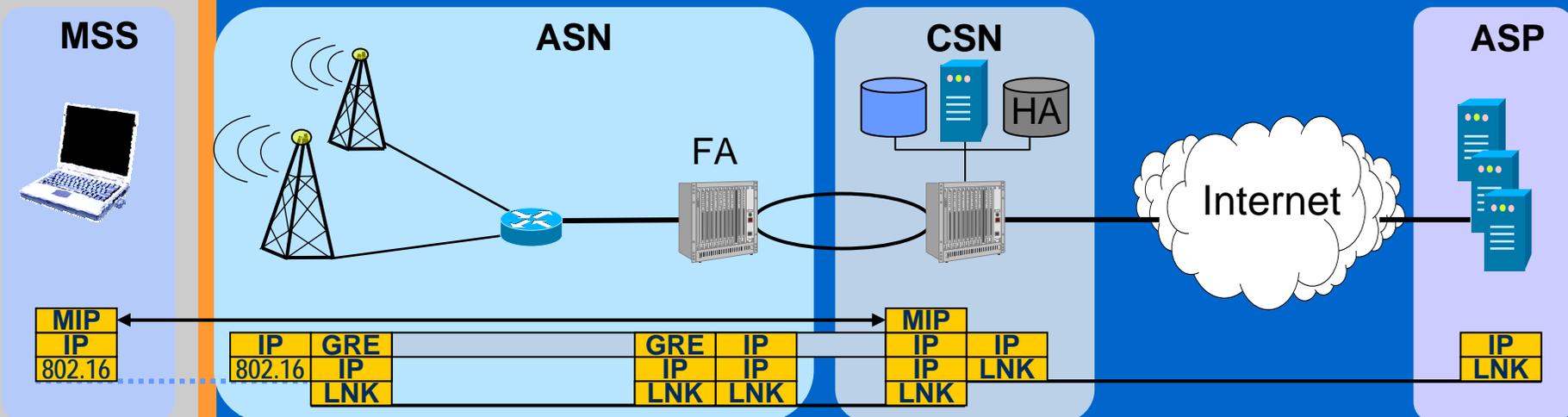


WiMAX Mobility Management

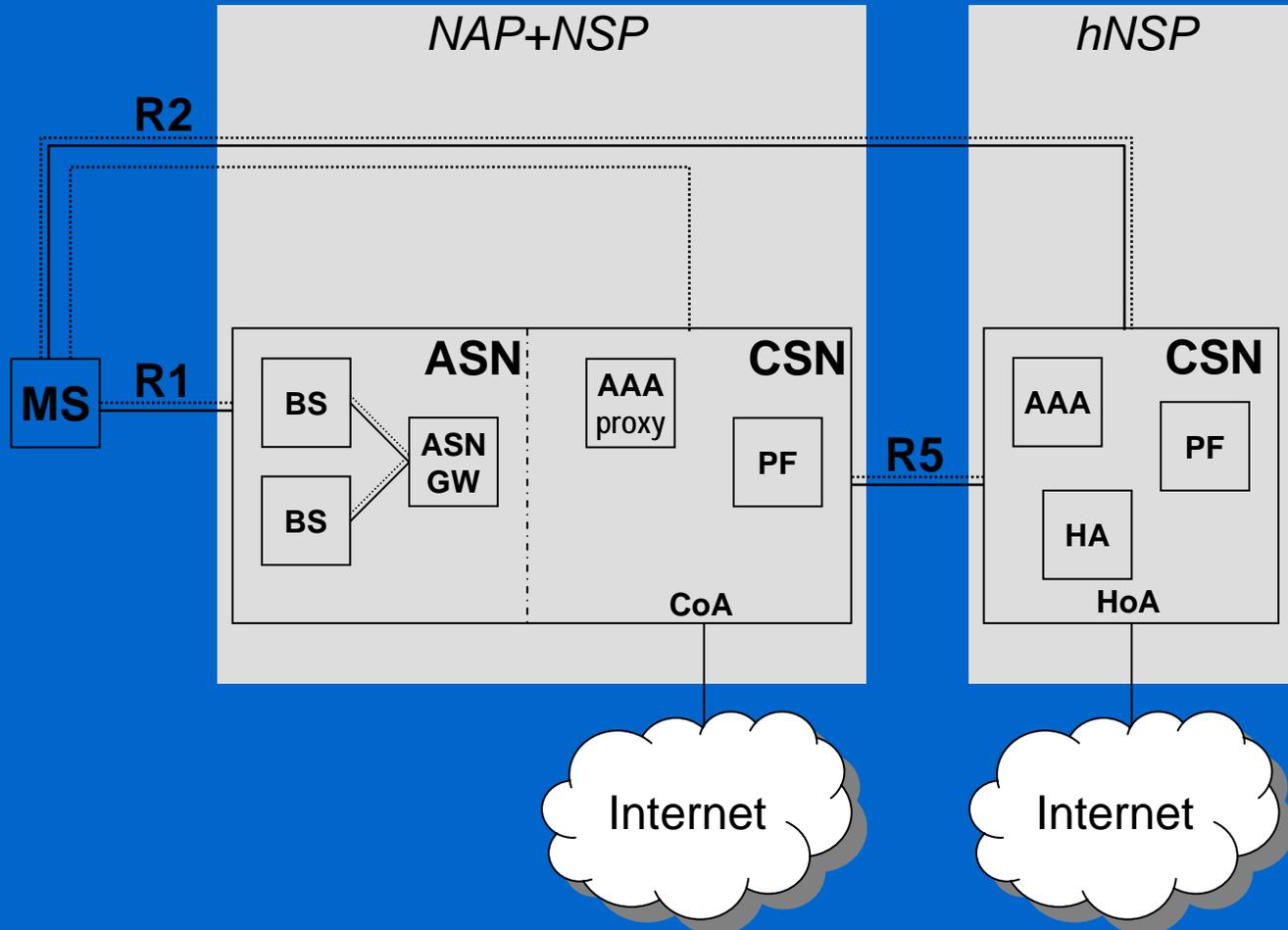
Proxy-MIP: MIP Client resides in ASN-GW



Client-MIP: MIP Client resides in MSS



MIPv6 Network Model in WiMAX (Rel. 1 supports dual-stack operation)



IPv6 issues in Mobile WiMAX

- Link model
 - Point-to-point like in 3GPP
 - Ethernet like multicast capable link
 - Terminal power consumption and radio resource usage
 - Native multicast support only on downstream
 - Special support functions needed for Ethernet emulation as well as native IPv6 over 802.16

=> topic of IETF 16ng WG
- Mobility
 - Currently only CMIPv6 specified
 - PMIPv6 may be done in a later release
 - Communication on CoA and route optimization
 - Security issues, LI, QoS, accounting

Summary: Mobile WiMAX

For comparison: Equivalent functions in a 3G network

UE

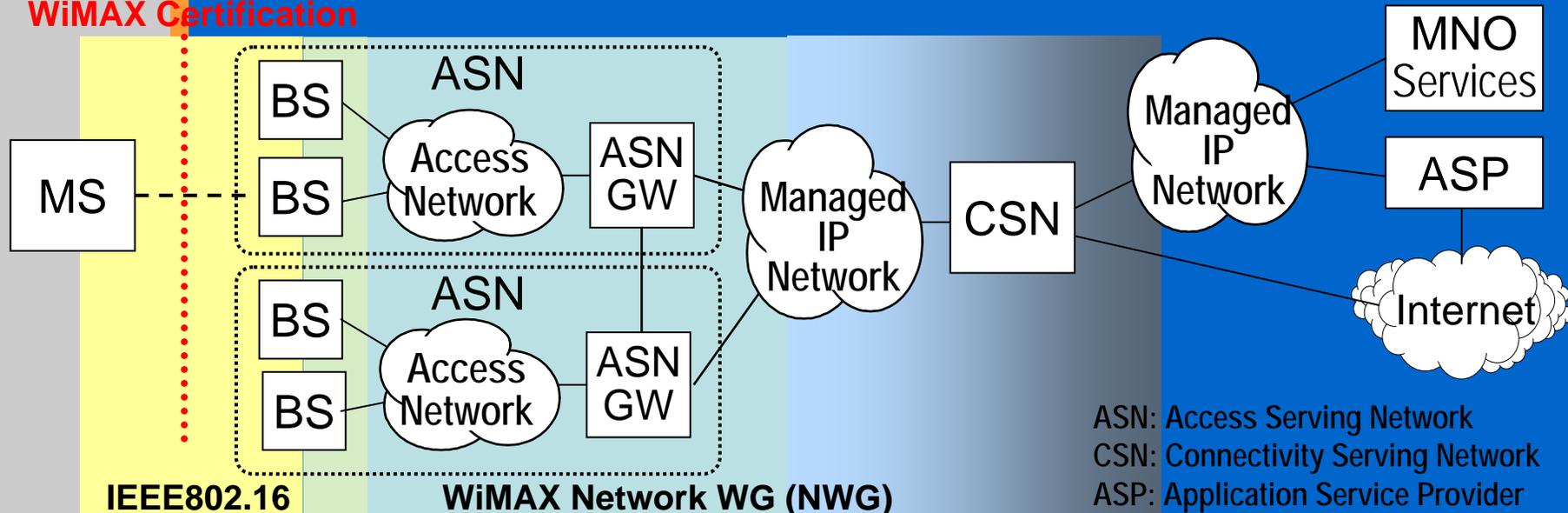
NodeB

RNC, SGSN

GGSN, HSS

IMS

WiMAX Certification



- IEEE802.16 takes care of PHY and MAC of radio interface
 - 802.16e extends MAC & PHY for mobility
- WiMAX provides profiles and certification for .16e
- WiMAX NWG specifies access network architecture
 - based on IETF protocols, 'merged' 3GPP2/DSL/(3GPP) architecture

Done
Eng '05
Mid '06
Rel 1: End '06

The End

- Thank you for your attention
- Questions?