

Interpretation of the WiMAX Standards:

- ❑ What are the mandatory fields for Interoperability?
- ❑ What Features do Operators want to incorporate?

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Outline

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Preface

Mobile WiMAX Use Case Scenarios



Business case

- Broadband beyond copper reach

- Last mile access, avoiding unbundled line cost
- Mobility addition to DSL

- Complementing mobile services to personal broadband

Services

- VoIP, fax, Internet, public services

- Broadband Internet, VoIP

- Mobile data and voice

Terminals

- CPE with VoIP

- CPE with VoIP
- Tablet, laptop, USB

- Handset, laptop

Coverage

- Villages

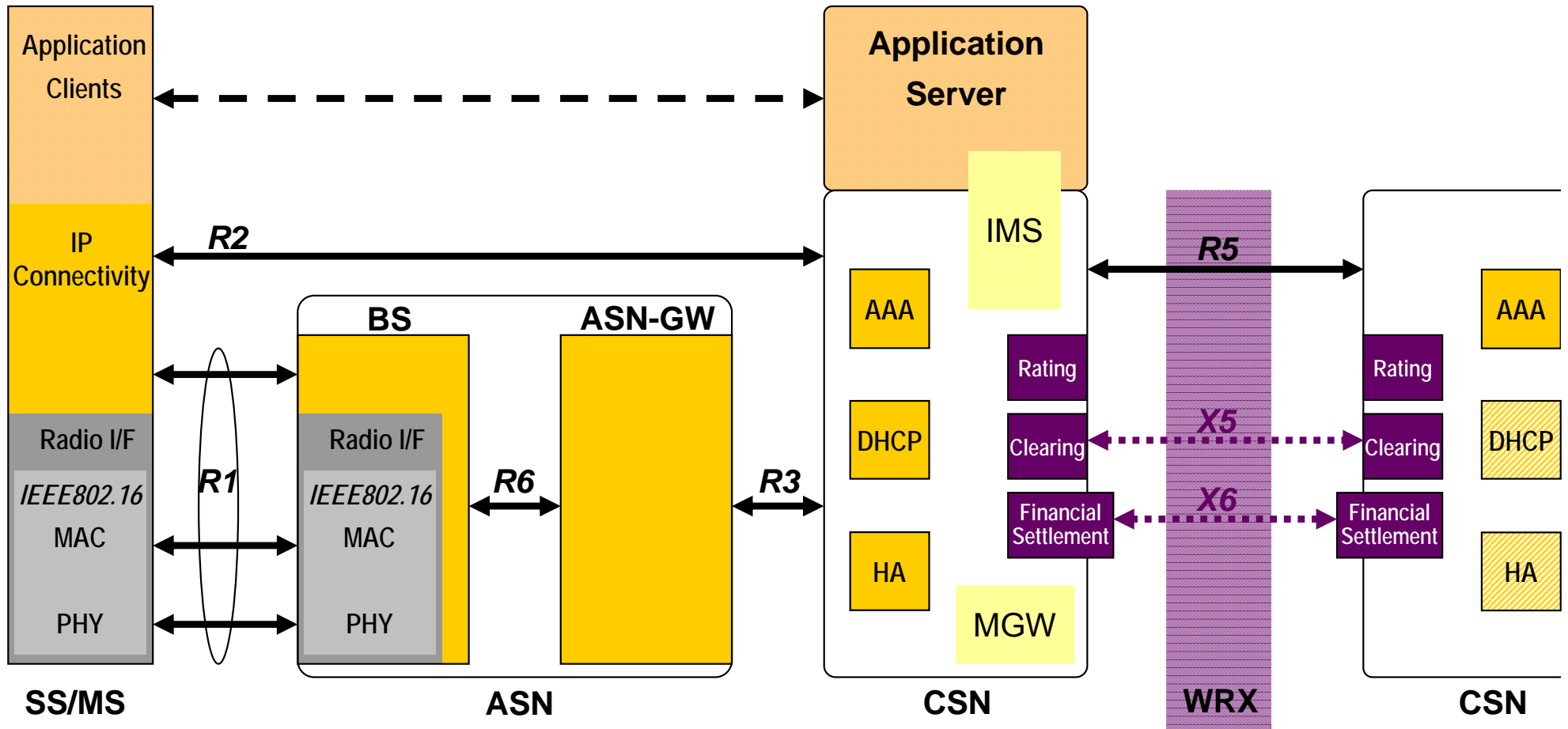
- Metropolitan

- Global roaming



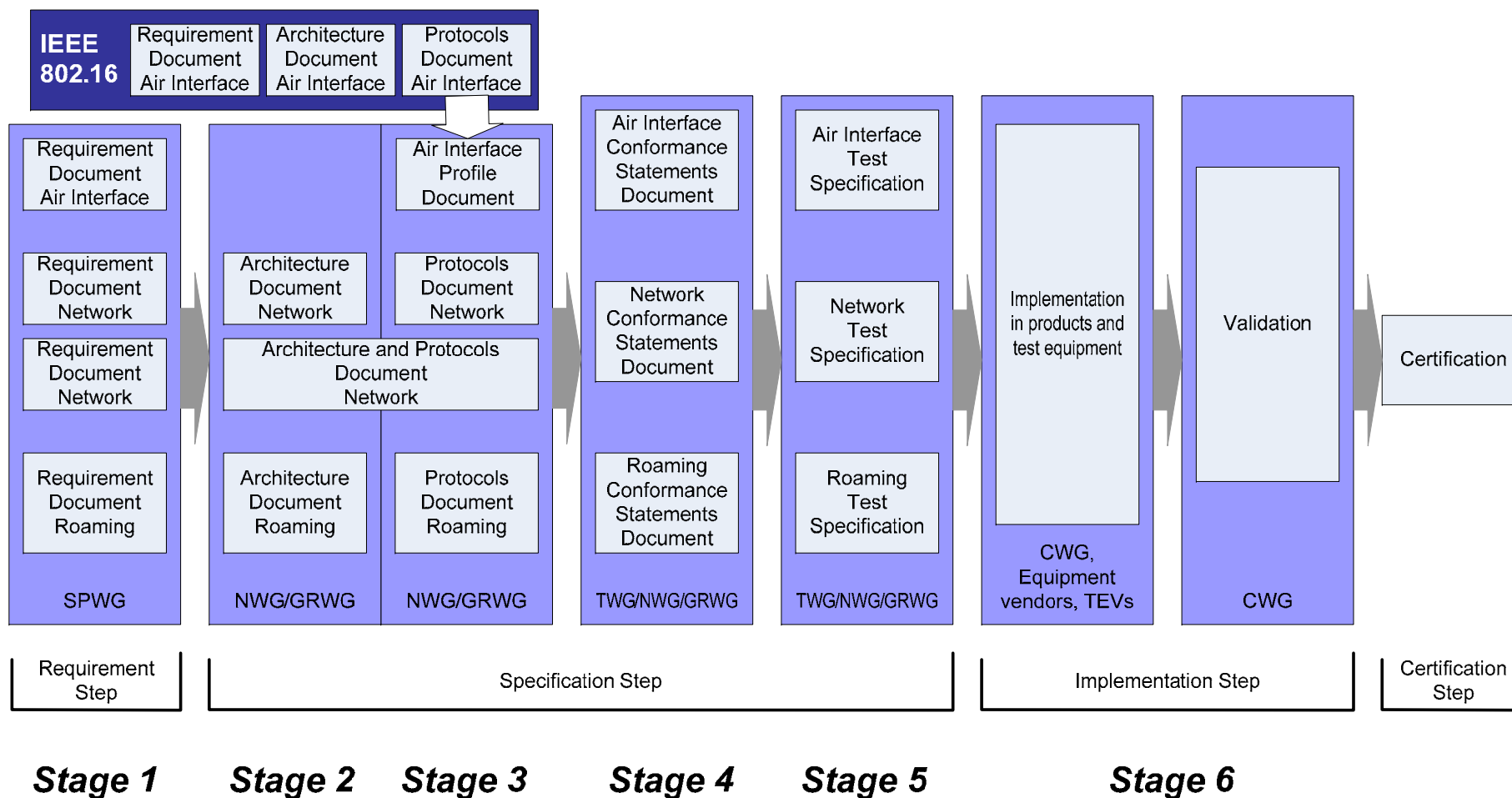
***The MobileWiMAX
Standards Suite***

Mobile WiMAX Architecture Framework



Main WiMAX Standardization Areas: Radio – Network – Roaming

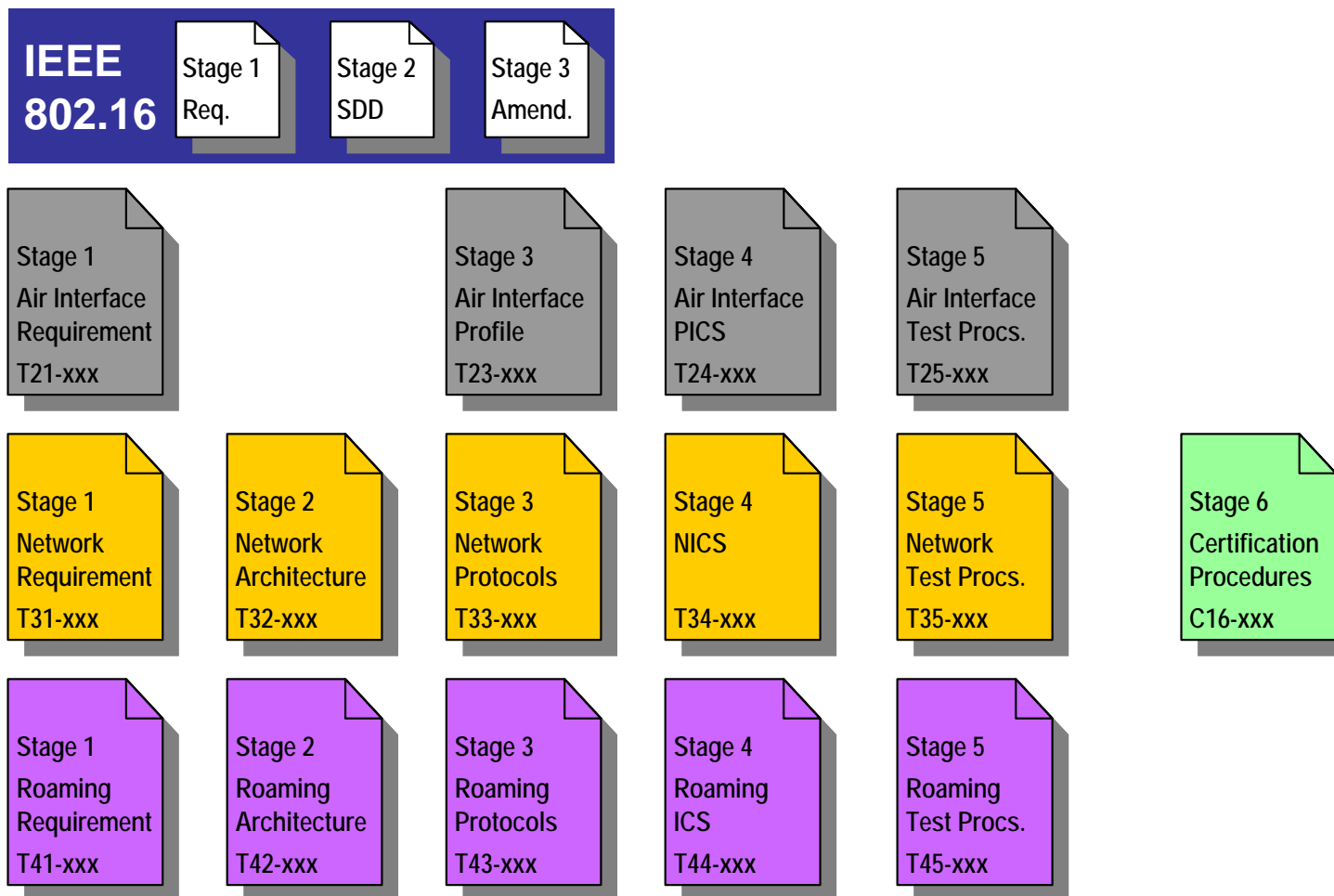
WiMAX Standards Development



WiMAX Forum Standardization extended the legacy 3-stage process to 6 stages to establish certified interoperability in Mobile WiMAX.



The WiMAX Standards Suite



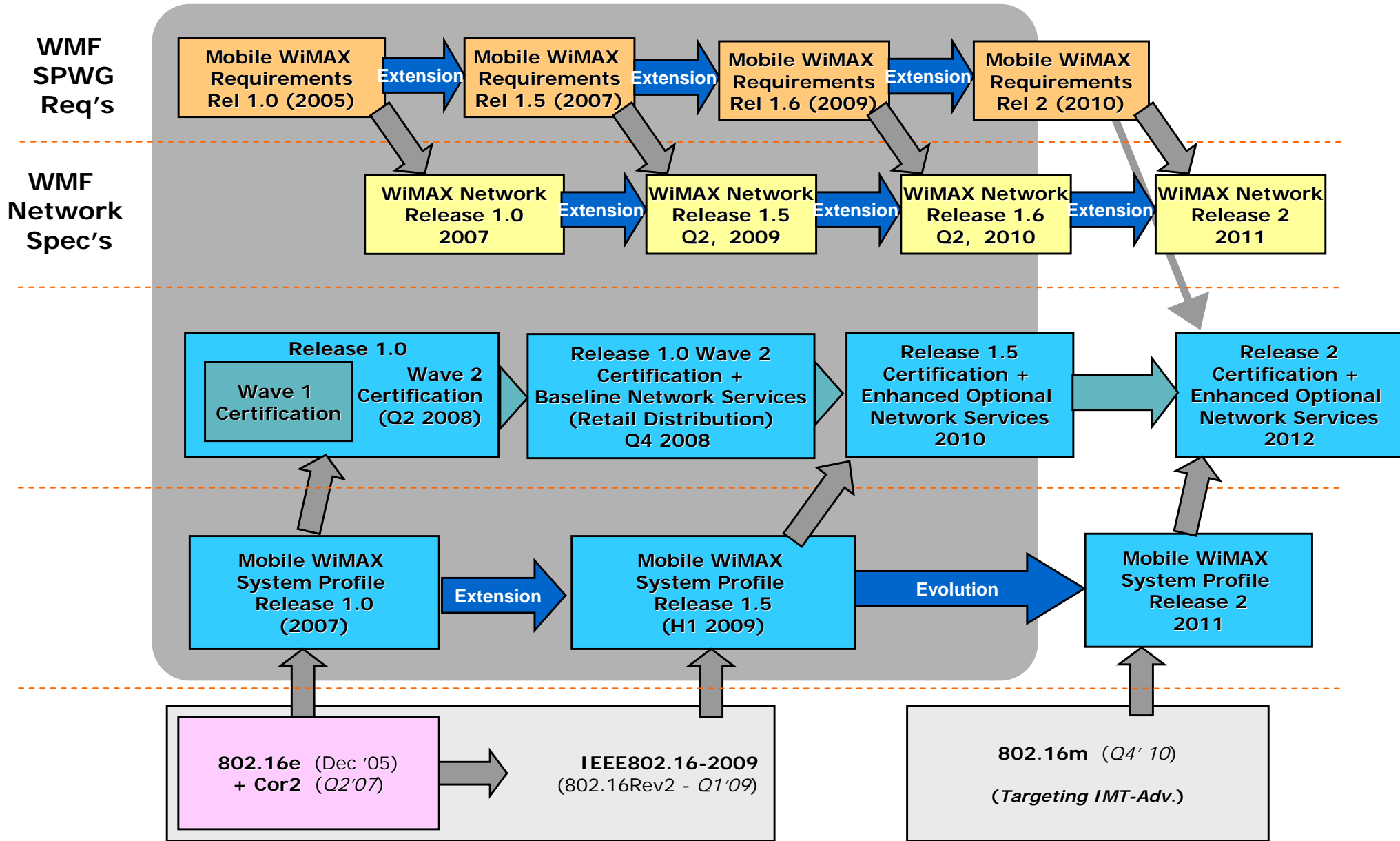
WiMAX Forum introduces common document identification format, e.g.

- WMF-T33-001-R015v01_Network-Stage3-Base.pdf
- WMF-T42-001-R010v02_WRI-Stage-2-Overview.pdf



***Mobile WiMAX
Roadmap and
Releases***

Overview of WiMAX Releases



Mobile WiMAX Radio Releases

Release 1.0

Underlying Radio Standard
IEEE802.16e-2005

Key Technology Attributes

- Channel BW up to 10MHz
- Focus on TDD
- MIMO
- All IP end to end network
- QoS Support
- *Projected Peak Performance:*
 - up to 40Mbps DL

Applications

- VoIP
-

Timeline

- 1st Mobile WiMAX Release 1.0 Certified Equipment in 2008

Release 1.5

Underlying Radio Standard
IEEE802.16-2009

Key Enhancements

- Additional Spectrum Bands
- (H)FDD Profile
- MIMO with AMC
- Persistent scheduling for VoIP
- Load balancing
- *Projected Peak Performance:*
 - up to 140Mbps DL

Applications

- Higher VoIP Capacity
- Support for emergency services E-911 & LBS
- Dynamic QoS Provisioning
- Multicast and Broadcast Services

Timeline

- Release 1.5 System Profile approval expected 1H2009
- First certified products in 2010

Release 2

Underlying Radio Standard
IEEE802.16m

Target Enhancements

- Aimed for IMT-Advanced
- Backwards Compatible with Release 1.5 & 1.0
- Wider Band Channels (TDD & FDD in 5,10, 20MHz)
- Higher Data Rates
 - peak up to 300Mbps
- Higher Spectrum Efficiency
- Lower Latency

Applications

- Higher throughput
- Higher VoIP capacity

Timeline

- First certified products expected in 2012

Mobile WiMAX Network Releases

Release 1.0

Release date: March 2007

- Radio: *Mobile Profile 1.0*

Features

- Mobile and stationary base specification
- ASN anchored mobility
- CSN anchored mobility (CMIP, PMIP)
- IPv4 & optional IPv6 connectivity
- Pre-provisioned/static QoS,
- Idle mode and paging
- Network discovery/selection
- Optional RRM
- EAP-based authentication
- Pre- and Post-paid RADIUS accounting
- Roaming (RADIUS only)
- 3 ASN profiles
- DSL, 3GPP and 3GPP2 Interworking

NWIoT Release: March '09

- Release 1.0 (NCT/IIOT)

Release 1.5

Release date: Aug '09

- Radio: *Mobile Profile 1.0/1.5*

Additional features

- Network architecture w/o MIP ('Simple IP', 'Simple ETH')
- IMS and PCC
- Emergency services and lawful intercept for VoIP over WiMAX
- RoHC support
- OTA pre-provisioning and device management
- Location based services
- Diameter based AAA
- Dynamic QoS w/o PCC
- Ethernet services
- Fixed/Nomadic Access
- WiMAX SIM
- Proxy MIPv6
- Universal Services Interface
- Multicast/Broadcast Services
- Single ASN profile
- Pre-Rel 8 and Rel 8 EPC IWK
- Enhancements to 3GPP2 and DSL IWK

NWIoT Release: t.b.d.

- Release 1.5 (NCT/IIOT)

Release 1.6

Release date: Target Q2 '10

- Radio: *Mobile Profile 1.5*

Additional features

- IPv4/IPv6 Transition
- WiMAX-WiFi IWK
- Femto-cell support
- SON for Femto cells
- DRMD
- OTA Evolution
- Arch Enhancements, e.g.
 - R6 Flex
 - Inter NAP HO
 - R4 relocations
 - Options clean-up

NWIoT

- Third-gen. NWIoT framework

Release 2

Release date: t.b.d.

- Radio: *Mobile Profile 2*

Additional features t.b.d.

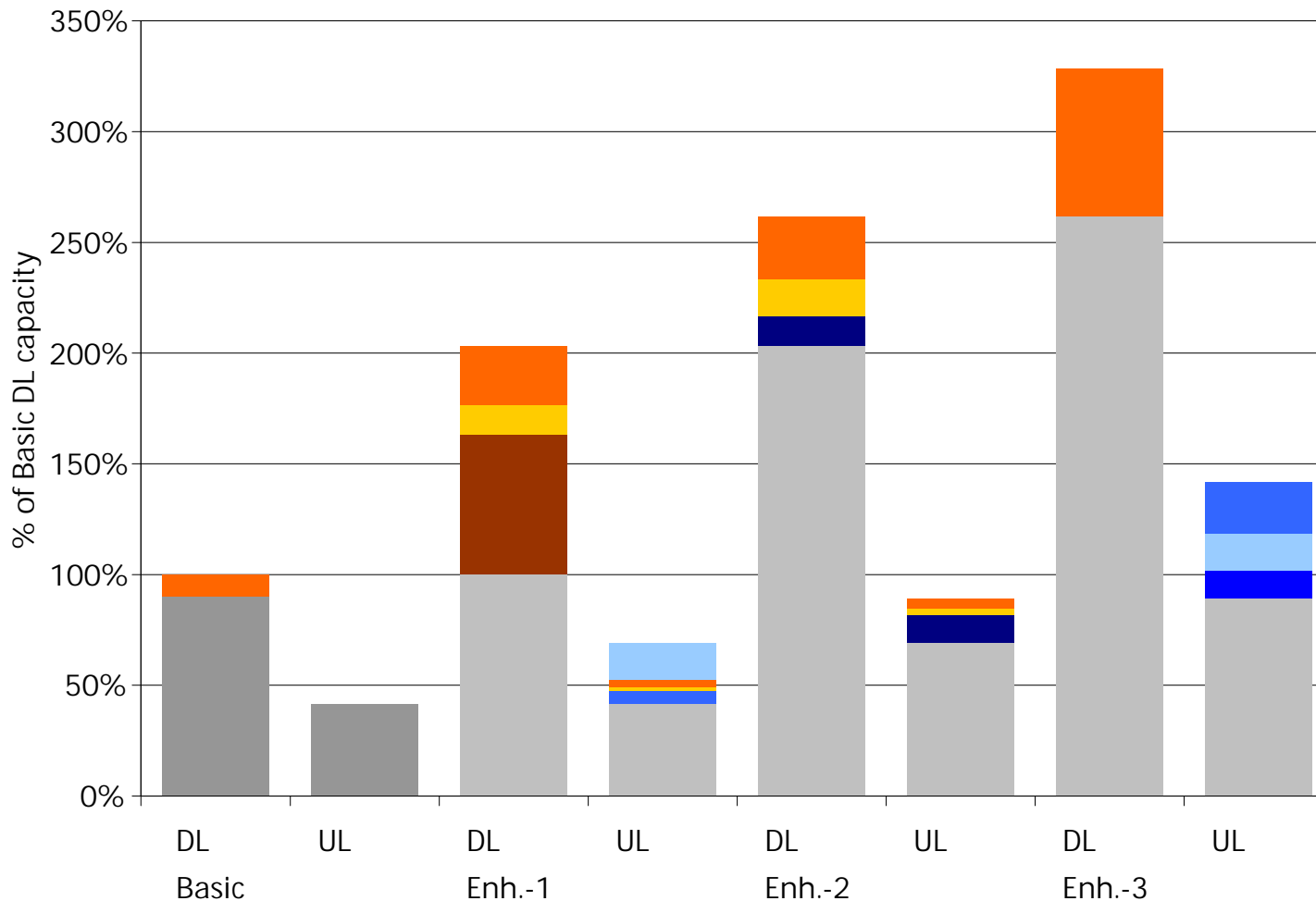
e.g.

- *Multimedia Session Continuity*
- *Roaming Enhancements*
- *Network Management*
- *Emergency Services Support*
- *Support for Relays*

NWIoT

- Fourth-generation. NWIoT

Mobile WiMAX Performance Enhancements



- Basic**
 - Compressed MAP
 - Baseline DL (SISO)
 - Baseline UL (MRC)
- Enhancements-1**
 - Proportional fair scheduling
 - RoHC
 - MIMO-B 2*2
 - 4 RX RF
 - IRC-1
 - Previous release
- Enhancements-2**
 - RRM improvements
 - Persistent scheduling for VoIP
 - AMC 2*3 with FSS
 - Previous release
- Enhancements-3**
 - DL Beam forming MIMO
 - UL MIMO
 - UL 64-QAM
 - IRC-2
 - Previous release

Disclaimer: Relative sector throughput as represented in this slide is based on theoretical simulations and subject to continuous research and development.
Actual capacity gains of individual features are dependent on usage patterns and will vary between operators.





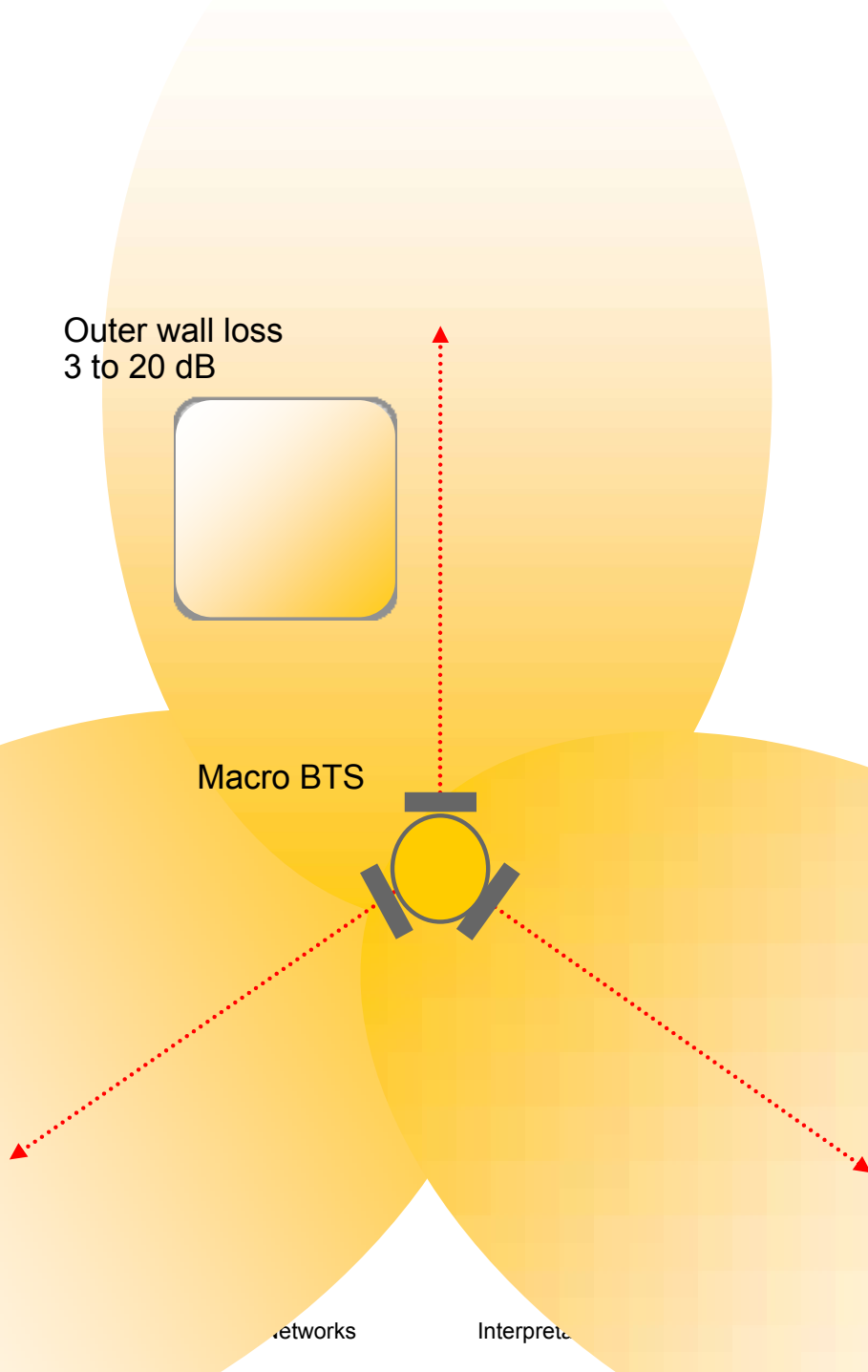
*Providing Coverage
with WiMAX*

WiMAX coverage solution comparison

	Macro BTS	Pico BTS	Femto Access Point (FAP)	Wi-Fi Access Point	Relay station (RS)
Overview	<i>Dense enough macro network to penetrate buildings.</i>	<i>Gap filler in shopping malls etc. Also outdoor shadow coverage and hotspots.</i>	<i>Subscriber installed WiMAX access point for home coverage.</i>	<i>Subscriber installed Wi-Fi access point for home coverage.</i>	<i>Concentrate existing WiMAX capacity and coverage to areas of high usage.</i>
Ownership and operations	Always operator owned and managed.		Operator manages automated setup and SW updates. Subscriber owns the FAP and can control access list.	Both managed and unmanaged Wi-Fi versions exist.	RS always operator owned and managed.
Backhaul transport	Typically fixed wireline transport, or microwave radios. DSL or Cable modem also possible.		DSL or Cable modem		RS with inband transport.
Network planning	Radio network plan needed. Indoor Pico typically not planned but often has dedicated carrier.		No planning, adhoc deployment by the subscribers. Licensed band but separate from macro.	No planning, adhoc deployment by the subscribers. Unlicensed frequency band.	RS planning like in Pico or macro.
Sites	Rooftop and tower sites typically shared	Wall mounted	Subscriber homes		RS like Pico or macro.



Macro BTS



Indoor coverage by dense macro network

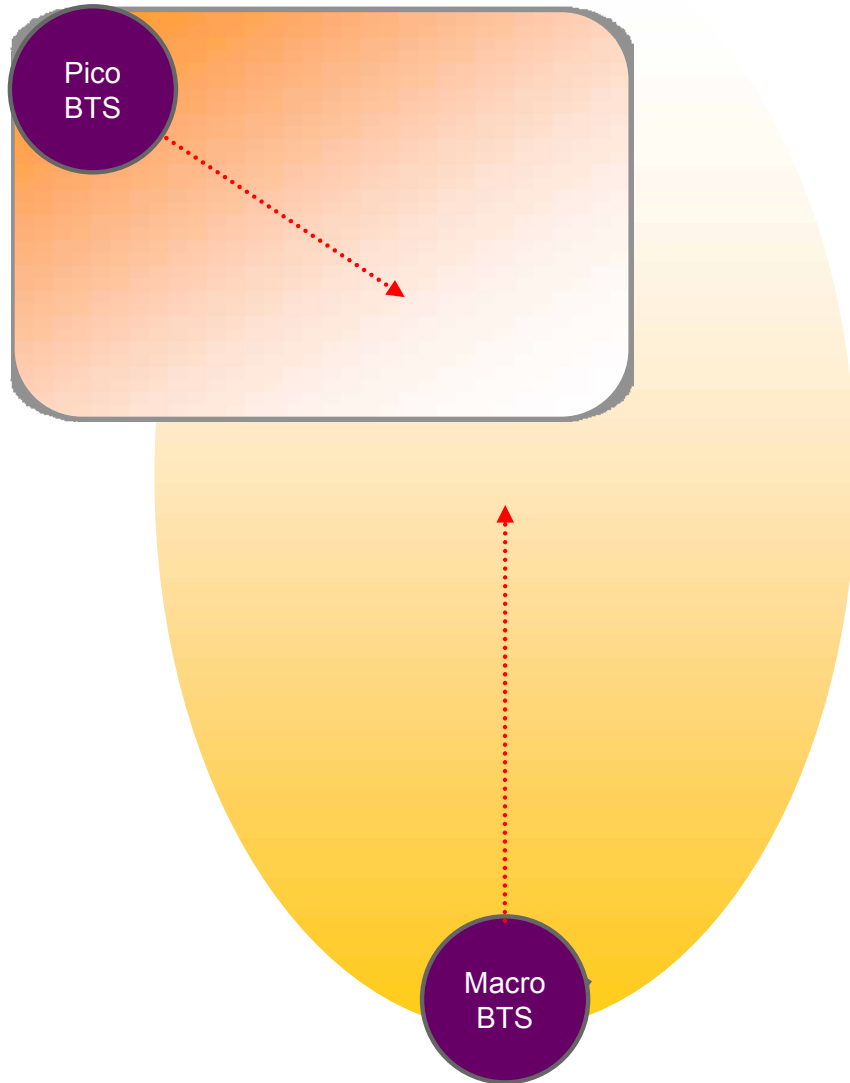
Pros

- Use existing macro network also for indoor coverage
- No need to specialize for the indoor case
- Contiguous coverage layer with full mobility

Cons

- Deep indoor coverage limited
- Adjusting macro site density is often not feasible
- Most users near cell edge
 - Limits site capacity

Pico BTS



Large indoor spaces and outdoor gap filler

Pros

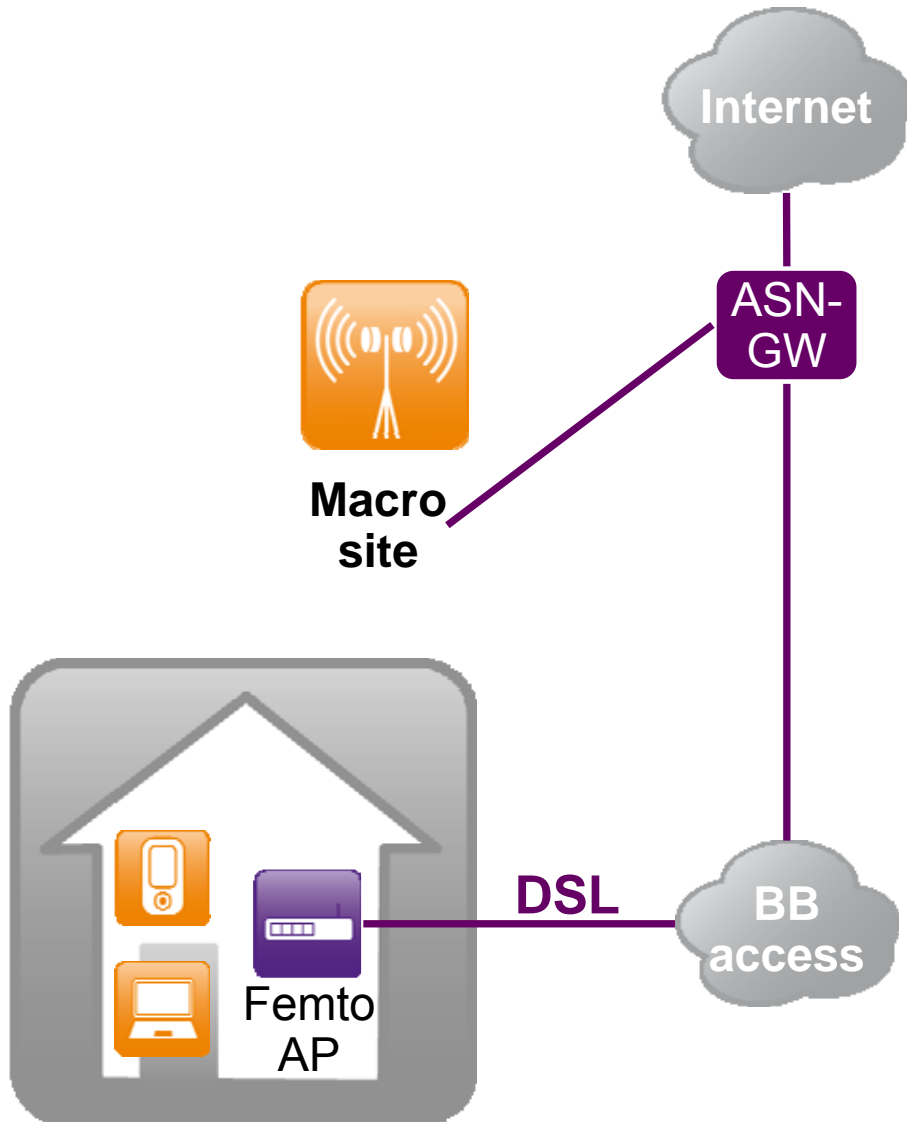
- All-in-one compact base station
- Fast installation and rollout
- Unobtrusive wall mounting
- Integrated GPS receiver for synchronization

Cons

- Weak GPS signal indoors
- Challenging indoor site security
- Large number of sites

Femto Access Point (FAP)

Subscriber installed WiMAX access point for home coverage



Pros

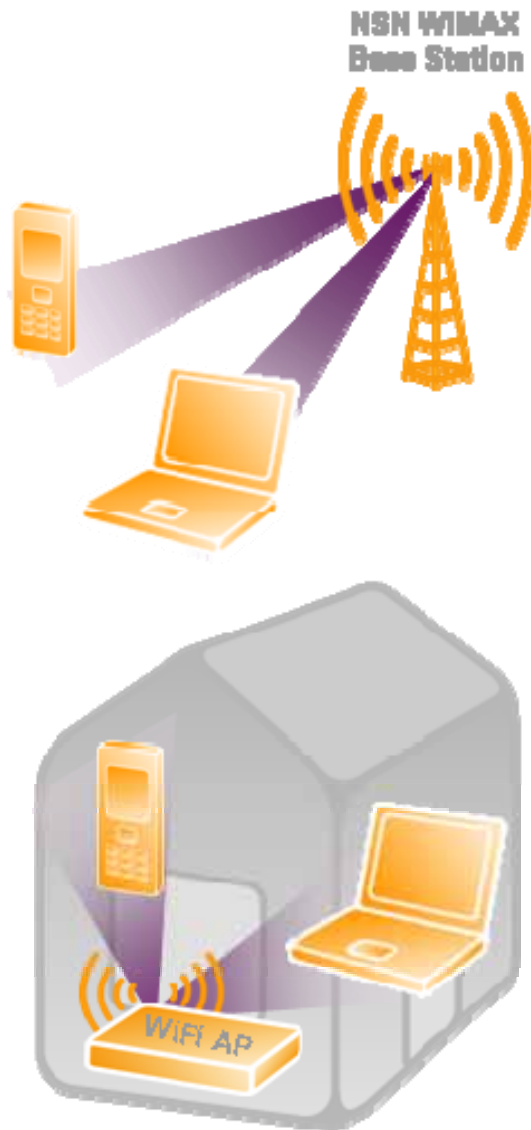
- Simple installation without planning and installation effort by operator
- Same terminal at home and outdoors
- Shared broadband Internet backhaul
- Offload subscribers from macro

Cons

- No control over the transport backhaul, site (home) or the FAP device
- RF interference
- Synchronization when deep indoor
- Managing huge number of sites
- Challenging handover to Femto from macro
- Standard not ready
- Need subscriber support and help desk

Wi-Fi Access Point

Existing Wi-Fi access point for indoor coverage



Pros

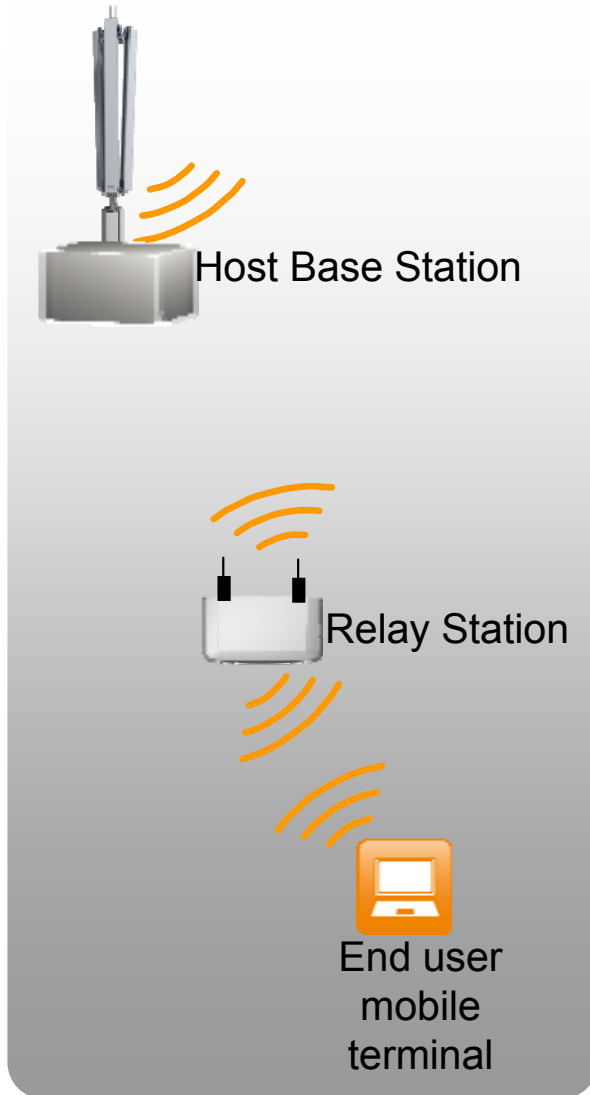
- Simple installation and operation without operator involvement
- Standard technology
- Leveraging installed base of access points and devices
- Leveraging existing broadband Internet backhaul
- No need for TDD synchronization

Cons

- Less mobility features than in 'plain' WiMAX coverage
- No control over the transport backhaul, site (home) or the Wi-Fi device
- QoS and security differs

Relay station (RS)

Leverage spare WiMAX Capacity to extend Coverage



Pros

- Inband transport obviates the need for wired backhaul
- Synchronization to upstream BTS obviates the need for GPS
- All standard WiMAX Forum mobility, QoS and security features supported
- Simple Installation

Cons

- Challenging indoor site security
- IEEE 802.16j relay station standards not yet adopted by WiMAX Forum
- Reduced WiMAX capacity for subscribers

WiMAX Coverage Solutions Summary

- Blanket macro coverage outdoors is the first step
- Several indoor solution alternatives
 - Extend macro cells to indoors
 - Add pico capacity to fill the gaps
 - Add femto capacity to fill the gaps
 - Use Wi-Fi in the homes and offices
 - Relay Stations – at the horizon

Keep in mind:

- Efficient transport and site solutions needed
 - Consider sharing / interworking with existing technologies
 - Consider capacity growth and standards in the network evolution



Conclusion

Conclusion

- Mobile WiMAX provides a rich set of options to fit all kind of deployments.
- Unique features, you wont find in other cellular radio technologies, e.g.:
 - NAP sharing
 - support for wholesale and network sharing
 - EAP based authentication
 - support for all kind of back-end user authentication
 - Simple IP network model
 - less complex network solution for nomadic access, upgradeable to full mobility
 - Ethernet Services support
 - easy to adopt to DSL networks
 - Certified network interfaces
 - plenty of interoperable products
 - Single radio WiFi/WiMAX solutions
 - less expensive terminal solutions

WiMAX is the best wireless solution for providing broadband Internet access.



Thank you!

Questions, Comments?