

# **Broadband Wireless Access Networks – Standardization Activities in ETSI and other Fora**

ECRR 2007

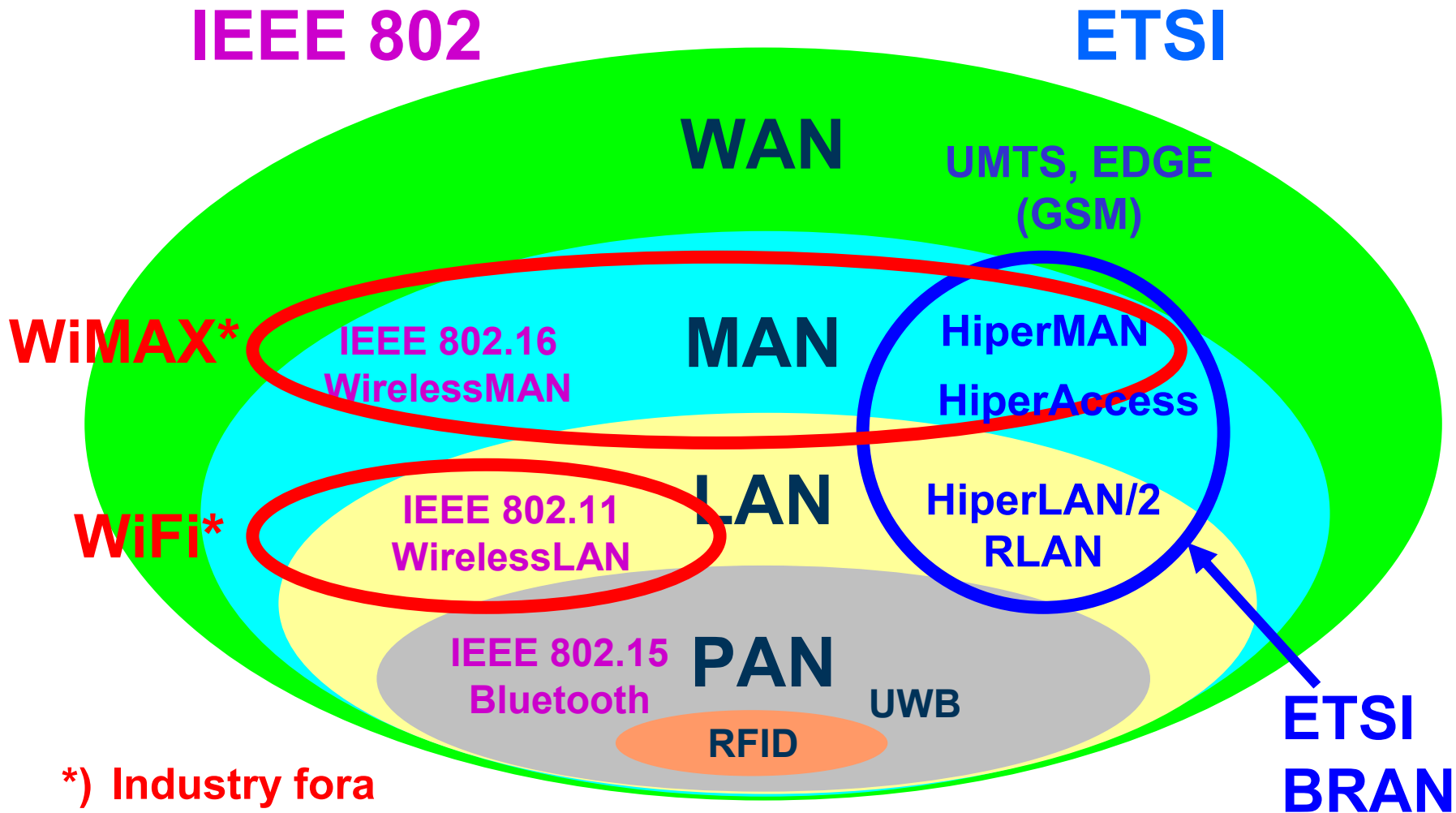
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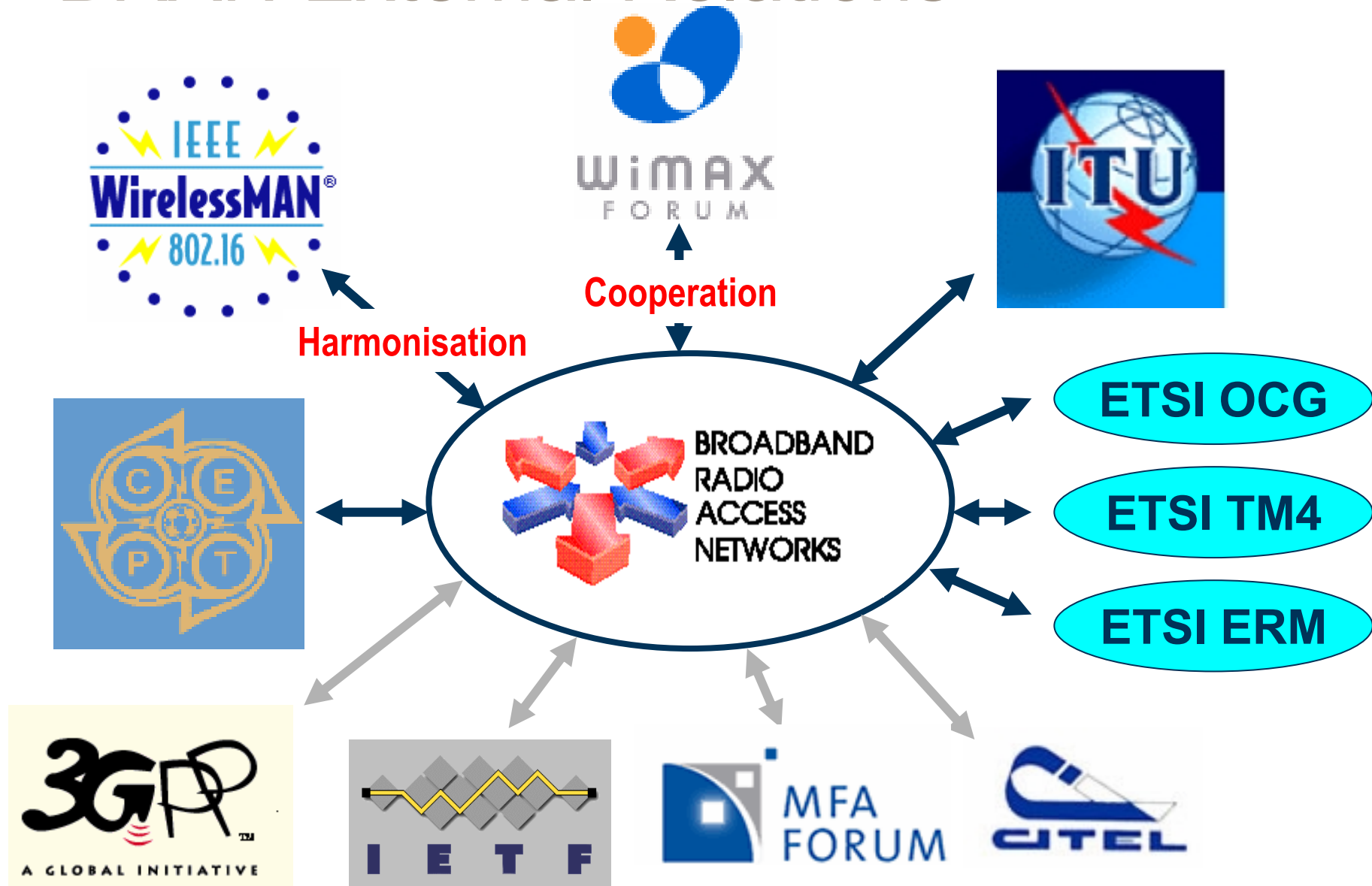
- Overview
  - ETSI BRAN (Broadband Radio Access Networks) structure
  - Global BWA (Broadband Wireless Access) standards
  
- BRAN Interoperable Standards
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- BRAN Regulatory Activities
  
- BRAN Testing
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  - Co-operation with WiMAX Forum
  
- Software Defined Radio

# Global Wireless Standards

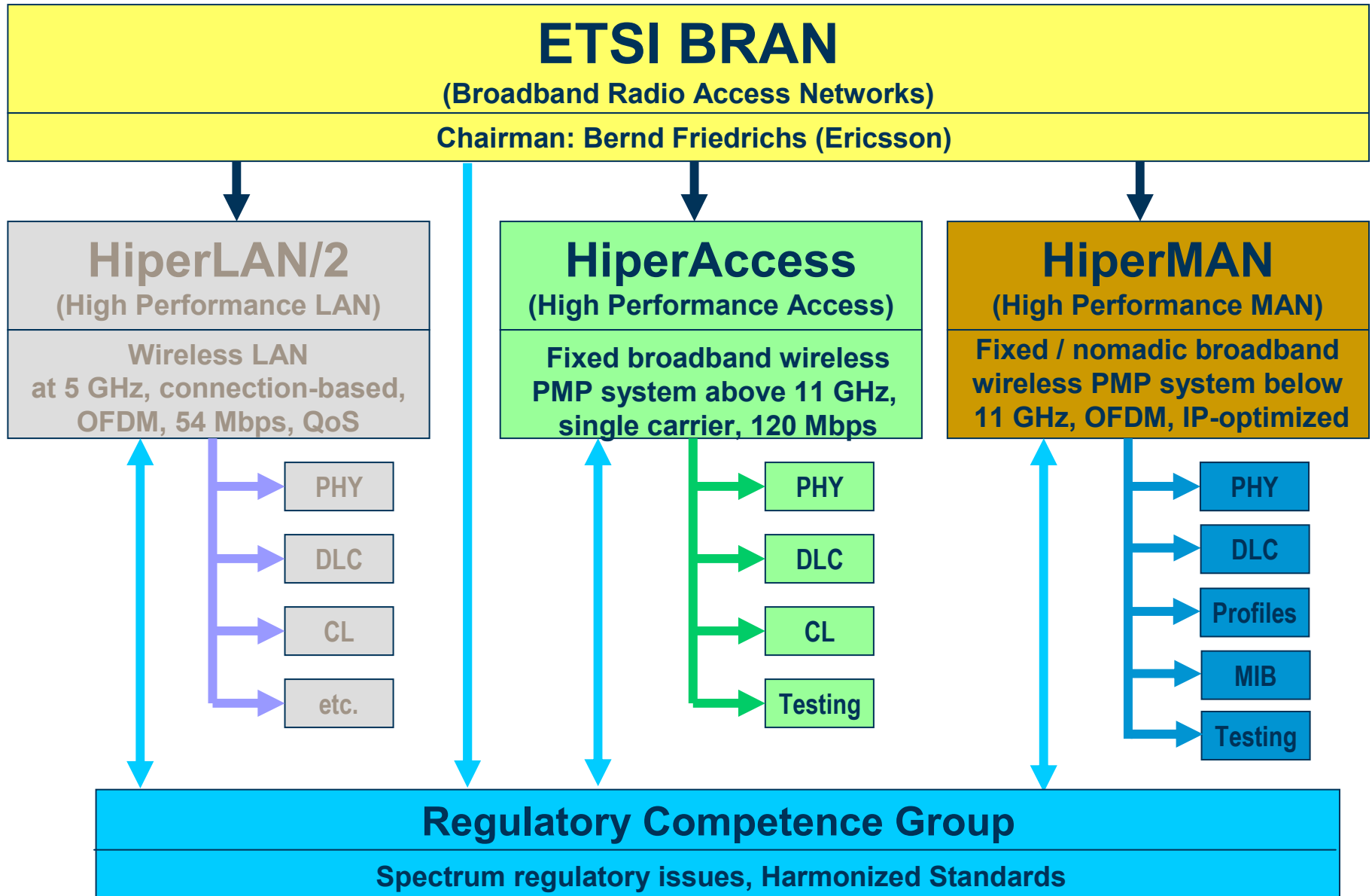


\*) Industry fora for promotion and certification

# BRAN External Relations



# ETSI BRAN Structure



# TC BRAN – Overview (1 of 3)

## Interoperable Systems

- Interoperable systems for Broadband Wireless Access (BWA)
  - HiperAccess (for cellular and hotspot backhauling)
  - HiperMAN (fixed/nomadic wireless-DSL like system, also for rural areas)
  - „Interoperability“: to ensure communication between devices from different vendors
- Major improvements compared to traditional systems due to
  - adaptive operation
  - packed-based transmission over the air interface
  - cross-layer optimization
- ETSI Specifications
  - Base specifications (PHY layer, DLC layer, management)
  - Test specifications (radio and protocol conformance)
  - First publications in 2002 (HA) and 2004 (HM)
- International cooperation

# HiperAccess – General Overview

- Fixed BWA system (FWA)
  - Point-to-Multipoint (PMP) architecture
  - High speed (134.4 Mbit/s gross rate @ 28 MHz channels) and high QoS
  - Optimized for frequencies >11 GHz like 26, 28, 32, 38 GHz under Line-of-Sight (LOS) conditions
  - Range up to 12 km
  - Single-carrier transmission
  - Optimized for packet- and cell-based core networks
- Main applications
  - Cellular (2G, 3G) and hot-spot (WiFi, WiMAX) backhauling
  - SOHO, SME
  - Typically too expensive for residential access / WLL / LMDS
- Products
  - Ericsson's MINI-LINK AXR is based on ETSI HiperAccess

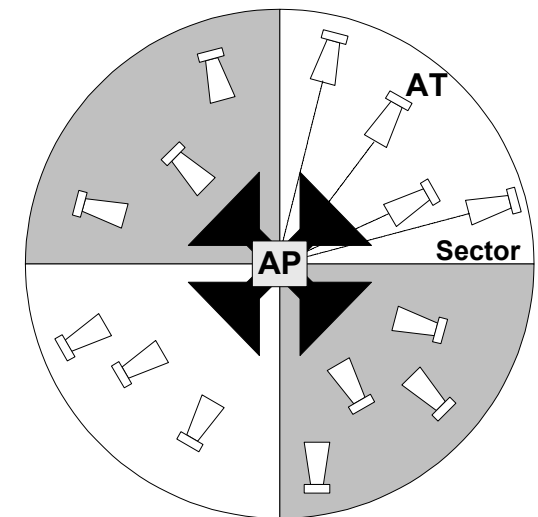
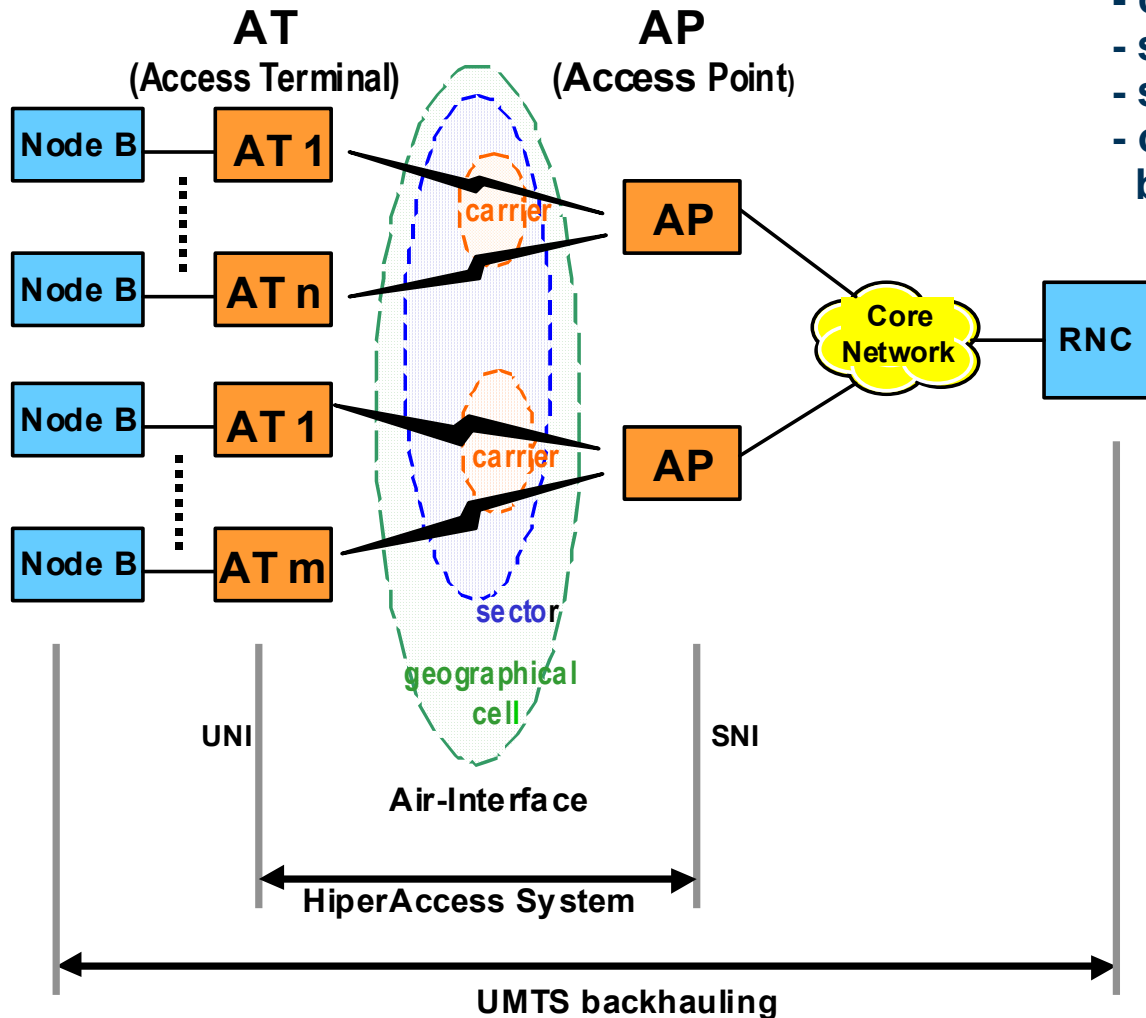
# HiperMAN – General Overview

- **Fixed / Nomadic / (Mobile) BWA system**
  - HiperMAN 1.2.1 - for fixed (FWA) and nomadic (NWA) use
  - HiperMAN 1.3.1 - for mobile applications
  - PMP (or meshed) architecture
  - Optimized for frequency bands below 11 GHz without LOS, robust against multipath propagation
  - both TDD and FDD duplexing
  - SOFDMA transmission
    - S = selectable (according to carrier width)
    - A = sub-channelization (+12 dB), allows for high cell radius
  - Support for adaptive antennas, space time coding, turbo codes
  
- **Relations to...**
  - IEEE: HiperMAN is fully harmonized to a subset of IEEE 802.16-2004 and IEEE 802.16e-2005, networking is excluded
  - WiMAX Forum: Joint development of test specifications used for certification

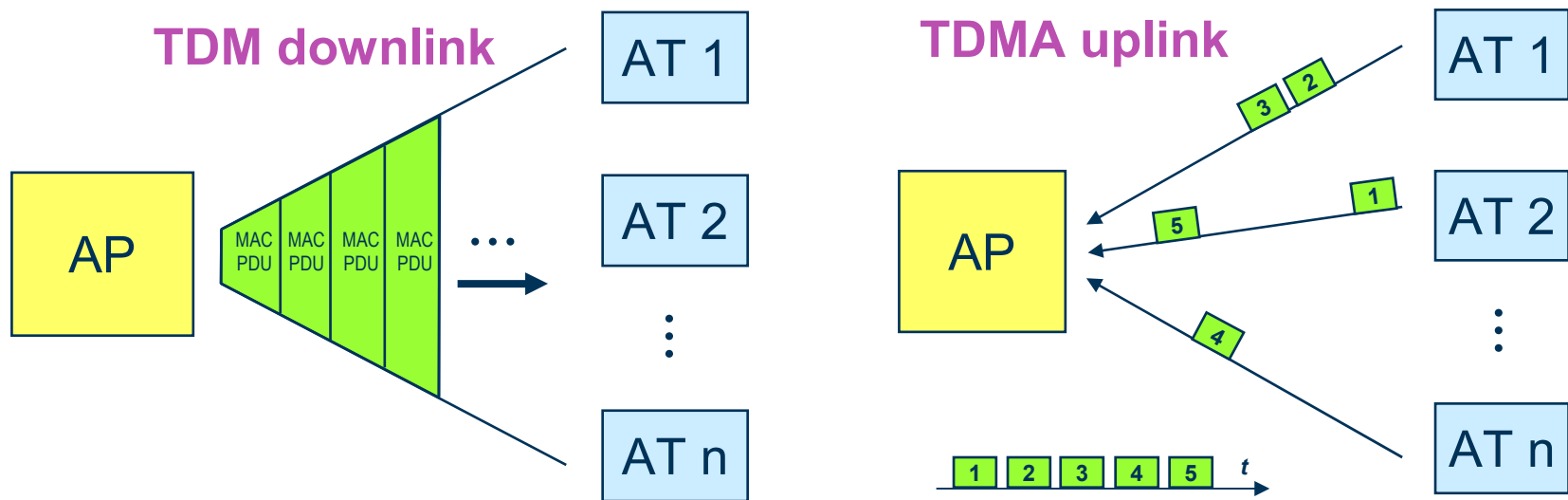


# PMP System for Cellular Backhauling

- one AP per carrier
- one AP per cell
- several sectors per cell
- several carriers per sector
- overlapping cells (separated by frequency or polarization)



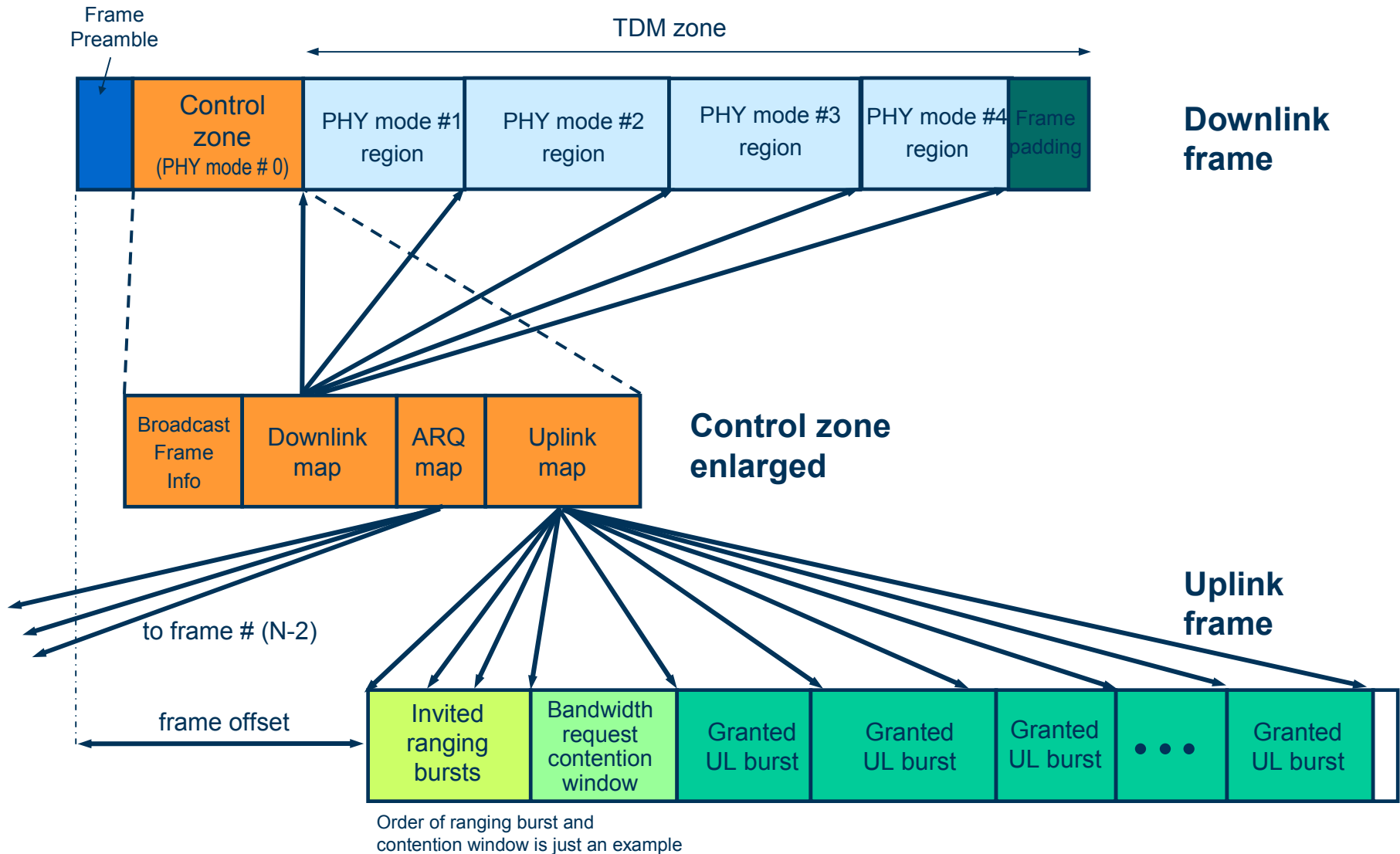
# Downlink and Uplink in a PMP System



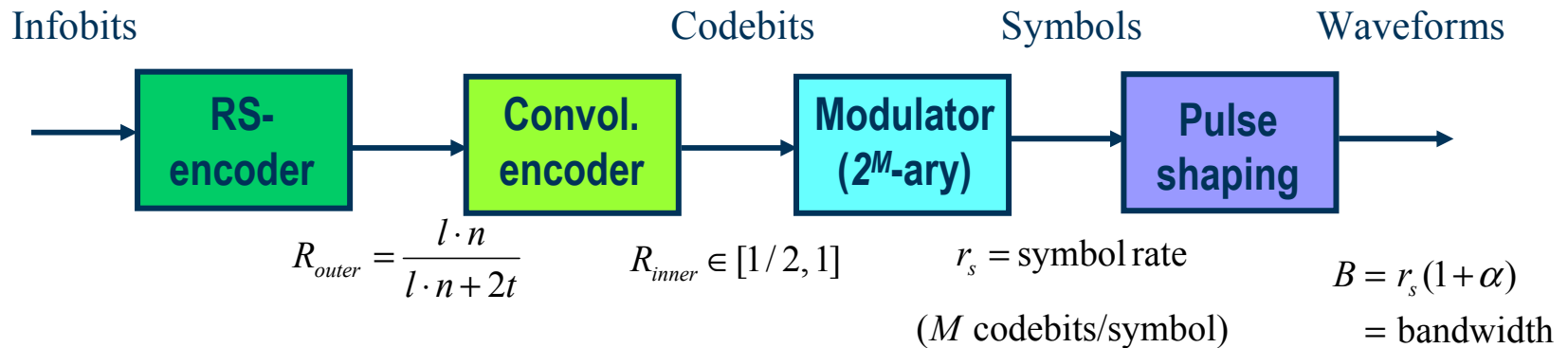
## Further important properties of downlink and uplink (HA)

	Downlink	Uplink
Link budget & rain fading & multipath propagation	approx. identical	
Co-channel interference	time-invariant from other APs	time-variant from other ATs
Transmit power (same bandwidth)	constant for all ATs	individual per AT (distance, modulation, fading) for constant RX power

# Frame Structure Overview for FDD



# Robustness vs. Efficiency



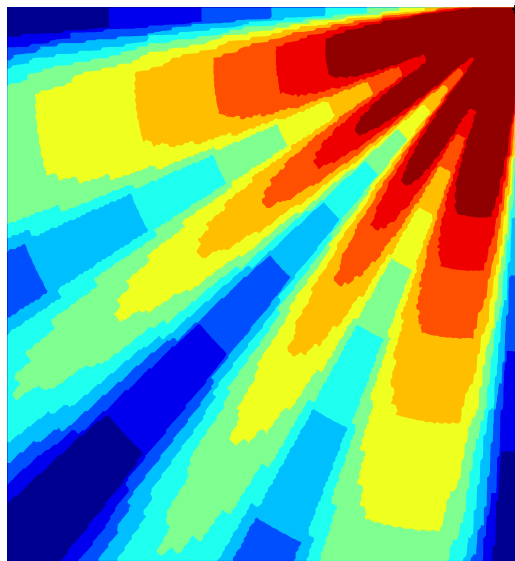
**PHY mode = combination of concatenated coding and modulation**

PHY Mode	$R_{outer}$ (for $l=4$ )	$R_{inner}$	$M$	Spectral efficiency	$C/(N+I)_{required}$
0 (CZ)	0.65	1/2	2	0.52	7 dB
1 (all sets)	0.93	2/3	2	0.99	8 dB
2 (all sets)	0.93	1	2	1.49	12 dB
3 (set 1)	0.93	7/8	4	2.60	18 dB
4 (set 1)	0.93	5/6	6	3.72	24 dB
3 (set 2)	0.93	1	4	2.98	20 dB
4 (set 2)	0.93	1	6	4.46	26 dB

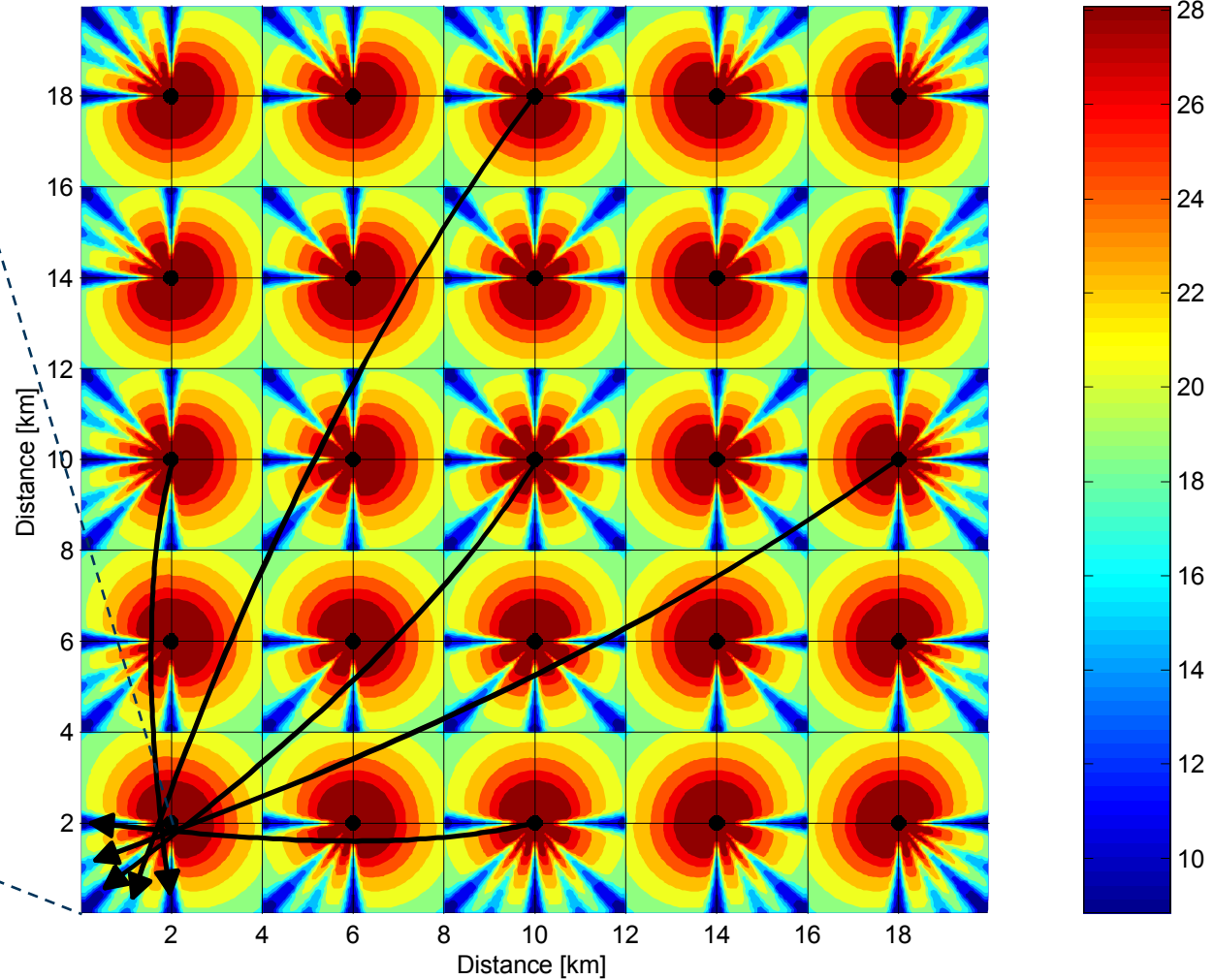
# Interference Pattern

$C/(N+I)$  shown for 5x5 Rectangular Constellation, Downlink, ClearSky, ReUseFactor=4

$C/(N+I)$  pattern @ BS distance = 4 km; TX power = 21.5 dBm; rainfading = 0 dB/km



worst sector enlarged



# Summary of Adaptive Operation

- Adaptation of transmission scheme according to
  - $d$  = distance
  - $I$  = interference (slow in DL, fast in UL)
  - $N$  = noise (representing link budget  $C/N$ )
  - $L_{rain}$  = rain fading (fast, 20 dB/s)
- Mechanisms
  - PHY mode change per terminal
  - PHY mode change per frame
  - combined with ATPC (Adaptive Transmit Power Control)
- Control loop
  - decided centrally by AP
  - based on measurement reports from AT and received signal in AP
  - commanded as announcement in DL map and granted per UL map
- Adaptive changes of throughput are supported by adaptive operation of scheduling mechanisms.

# TC BRAN – Overview (2 of 3)

## Regulatory Activities

- **Regulatory competence working group (RCWG)**
  - Coordination of all spectrum related and regulatory issues
  - Assistance to regulatory bodies to define spectrum requirements and radio conformance specs for new broadband radio networks
- **Deliverables**
  - Development of Harmonised Standards covering essential requirements under article 3.2 of the R&TTE directive (HEN)
  - System Reference Documents (SRDoc)
- **Current Activities**
  - EN 302 544 HEN for 2.6 GHz Personal Broadband
  - TR 102 453 SRDoc for converged fixed-nomadic (-mobile) BWA (< / > 3.4 GHz, input to ECC aiming at more spectrum)
  - EN 301 893 HEN for 5 GHz RLAN (Pioneering work on DFS)
  - EN 302 502 HEN for 5.8 GHz FWA (Pioneering work on DFS)
  - TR 102 555 SRDoc for 60 GHz WPAN
  - EN 302 567 HEN for 60 GHz WPAN

# Harmonized Standards Basics

- ETSI is mandated by EC to prepare HENs under the R&TTE Directive.
  - The HEN from ETSI provides access to the European market for compliant product on a legal basis when the HEN is listed in the OJEC.
  - The legal basis for placing product on the market is not provided by the administrations (CEPT), however, the use of radio product and any licence conditions is the responsibility of the administrations.
- CEPT ECC and ETSI agree under their MoU on a mechanism for cooperation to take account of each others' requirements
  - Technical parameters which are relevant both to spectrum use and to avoidance of harmful interference are developed by co-operation.
  - CEPT is responsible for the determination of the limits of the technical parameters (usually resulting from sharing and compatibility studies) and for any technical usage conditions that may be necessary for regulation.
  - ETSI is responsible for the technical parameters within its own deliverables and implementation in HENs.
  - In case of a fundamental disagreement between ETSI and some CEPT administrations, the HEN has priority over any National regulation (administrations are not entitled to add further technical regulations).
  - If an administration still has a problem with the HEN then it will need to take their concerns to TCAM.
- ETSI has entire responsibility for its HEN (including masks), CEPT has entire responsibility for its regulations (may include requirements related to spectrum).



# EN 302 555 (1 of 2)

## ■ EN 302 544 – Scope

- Broadband Data Transmitting System equipment operating in the frequency range 2500-2690 MHz
- Technology-neutral
- ... obviously the technology to be addressed is mobile WiMAX based on IEEE 802.16e-2005 and ETSI BRAN HiperMAN1.3.1.

## ■ ECC Decision (05)05:

- The band is designated for terrestrial IMT-2000/UMTS systems.
- There is flexibility to allow other systems to be deployed on a national basis in European countries subject to market demand as long as these systems comply with harmonized standards.
- Note: there is a trend towards more flexibility (EC, WAPECS)

## ■ Lack of consensus

- Work on the HEN was started in April 2006 although several ETSI members expressed concerns.
- No agreement on compatibility studies achieved

# EN 302 555 (2 of 2)

- **Some ETSI members are concerned about compatibility:**
  - In order to avoid harmful interference and to sufficiently protect IMT-2000 systems, **compatibility studies** are considered necessary (e.g. to be done in ECC PT1) to derive meaningful parameters like
    - Transmit power, masks, bandwidths, power control mechanisms
    - Deployment scenarios (fixed / nomadic / mobile, antennas)
    - Duplexing (FDD / TDD)
  - HEN should be preceded by a SRDoc according to normal practice as outlined in ETSI-ECC MoU.
  - Compatibility parameters belong to the essential requirements of the R&TTE Directive and are therefore to be harmonised in Europe and should not be a matter for national licensing.
  
- **Some counter-arguments:**
  - Compatibility studies are performed in ITU-R WP 8F
  - Compatibility needs to be assured by the licensing body (where no guidance by HENs is needed for administrations)
  - HEN is addressing Article 3.2 of the R&TTE relating to **placing products on the market**, whilst only Article 7.2 relates to **putting into service**.

Advise from ECC PT1: the downlink (base station) is under national regulation, so compatibility issues are restricted to the uplink (terminals).

# TC BRAN – Overview (3 of 3)

## Testing

- Coverage
  - Radio Conformance Testing
  - Protocol Conformance Testing
  - Network Interoperability Testing
- Relevance of Specifications
  - Normative part of standard
  - Controlled in the open forum in the same way as base specs
  - Actual testing and certification is left to industry and their associations
- Methods
  - Good results from using advanced spec methods and languages
- Organization
  - Work is progressed through STF (Special Task Force)
  - STF funded by ETSI, operating under the guidance of BRAN
  - Supported by ETSI PTCC
- Cooperation with Industry Forums (WiMAX)
  - Protocol conf. test specs for HiperMAN, co-funded by WiMAX Forum

# ETSI – WiMAX Coop Agreement

## ■ Status

- The initial version of the agreement was signed in April 2005
- New amendments covering work agreed for 2006 and 2007

## ■ ETSI and WiMAX

- confirmed their common interest to perform and promote standardization towards a global market
- co-operate for testing and certification, standards development and regulatory activities to provide the necessary spectrum

## ■ Role of WiMAX Forum

- full control of the certification scheme to assure interoperability

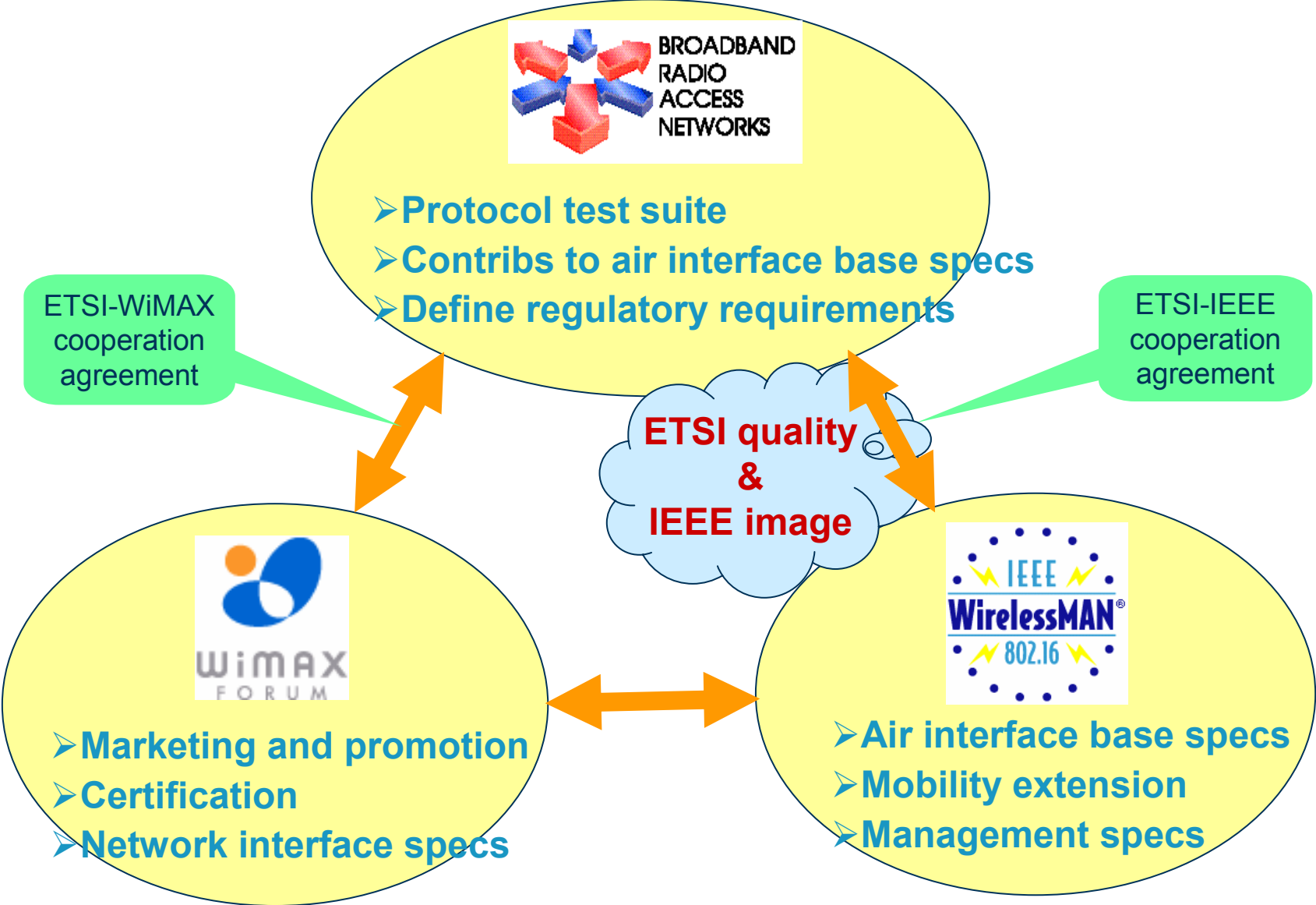
## ■ Role of ETSI

- develop protocol test specs (PICS, TSS&TP, ATS) used for certification
- contribute to validation together with test tool vendors and certification labs

## ■ Extension to Network Interoperability Testing

- currently under discussion
- e.g. by ETSI ISG or TC

# BWA – Summary of Main Competence



# SDR & CR

- CR (Cognitive Radio)
  - Some expect improved spectrum usage from CR
  - Others request clean spectrum (free of interference) in order to maximize throughput, at least for wide-area systems
  - Is interference-free spectrum sharing (for trading) acceptable?
- SDR (Software Defined Radio)
  - If restricted to an implementation of multistandard terminals, then there is no need for and benefit from standards
- E2R (End-toEnd Reconfigurability)
  - Selection of best access technology by the network
- ETSI Status
  - Recent seminar indicated lack of consensus
  - Study group to be established

# Conclusions

- **Wireless Broadband industry needs GLOBAL standards**
  - Range from spectrum conformance to interoperability
  - Drive costs down, use spectrum efficiently!!!
- **ETSI BRAN supports harmonization efforts with other parallel standardization bodies**
- **IEEE 802.16 - BRAN co-operation shows**
  - What can be achieved
  - How standard bodies can contribute to each other
- **WiMAX Forum - BRAN co-operation**
  - Important signal to the market
  - ETSI benefits from WiMAX marketing and certification
  - WiMAX Forum benefits from ETSI experience and work approach

# For further information...

More details can be found on

<http://portal.etsi.org/bran/summary.asp>

<http://portal.etsi.org/radio/>

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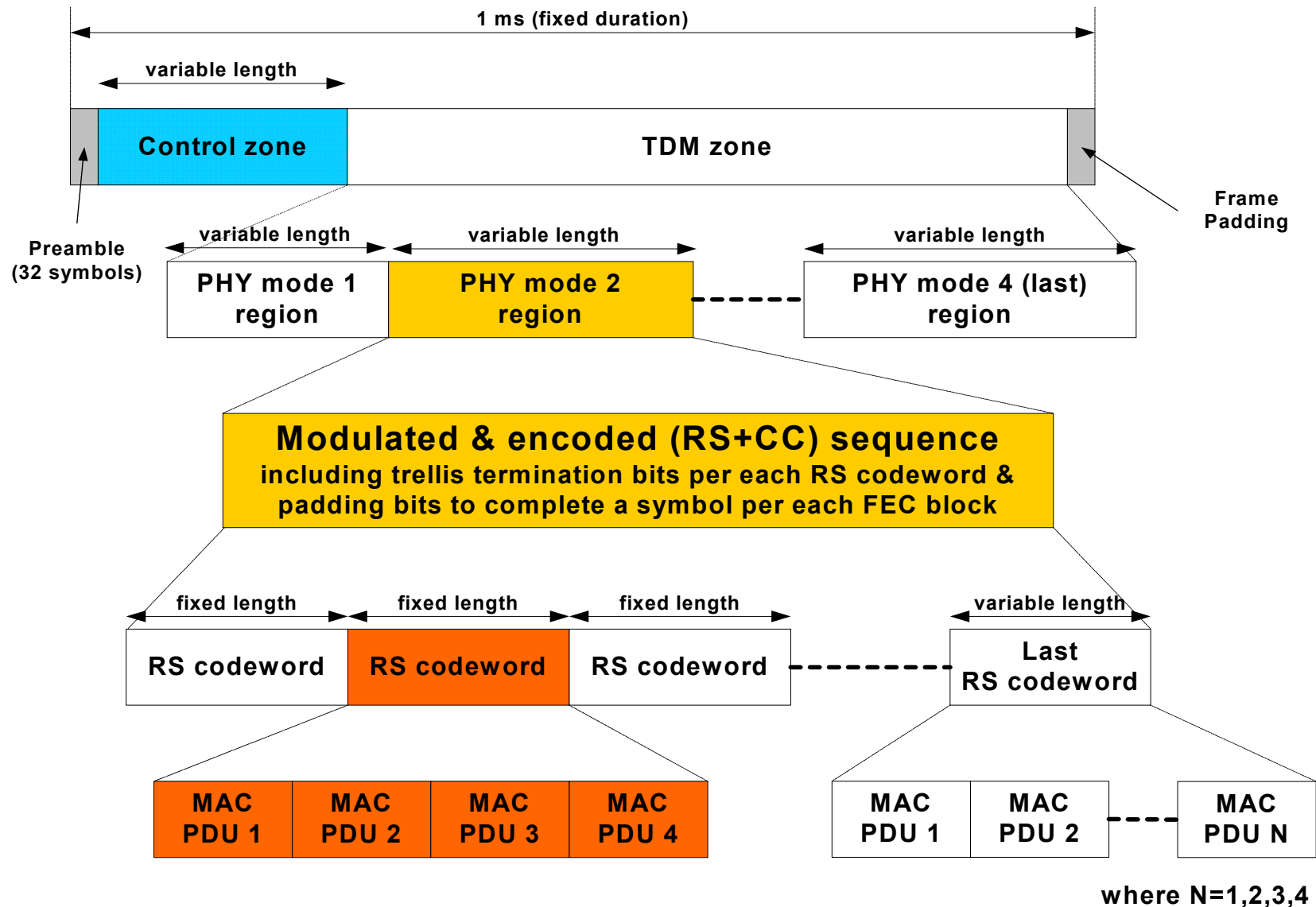
71522 Backnang, Germany



**ERICSSON** 

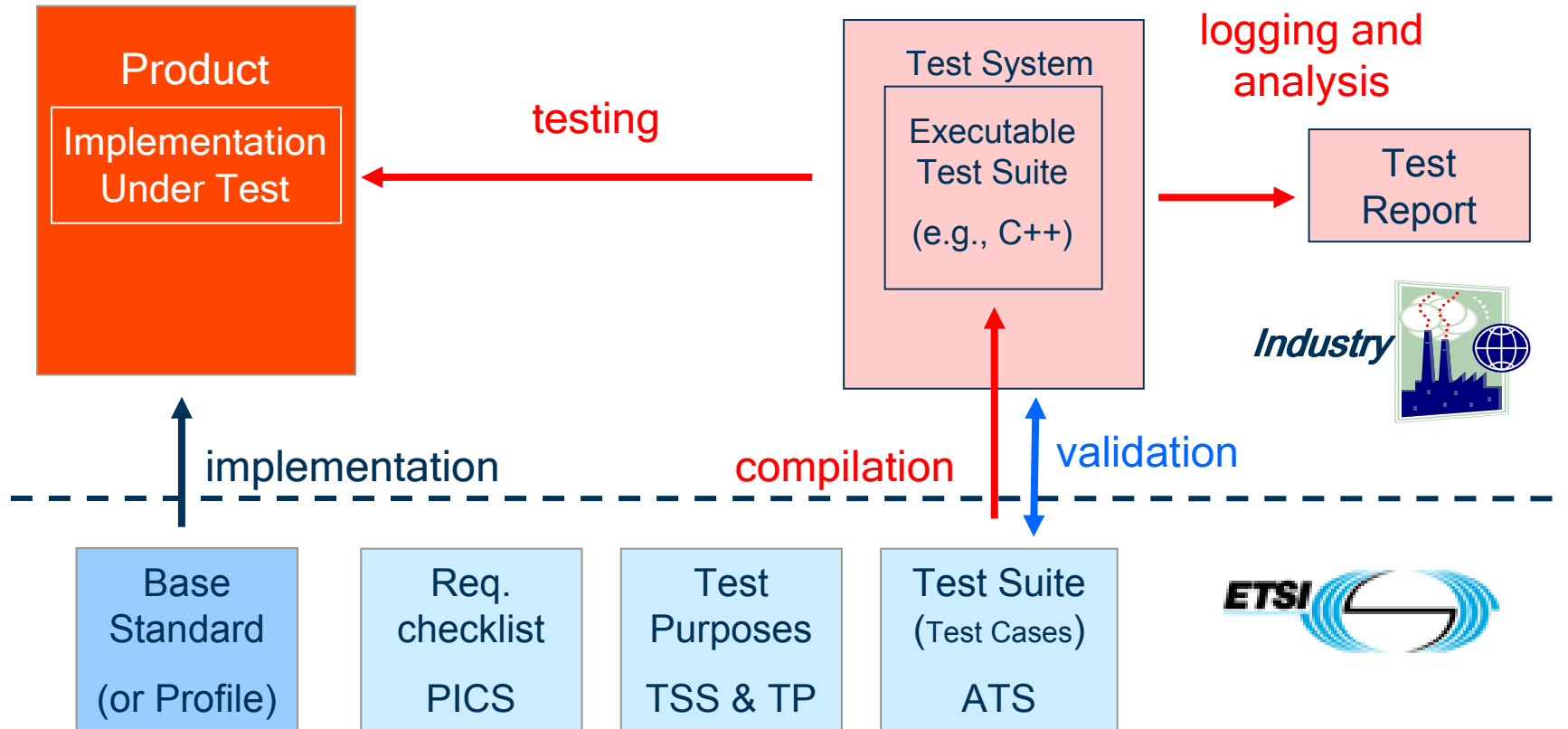
**TAKING YOU FORWARD**

# DL Frame and Concatenated Coding



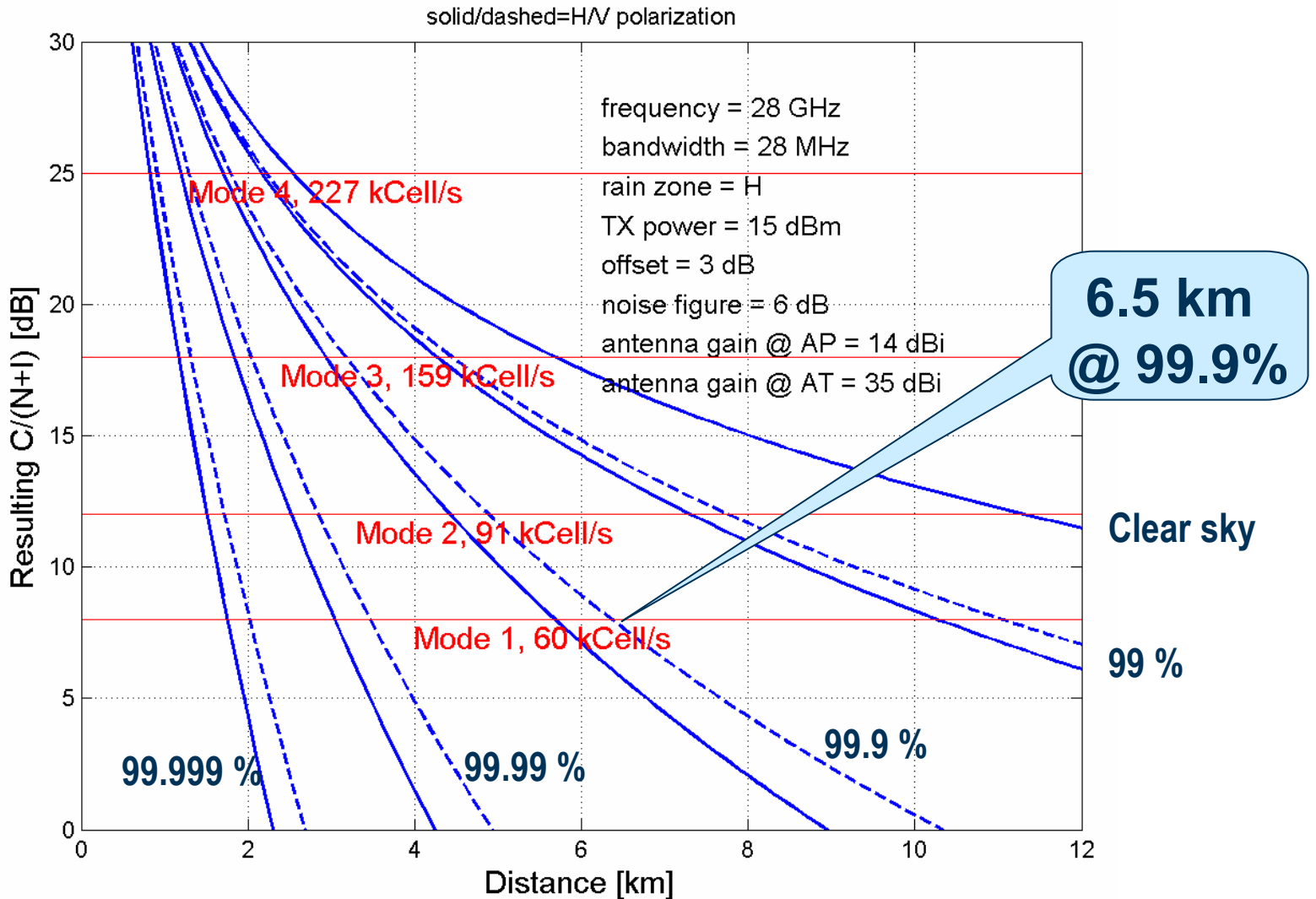
# Conformance Testing

## (ISO 9646 Scheme)

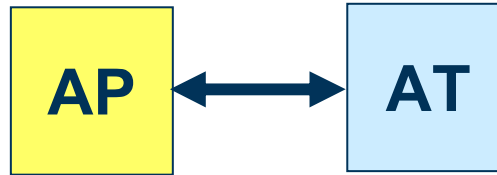


Continuous interaction between all partners is essential for the process (WiMAX, BRAN, PTCC, STF, test house, test tool vendors, manufacturers)

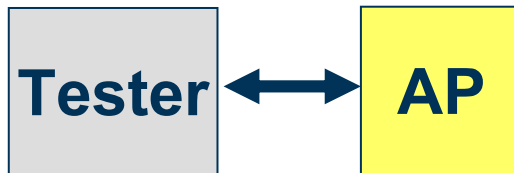
# Throughput, Range and Availability



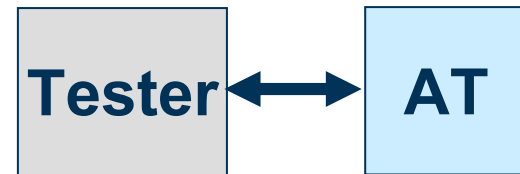
# Conformance Testing (Protocol, Radio) vs. Interoperability Testing



Interoperability testing  
(devices from different vendors)



Protocol and radio conformance testing  
(of a base station)

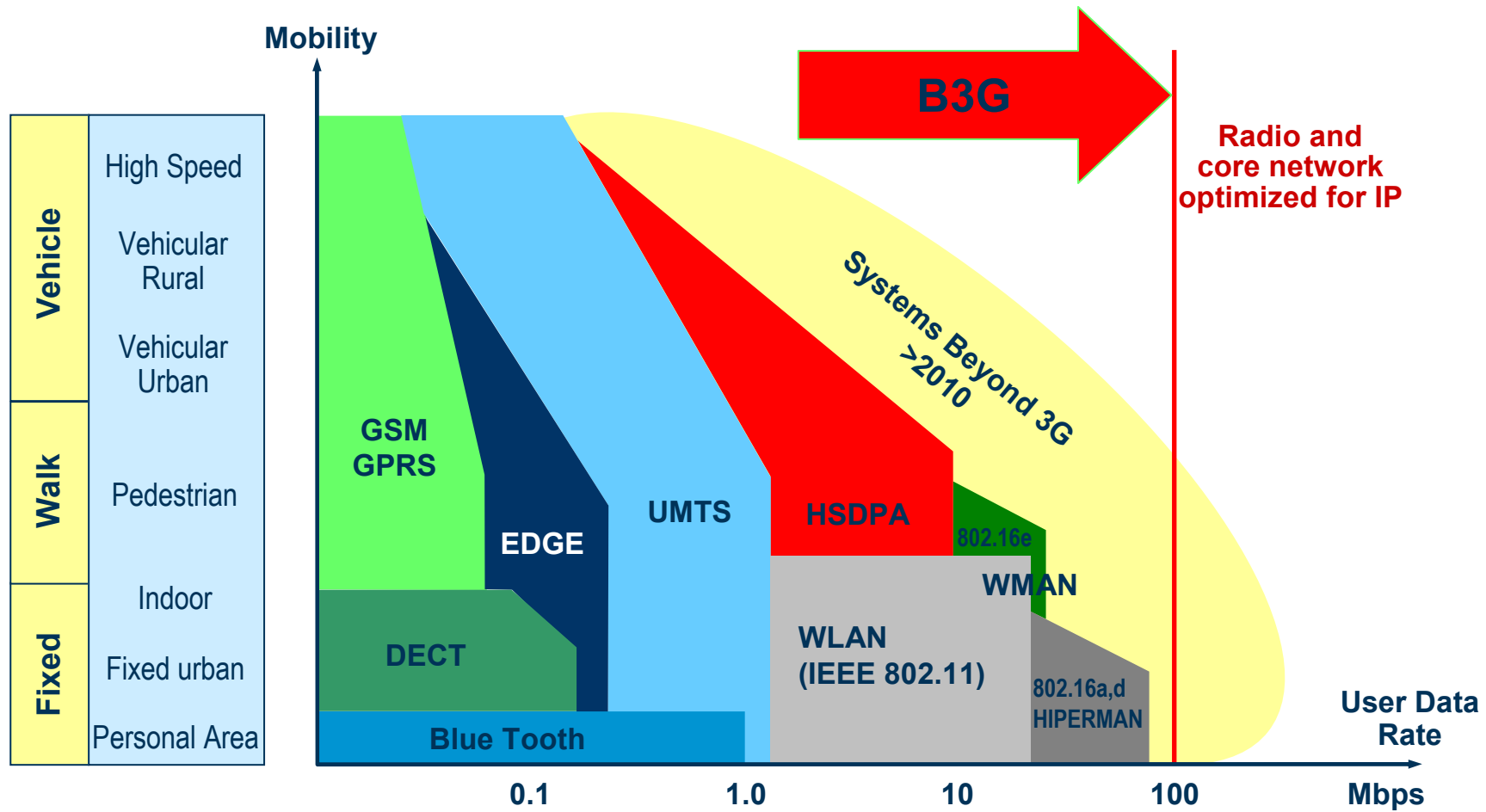


(of a terminal)

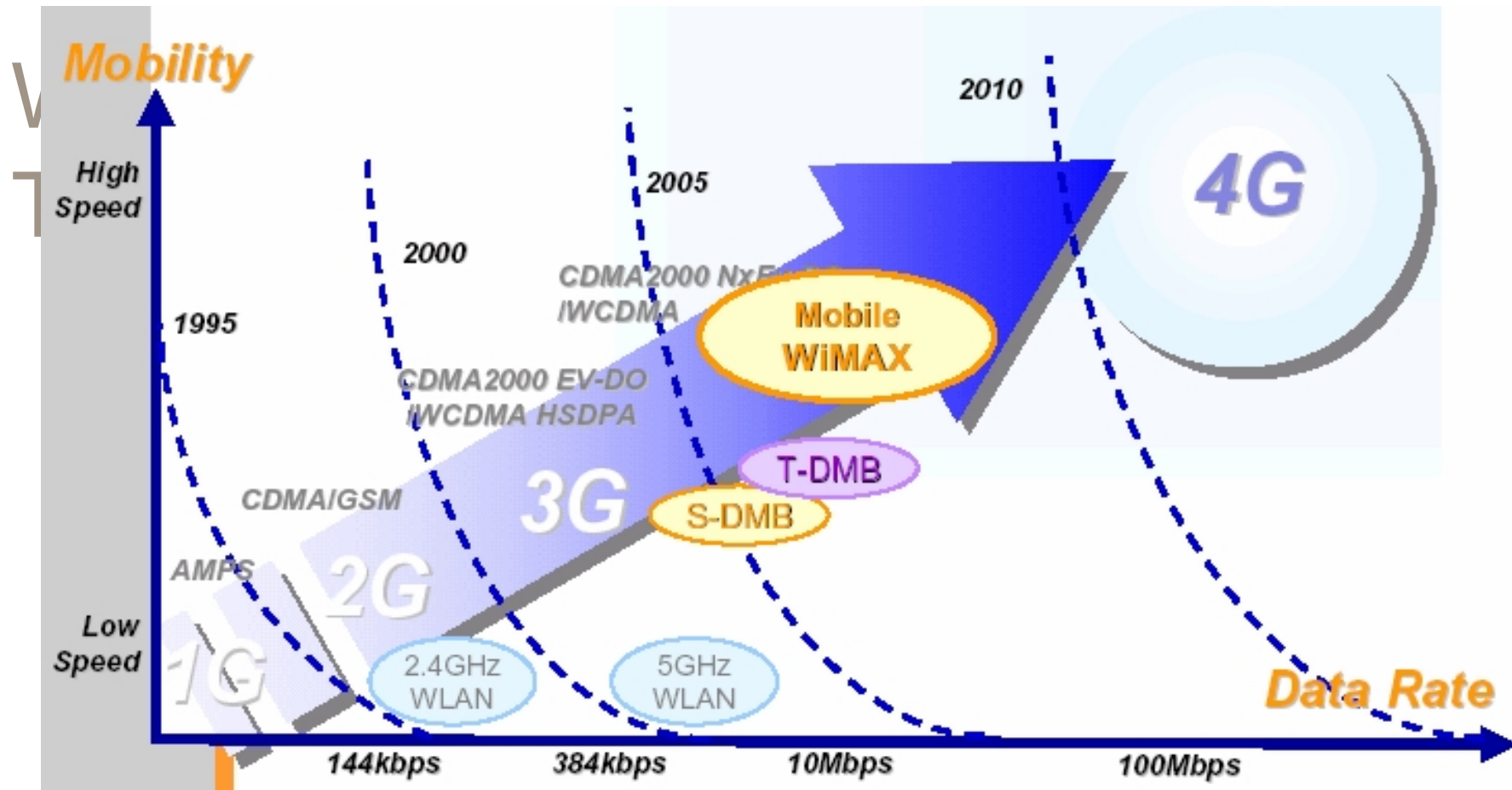
“**WiMAX Forum certified**” requires passing of...

- (1) interoperability tests with three devices from different vendors
- (2) protocol conformance tests
- (3) radio conformance tests

# Wireless Evolution – UMTS View



# Wireless Evolution – WiMAX View



Sources: WiMAX Forum, Nov.2005