Standards for Business

WiMAX Forum und Standardisierung breitbandiger funkbasierter Zugangssysteme für feste und mobile Nutzer

Prof. Dr. Bernd Friedrichs
ETSI BRAN Chairman
Marconi Communications, Germany

Contents

- Overview
  - ETSI BRAN structure
  - Global BWA (Broadband Wireless Access) standards
- BRAN areas of activity
  - HiperAccess
  - HiperMAN
  - RCWG (Regulatory Competence WG)
- WiMAX Forum
  - Cooperation agreement with ETSI
  - Testing
  - Critical review
- Summary

Standards for Business

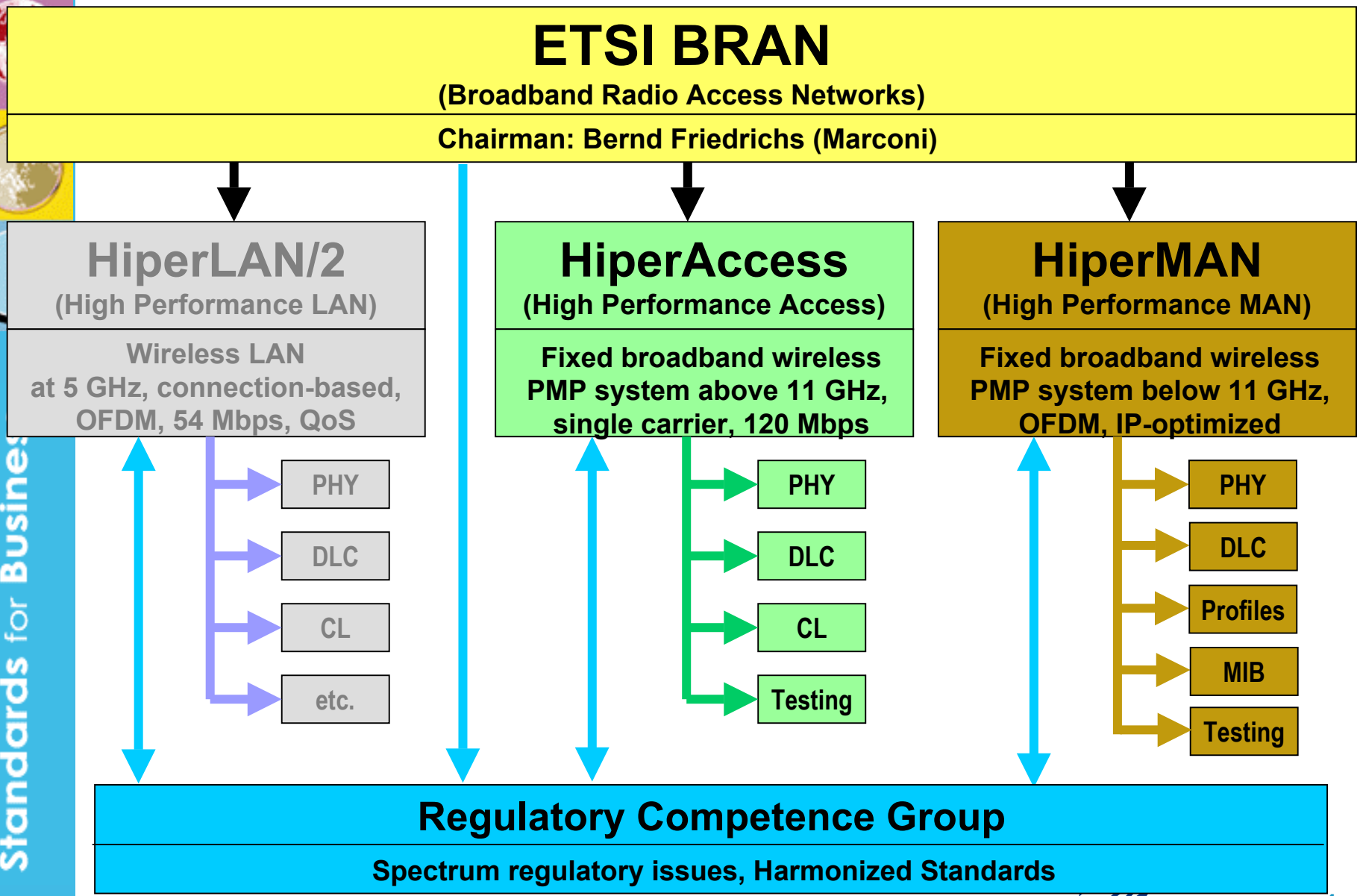
ETSI
European Telecommunications Standards Institute

- Recognized as Standards Development Organization
- Created in 1988 as an independent, not-for-profit entity, based in Sophia Antipolis, Nice Cote d'Azur (France)
- Market driven organization members decide about work program and resource allocation
- 637 members from 56 countries (manufacturers, network operators, service providers, administrations, research bodies, users)
- ~11,000 technical standards and deliverables since 1988 (GSM, UMTS, DECT, TETRA, SAT COM, DVB, NGN, VoIP, BWA, PLT, IP Cablecom, …)
- ~60 co-operation agreements

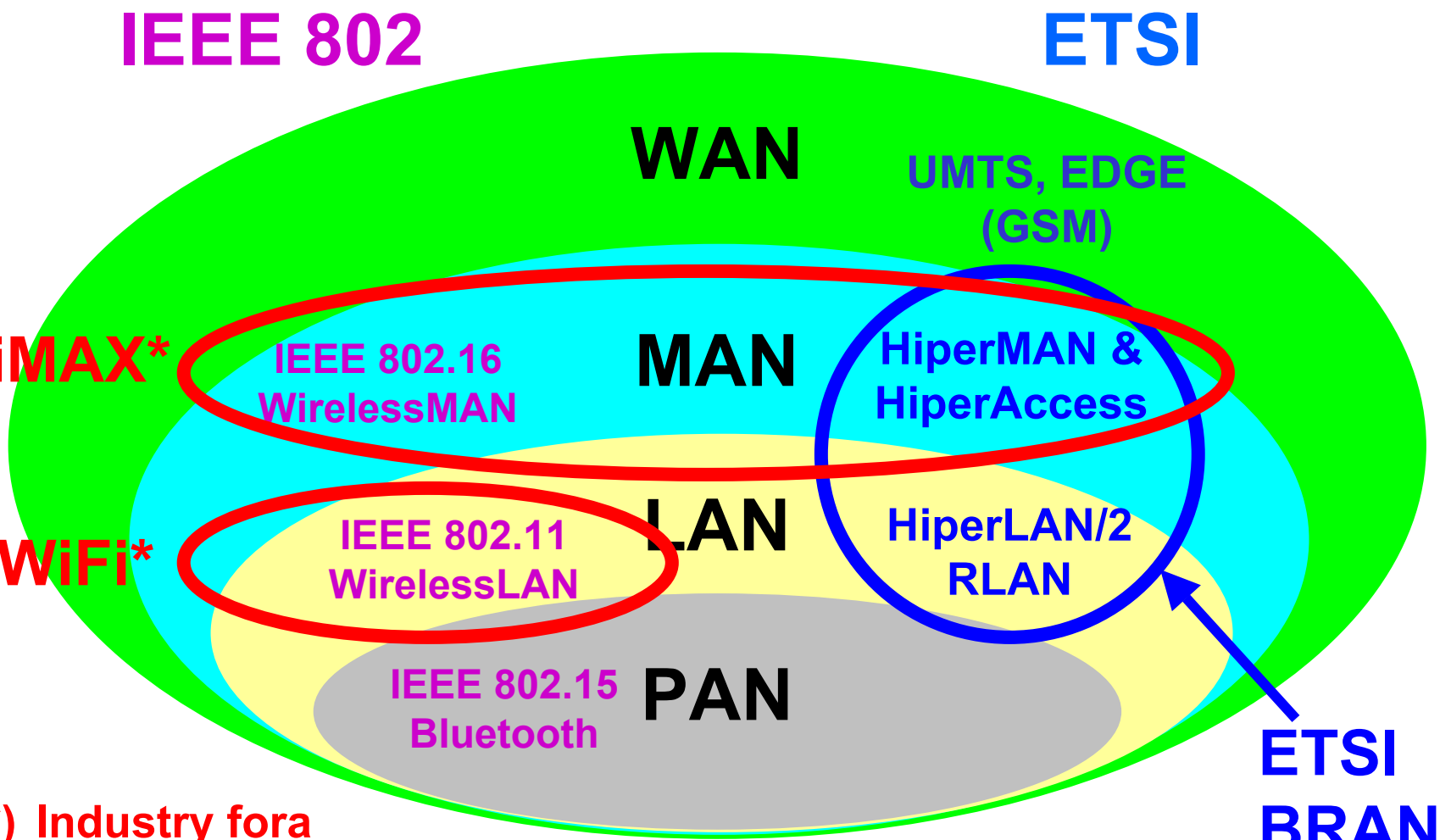
Standards for Business

Marconi

TC BRAN Structure



Global Wireless Standards



*) Industry fora for promotion and certfication

Standards for Business

HiperAccess (1 of 4)
General Overview

- Fixed BWA system (FWA)
  - Point-to-Multipoint (PMP) architecture
  - High speed (120 Mbit/s) and high QoS
  - Optimized for frequencies >11 GHz under Line-of-Sight (LOS) conditions
  - 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
- ETSI BRAN developed protocol stack and radio specifications
- Commercial roll-out
  - First BRAN-compliant product was rolled-out in December 2004 (Point-to-Point derivative of HA)
  - Full HiperAccess-compliant products will be available in 2005
  - High interest from numerous operators

Standards for Business

Marconi

HiperAccess (2 of 4)
PHY Layer

- Focus on frequency bands
  - 40.5 – 43.5, 31.8 – 33.4, 27.5 – 29.5 GHz, 24.5 – 26.5 GHz, etc.
- Channel size = 28 MHz, Baudrate = 22.4 MBaud
  - Paired bands (FDD mode, fixed asymmetric rates)
  - Unpaired bands (TDD mode, adaptive asymmetric rates)
- Important parameters
  - Frame based (1ms)
  - Option for H-FDD terminals
  - Option for ARQ (UL only)
  - Fixed length PDUs (efficient support of ATM and IP, robust, high QoS, allows ARQ)
  - Adaptive modulation and coding (from QPSK to 64-QAM)
  - Downlink and uplink main parameters:

	Downlink (AP → AT)	Uplink (AT → AP)
Data rates (Mbit/s)	20...120 (typically 80)	20...80 (typically 50)
Transmit power	15 dBm	14 dBm
Range	up to 12 km (hard limit from ranging, effectively depending on availability and rain zone)	

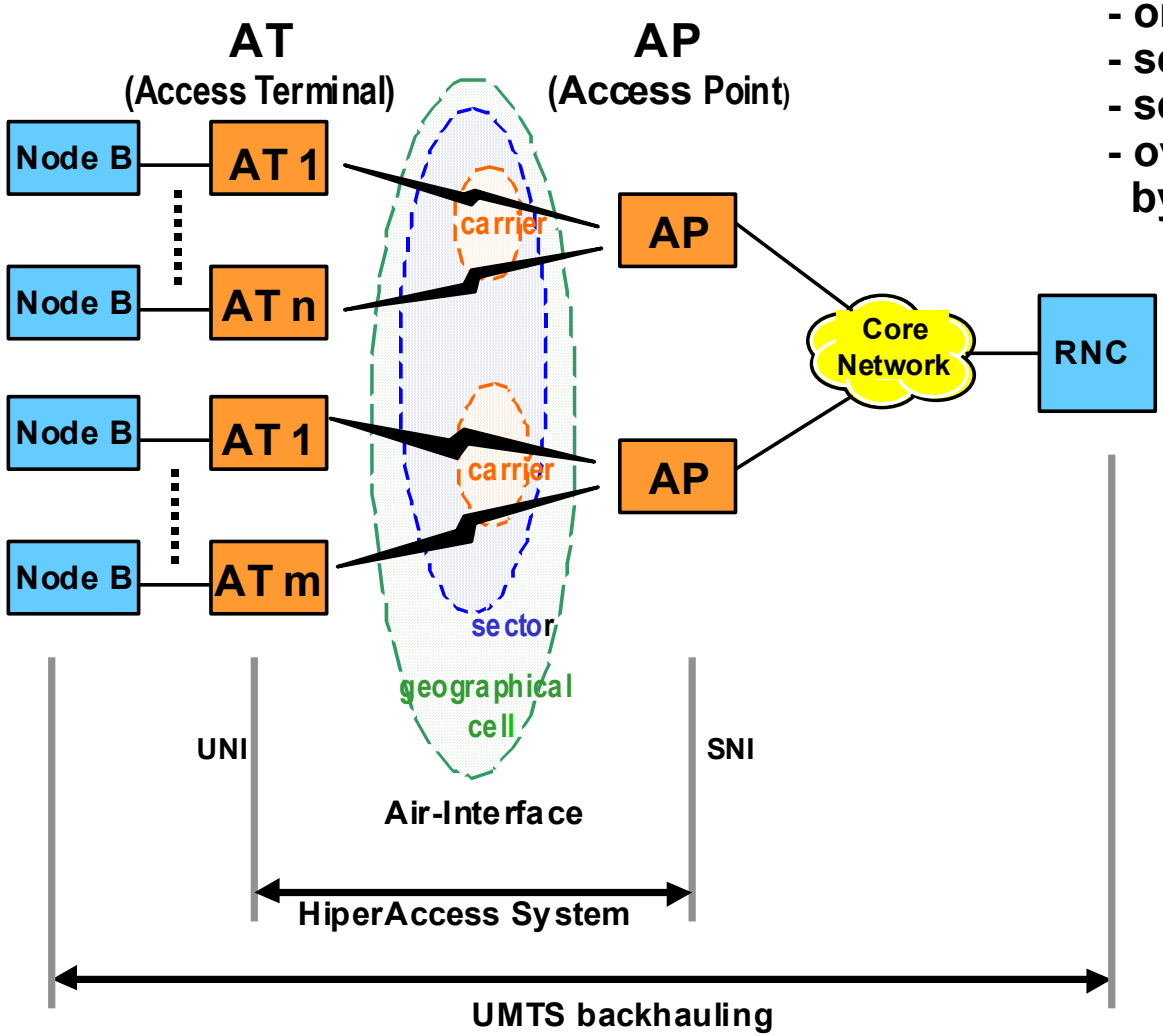
Standards for Business

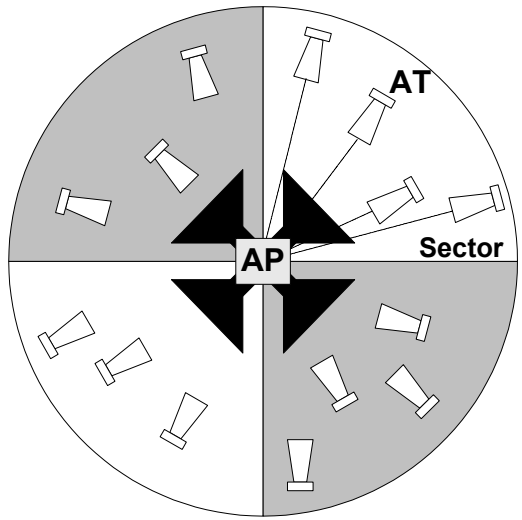
HiperAccess (3 of 4)
Protocol development

- HiperAccess is interoperable, ...
  - so both normal (error free messaging) and exceptional behaviour of the system need to be specified in detail
- The specification of the DLC layer is based on...
  - standardized specification languages such as MSC, SDL and ASN.1 in addition to textual description and informative figures
- Specification of protocol messages and their formats...
  - is done in ASN.1, where Packet Encoding Rules (PER) with byte alignment are used for the transfer encoding (heart of the standard!)
- Exceptional behaviour...
  - is described in full detail by Message Sequence Charts (MSC) and High-level MSC (HMSC)
- Normative behaviour...
  - is given in SDL models covering all key protocol aspects
  - The SDL models were extensively validated using state exploration tools
  - The validation results demonstrate the absence of a number of undesirable properties such as deadlocks, livelocks, etc.
  - The SDL model represents a reference implementation of the protocol

HiperAccess (4 of 4)
Network Topology Model for Backhauling

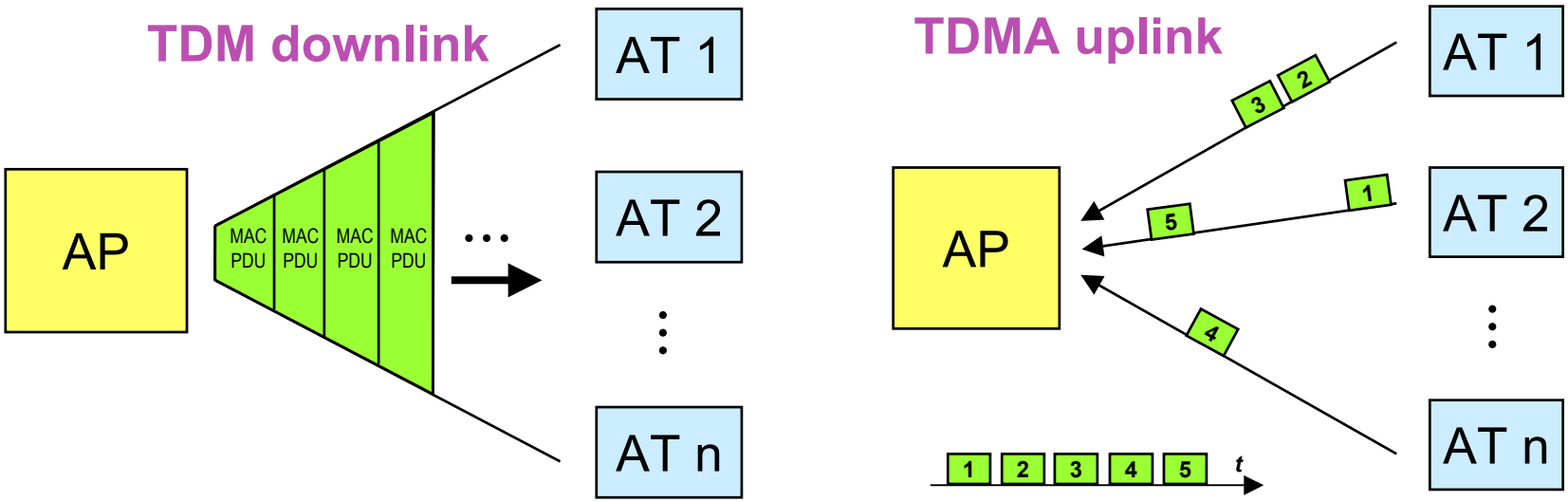
- one APT per carrier
- one APC per cell
- several sectors per cell
- several carriers per sector
- overlapping cells (separated by frequency or polarization)





Cell with four sectors

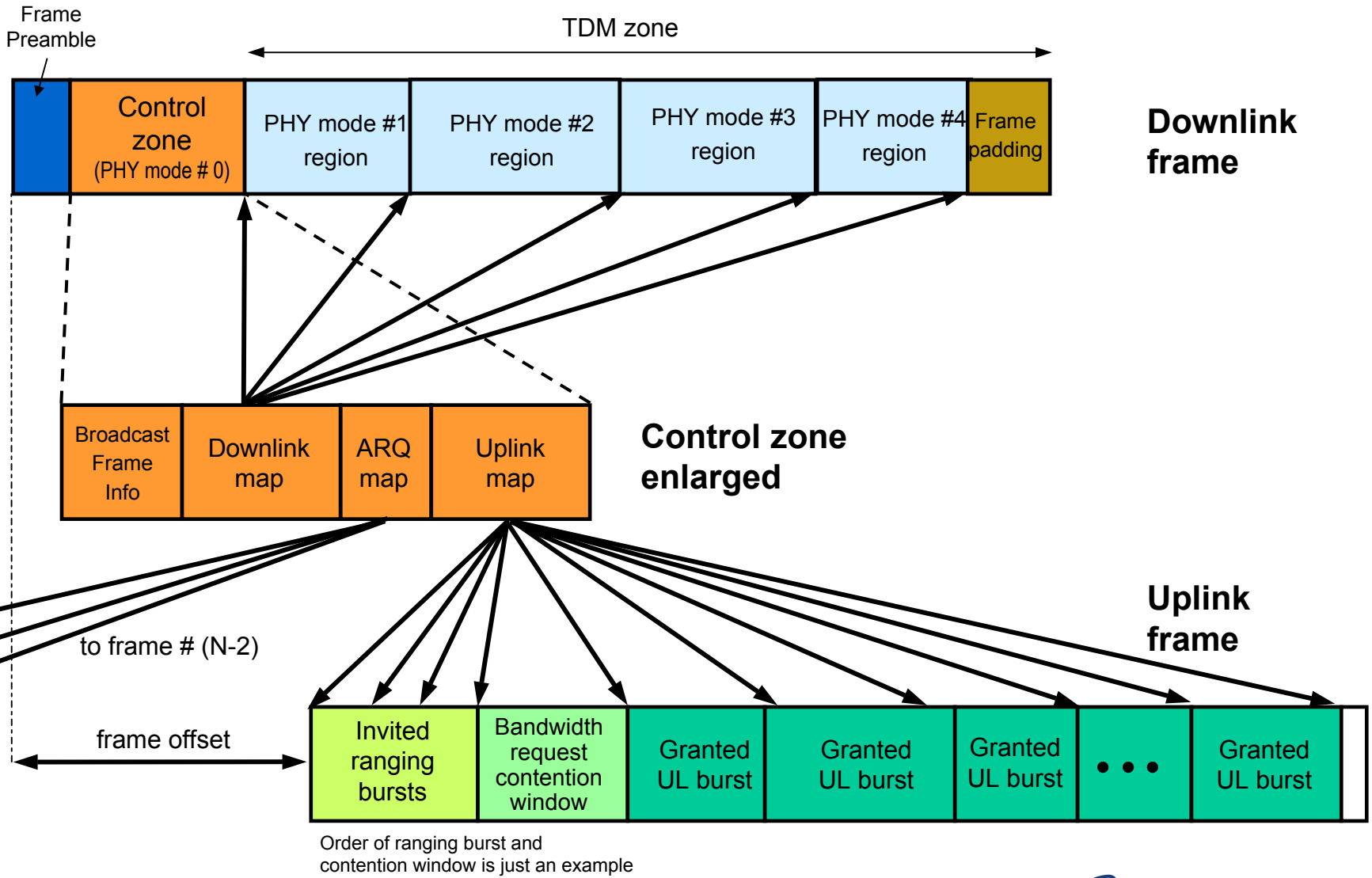
Multiple Access for PMP



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 (HA, HM)



HiperMAN (1 of 2)

- **BWA system**
  - For fixed (FWA) and nomadic (NWA) or mobile applications
  - PMP (or meshed) architecture
  - High speed and covers large geographical area
  - Optimized for frequency bands below 11 GHz without LOS
  - Optimized for IP traffic

- **Main applications**
  - Wireless DSL, primarily for residential and small business users
  - First release: FWA below 11 GHz
  - Later: Residential (self installation), SOHO, SME
  - Mesh radio networks (radio based routers)

Standards for Business

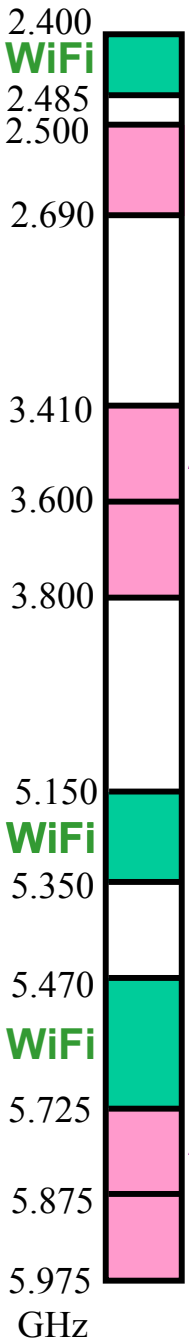
HiperMAN (2 of 2)

- Main Features
  - Both FDD and TDD, including H-FDD CPE
  - High spectral efficiency and data rates, up to 25 Mbit/s in 7 MHz
  - Adaptive modulation (from QPSK to 64-QAM)
  - Interoperability profiles for 1.75, 3.5, 7 and 10MHz
  - Robust (high multi-path environments)
  - High security TEK encryption algorithms
- Only one PHY mode (OFDM)...
  - instead of 3 PHY modes in 802.16 (for FWA)
- Uplink OFDMA (subchannelization)...
  - allows for high cell radius, up to 50 km with directive antenna
  - gives 12 dB more for same CPE output power (256 FFT)
- Advanced features
  - Support of advanced antenna systems (AAS)
  - Space-Time Coding (2 diversity antennae on BS give 5-7dB)
  - Turbo-coding (2 dB more)

RCWG
Regulatory Competence Working Group

- "Horizontal" group, focus on
  - regulatory issues, harmonized standards system reference docs
- 5 GHz Harmonized EN 301 893 (RLAN)
  - To be used for European type approval in < 5.725 GHz
  - Version 1.3.1 to be published in OJEC
  - Revisions for higher throughput technologies (MIMO, bonding)
- 5.8 GHz Harmonized EN 302 502 (FWA)
  - To be used for European type approval in 5.725 - 5.975 GHz
  - Standard was send into PE on 24 August 2005
- SRDoc on Converged Fixed-Nomadic BWA < 11 GHz
  - To be used by ECC for more spectrum allocation
  - Split in Part 1 (3.4 to 3.8 GHz) and Part 2 (< 3.4 GHz)

WiMAX Prime Spectrum



2.5 – 2.69 GHz: licensed (UMTS extension band)

- "technology-neutral" or "IMT-2000 (3G) only" approaches under discussion
- mainly availabe in US (FCC allows fixed BWA)
- ITU-R 8F sharing studies

3.4 – 3.6 (3.8) GHz: licensed

- Europe and Asia allow FWA (not available in US)
  - implies also nomadic operation if AT sites are not registered
  - open for WiBRO in Korea
- FDD or TDD, 3.5 and 7 MHz bands
- CEPT ECC SE19 Draft Rec (04)05 for Public Consultation
- CEPT ECC JPT BFWA

5.725 – 5.875 (5.975) GHz: unlicensed

- BRAN works on EN 302 502
- DFS (AP, AT) to protect primary users, TPC
- 36 dBm (4000 mW) EIRP, 23 dBm/MHz @ 20 MHz channels
- CEPT ECC SE38 compatibility studies

Standards for Business

Marconi

Overview: Fixed - Nomadic - Mobile

	Inter-operability	TX/RX during move	AT frequency planning	Handover	Roaming (IRAP)
Fixed	Desired	No	Yes	No	no
Nomadic		No	No	No	
Mobile	Required	Yes	No	Yes	yes
Related to:	Base specs, testing, certification	Air interface	Regulation, interference budget	Protocol stack, network architecture and interfaces	

Standards for Business

ETSI - WiMAX Cooperation Agreement

- Signed in April 2005 (after 20 months of negotiation)

Karl-Heinz Rosenbrock (ETSI Director-General)
@ ETSI General Assembly, Nice (France), 5 April 2005

Ronald J. Resnick (WiMAX Forum President)
@ WiMAX F2F Meeting, Malaga (Spain), 12 April 2005

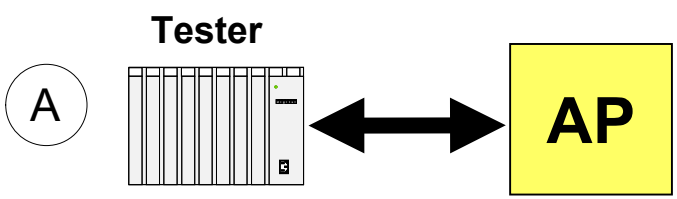
- ETSI and WiMAX have a common interest
  - to perform and promote standardization with the aim of a global market
- ETSI and WiMAX co-operate for
  - Testing and certificating of HiperMAN (50% co-funding by WiMAX)
  - Standards development
  - Regulatory activities to provide the necessary spectrum
  - Future work for nomadic-portable support

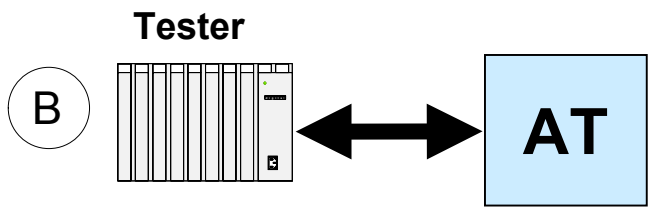
Standards for Business

Marconi

Conformance Testing (Protocol, Radio) and Interoperability Testing

Interoperability testing
(devices from different vendors)



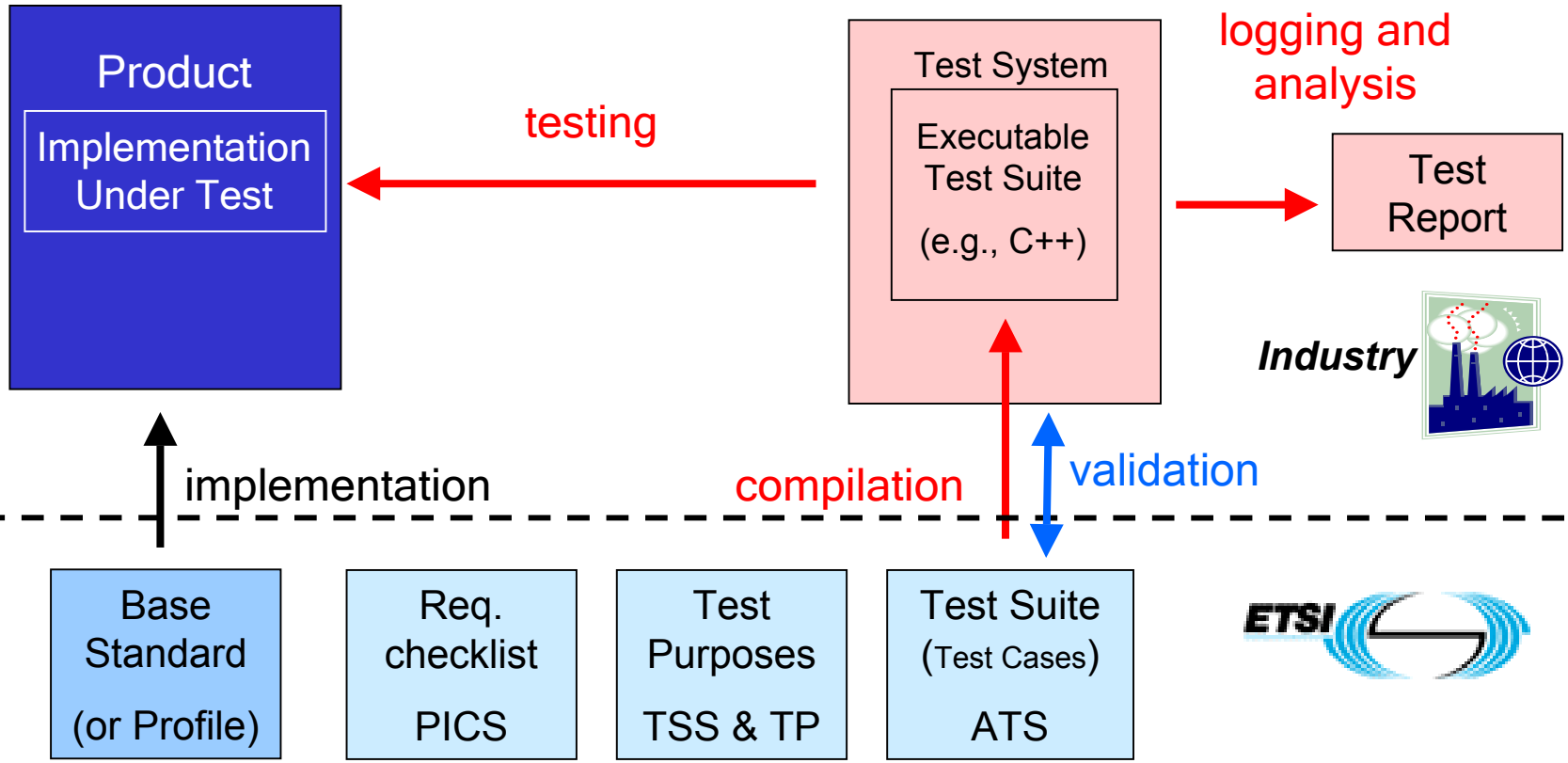


Protocol Conformance and Radio Conformance testing
(of a base station) (of a terminal)

„WiMAX Forum certified“ requires passing of...
(1) interoperability tests with three devices from different vendors
(2) protocol conformance tests
(3) radio conformance tests

Standards for Business

ETSI - WiMAX Cooperation on 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)

Standards for Business

“WiMAX Forum Certfied”

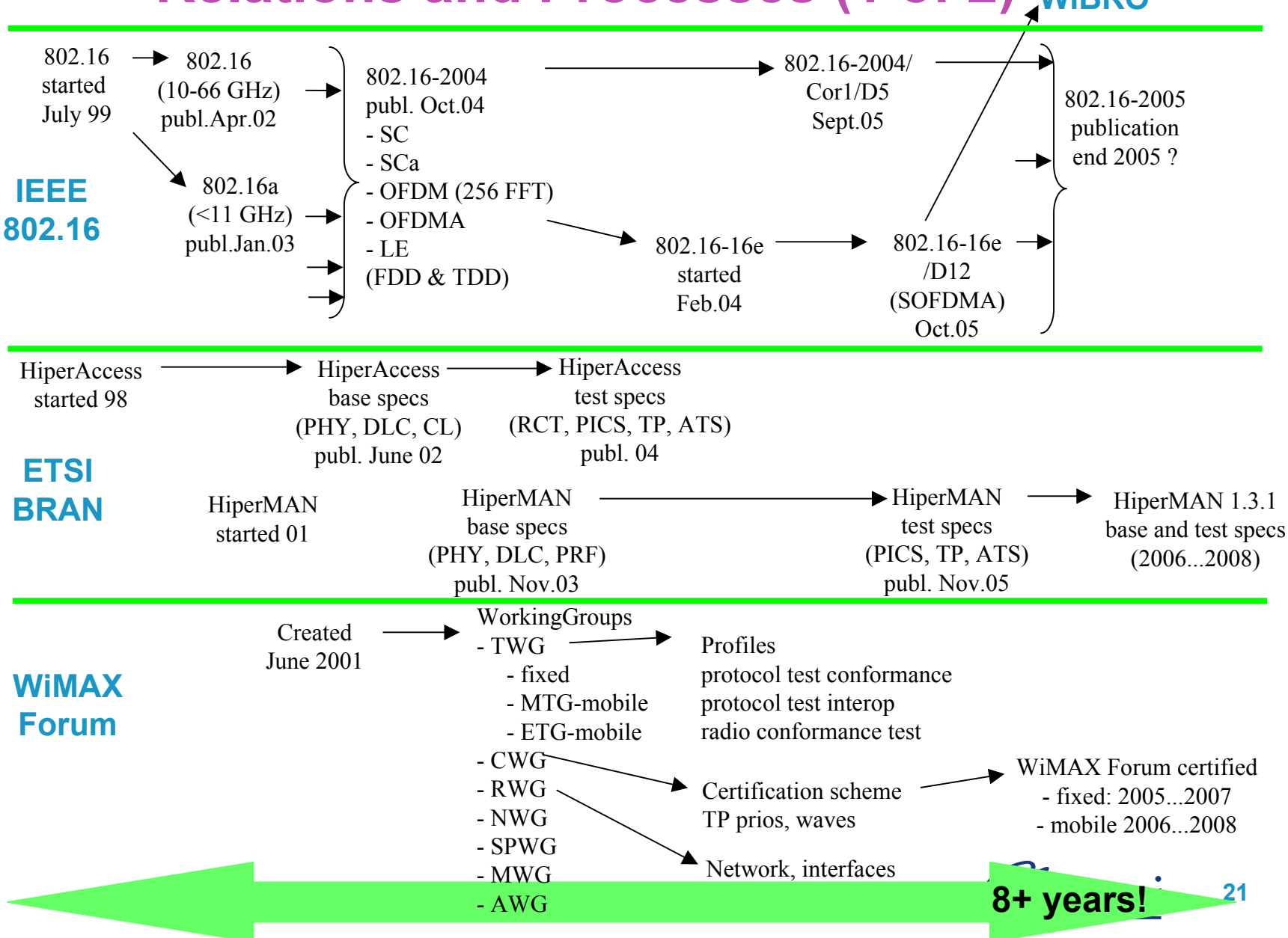
- Mandatory to pass...
  - radio conformance test
  - protocol conformance test (organization in waves)
  - interoperability test (against 3 other vendors)
- Rules defined for...
  - re-testing
  - legal relation between vendor, test house, operator, WiMAX Forum
- Test cases
  - BRAN developed 900 (fixed only), independent of certification
  - Subsets selected for certification by subgroup of 14 vendors
  - BRAN develop ATS only for selected TPs
- Certfication waves

Wave	Time	#TP	Contents
1	2H05	58	Key features for interoperability
2	1H06	+100	VoIP, video conf, video stream
3	2H06	+120	Improvements in gain
4	1H07	+120	

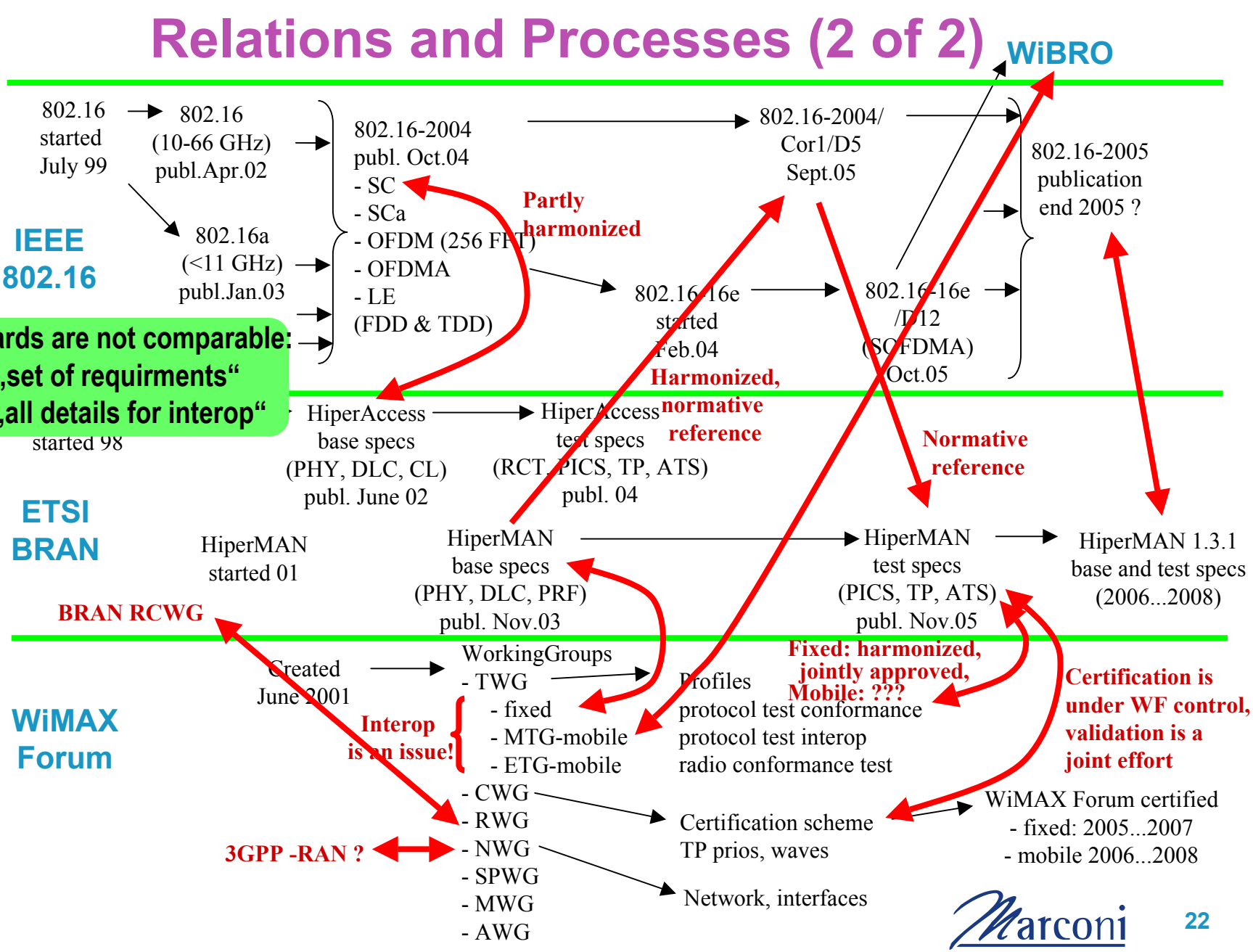
Standards for Business

Marconi

ETSI BRAN - IEEE 802.16 - WiMAX Forum Relations and Processes (1 of 2)



ETSI BRAN - IEEE 802.16 - WiMAX Forum Relations and Processes (2 of 2)



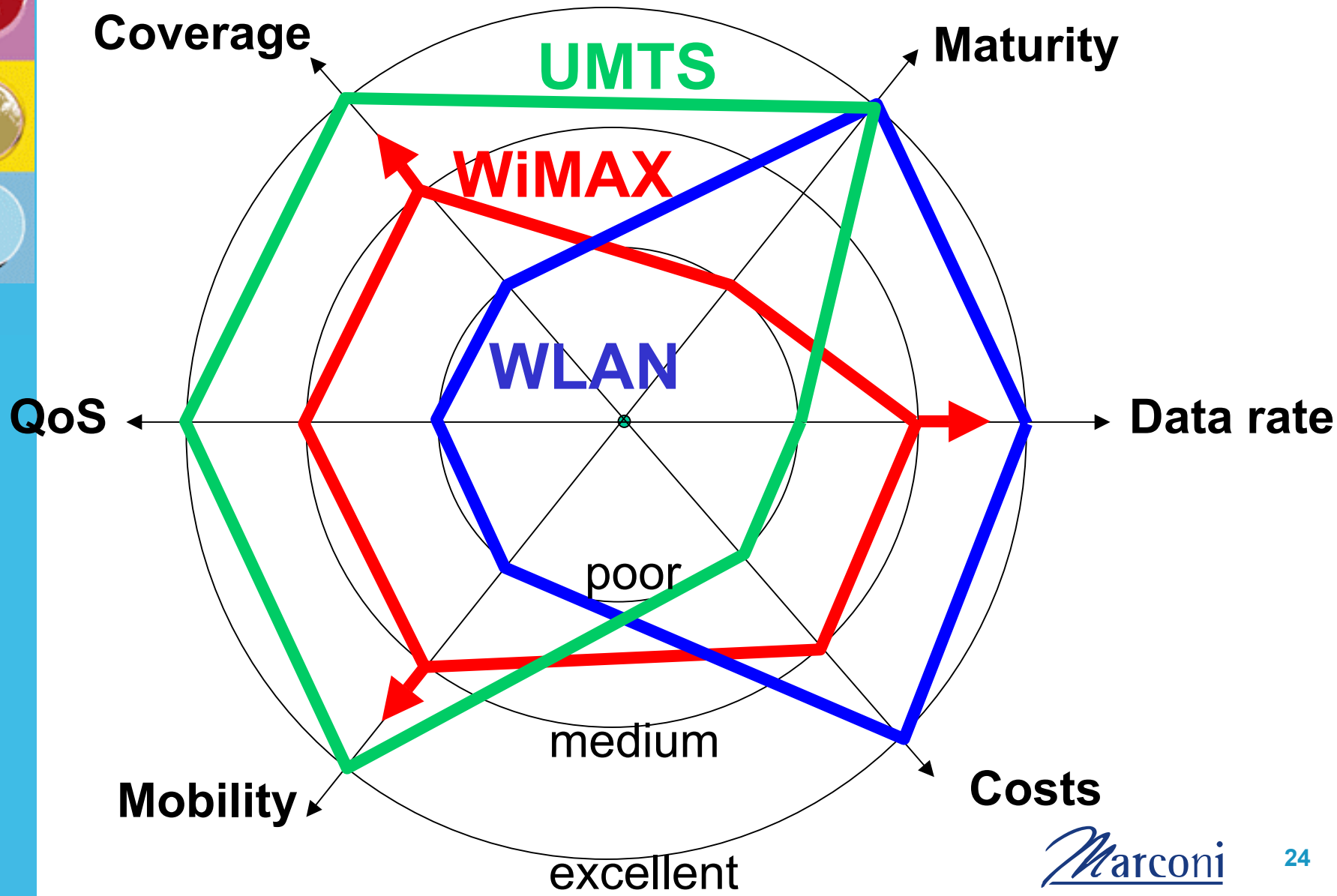
WiMAX Risks – A Personal View

[Disclaimer: The content of this slide does not represent the official position of ETSI]

- **Organization**
  - Aggressive marketing, partly out of control
  - Incompatible speeds: fast marketing vs. slow technical decisions
  - Technical complexity growing
  - Business case not stable (perceptions from fixed wireless-DSL to 4G)
  - "WiMAX" is not a registered trademark, only "WiMAX Forum certified"
- **Schedule**
  - Fully interoperable products 2..3 years behind expectations
  - Mobile WiMAX too late after ubiquitious adoption of UMTS
- **Performance**
  - 50 km and 100 Mbit/s are incompatible (on the same link), "typically 3...5 miles and 2 Mbit/s" [AT&T, 27.10.2005]
  - Latency and throughput per user or sector degraded with narrow channels
  - Network architecture compatible to UMTS-RAN ?
- **Spectrum...**
  - not enough available (esp. lower frequencies), not harmonized world-wide
  - limitations in transmit power, usage, rights of primary users (unlicensed)
- **Competing technologies (or complementing?)**
  - IMT-2000 (& WiFi)
  - UMTS-LTE - 4G most likely based on OFDM instead of CDMA
  - Flash OFDM, "Why MAX?" [Qualcomm, Sept. 2005]

Comparison: WLAN - WiMAX mobile - UMTS

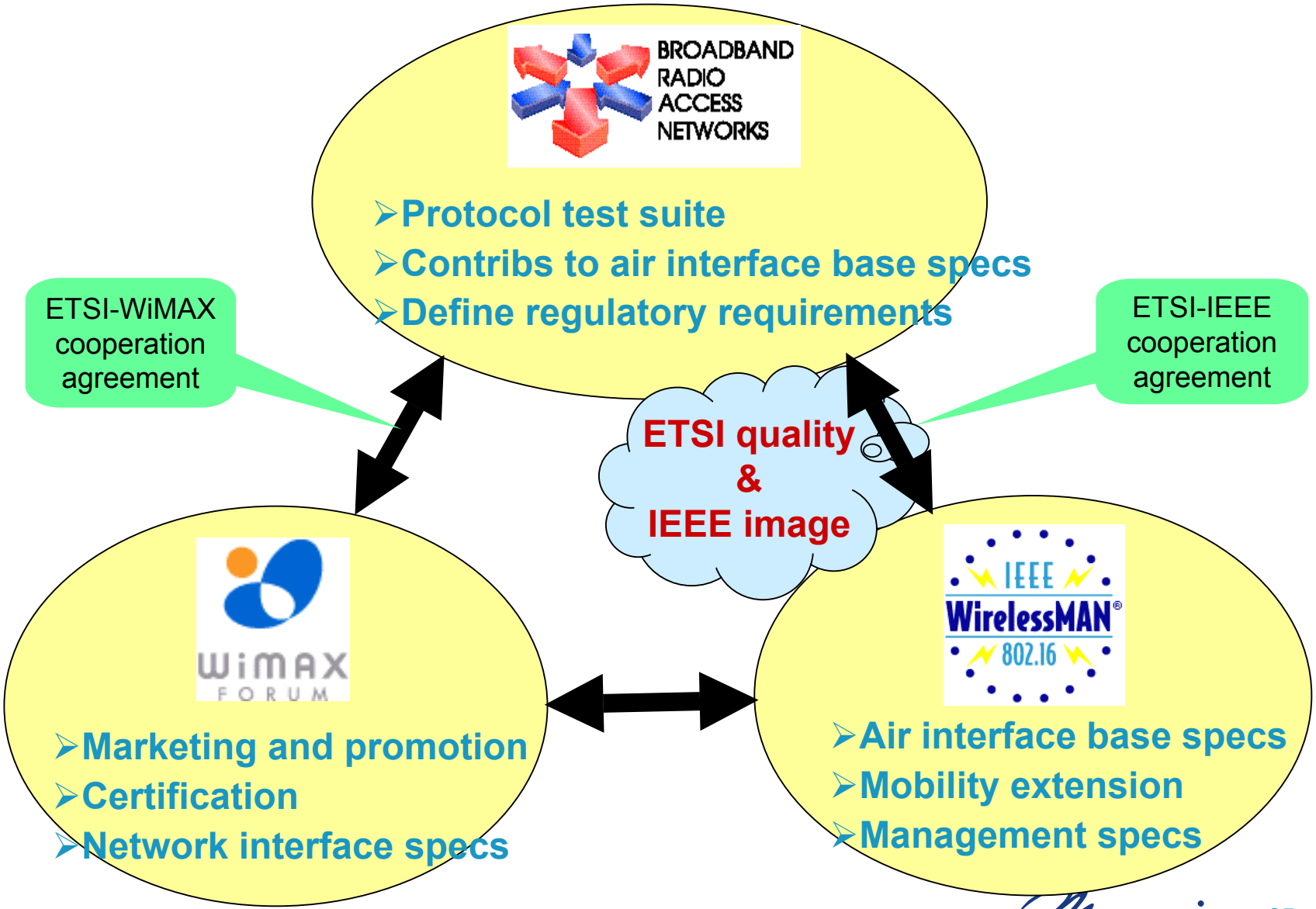
[Disclaimer: The content of this slide does not represent the official position of ETSI]



Standards for Business

Marconi

BWA below 11 GHz
Summary of Main Competence



Standards for Business

Summary

- BWA (Broadband Wireless Access)
  - Feeder networks (HiperAccess)
    - Successful on the market since 2005
  - Residential access (HiperMAN / WiMAX)
    - Fixed/nomadic version available in 2006...2007
    - Mobile version available in 2007...2008, risks to be minimized
- ETSI BRAN co-operation with...
  - IEEE 802.16
    - Shows how standard bodies can successfully contribute to each other
  - WiMAX Forum
    - ETSI benefits from WiMAX marketing and certification
    - WiMAX Forum benefits from ETSI experience and work approach
  - Spectrum regulatory bodies
    - Secure bandwidth
    - Pioneering work on DFS (unlicensed bands)
- WiMAX technology versus 3G/4G ?

Standards for Business

Marconi

For further information...

More details can be found on

http://portal.etsi.org/bran/summary.asp
http://portal.etsi.org/radio/

My contact data:

Prof. Dr. Bernd Friedrichs, Chairman TC BRAN

mailto:bernd.friedrichs@marconi.com
Phone +49 7191 2448
Marconi Communications,
71522 Backnang, Germany

Standards for Business