ETSI Standards for Broadband Radio Access Networks (BRAN Project)

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About ETSI BRAN

- ETSI Project (EP) BRAN established in 1997
- In response to growing market pressure for low-cost, high-capacity broadband radio systems
- Fixed Wireless Access (FWA) systems as competitive alternatives to wireline access systems with
  - high performance (QoS, spectral efficiency)
  - flexibility
  - easy to set up
- Interoperable standards
- BRAN assists (via ETSI ERM RM) regulatory bodies to define spectrum requirements and radio conformance specifications for new broadband radio networks

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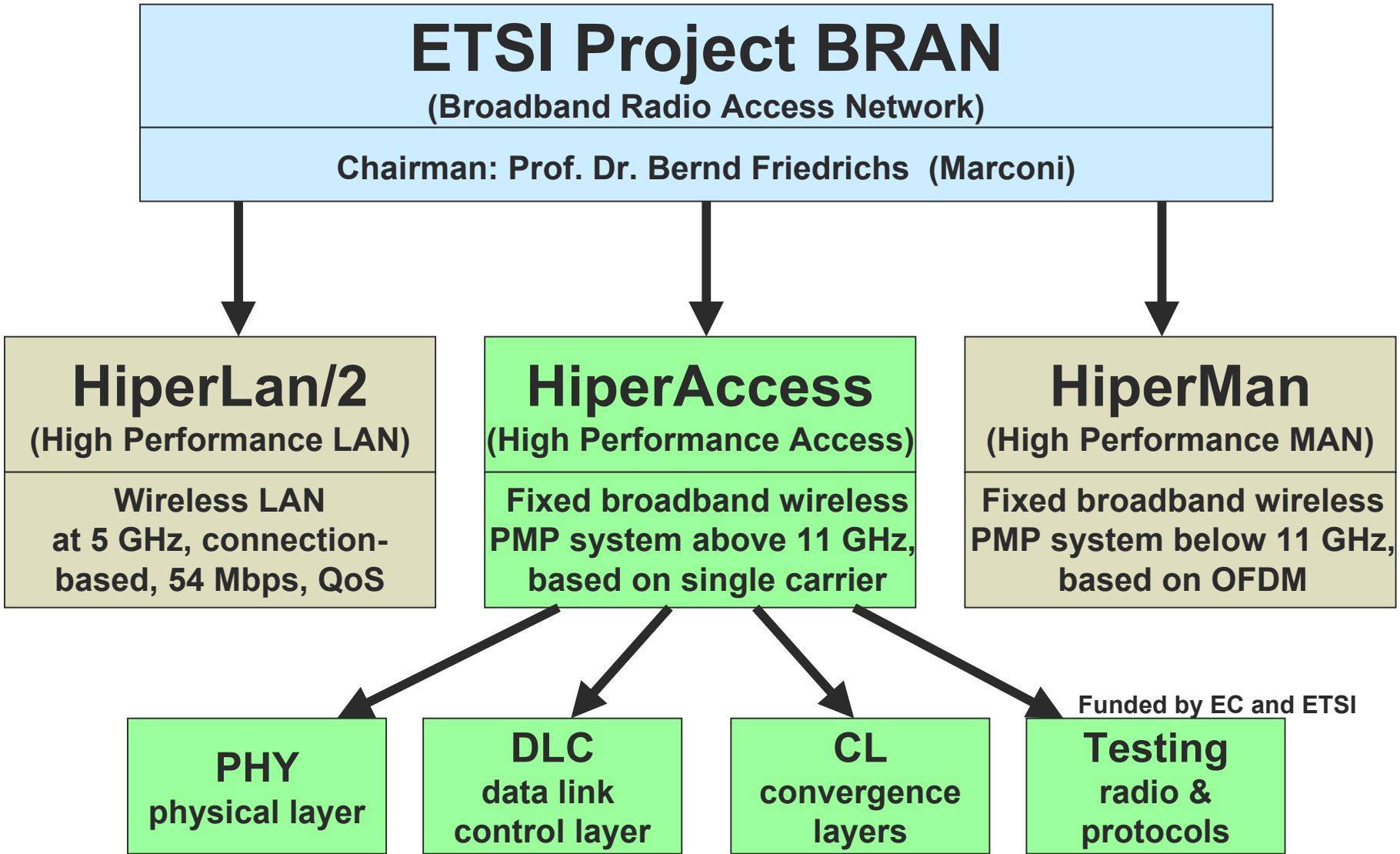
BRAN Technology-Specific Standard Areas



BRAN Relationship with Other Bodies and Forums

- IEEE 802.xx
  - IEEE 802.11a ~ BRAN HL (same PHY layer)
  - IEEE 802.16+ ~ BRAN HA (harmonization under discusion)
  - IEEE 802.16a ~ BRAN HM (close co-operation)
- HiperLAN2 Gobal Forum
- ATM Forum
- CEPT
- 3GPP
- IETF (Internet Engineering Task Force)
- MMAC-PC (Multimedia Mobile Access Communication Systems - Promotion Council)
- ITU-R, ITU-T
- ETSI OCG, ETSI TM4, ETSI ERM

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Why Do We Need Standards ?

- Active participation of many operators
  Optimized for important applications
  (Cellular backhaul, SME, SOHO, ...)

- Active participation of many manufacturers
  Low-cost and high performance
  (both for IP and ATM core networks)

- Low cost is critical for competiton with wireline access

- Interoperable standard large volume low cost

- Other advantages of an interoperable standard
  - easy for customers to compare
  - flexibility for customers
  - increased competition low cost

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HiperLan2: Overview

- Wireless Local Area Network (WLAN) -type system
- Complementary access mechanism in hot spot areas for public mobile network systems
- For corporate, public and home environments
- Wireless access to the Internet and future multimedia, real time video services at speeds of up to 54 Mbit/s
- Provide interworking with several core networks including the Ethernet, IEEE 1394, and ATM
- Close work with IEEE802.11 and MMAC-PC (Japan) to develop a global 5GHz radio

Current Work on 5 GHz Radio LANs

- **Harmonized Standard under development for 'high performance 5 GHz RLANs': EN 301 893**
- **Developed under the mandate from the European Commission under the R&TTE directive, covering essential requirements under article 3.2 (Radio)**
- **Technology neutral: covers HiperLAN/2, IEEE 802.11a/h, …**

HiperMan: Overview

- **Broadband Fixed Wireless Access (FWA)**
  - 2 - 11 GHz
  - FWA services to SMEs and residential users
- **Interoperable standard**
  - Defines only one PHY mode: OFDM, FFT 256 points
- **Main Features**
  - Using the basic MAC (DLC and CLs) of the IEEE 802.16-2001 standard as base-line
  - 12dB higher system gain in uplink, relative to 802.16a OFDM mode, to enable low cost, residential deployment
  - Non Line-of-Sight operation
  - Advanced antenna systems support

HiperMan: More Details

- Full QoS support (scheduled MAC)
- Almost double protocol efficiency vs. 802.11a
- Main focus is on IP traffic
- Enables both PMP and Mesh network architectures
- Supports both FDD and TDD frequency allocations
- Close cooperation with IEEE 802.16
  - HiperMan and the OFDM FFT256 subset of IEEE 802.16d-2004 standard will interoperate
- Future enhancements:
  - License Exempt bands (5.8GHz, etc.)
  - SMNP Management

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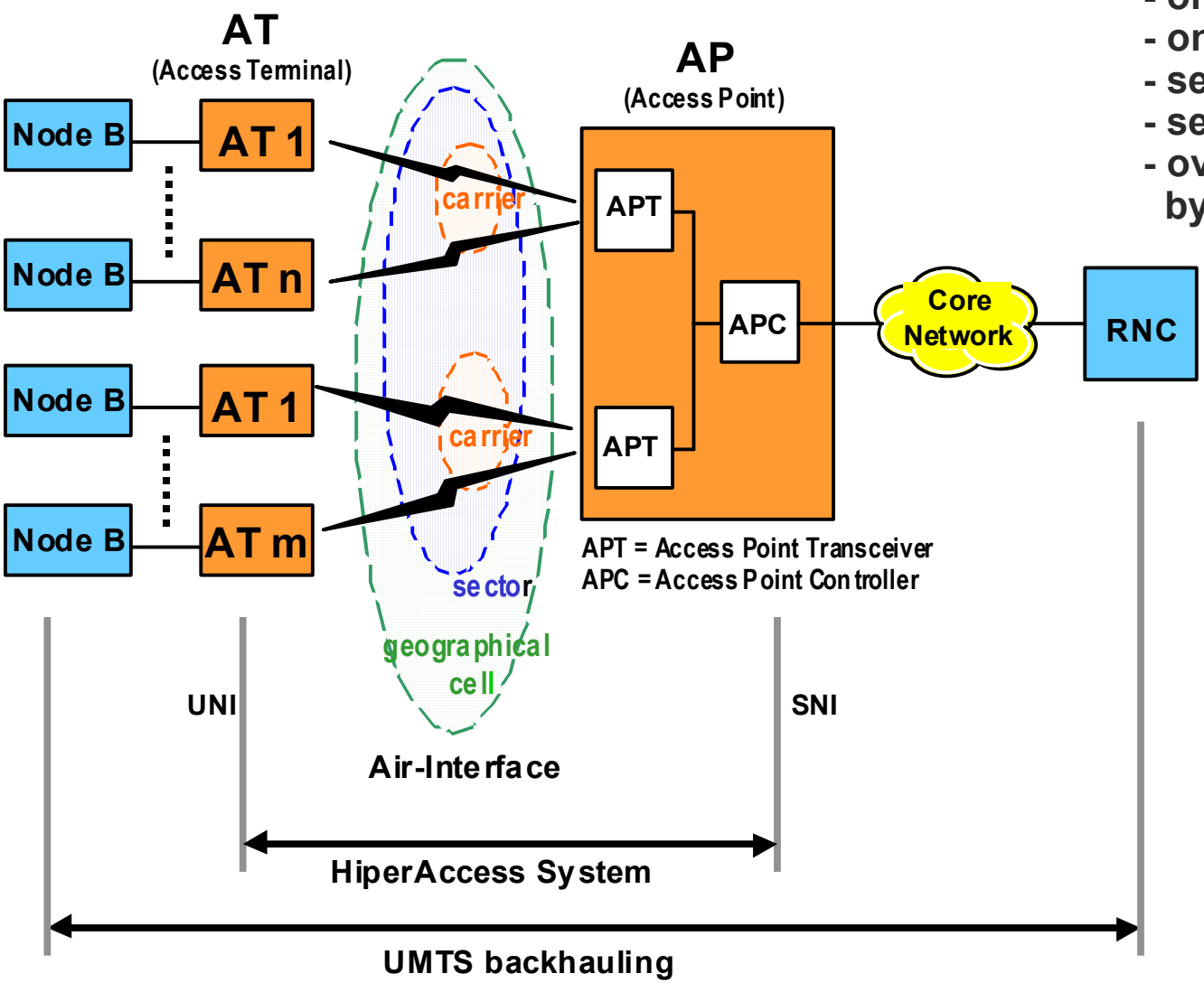
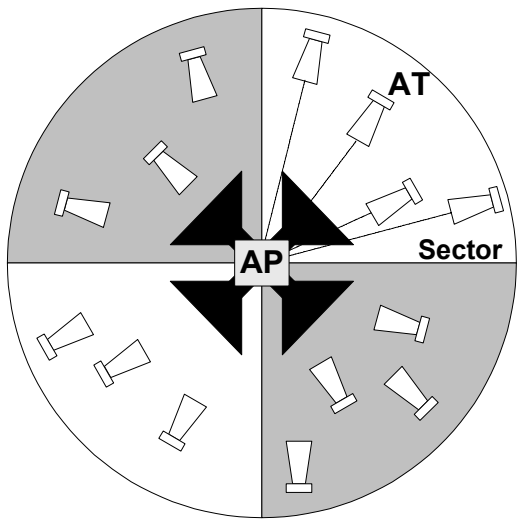
HiperAccess: Overview

- **Point-to-Multipoint (PMP)** topology
- **Interoperability** (testing is normative part of standard)
- Standard allows for **vendor-differentiated** products, e.g.,
  - management,
  - core network interfaces,
  - ARQ,
  - broad range of cellular constellations
  - security,
  - bandwidth allocation strategies, ...
- **Spectrum efficient** (both for IP and ATM core networks)
- **Interest in HA from**
  - Manufacturers: Alcatel, Ensemble, Ericsson, Marconi, Nokia, Siemens, ...
  - Operators: France Telecom, Omnitel Vodafone, Sonera, Telecom Italia, Telekom Austria, Telenor, Telia, ...

HiperAccess: Network Topology Model

- 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

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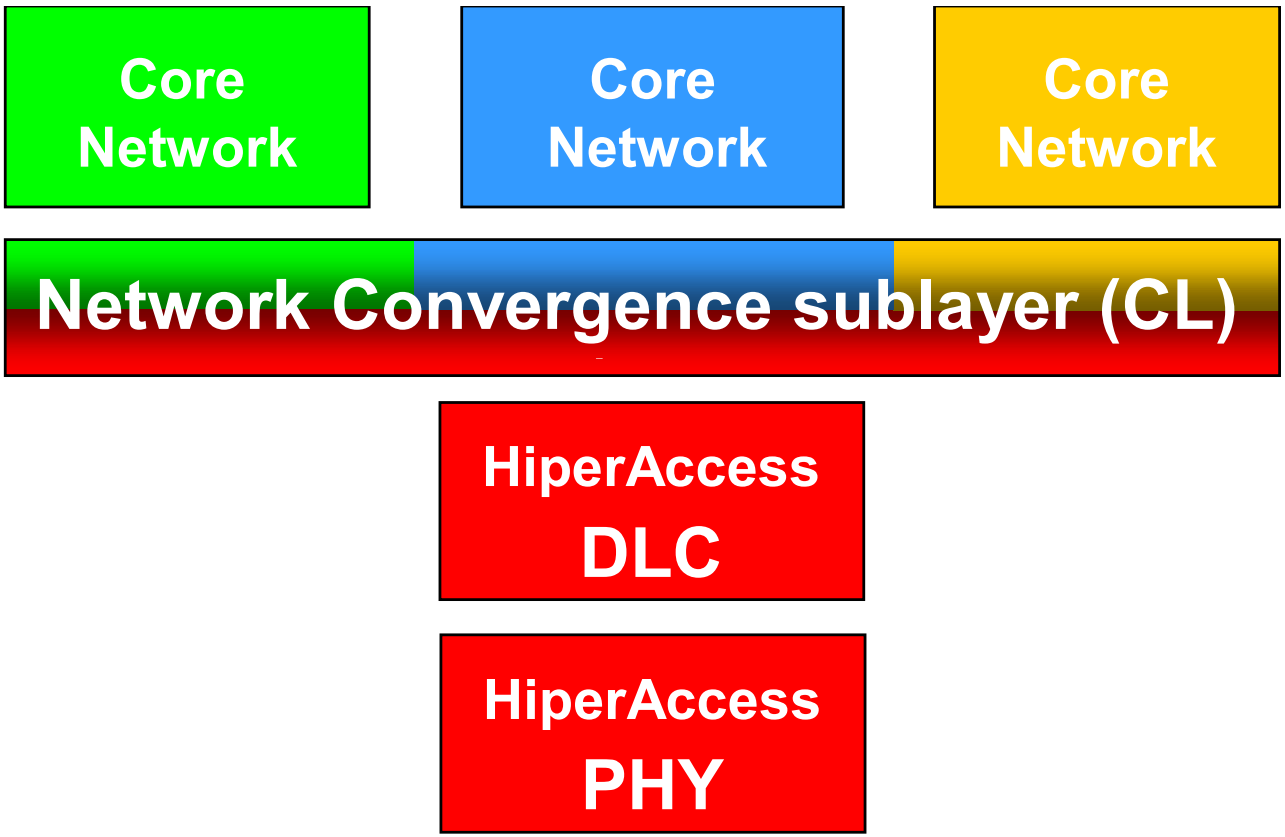
Interworking Approach (shown for HA, similar for all BRAN systems)



Core Networks:
ATM, IP, ISDN, PSTN,...

Removes differences between core networks

Matched to the requirements for supporting ATM and IP

Ensure cost-effective implementation and spectral efficiency

DLC and PHY layers are independent of the core network

HiperAccess: Basic Features

Focus on frequency bands

- 40.5 - 43.5 GHz
- 31.8 - 33.4 GHz
- 27.5 - 29.5 GHz
- 24.5 - 26.5 GHz
- other lower frequencies

Channel size = 28 MHz, Baudrate = 22.4 MBaud

- Paired bands (FDD mode, fixed asymmetric rates)
- Unpaired bands (TDD mode, adaptive asymmetric rates)
- Optimum trade-off between costs, peak data rate and statistical multiplex gain

Important 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 (depending on availability and rain zone)	

HiperAccess: Adaptive Coding and Modulation

Adaptation

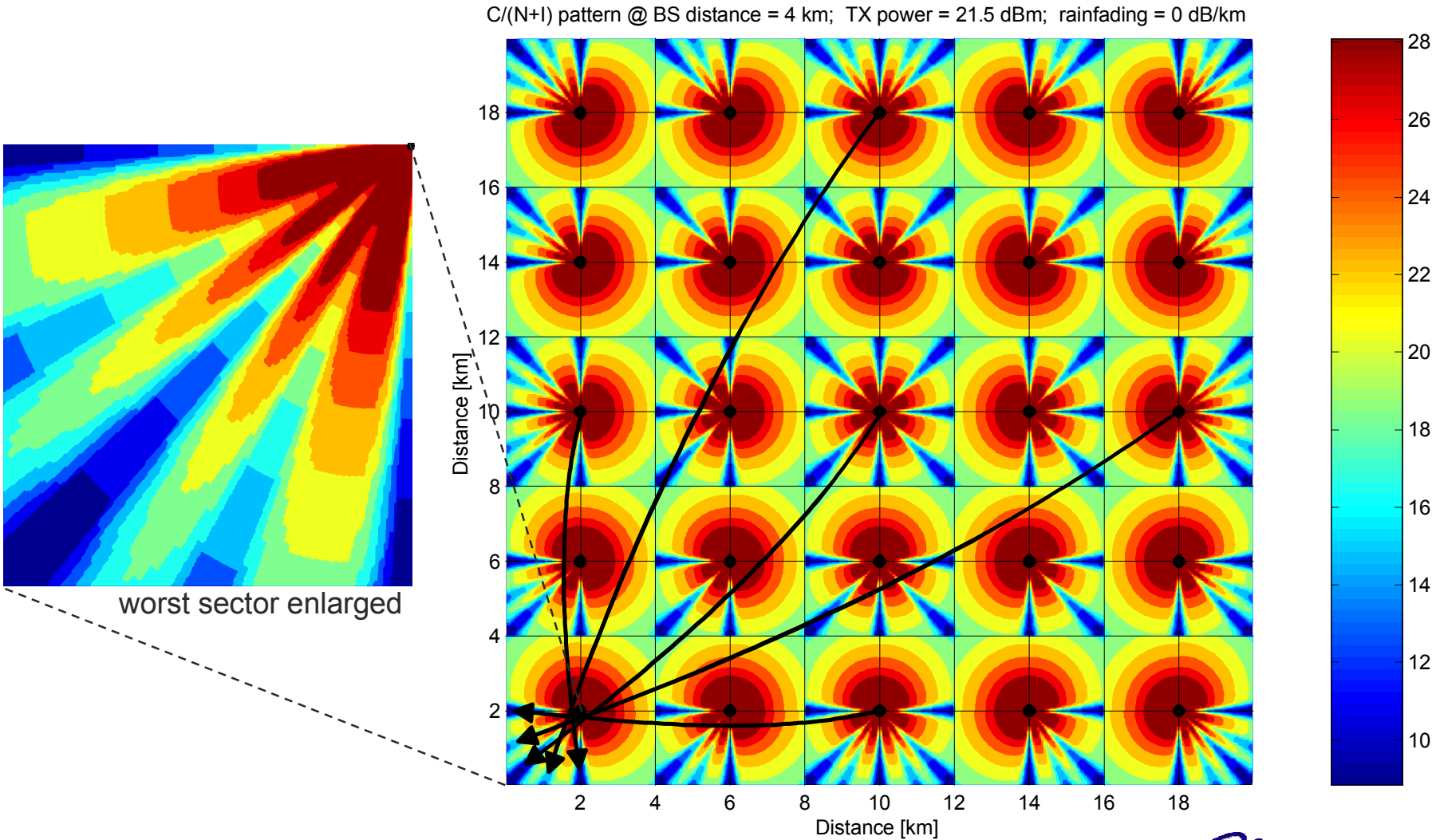
- according to distance
- according to interference
- according to rain fading (20 dB/s)
- per terminal
- per frame
- combined with ATPC (Adaptive Transmit Power Control)

PHY mode defined by modulation and concatenated coding

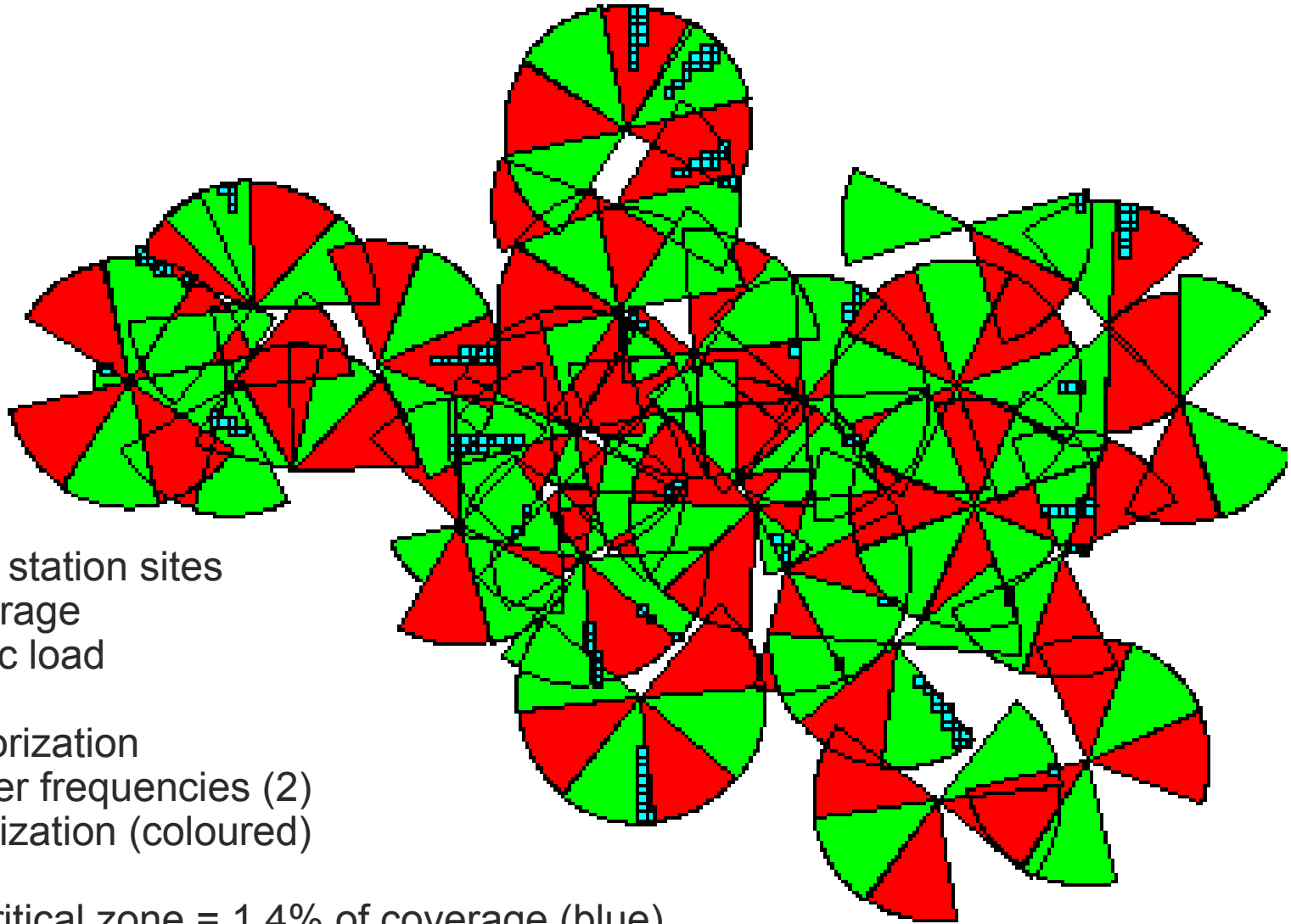
Mode	Modulation	Outer Block Code	Inner Convolutional Code	Information word length	Spectral efficiency	Required C/(N+I)
0 (CZ)	QPSK	RS(t=8)	R=1/2	30 byte	from ~ 0.5 bit/s/Hz to ~ 3.8 bit/s/Hz	7 dB
1	QPSK	RS(t=8)	R=2/3	1...4 PDU		8 dB
2	QPSK	RS(t=8)	-	1...4 PDU		12 dB
3	16-QAM	RS(t=8)	R=7/8	1...4 PDU		18 dB
4	64-QAM	RS(t=8)	R=5/6	1...4 PDU		25 dB

PHY mode set 1

HiperAccess: C/(N+I) Pattern in a 5x5 Rectangular Constellation (Downlink, ClearSky, Re-use=4)



Marconi's Radio Network Planning Tool (Realistic Constellation with 142 Sectors)



Input: Base station sites
Coverage
Traffic load

Output: Sectorization
Carrier frequencies (2)
Polarization (coloured)

Interference critical zone = 1.4% of coverage (blue)

ETSI Approach for Normative Testing Interoperable Standard

Basic protocol standard development

- **Abstract Syntax Notation (ASN.1) message structure specification, ITU-T X.680**
- **Packed encoding rules (PER) for transfer encoding, ITU-T X.691**
- **Message Sequence Charts (MSC) for message flow description, ITU-T Z.120,**
- **Specification and Description Language (SDL) specification, ITU-T Z.100**
  - SDL models used to precisely define the protocol behaviour.
  - Simulations and validations to early remove ambiguities and erroneous protocol behaviour.

Protocol test specifications (ITU-T X.291...296, ISO/IEC 9646)

- **PICS** **Protocol Implementation Conformance Statement**
- **TSS & TP** **Test Suite Structure and Test Purposes**
- **ATS** **Abstract Test Suite (TTCN)**
  - Significant effort was spent (30 man month of funded expert work plus voluntary contribution by member companies and ETSI PTCC work)

Radio test specifications

- **RCT** **Radio Conformance Test**
- **EN** **Harmonized Standard (European Norm)**, covering the essential requirements of article 3.2 of the EC R&TTE Directives

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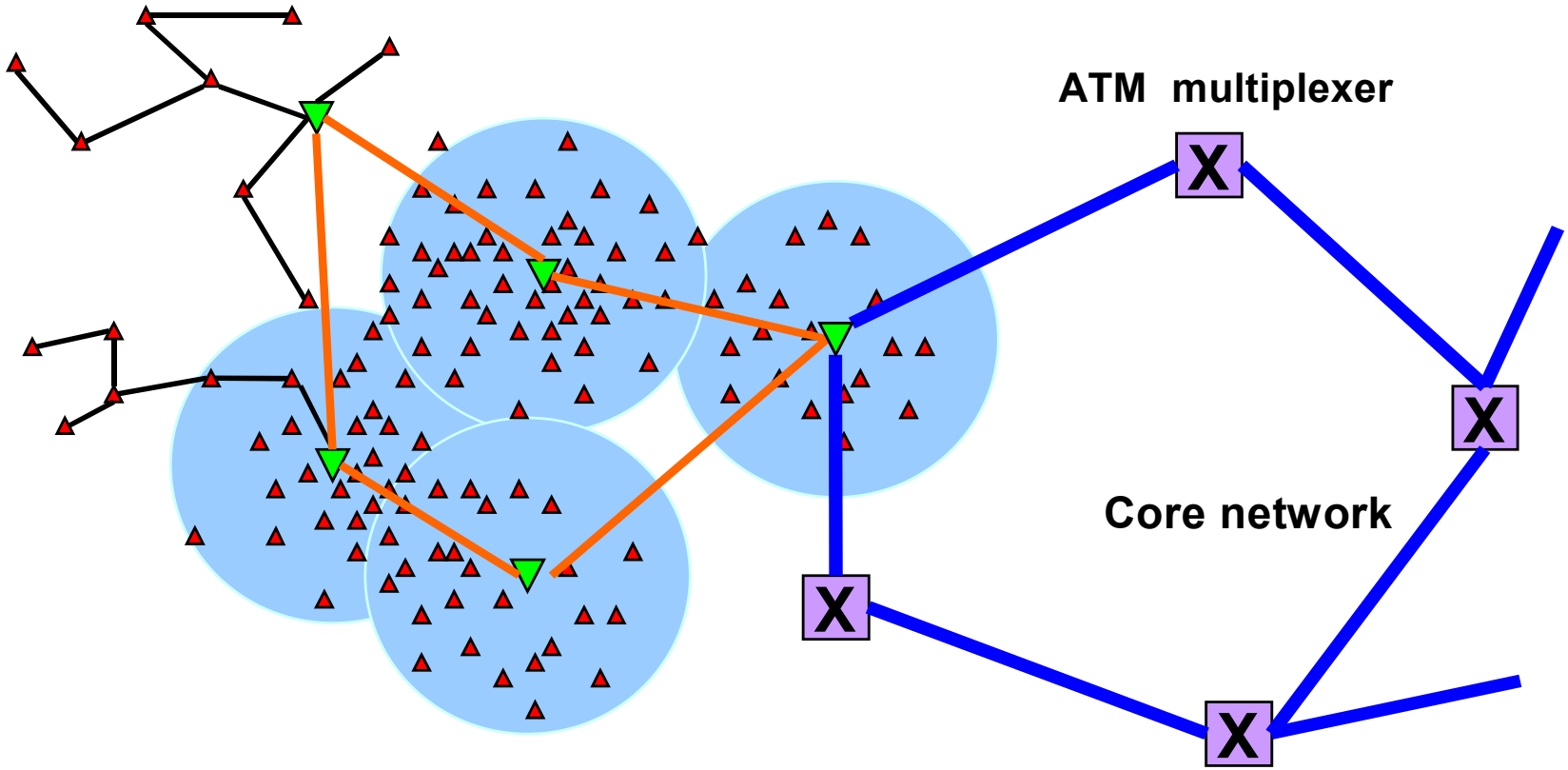
Marconi's PMP / PTP Network Solution for UMTS Backhauling



Future access network IP-based

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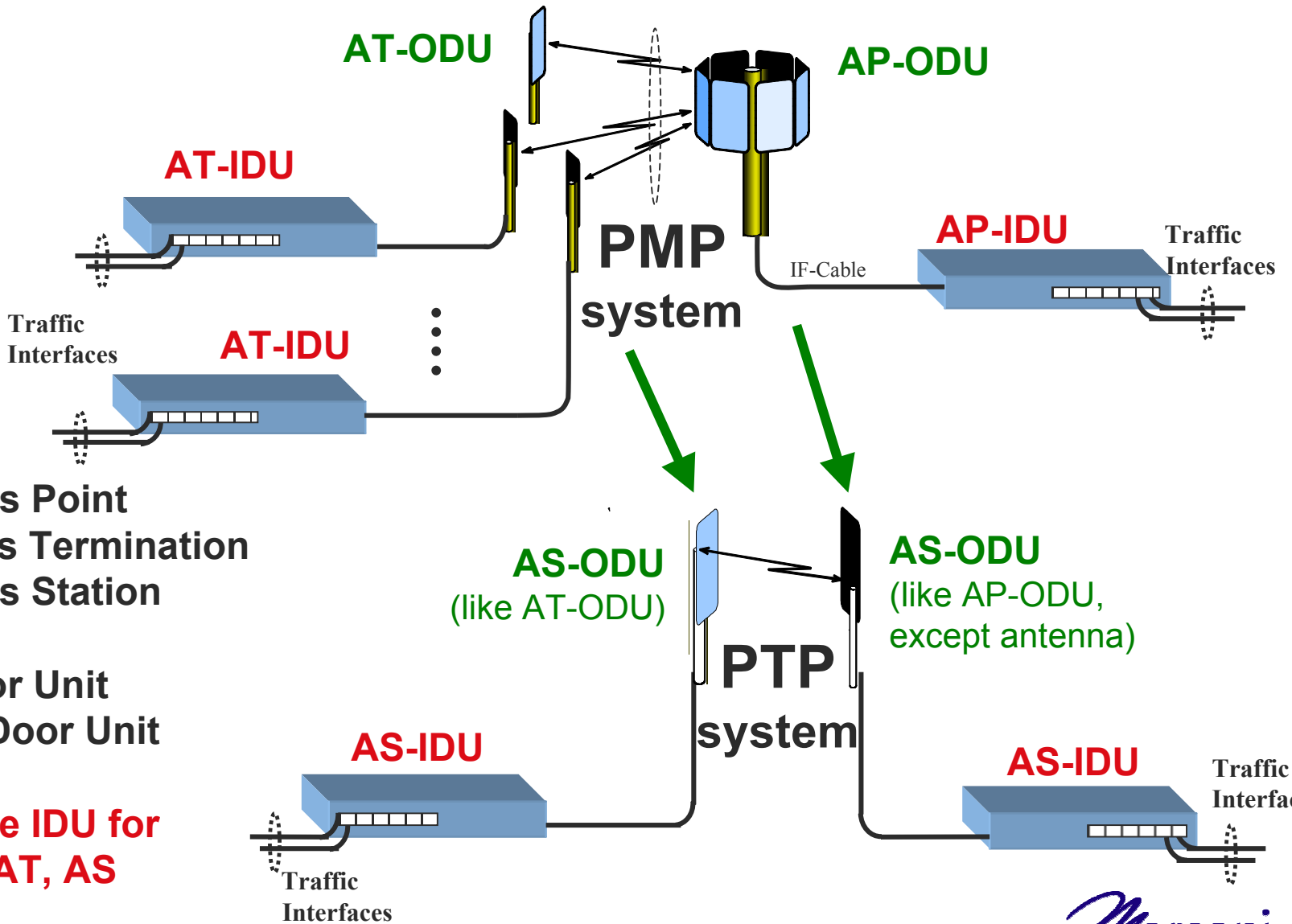
Marconi's Components for PMP and PTP



AP: Access Point
AT: Access Termination
AS: Access Station

IDU: InDoor Unit
ODU: OutDoor Unit

Note: Same IDU for AP, AT, AS

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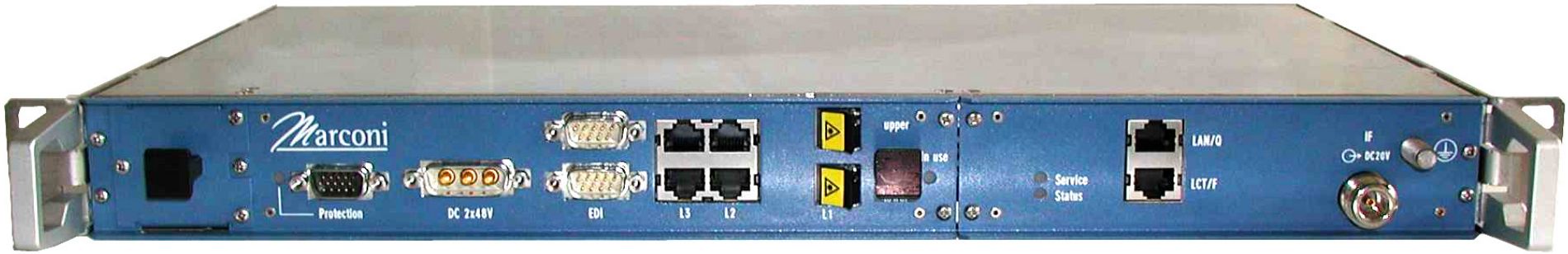
Marconi's IDU
for HA-compliant-PMP and PTP systems



Protection (Redundancy)

Power

EDI (External Device Interface)

4 x E1-IMA-ATM
4 x E1-CES
2 x 100BaseT

2 x STM1 (optical)

2 x Management (local and remote)

ODU (IF cable)

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Conclusions

- **BRAN is an important, respected and lively EP in ETSI**
- **Co-operation and harmonization with many other bodies**
- **Technical excellence, HA as an example:**

Requirement	→	HiperAccess solution:
Interoperability		Few well-controlled options, ASN.1-based message encoding, detailed test specifications.
Spectral efficiency		Adaptive modulation & coding & power control.
High QoS		Centralized control and scheduling, robust messaging.
Low cost design		Large network-independent part, option for TDD, support of H-FDD.
Future proof		„hooks“ for future evolution, phased roll-out: 1st ATM, 2nd IP

For more information ...

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