Baseline Proposal
EFM_PHY_rev 0.3

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Arriving to EoVDSL

- Section 1.0

Arriving to EoVDSL
Goals

- Specify a PHY which is compliant with
  - IEEE 802.3 Architecture
- and which covers all the objectives of the EFM Task Force (Cu track):
  - 10Mbps full duplex on a single pair @ 750 meters
  - Spectrally Compatible WW
  - Optional Multi-pair Mode
- Additionally leverages ITU-T G.995.1 Reference Layered Protocol Architecture

Arriving to EoVDSL
Principles

- When applicable to EFM, take text from existing standards “as is”.
- Add specifications for parts that are not standardized elsewhere.

Arriving at EoVDSL

Standardized VDSL as basis for EFM-Copper PHY

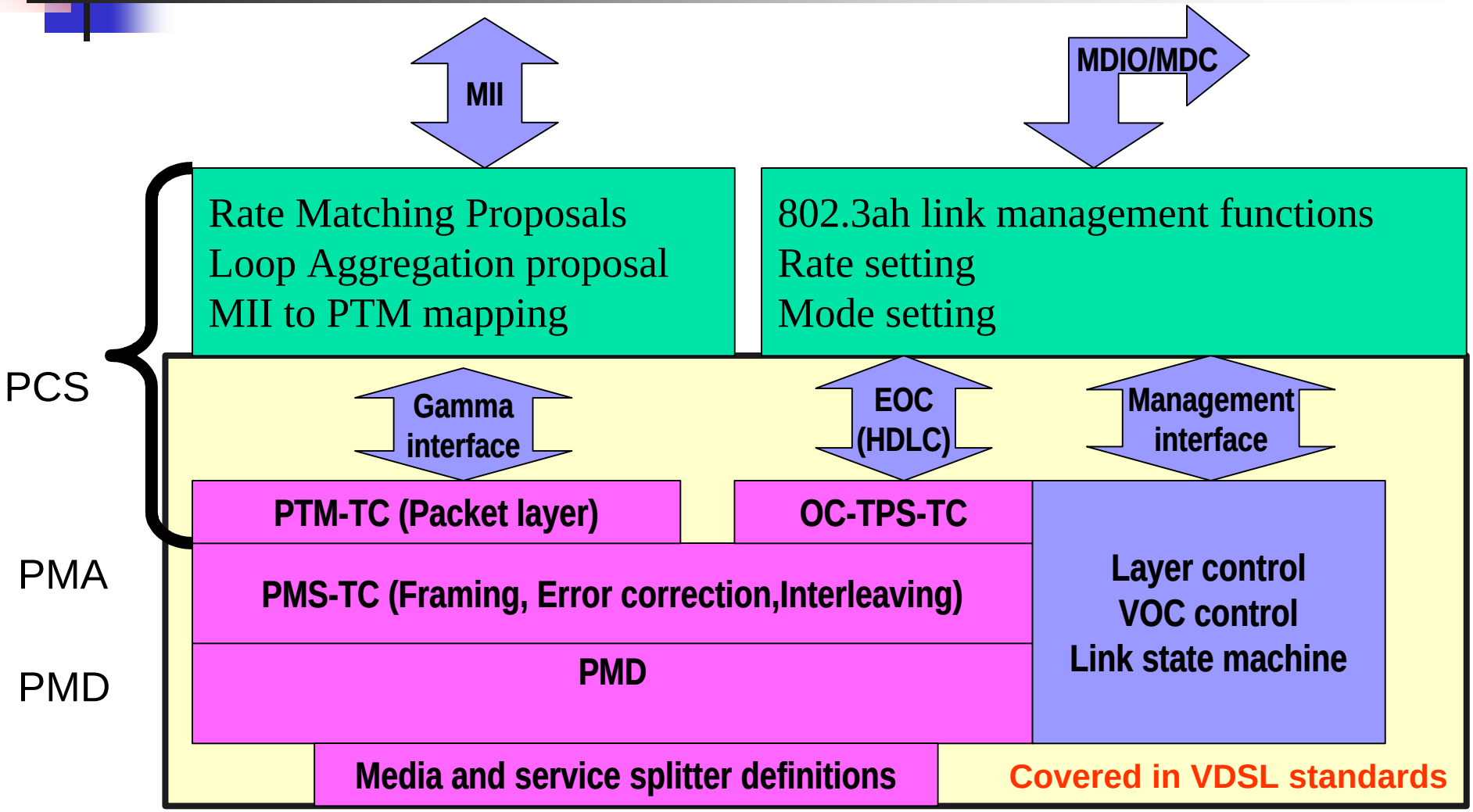
This presentation provides the details and open issues:

- How standards-based VDSL can be used as the basis for 802.3ah PHY
  - Sublayers can be taken, from ANSI/ETSI/ITU standards for VDSL
  - Changes/additions need to be defined by the EFM in order to create a definition that meets public network standards and IEEE PAR objectives
- VDSL is standardized in:
  - ETSI TS10127001 (requirements) and TS10127002 (specification)
  - T1E1's draft trial use standard <LB941-D>
  - ITU's G.993.1

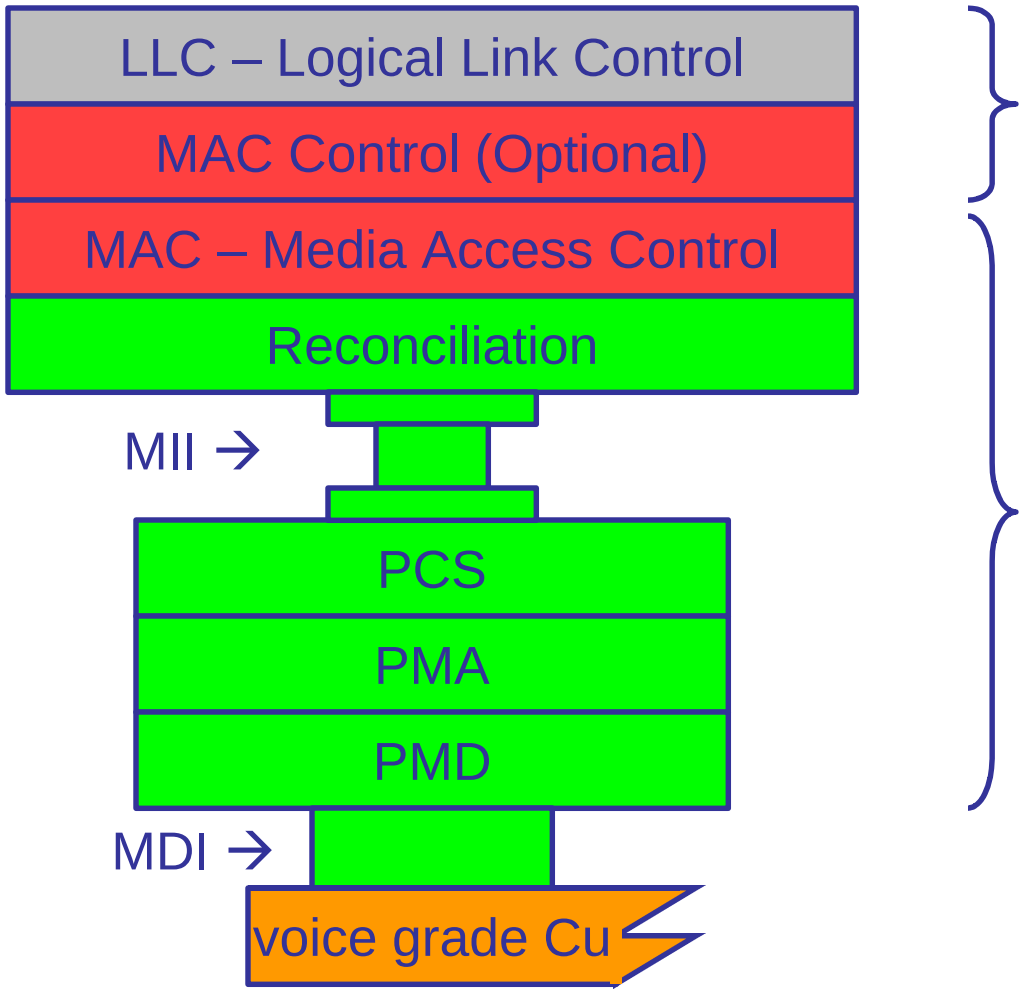
Architectural and Protocol Requirements

- Section 2.0

Architectural and Protocol Requirements
Overall interfaces



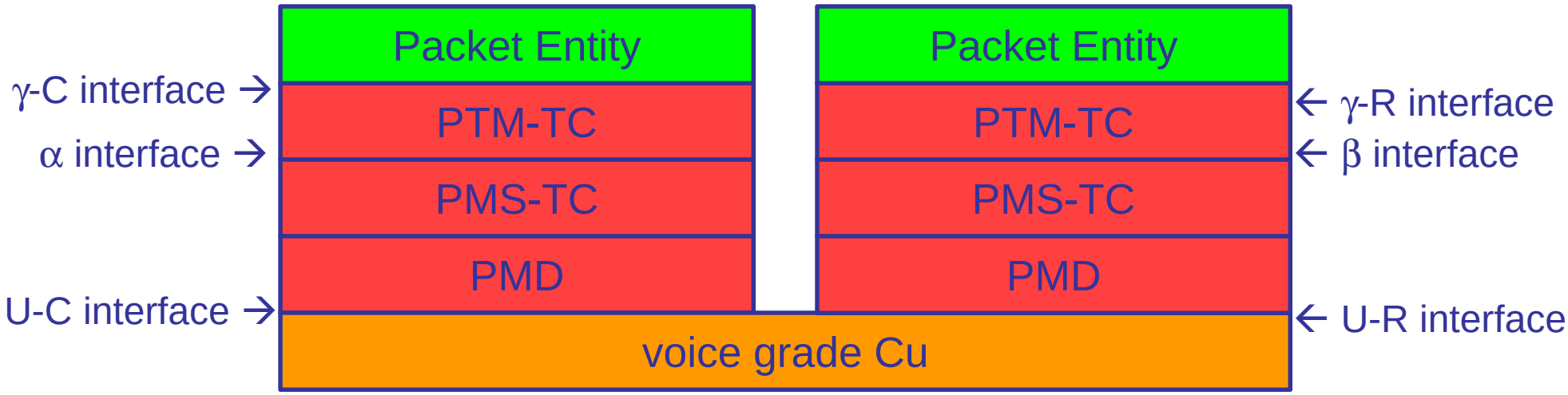
Architectural and Protocol Requirements IEEE 802.3 (10/100 Mbps)



"Minimal changes" are allowed here if necessary.

The approved PAR authorizes the EFM Task Force to specify these layers.

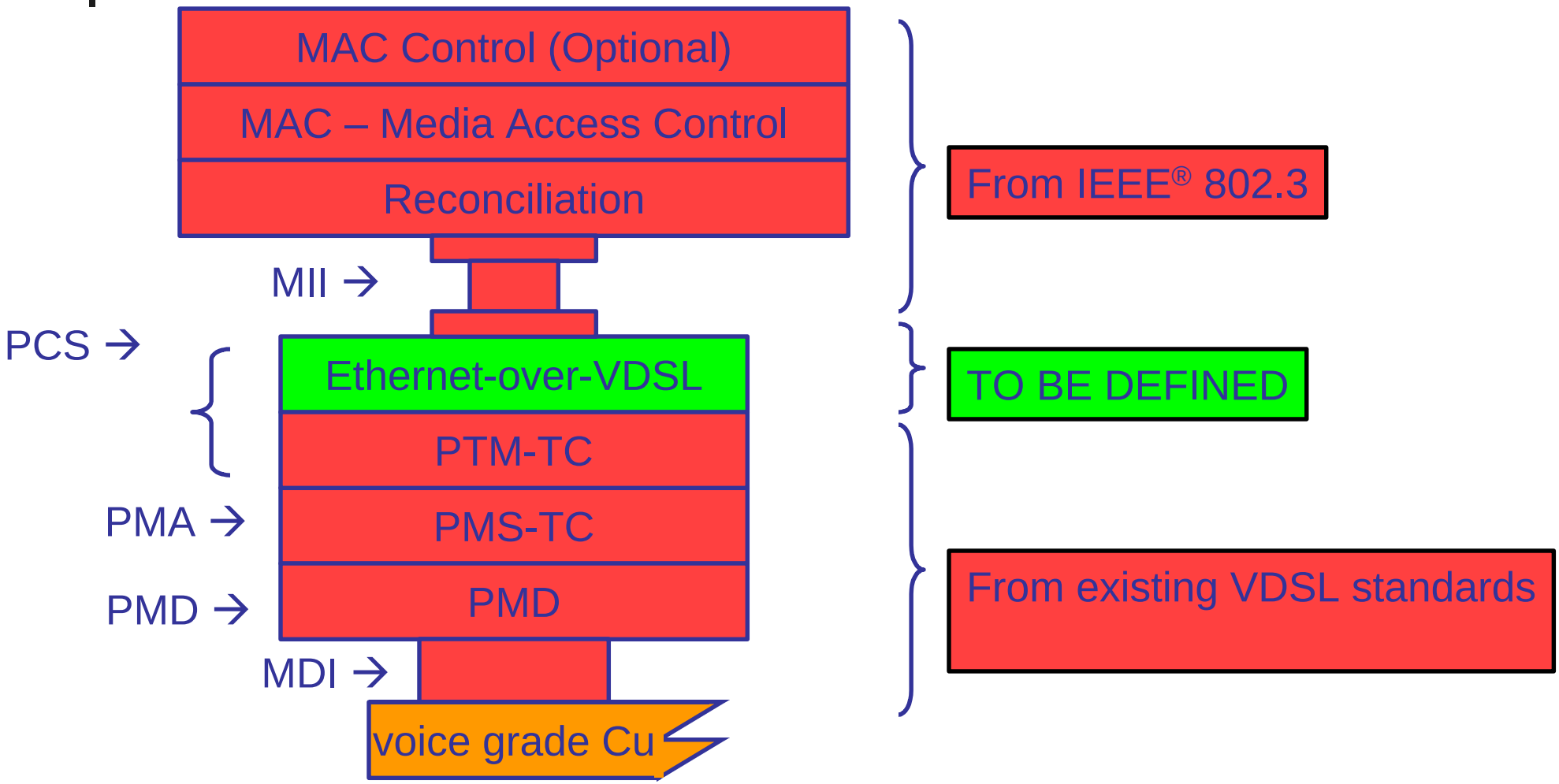
Architectural and Protocol Requirements
ITU-T G.995.1 reference model



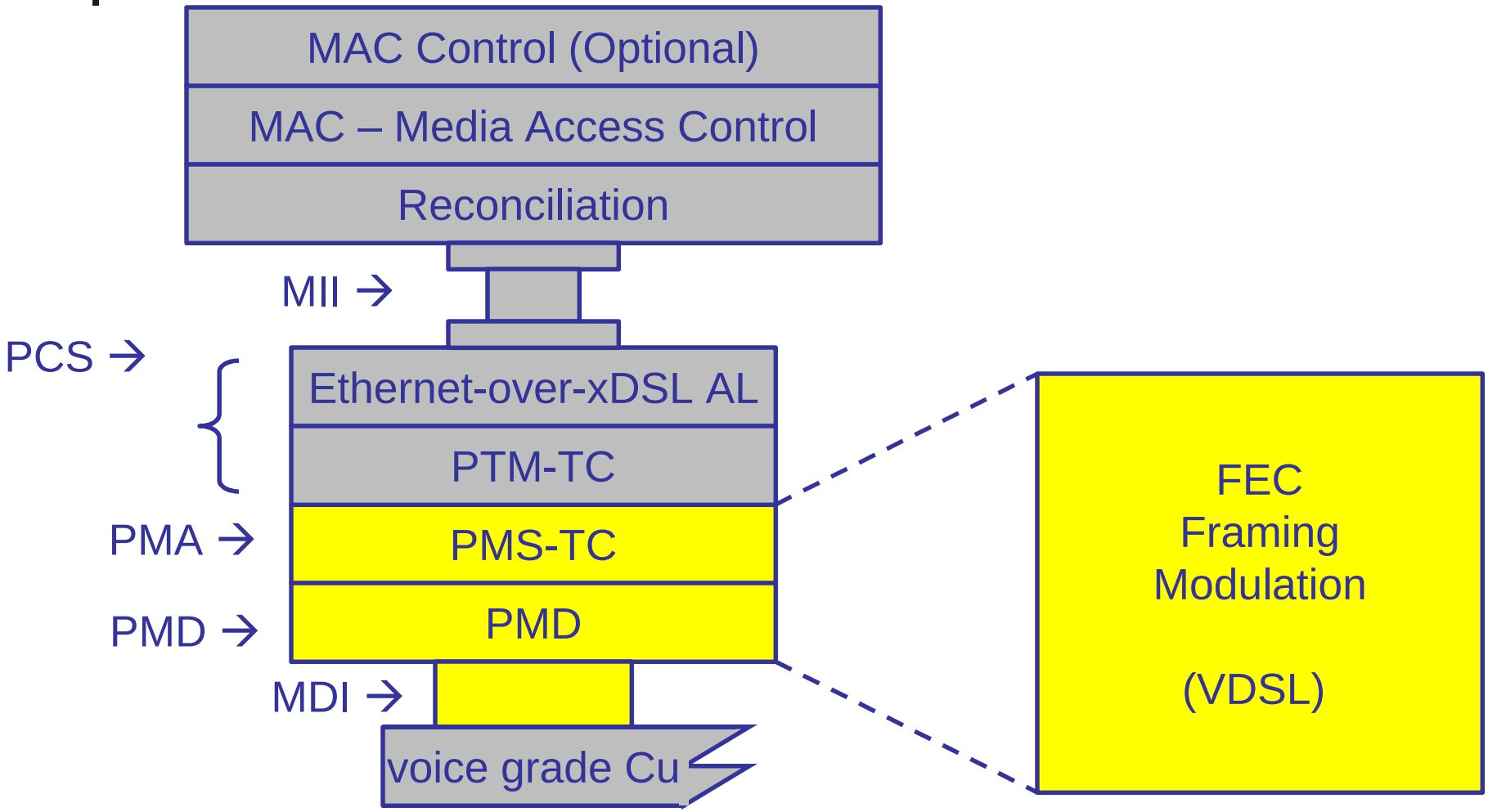
The red blocks have been specified for different media/service requirements.

The green blocks have been declared “out of scope” by ITU-T, and can be used for EFM.

Architectural and Protocol Requirements
Merged Model



Architectural and Protocol Requirements
PMS-TC/PMD



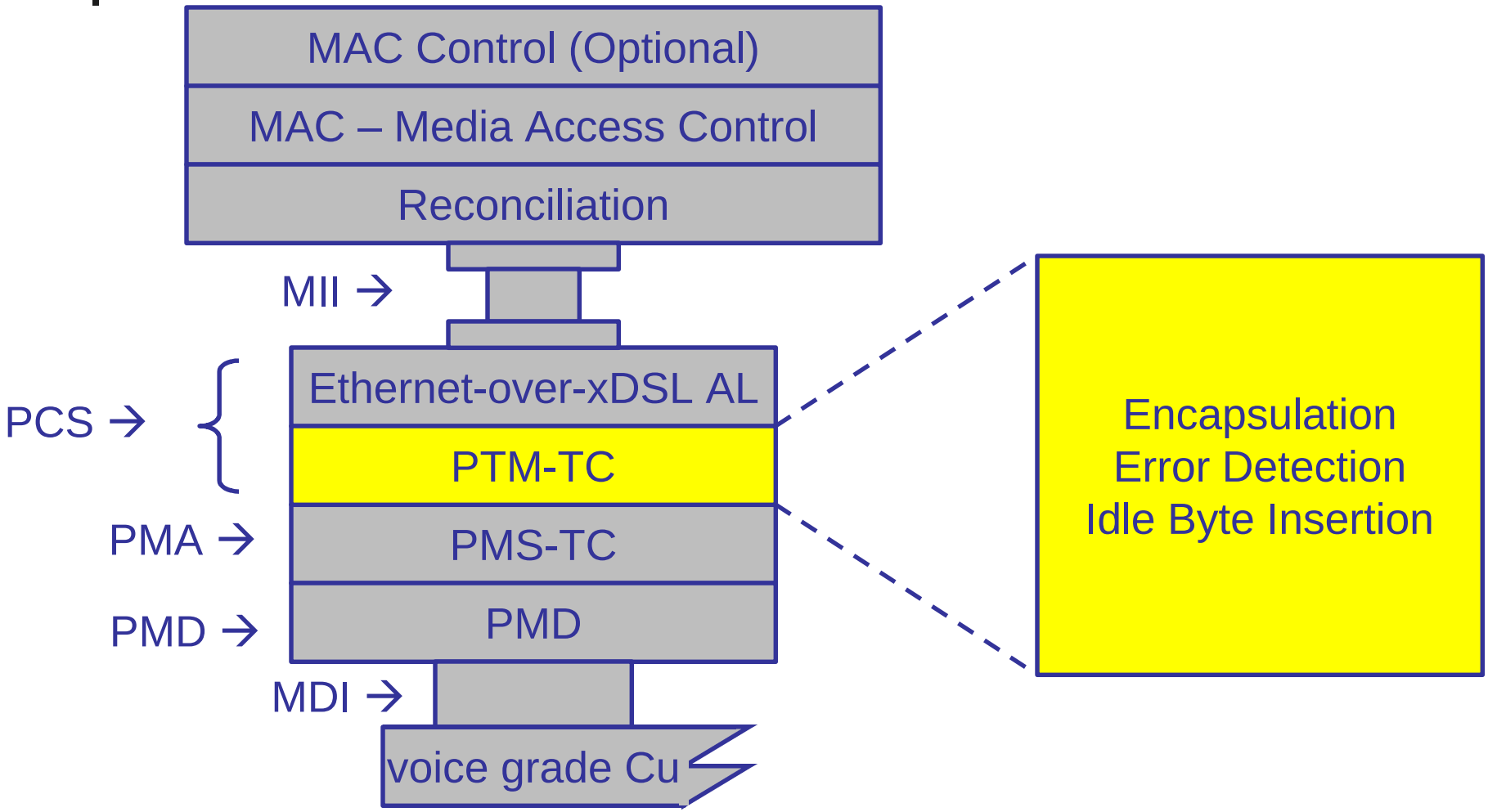
Architectural and Protocol Requirements
PMS-TC/PMD ITU-T G.993 Transceiver Specifications

- G.993.1 VDSL
  - VDSL technical foundation
  - Different regional band plans approved by ITU-T.
  - At this time, the Recommendation does not yet specify the modulation method.
  - A pointer to the physical layers of the T1E1.4 Trial Use standard is appropriate.
  - Specifies TPS-TC sublayers

Architectural and Protocol Requirements
PMS-TC/PMD ITU-T G.99x reference documents

- G.994.1 “Handshaking Procedures for DSL Transceivers”
- G.995.1 “Overview of DSL Recommendations”
- G.996.1 “Test Procedures for DSL Transceivers”
- G.997.1 “Physical Layer Management for DSL Transceivers”

Architectural and Protocol Requirements
PTM-TC



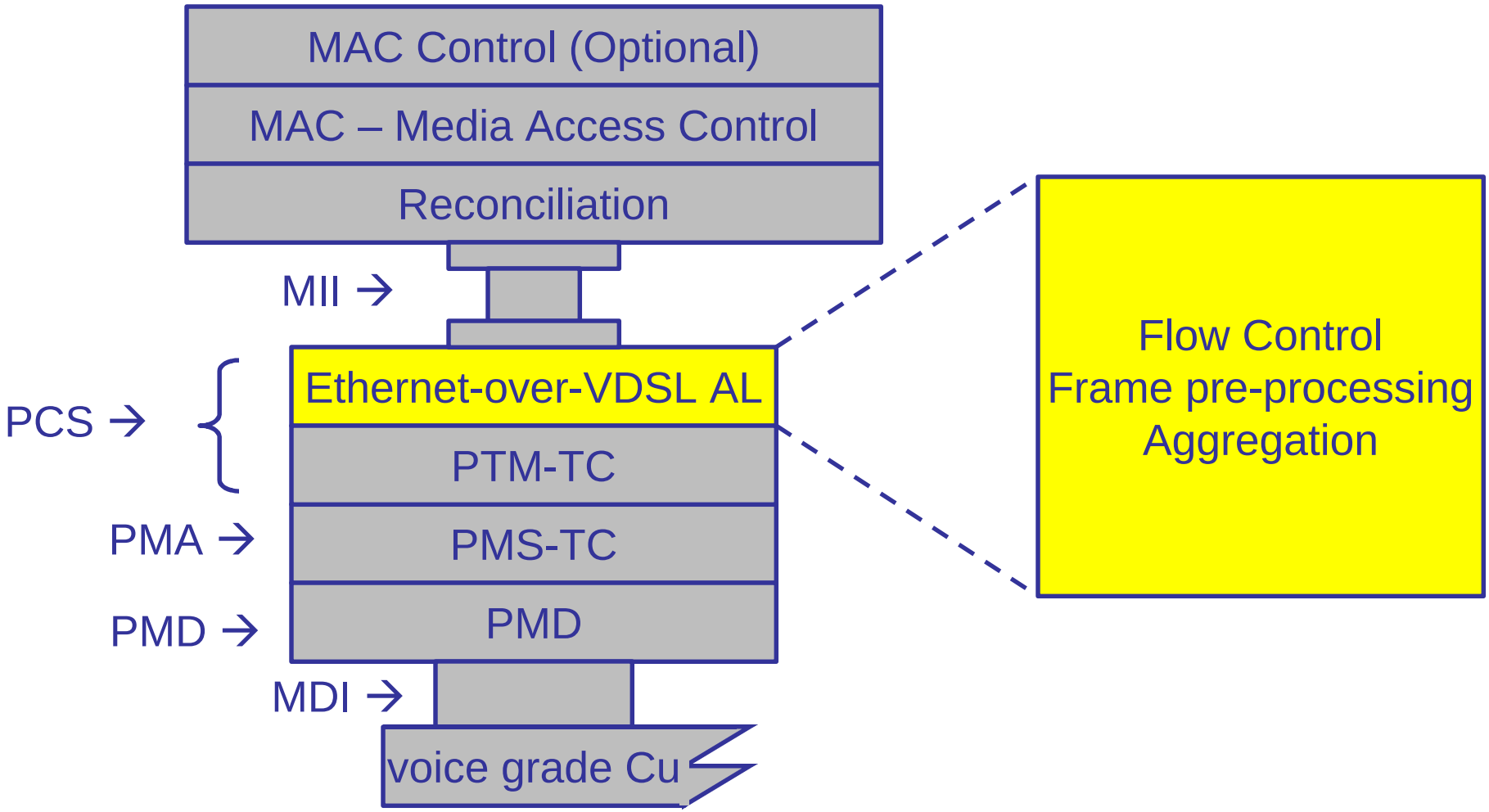
Architectural and Protocol Requirements
PTM-TC description

- Transmit PTM-TC Layer performs HDLC encapsulation
  - Byte stuffing mode
  - 0x7E Bytes are inserted between packets
  - CRC-16
- Receive PTM-TC Layer performs decapsulation
  - Every received packet is sent to the Packet Entity, an error signal is provided at the end of the packet (OK/CRC/abort)
- Interfaces
  - With the physical layer: α/β-interface
  - With the Packet Entity: γ-interface (PTM-TC controls the flow)

Architectural and Protocol Requirements
PTM-TC References

- Architecture and γ-interface
  - ITU-T Annex H /G.993.1
  - ITU-T Liaison Letter SC-097R2.pdf

Architectural and Protocol Requirements
Ethernet-over-VDSL Adaptation Layer



EoVDSL PHY Rate Matching and loop aggregation

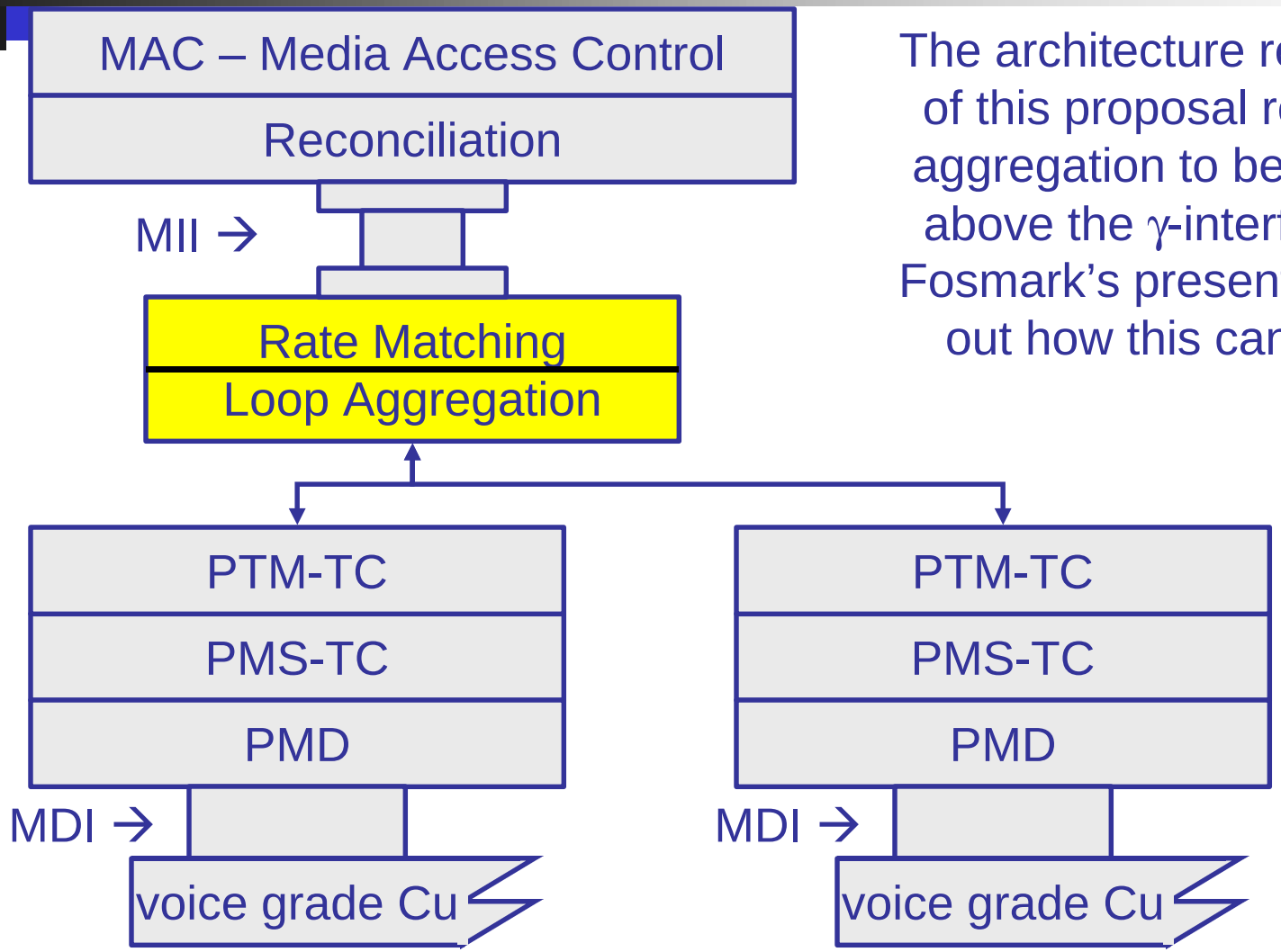
- Section 3.0

EoVDSL PHY Rate Matching
References, separate baseline propsoals

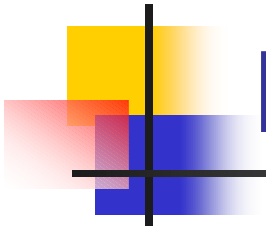
- Flow Control
- MII: Arthur Marris' proposal marris_1_0302
  - Aggregation
- fosmark_1_0302.pdf. It will be covered in a separate baseline proposal

EoVDSL PHY Rate Matching and loop aggregation

Reference Model for Rate Matching and Loop Aggregation



The architecture requirements of this proposal require loop aggregation to be carried out above the γ-interface. Klaus Fosmark's presentation points out how this can be done.

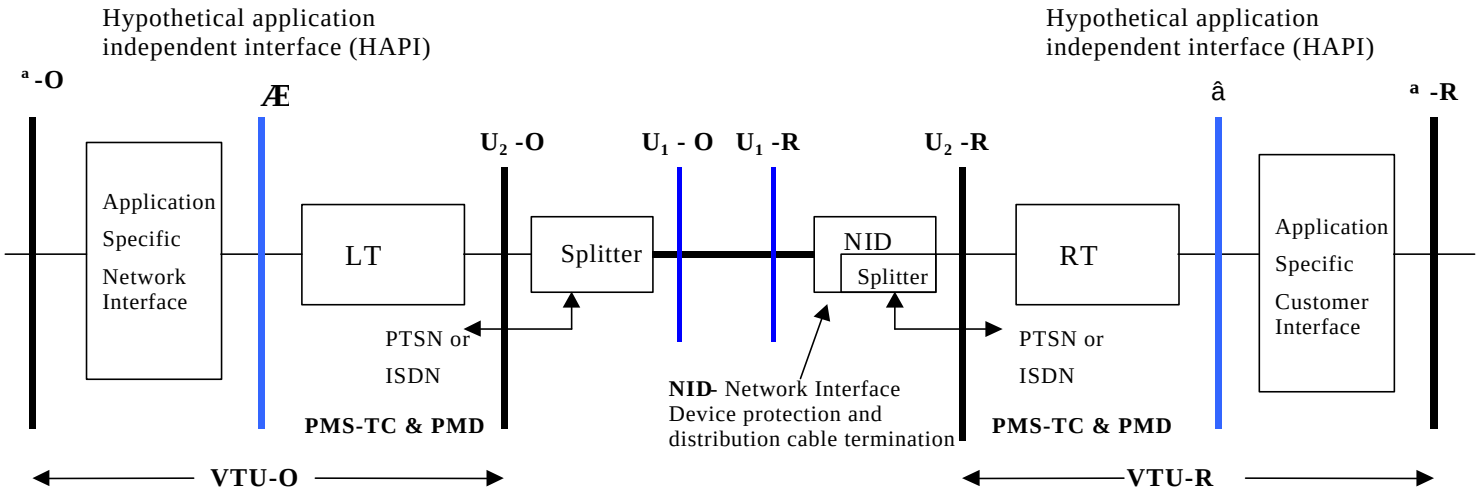


EoVDSL Specifications

- Section 4.0

EoVDSL Specifications

VDSL reference model



- **The VDSL reference model, chapter 5.1 VDSL-Part 1/T1E1.4**
  - **There are 2 types of devices:**
    - **VTU-O: The master device, located in the switch/line card**
    - **VTU-R: The slave device, located in customer's premises (such as a NIC or CPE)**
  - **Service splitter allows the loop to be shared with POTS or BR-ISDN**
- The VTU-R (NT) resembles the VTU-O except:
  - **Network timing reference (NTR) is an output**
  - **Device acts has a slave link state machine and is controlled by the VTU-O**

EoVDSL Specifications

The PMD layer (T1E1.4 VDSL Part 1, section 8)

- Two line codes are referenced by section 8 of ANSI's part 1:
  - QAM PMD is defined in part 2 of VDSL spec (T1E1.4)
  - DMT PMD is defined in part 3 of VDSL spec (T1E1.4)
- A T1E1 trial use standard is valid for two years with both line codes supported during this period
- Power control and line interfacing performed by PMD layer

EoVDSL Specifications

PMD details – Parts 2 & 3 of T1E1.4

- **Baseline PMD proposal includes:**
  - All items covered in parts 2 and 3 of T1E1.4 trial use spec
  - PMD MIB parameters
  - Profiles (as appropriate)
  - Control functions (via Code words, EOC/VOC, link state?)
  - Simplifications where applicable
- **Common elements between line codes will be consolidated**
  - States, PSD masks ...

EoVDSL Specifications

PMD – items defined in VDSL pt 1 (i)

- Section 5.5 coexistence with POTS & ISDN (also section 12)
  - Do we need ISDN co-existence? Regional Annex (A,B,C)?
- Sections 5.6, 5.7 – remote power and repeater – not needed
- Section 6 transport capacity & performance
  - Payload rates better defined in parts 2 & 3 than part 1
  - Define profiles / parameters for the MIB?
- Performance requirements
  - Probability of error 10^{-7} (with 6dB margin)
  - This is effective BER with RS FEC

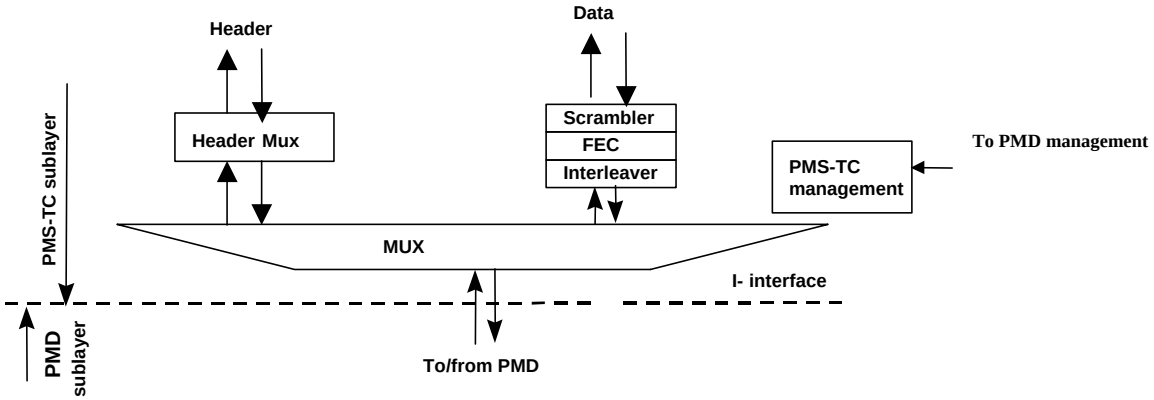
EoVDSL Specifications

PMD – items defined in VDSL pt 1 (ii)

- Section 7 – U interface
  - PSD templates/power – use as is?
  - Spectral Plan – 998, 997, Fx, proprietary?
  - Allow variances (via MIB parameters) or fix?
  - PnP compatibility with multiple spectra?
- Section 7.1.3 Power control (includes UPBO)
  - PBO mask or “better” technique?
- Termination impedance, return loss, signal balance
  - All – as is
- Connector definition?
  - Demarcation point for standard...

EoVDSL Specifications

PMA layer (PMS-TC)

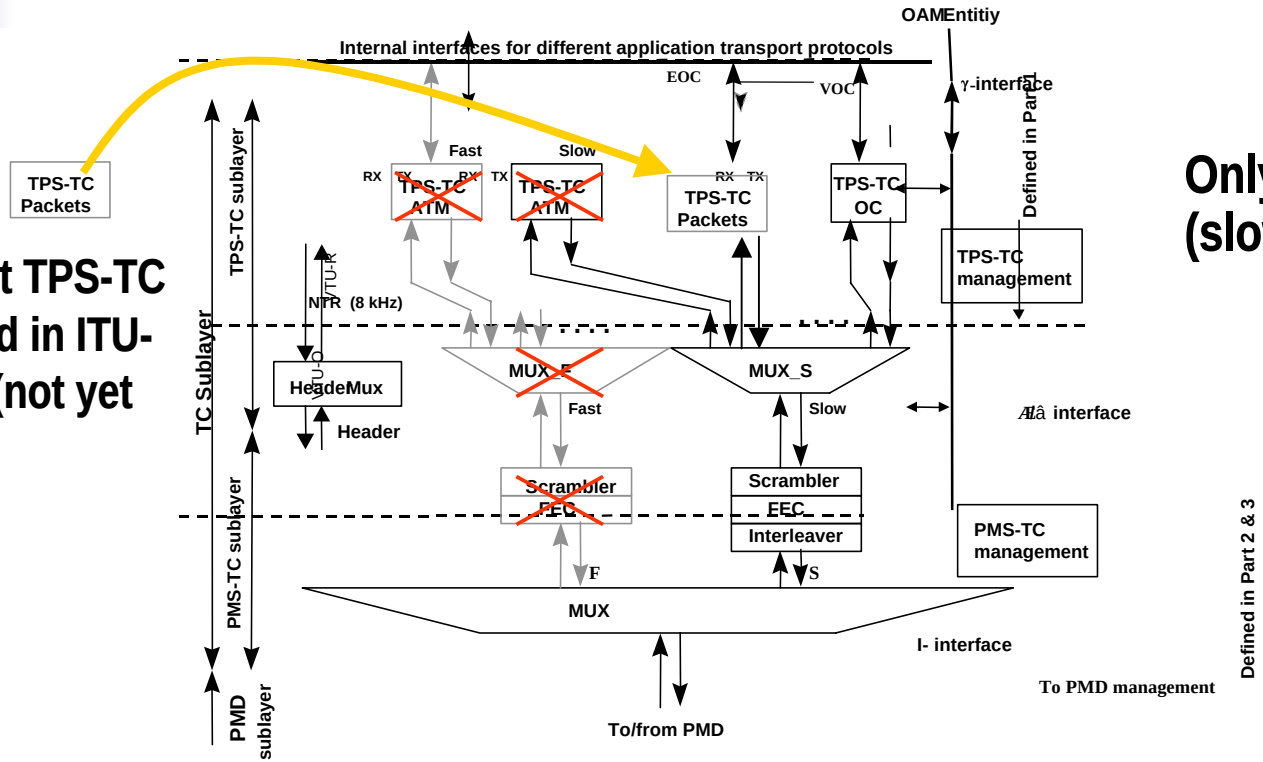


- PMA – mostly common between line codes
  - Scrambler, FEC, Interleaver all common
- I-interface (to PMD)
  - Only one data stream (Tx + Rx)
  - EOC, VOC defined as part of frame across I-interface
- Latency
  - Single latency only with programmable delay

EoVDSL Specifications

Transmission Convergence reference model (VDSL Part 1, section 9)

The Packet TPS-TC is specified in ITU-T G.993.1 (not yet in T1E1)

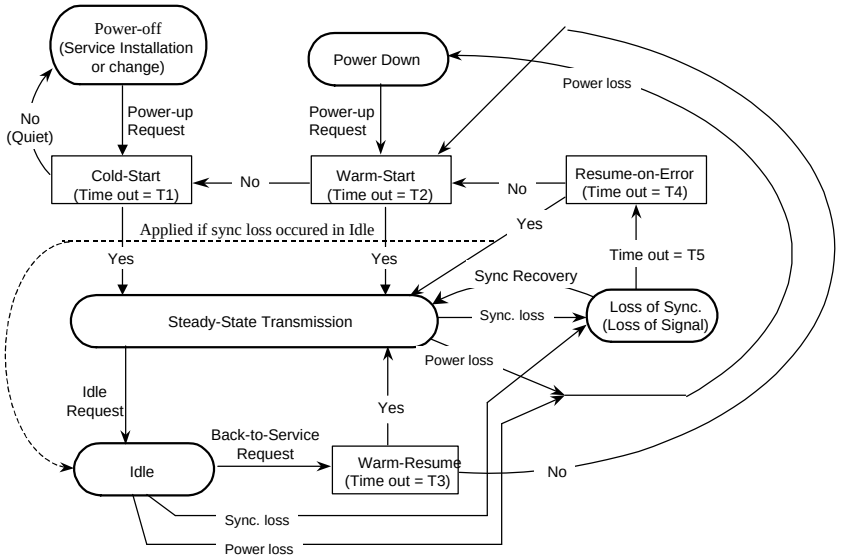


Only the interleaved (slow) path is supported

- **Only two TPS-TC functions supported:**
  - Packet Transfer Mode as defined in Annex H / G.993.1
  - VDSL embedded operations channel (EOC)
  - PCS (TPS-TC) is common for both line codes

EoVDSL Specifications

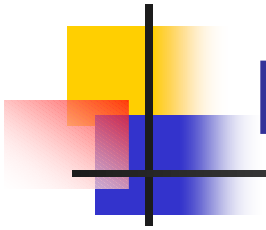
The T1E1 VDSL link state machine



- Areas for work
  - Simplification, unnecessary states?
    - Warm start, Resume on error, Power down, Loss of sync, Warm resume, Idle...
  - Timing & stability, define hysteresis

PCS – Encapsulation

- Between MII interface and alpha/beta interface
  - TBD
    - HDLC as defined in annex H / G993.1
    - 64b/66b
- Errored frames are handled as defined by ITU
- OAM
  - Needs liaison with OAM track

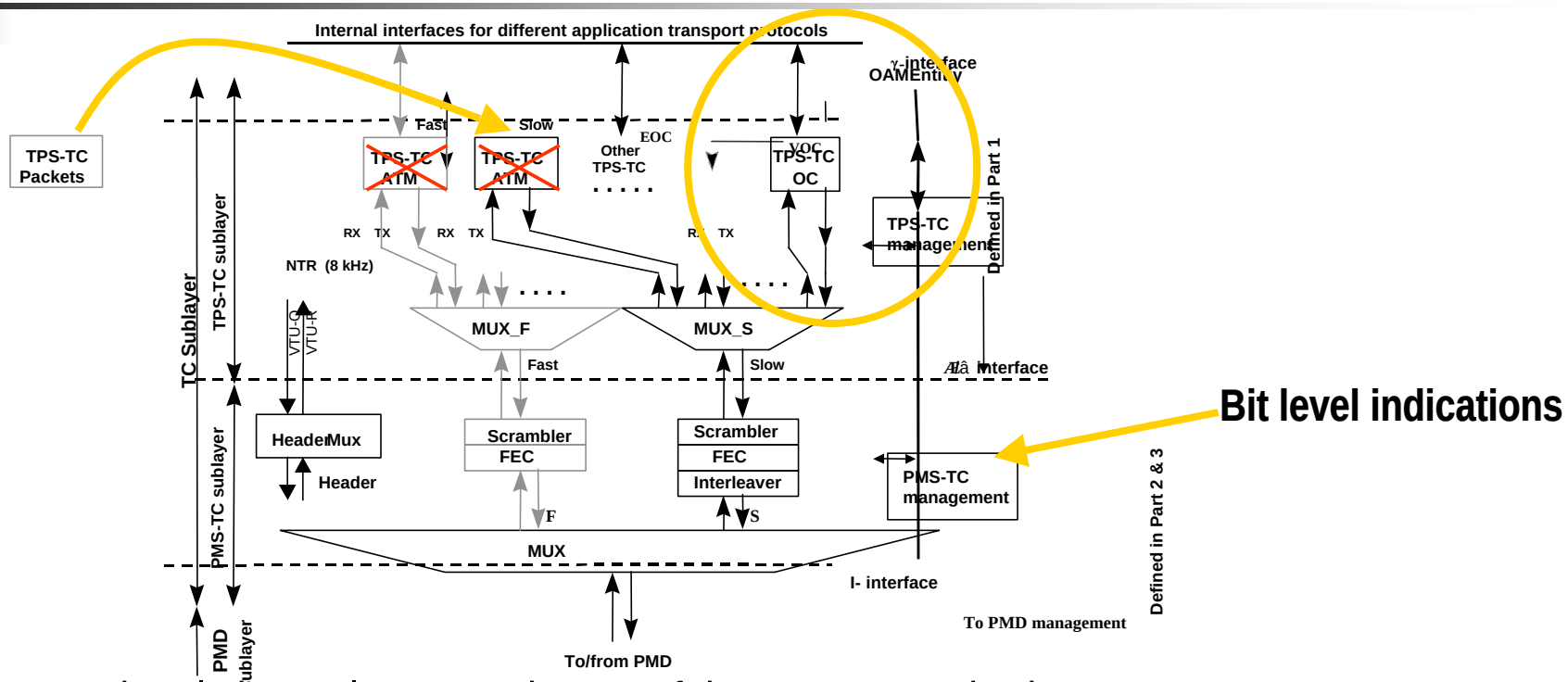


EoVDSL Operation and Maintenance

- Section 5.0

EoVDSL Operation and Management

An operational channel is defined for VDSL (VDSL Part 1/T1E1.4, section 9.2.3.1)



- The operational channel TPS-TC is part of the VDSL standard
  - Management controls the usage of the VDSL operational channel (VOC) messages
  - All VDSL management functions can be controlled with the VOC
  - Contribution simon_1_0302.pdf defines PMD control mechanism

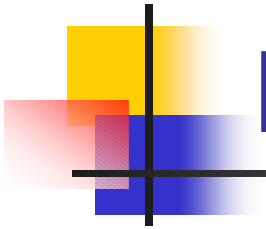
Summary

- Existing VDSL standards provide a definition of lower PHY sublayers
- Upper sublayers must be added by EFM
- Simplification improves uniformity, Ethernet compatibility & interoperability
- EoVDSL will meet the EFM copper objectives:
  - >= 750 meter with >= 10Mbps full-duplex payload bit rate can be met with Plan 998 in US and Japan, Band Plan 997 in Europe
    - Plan 998 is more asymmetric. Plan 997 is more symmetric

  Compliant with spectral management standard and frequency plans approved by T1.417, ITU-T,NRIC, and ETSI/TM6

Appendix A: any new work

- New PSDs may be needed for private networks.
- Medium reach may be defined in IEEE objectives
- HDLC encapsulation may not be “optimal” for Ethernet frames, but it allows a generic architecture that accommodates any kind of packets.



References

- Steven Haas, NC meeting presentation
- Miachael Beck, NC presentation
- Behrooz Rezvani