EPON over Coax

EPoC Architecture Considerations

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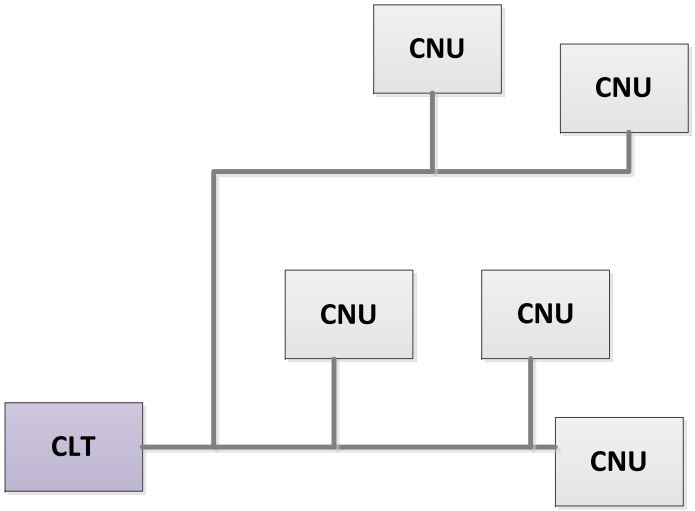
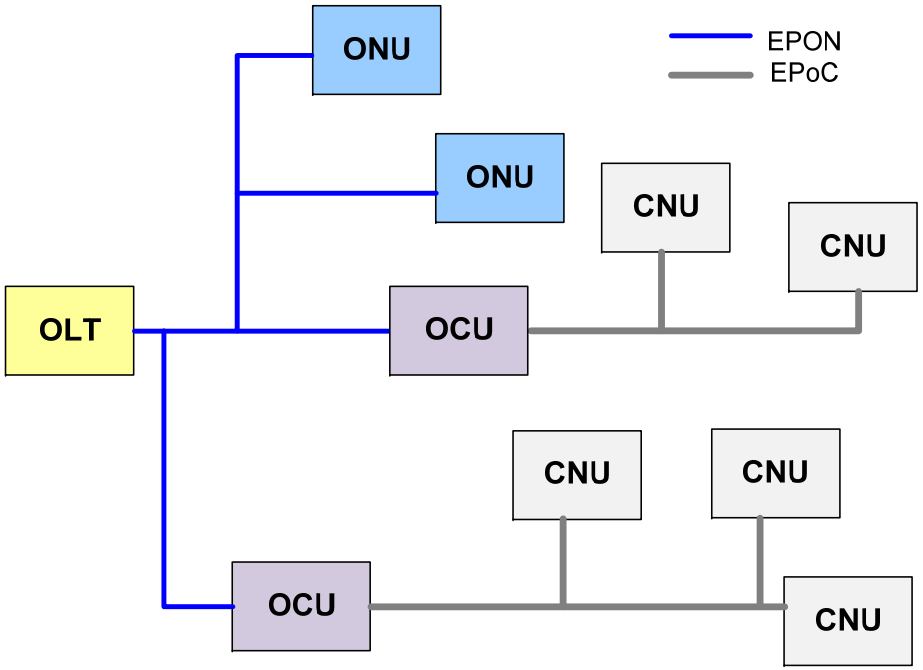
Reference Architectures for EPoC Deployment



(a) Standalone EPoC Plant

- CLT-CNU plant with similar functionalities as in EPON
- Simplest architecture for EPoC



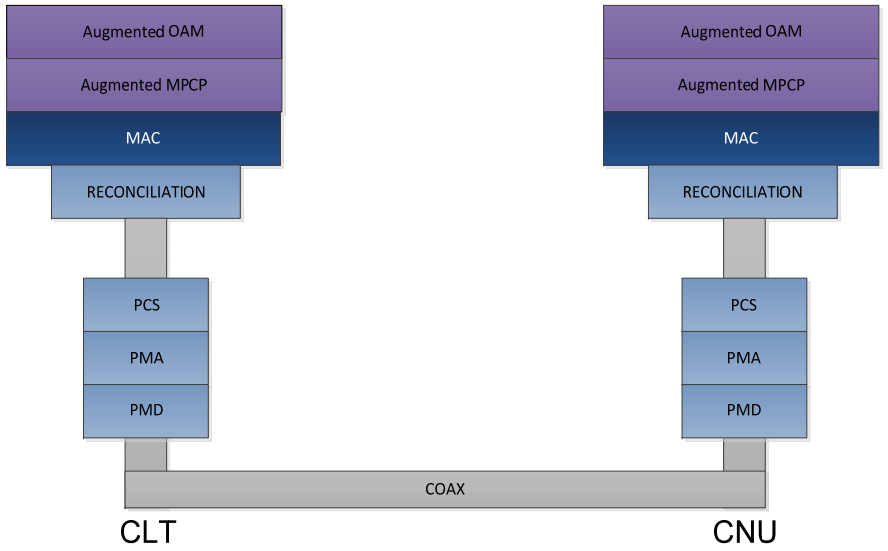
(b) Integrated EPON / EPoC Plant

- OCU to act as a *smart relay* between fiber and coax (not as bridge or repeater)
- Enhanced architecture for EPoC
- With regards to EPON, we need to ensure:
  - *compatibility* with EPON network protocols
  - *no OLT changes*
  - *efficient inter-operation* with EPON network protocols

EPoC Protocol Architecture - Overview

(a) Standalone EPoC Plant

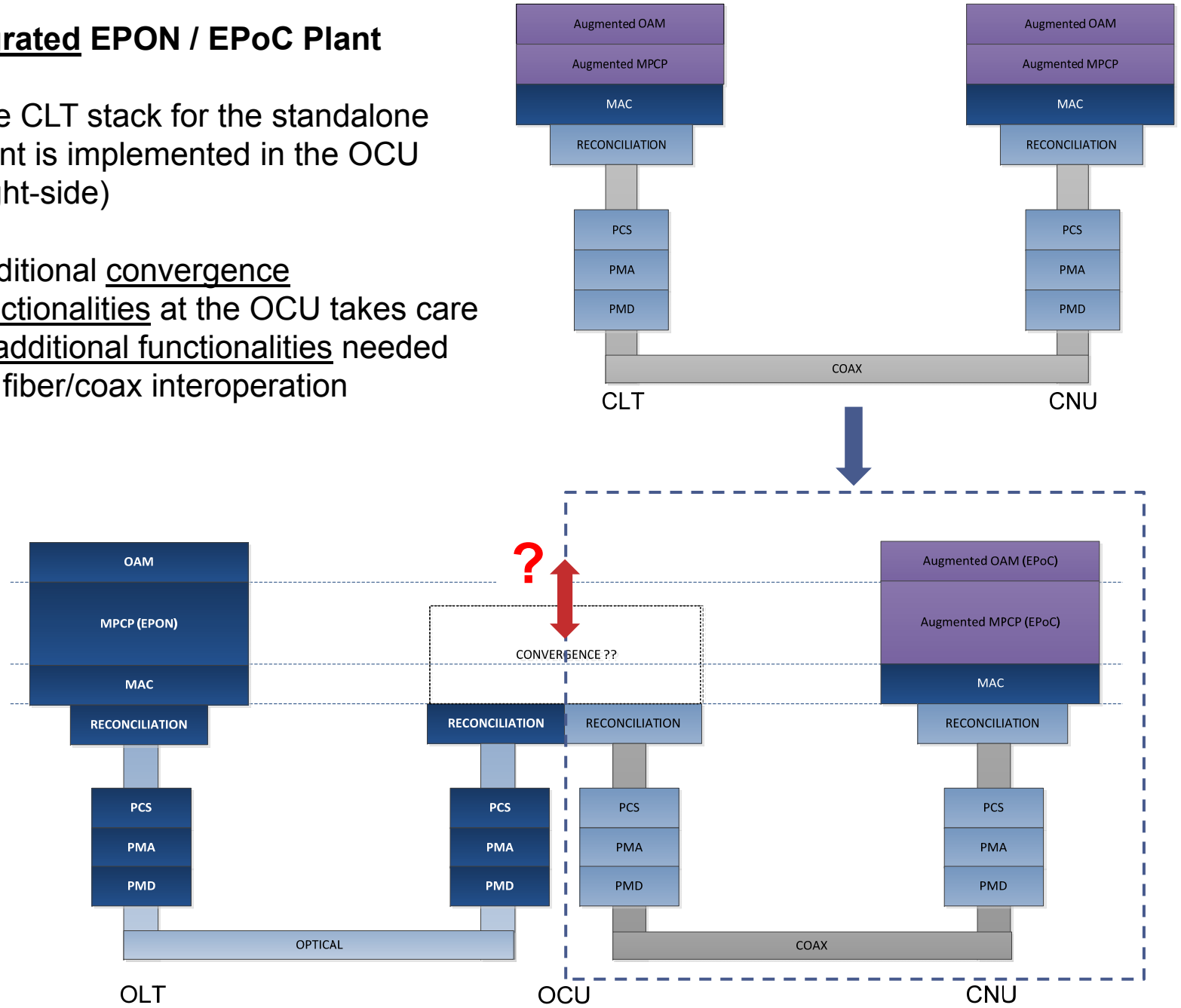
- **Legacy Ethernet MAC**
- **New PHY for coax media types**
- **Evolutionary MPCP/OAM**



EPoC Protocol Architecture - Overview

(b) Integrated EPON / EPoC Plant

- The CLT stack for the standalone plant is implemented in the OCU (right-side)
- Additional convergence functionalities at the OCU takes care of additional functionalities needed for fiber/coax interoperation



Essential functionalities for EPoC

Standalone EPoC

a) New PHY allowing multiple transmissions in the frequency domain

b) Resource management for the coax link implemented at the CLT

c) 120 MHz band ensures 1Gb/s operation (scalable according to channel conditions and available bandwidth)

d) Support for both FDD and TDD modes

e) Adaptive modulation and coding for different users and channel conditions

Integrated EPON/EPoC

Support *all* the above (a-e) + additional functionalities for convergence:

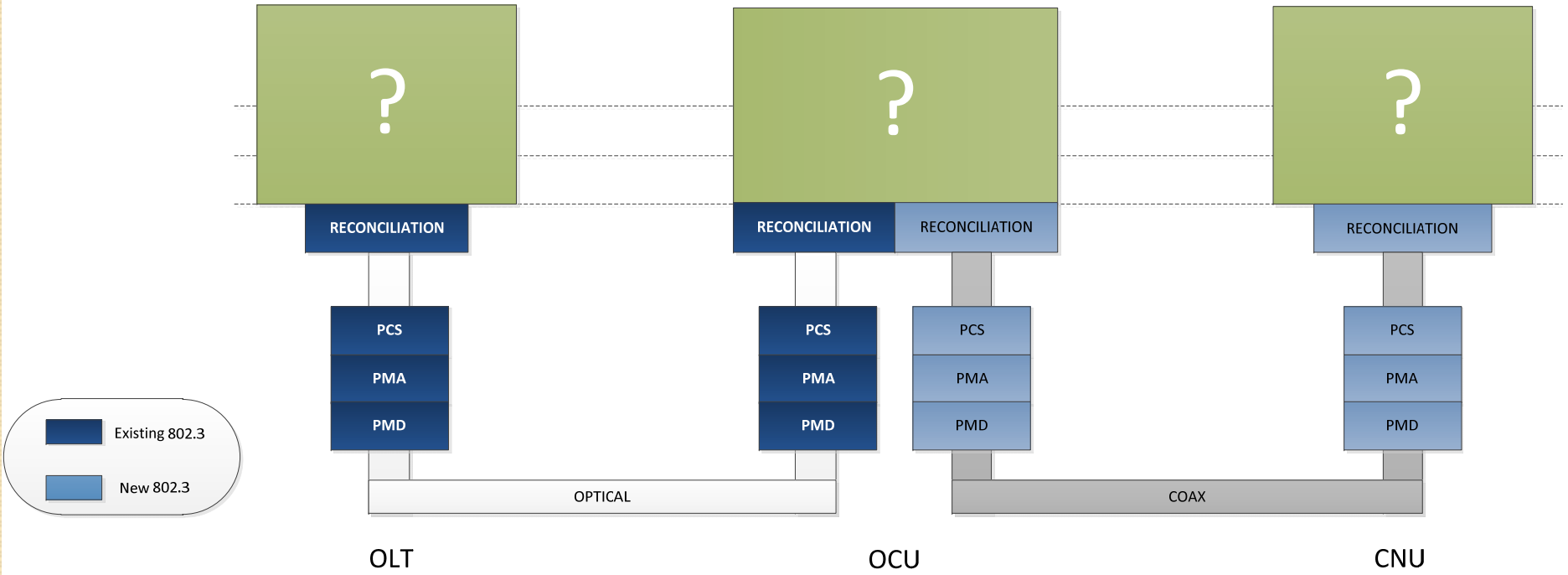
f) Packet filtering (to prevent overloading the coax link with unwanted traffic)

g) Ensure efficient inter-operability and compatibility (preventing optical link starvation):

- OLT manages scheduling and traffic for ONU/CNU (no changes to OLT)
- OCU performs resources allocation over coax provided the scheduling choices made at the OLT (i.e. OLT decides transmission order/bandwidth to CNU, OCU translates them into frequency allocation on the coax)
- A single scheduler is maintained this way

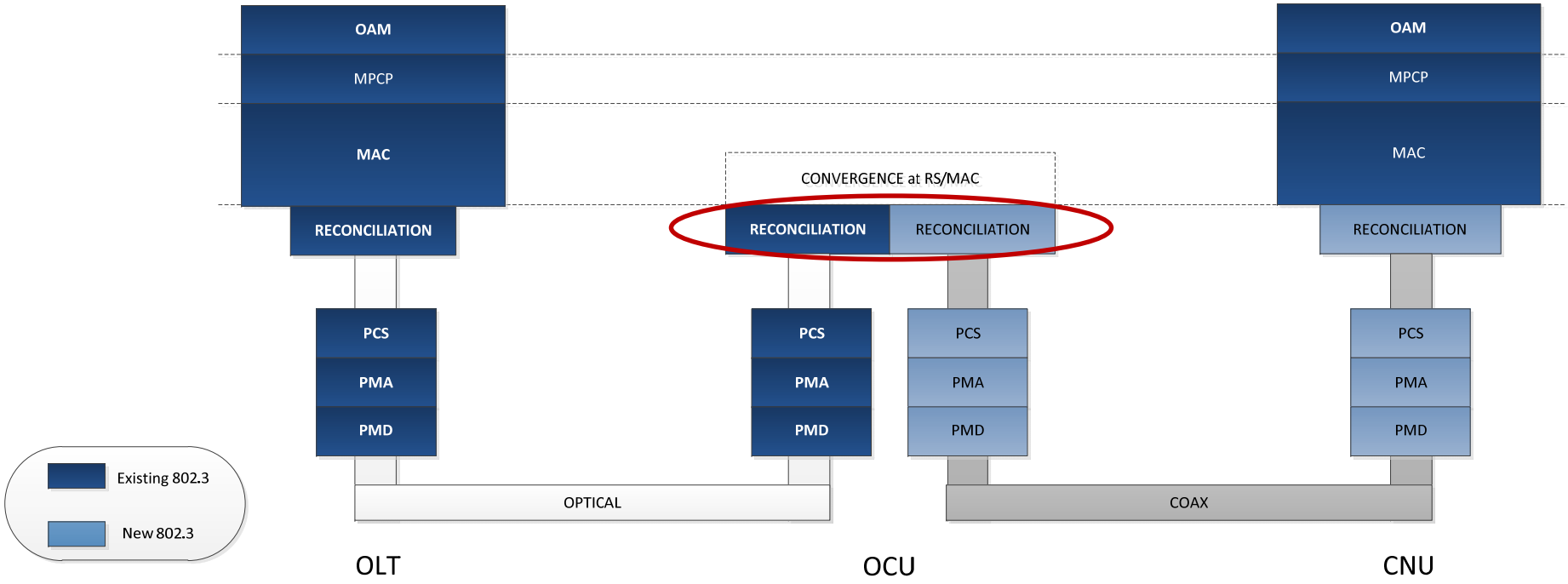
Alternative EPON/EPoC protocol architectures

- Questions to be addressed:
  - How to enable the essential functionalities for EPoC ?
  - How to re-use existing protocols and minimize changes ?
  - What kind of convergence level is the OCU targeting ?
    1. Reconciliation/MAC level convergence
    2. MPCP level convergence
    3. OAM level convergence



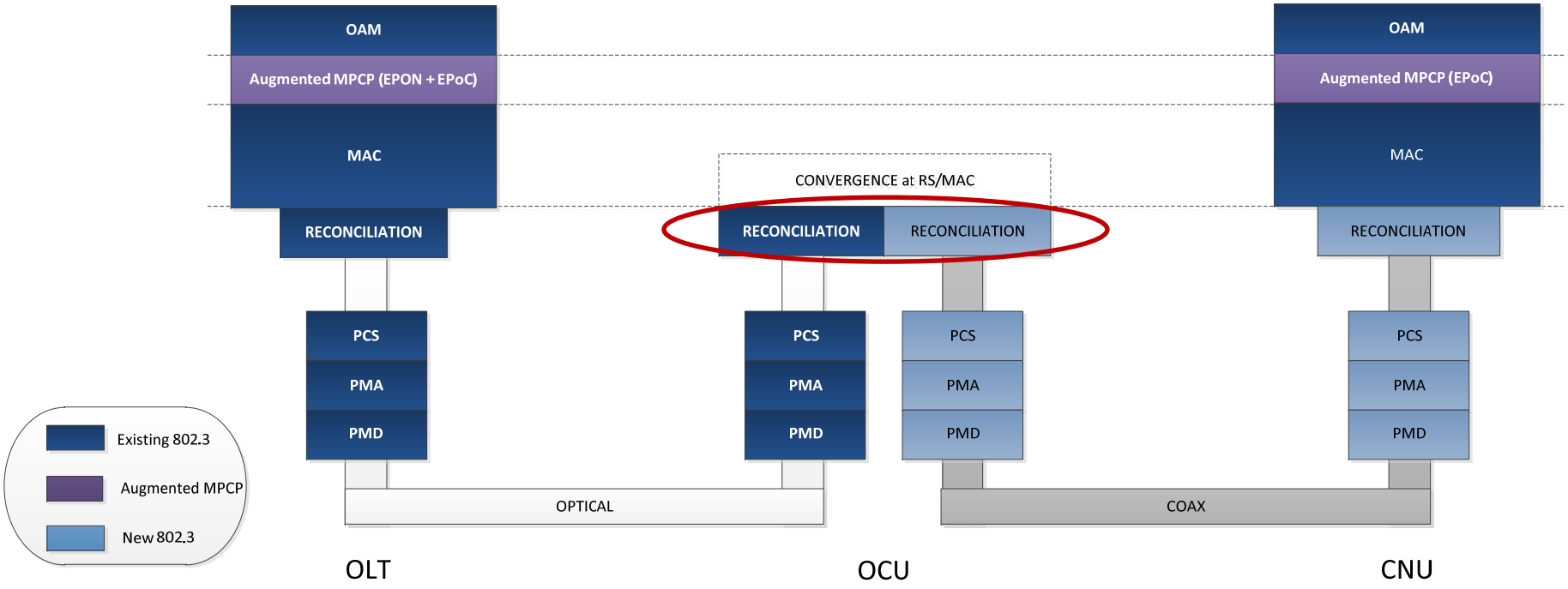
1.a OCU with Reconciliation/MAC level convergence

- EPON MPCP entity at the OLT performs time-domain resource allocation spanning over both optical and coax
- **Pros**: simplicity and transparency
- **Cons**:
  - OLT is unaware of coax channel conditions → transmission rate supported over coax may differ from 1 or 10 Gb/s and is *unknown* at OLT unless changes at OLT
  - Coax link potentially induces dramatic inefficiencies on the optical link:
    - Absence of packet filtering
    - Absence of resource allocation specific for coax



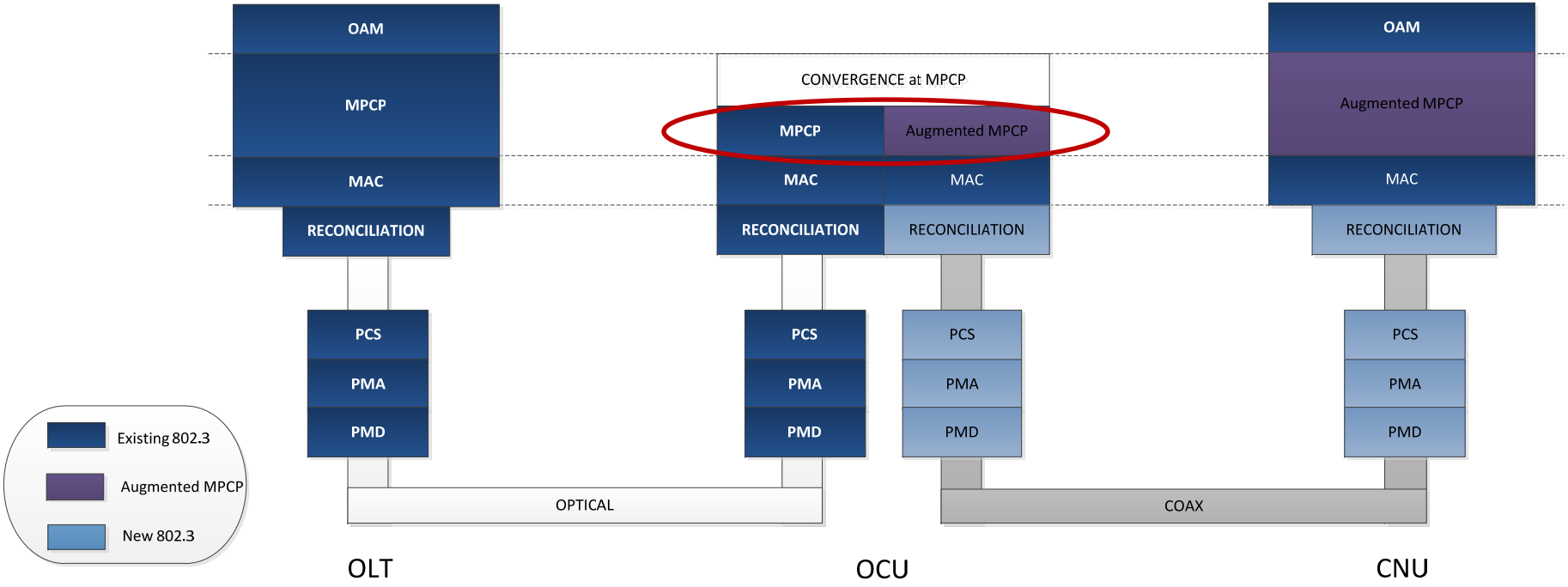
1.b OCU with Reconciliation/MAC level convergence

- MPCP at OLT is extended to properly manage resources on both fibre and coax
  - Evolutionary EPON+EPoC MPCP protocol includes new messages and procedures to manage coax resources
  - Coax channel conditions are reported directly to the OLT
- **Pros**: Logically equivalent to have MPCP-level convergence, BUT at the price of
- **Cons**: Changes at the OLT (SW or HW) !



2. OCU with MPCP level convergence

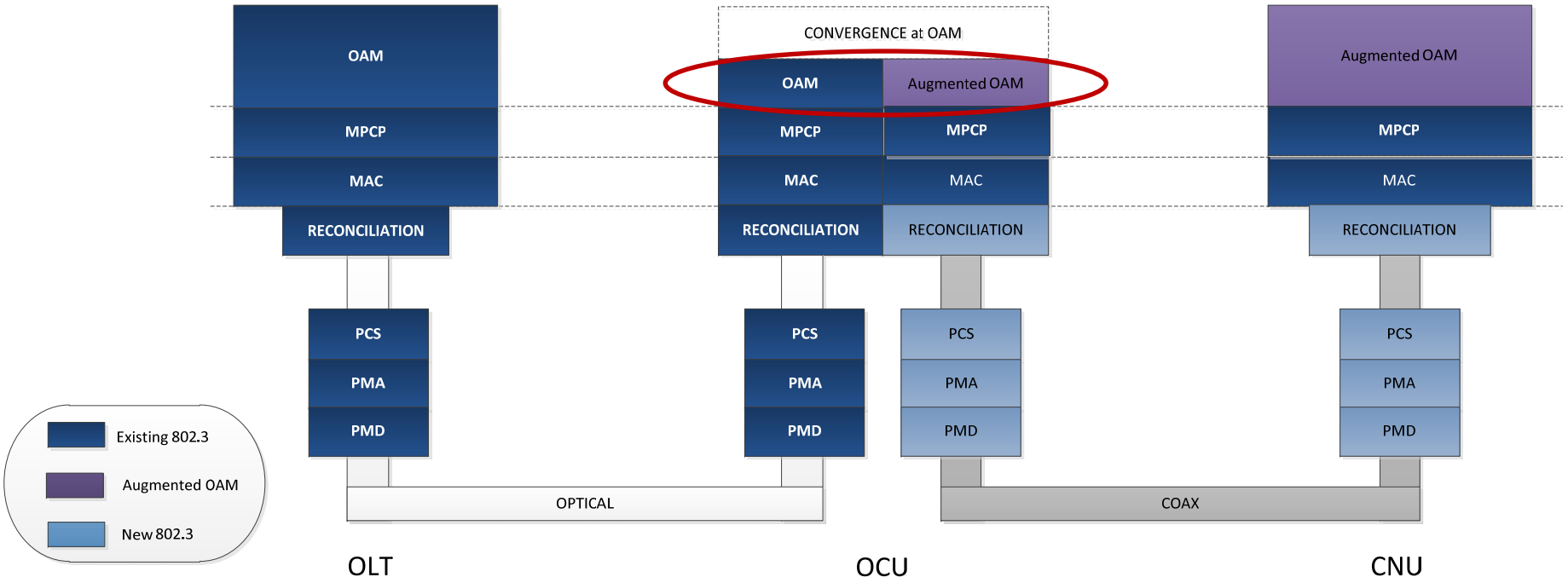
- The convergence function at MPCP level takes care of matching time scheduling over optical with resource allocation over coax
  - Legacy EPON MPCP protocol for queue scheduling and traffic management
  - Augmented MPCP protocol to manage resources over coax properly, while keeping single end-to-end LLID across optical and coax sections (OLT to CNU)
- **Pros**:
  - Ensures no changes to the OLT
  - Easy integration with DPoE (or any other upper layer protocol)
- **Cons**: none



3. OCU with OAM level convergence

- The convergence function at OAM level takes care of mapping OAM provisioning from optical to coax
- **Pros**:
  - Ensures no changes to the OLT
- **Cons**:
  - Resource management is not really in the scope of OAM as per IEEE (see clause 57 of 802.3)

  → Extension of OAM for coax resource management needed



Conclusions

- In our opinion both architectures presented in this presentation (standalone and integrated) are relevant to IEEE and EPoC industry

- For integrated EPON/EPoC architecture, MPCP level convergence is preferred
  - Convergence at MPCP level implies no changes to OLT
  - Convergence at Reconciliation/MAC level either requires OLT changes (to bring coax awareness to the OLT) or entails severe inefficiencies
  - Convergence at OAM level seems inappropriate as OAM is not in charge or resource management according to IEEE specification (clause 57 in 802.3)

Conclusions (cont.)

- EPoC features enabling efficient EPON/EPoC inter-operation shall be within of IEEE scope

  → we propose to manage <u>coax resource allocation via augmented/evolved MPCP</u>

- OCU network element can be inside or outside the scope of IEEE: SG is invited to discuss the issue and make a decision