



# Q2 Optical Access Networks

## Work program review

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# ITU and IEEE PON standards history

**A/B-PON**  
622M/155M  
G.983.x

**G-PON**  
2.5G/1.25G  
G.984.x

**XG-PON**  
10G/2.5G  
G.987.x

**NG-PON2**  
4λ 10G/10G  
G.989.x

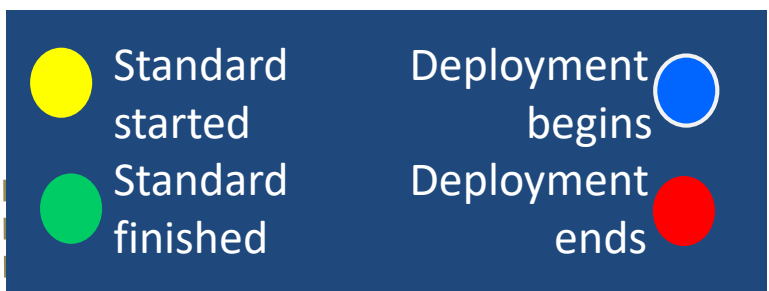
**XGS-PON**  
10G/10G  
G.9807.x

**HS-PON**  
50/25G  
G.hsp.x

**NG-EPON**  
25G/25G  
802.3ca

**10GE-PON**  
10G/10G  
802.3av

**E-PON**  
1G/1G  
802.3ah



**ITU**

**IEEE**

2000

2005

2010

2015

2020

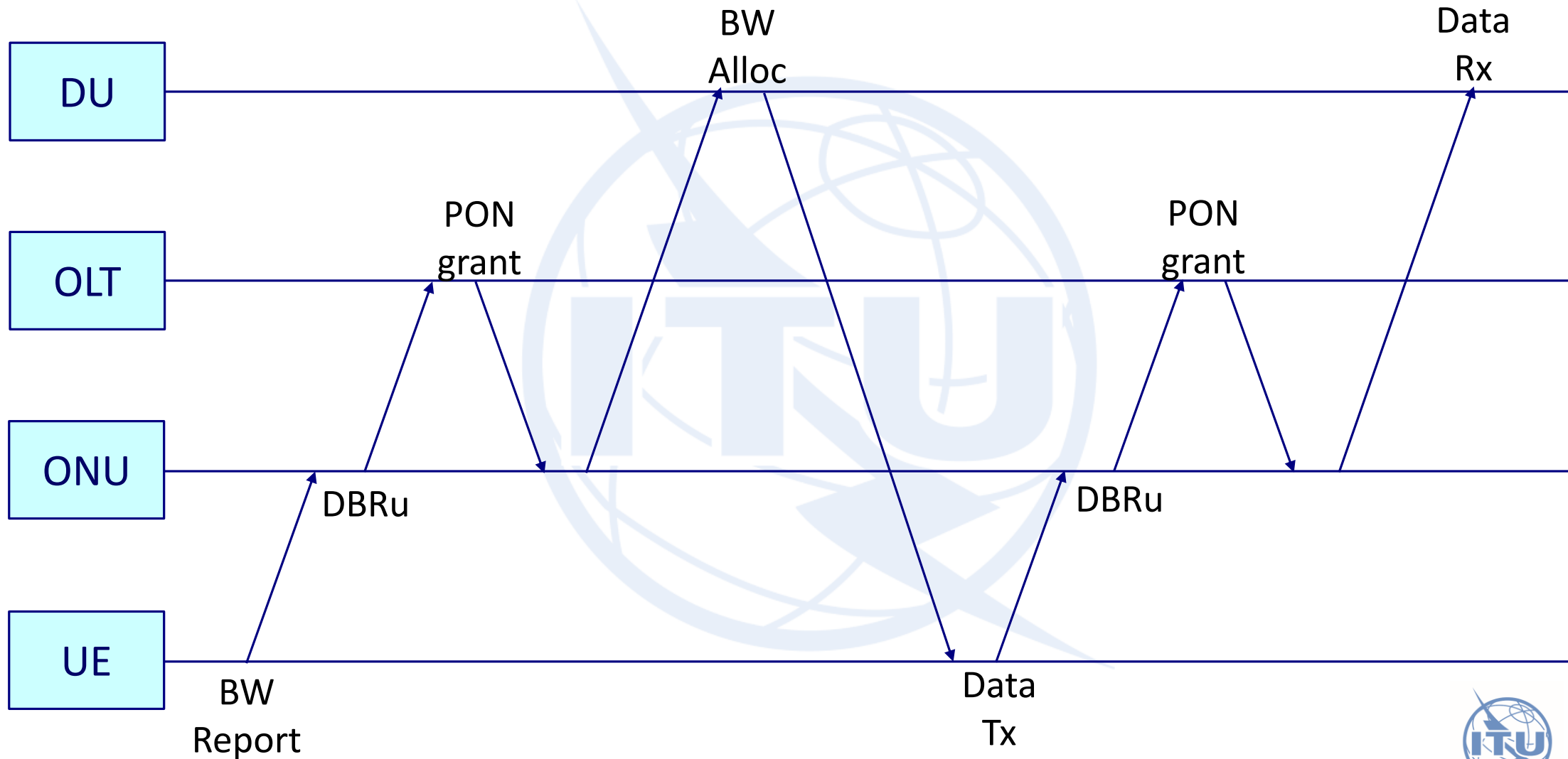


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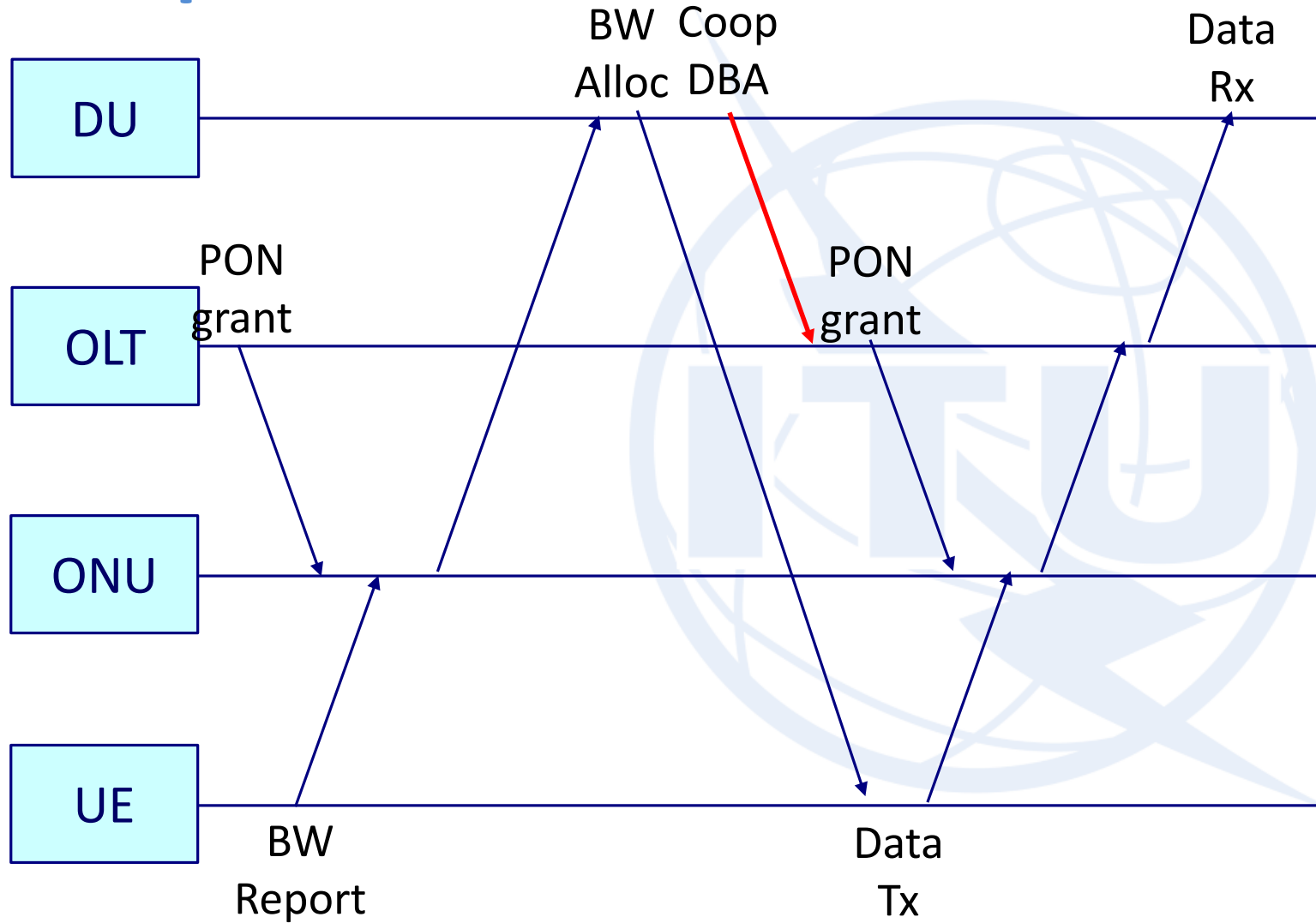
# Significant projects

- G.988: Regular maintenance of PON management
- G.989 Amendments: Cooperative DBA
- G.9804: Higher speed PONs
- G.sup.66: 5G in a PON context
- G.9806: Bidirectional point to point PHYs

# The problem of fronthaul over PON



# Cooperative DBA: How to run a MAC within a MAC

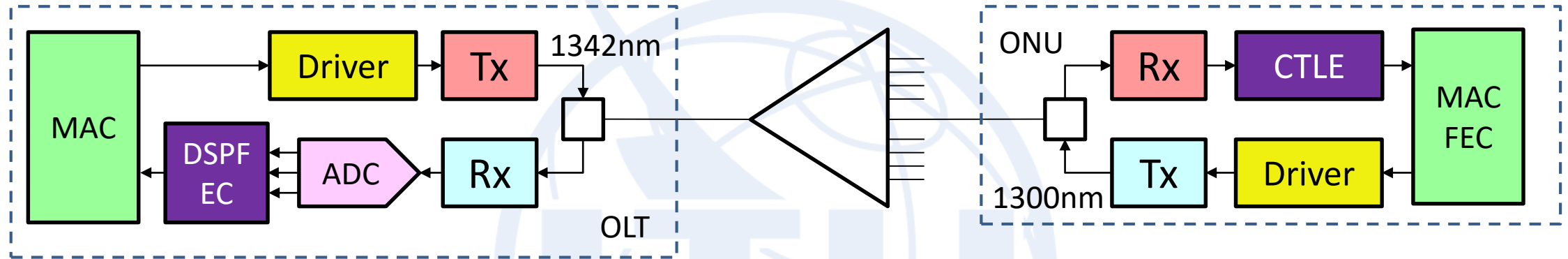


- Q2 has made additions to the TC layer to add delay and jitter requirements
- This gives guidance on how to build a DBA engine with proper controls
- ORAN alliance is working on the specification of the Cooperative Transport Interface
- This develops all the protocol elements needed to communicate with the OLT

# G.9804.1: Higher speed PON requirements

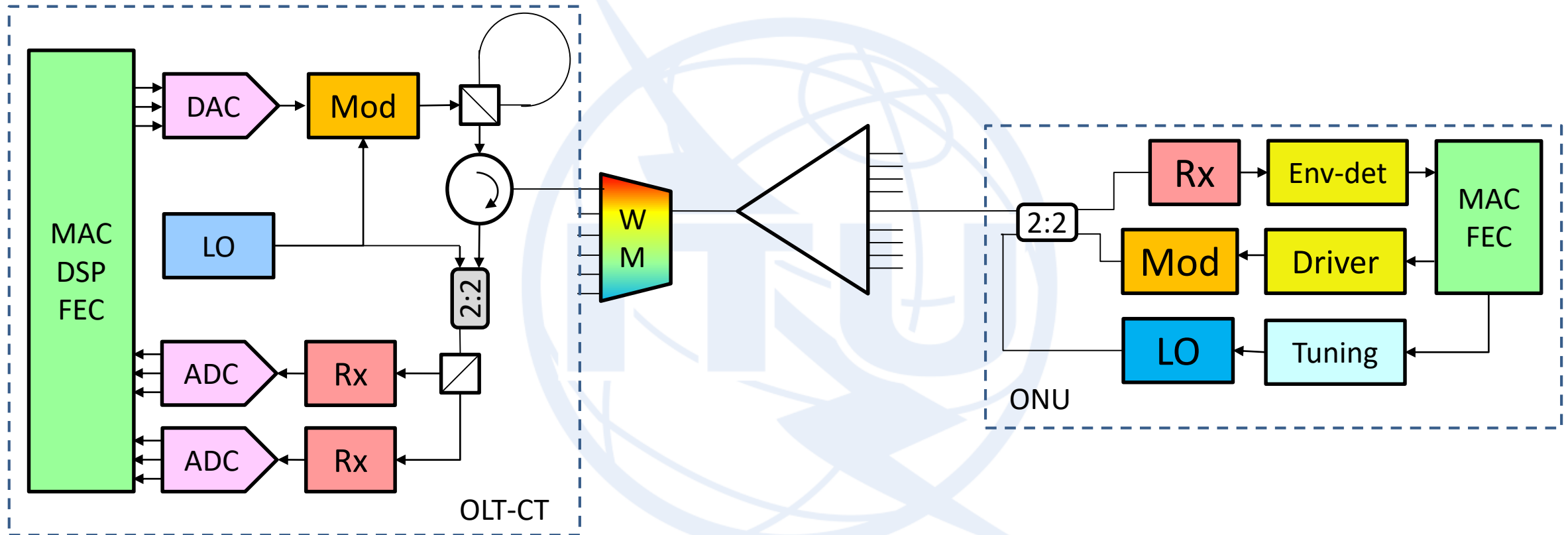
- Higher speed PONs share many requirements with existing systems
  - Must reuse the fiber plant based on splitters and G.652 fiber
  - Must support the same loss budgets and distances
- System of interest must have 50 Gb/s per channel downstream
  - The current deployment of 10G systems means that the HSP system will be deployed in 2024, and must have at least 4x capacity of the 10G system
  - The upstream can be a lower rate, 25 Gb/s looks attractive

# G.hsp.50Gpmd: Specifications of fixed 50G PMD



- Single channel system for low cost overall
- Use continuous time linear equalizer in downstream for low ONU cost
- Use DSP in the upstream to implement equalization and burst mode reception
- Wavelength plan reuse of 802.3ca, if possible
- MAC implements low density parity check (LDPC) code with soft decoding for high sensitivity, and flexible rate decoding for link budget elasticity

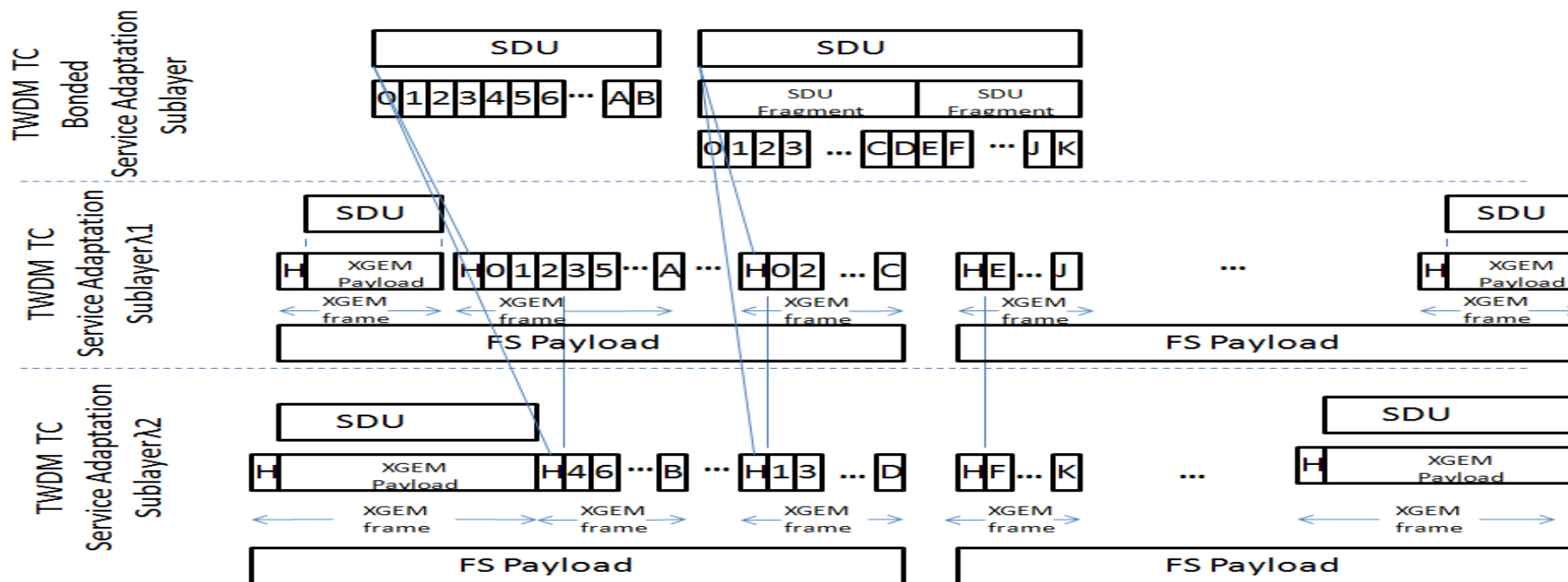
# G.hsp.TWDMpmd: Specifications of 200G TWDM PMD



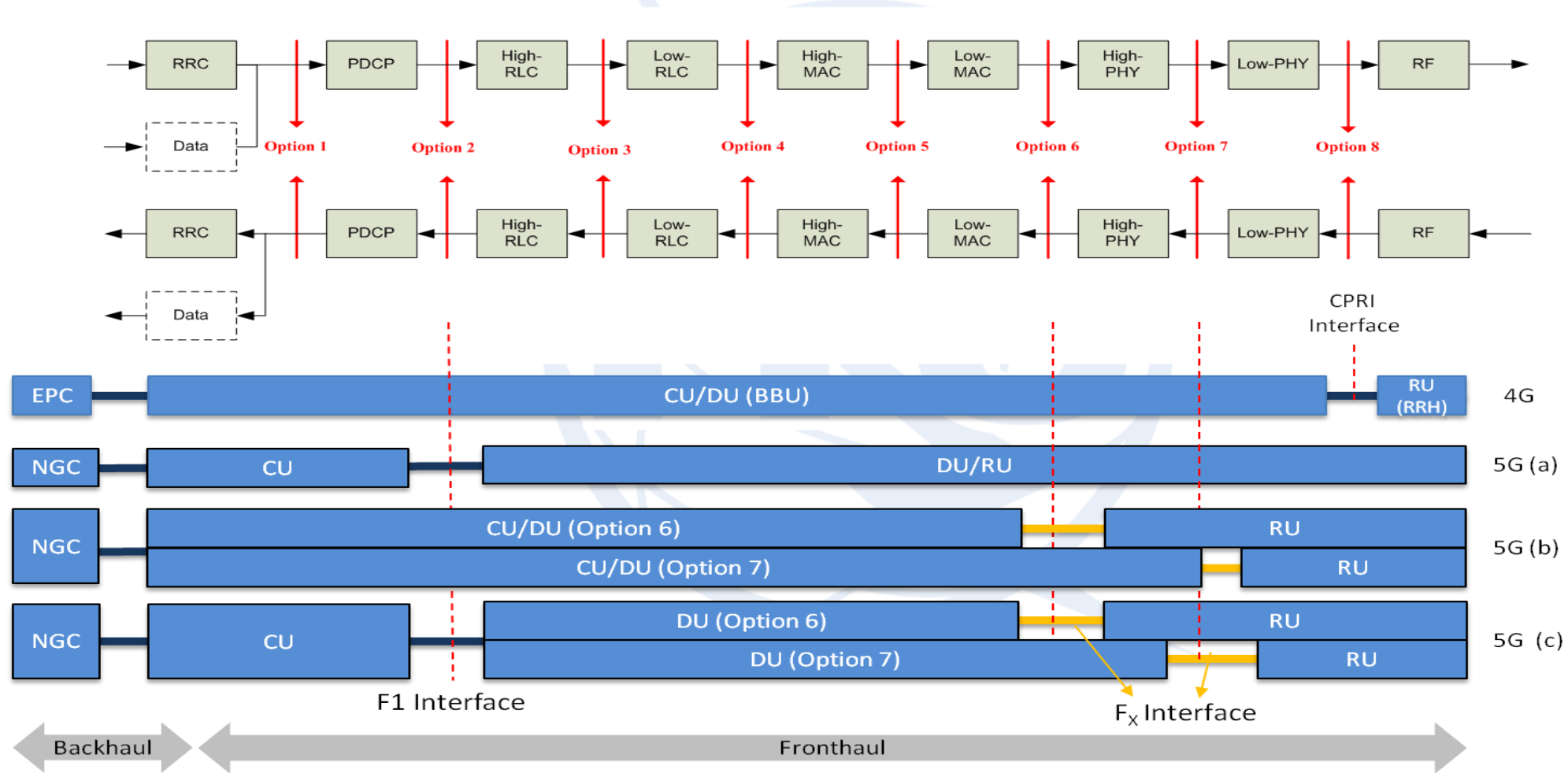
- Coherent transmission allows 50G transmission in the C and L bands over long distances
- Low-cost coherent (e.g., Alamouti coding) reduces need for DSP at the ONU
- Full coherent receiver in upstream enables good loss budget

# G.hsp.ComTC: The common TC for all HSP

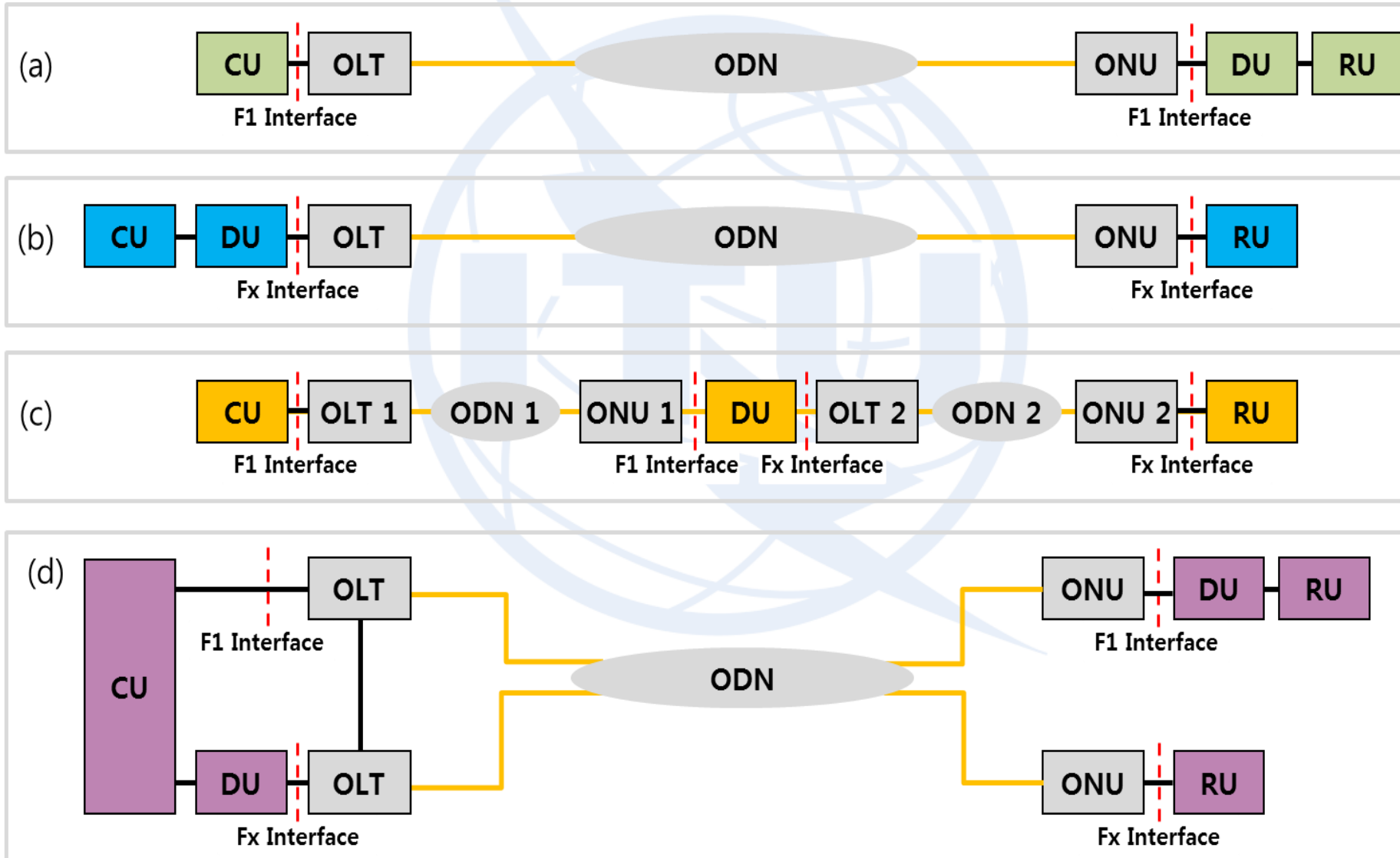
- G.hsp.ConvTC: The specifications for a converged TC layer
- Meant to cover all HSP systems (single and multiple wavelengths, fixed and tunable optics), and maximum commonality with other systems
- The basis for this is G.989.3 (which was based on G.987.3)



# G.sup.66: 5G wireless fronthaul in a PON context



# How might PON serve fronthaul needs?



# Point to point systems

- G.9806: Higher speed point to point optical access systems
  - Meant to be a follow on to G.986 (1G P2P Optical Access)
  - Aims to describe 10G, 25G, and 50G systems
  - A range of loss budgets are under consideration
  - “Silent start” feature, to avoid P2P ONUs jamming PONs
- In IEEE 802.3 there is a twin project, with exactly the same scope
  - The intention is to ensure convergence and compliance to one standard
- One unique problem is how to reconcile the different approval processes of the IEEE standard and the ITU recommendation
  - Must G.9806 wait until 802.3cp is finished (2021)?
  - Can G.9806 consent sooner, and then amended to track changes?



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# Summary

- Q2/15 is the standing group that works on optical access networks, with a wide range of projects spanning several PON generations
- Substantial work plan on higher speed (>10G) access
- Aim is to make this the “Last PON”
  - Common requirements and TC layer that is scalable to any reasonable rate combination
  - Many PMD projects to allow development at the pace of the technology (The PMD is generally the gating item on systems)



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