10G EPON – 1G EPON Coexistence

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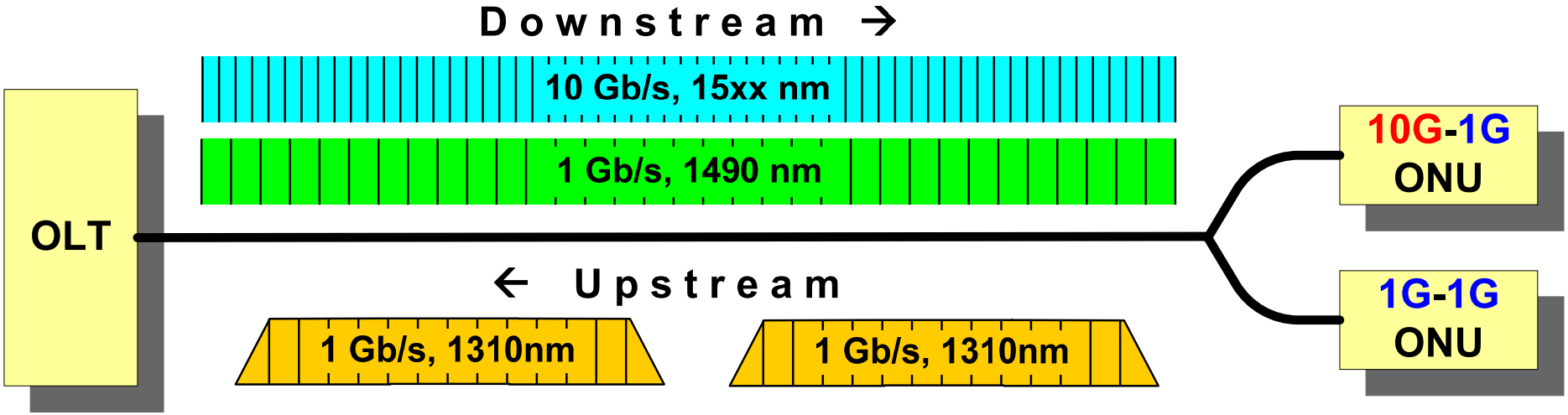
Goal and Proposal

- **Goal**
  1. Support coexistence of 10G-10G ONUs and 10G-1G ONUs on the same ODN
  2. Allow directly-modulated un-cooled lasers to be used in 10G ONUs
     - Requires using 1310 nm for 10G upstream

- **Proposal**
  1. Enable dual-rate upstream bursts by using dual MII

1Gb/s ONU + 10Gb/s Asymmetric ONU

- Downstream:
  - 1Gb/s ONUs use 1490 nm per IEEE 802.3ah
  - 10Gb/s ONUs use 15xx nm. Exact wavelength is TBD
- Upstream:
  - All ONUs use 1310 nm
  - All ONUs send bursts using 8b/10b @ 1.25 Gb/s



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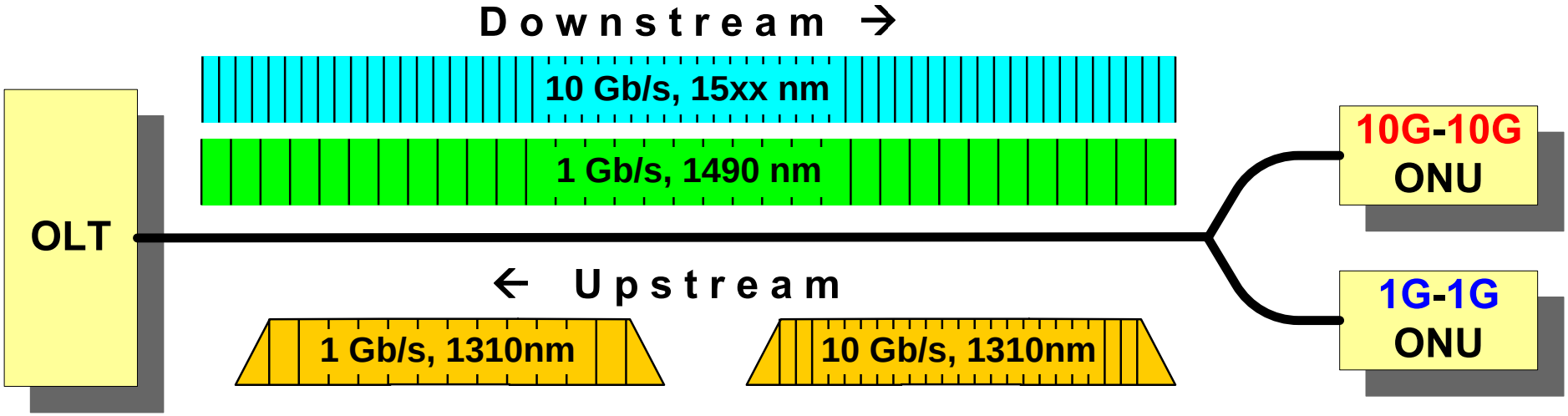

10Gb/s Symmetric + Asymmetric ONUs

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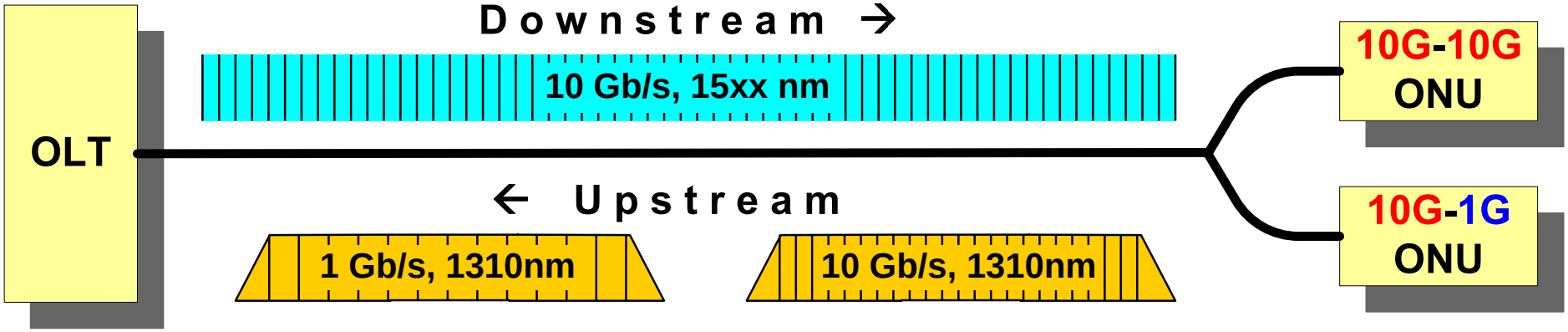
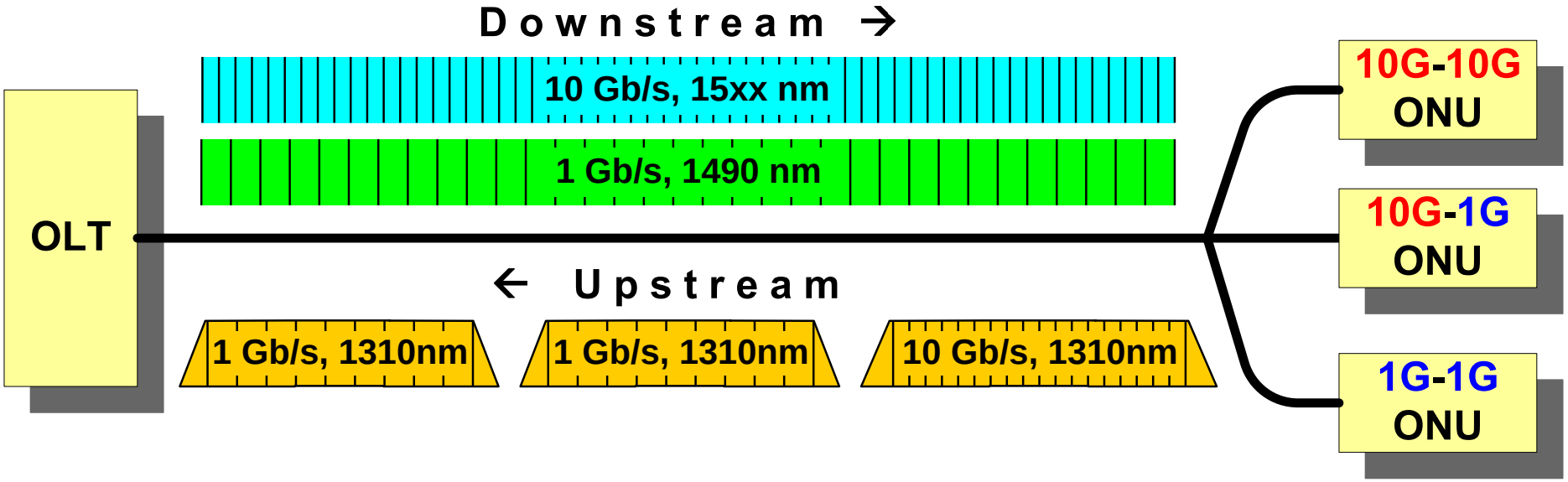


All ONU Types

- Downstream is trivial
  - Add additional wavelength
  - Many 1Gb/s ONUs already have filters to block C-band
  - 10Gb/s ONUs will have filters to block S-band (1490 nm)

- Upstream is more complicated

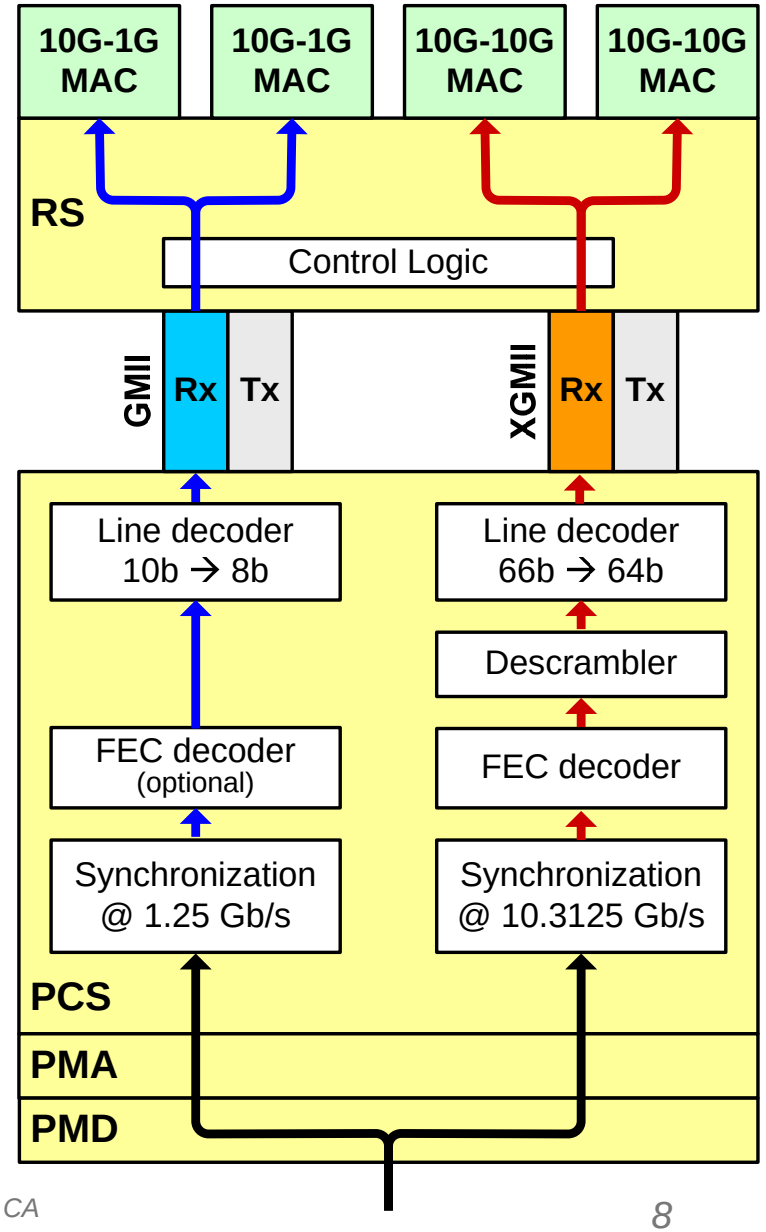


Good News

- Upstream burst mixing has no impact on ONUs
  - An ONU is blind to upstream transmissions from other ONUs
- All the complexity is in the OLT's burst synchronization circuit
- Implementation is not difficult – have 2 synchronization circuits and enable one at a time.
  - Scheduler knows which burst OLT should expect next and can enable the correct sync block.
  - But this approach creates layering issues

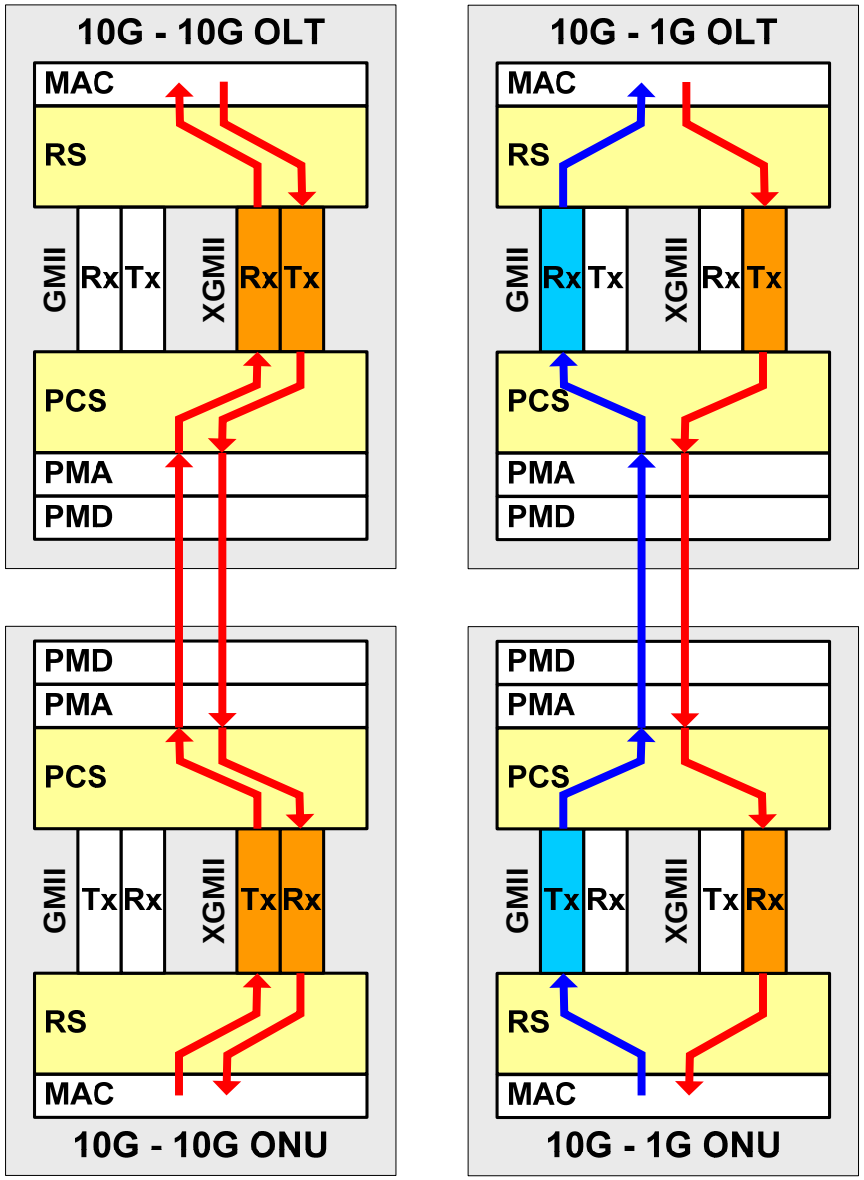
Proposal

- Use GMII and XGMII simultaneously
- PCS can split Rx signal into 1Gb/s and 10Gb/s paths
- Only one path will be able to synchronize and decode. The other path would generate errors (RX_ER).
- If one path receives good data, the RS substitutes errors by IDLEs for the other path.



Dual MII is Useful for Asymmetric EPON

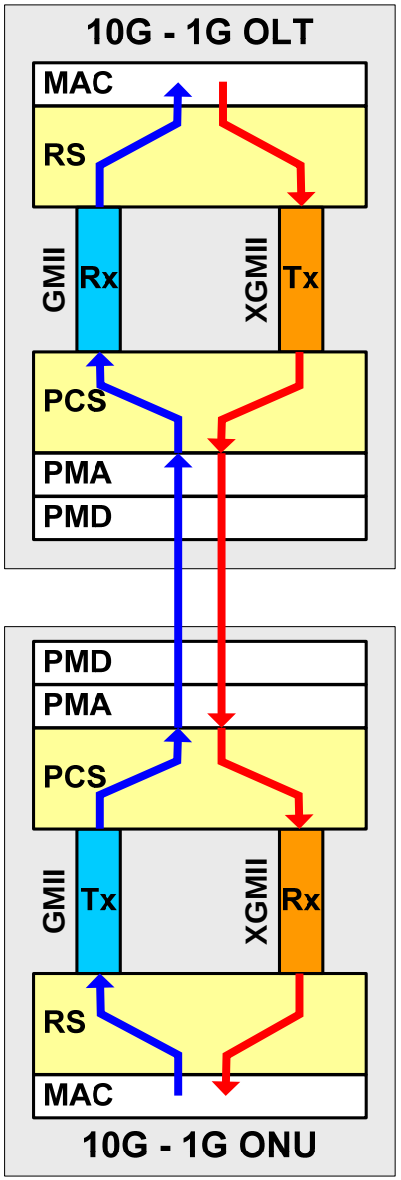
- Allows asymmetric EPON without defining new xxMII
- Existing GMII and XGMII can be used by reference. RS and PCS are extended to handle both interfaces together.
- Different configurations may be selected statically
  - **10-10 OLT:** XGMII.Tx + XGMII.Rx
  - **10-10 ONU:** XGMII.Tx + XGMII.Rx
  - **10-1 OLT:** XGMII.Tx + GMII.Rx
  - **10-1 ONU:** GMII.Tx + XGMII.Rx
- For mixed 10Gb/s and 1Gb/s bursts upstream, select between XGMII.Rx and GMII.Rx dynamically, based on the rate of the arrived burst.



Implementation Options

- This presentation only describes an approach to write specification

- Actual implementations do not need to implement parts that are never used. For example:
  - Asymmetric 10G-1G OLT would only implement XGMII.Tx and GMII.Rx.
  - Asymmetric 10G-1G ONU would only implement GMII.Tx and XGMII.Rx.



Conclusion

- To allow 10G ONU to use directly-modulated un-cooled lasers, we need to use 1310 nm upstream

- Dual interface approach (GMII+XGMII) provides a single solution to two problems:
  1. Coexistence using 1310nm requires dual rate Rx at the OLT.
  2. Asymmetric 10G/1G EPON requires different Tx and Rx speeds.

- Dual interface approach would allow using GMII and XGMII by reference, without the need to define 3 new interfaces:
  - Asymmetric MII for OLT (10G Tx, 1G Rx)
  - Asymmetric MII for ONU (1G Tx, 10G Rx)
  - Dual-Rate MII for OLT (1G+10G Rx)

Conclusion (cont.)

- As an added bonus, when using dual MII, an OLT can be configured to support 3 types of ONUs simultaneously:
  - 1G-1G
  - 10G-1G
  - 10G-10G