



More on Super-PON

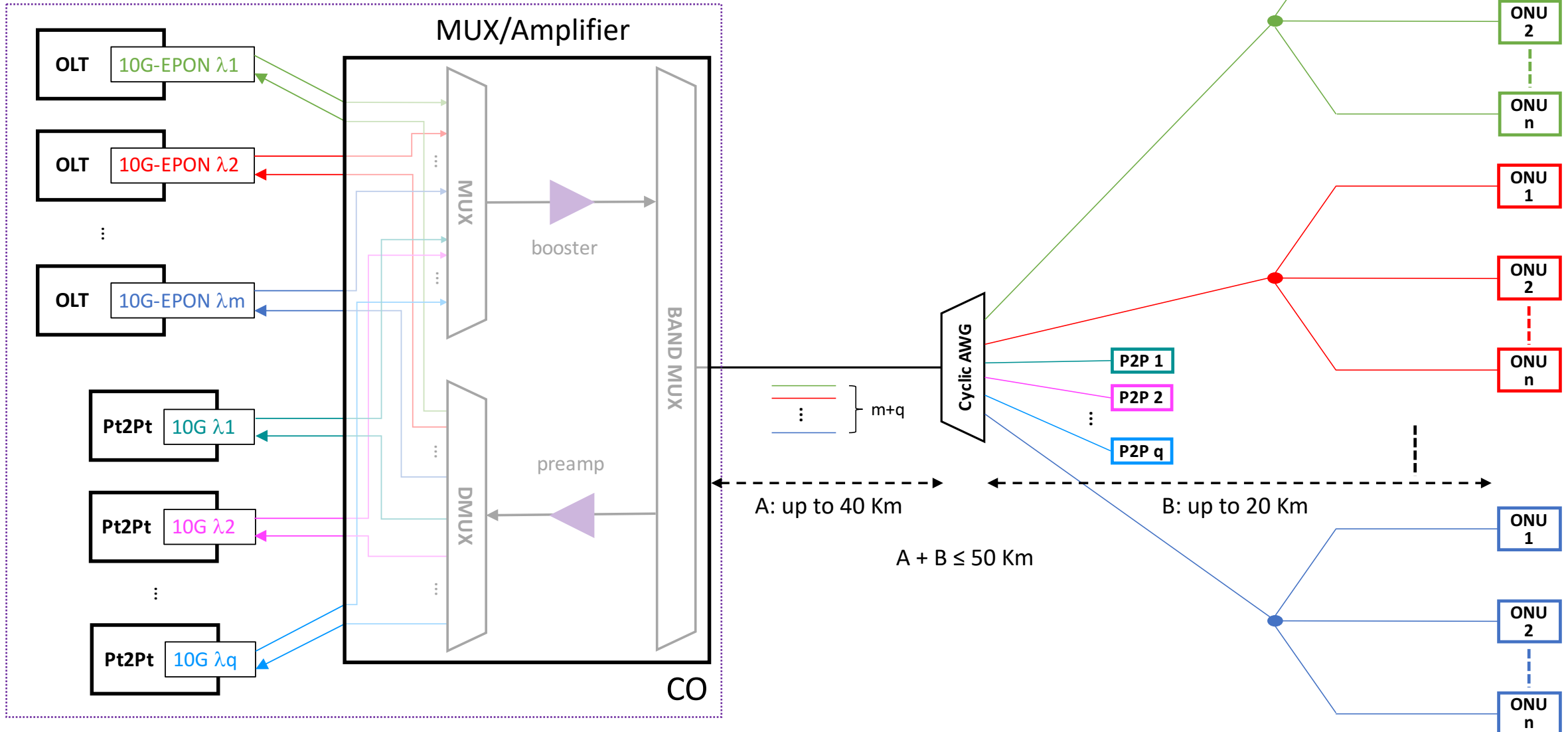
Scale Fully Passive Optical Access Networks to Longer Reaches and
to a Significantly Higher Number of Subscribers

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Liang Du

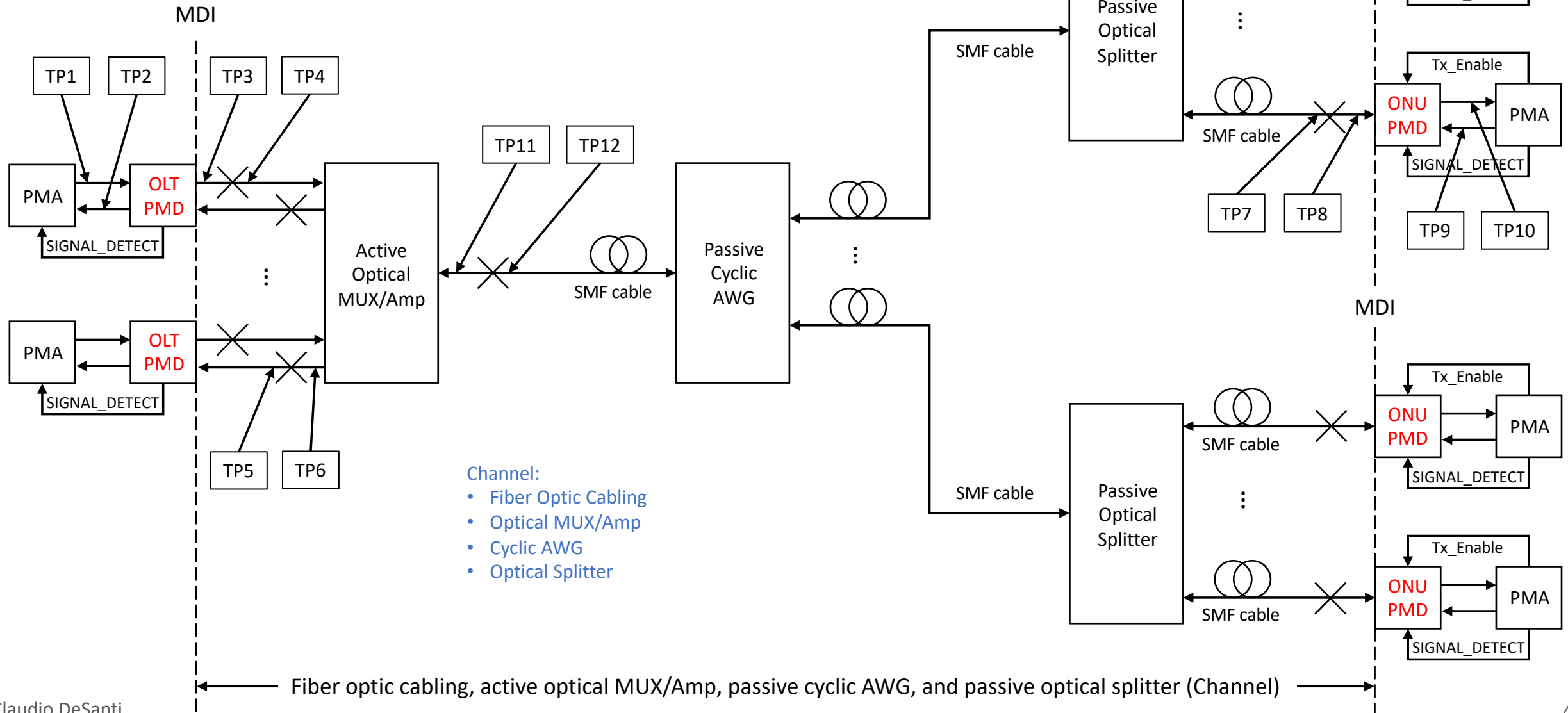
Agenda

- PMD Refinements
- 2.5G-EPON Upstream Speed Considerations

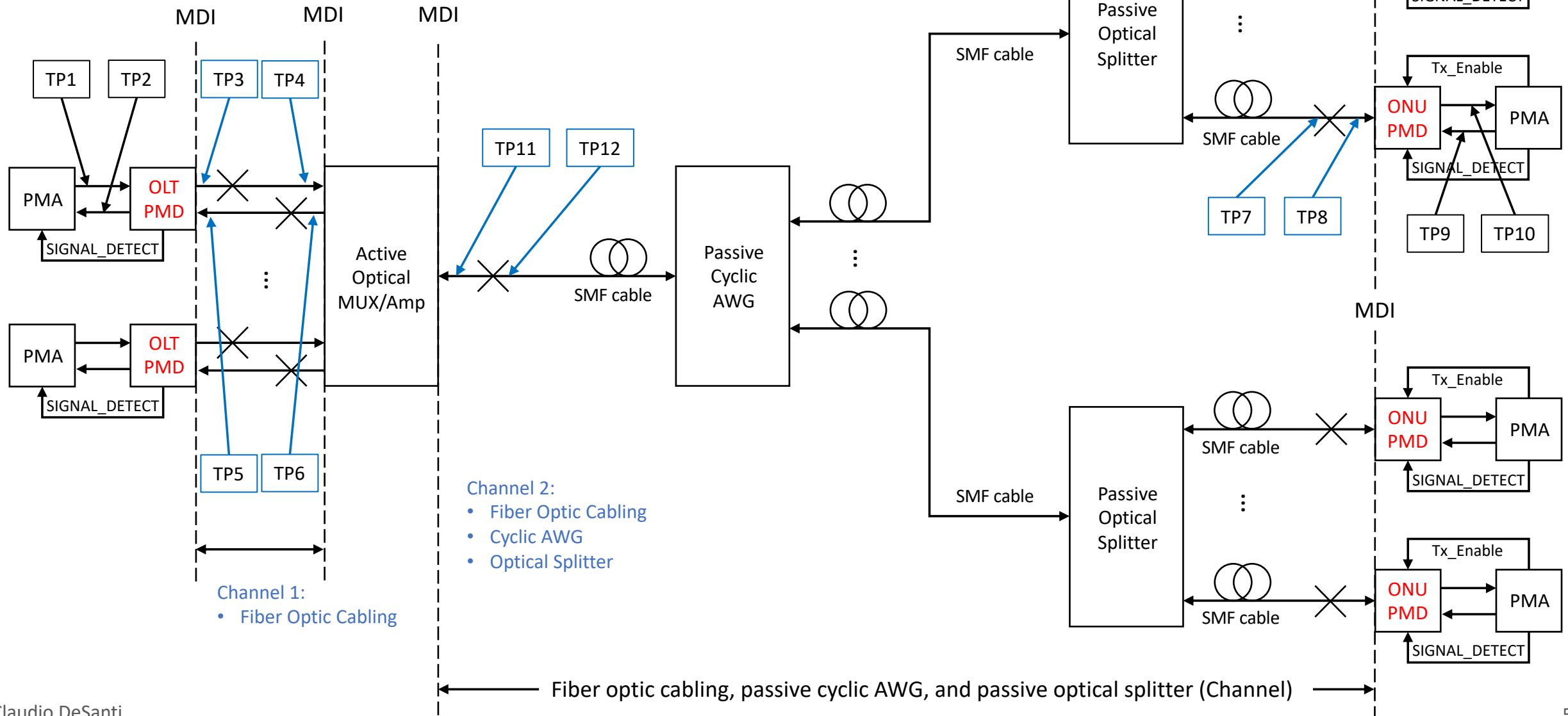
Super-PON Architecture – Complete



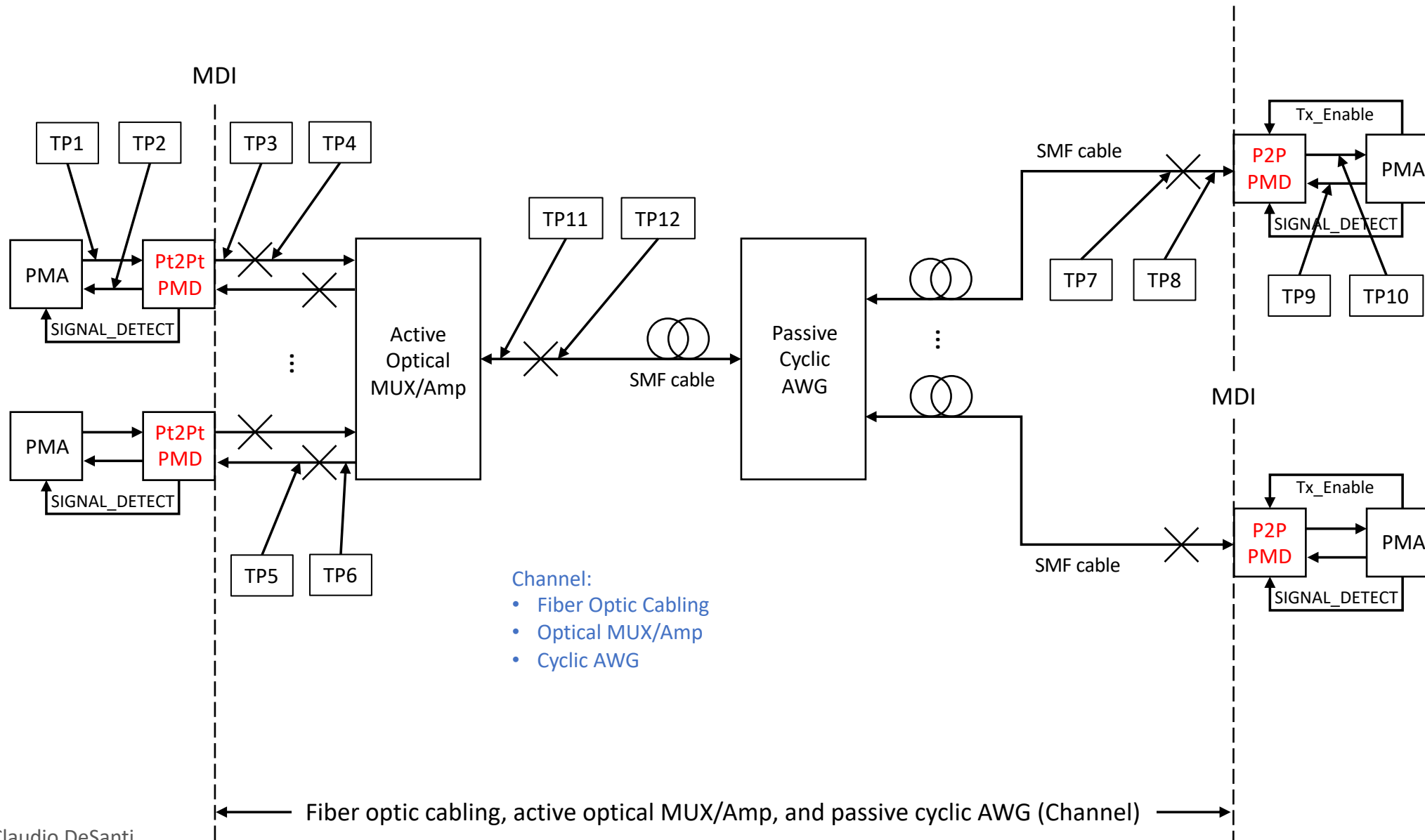
Super-PON PMD – Residential



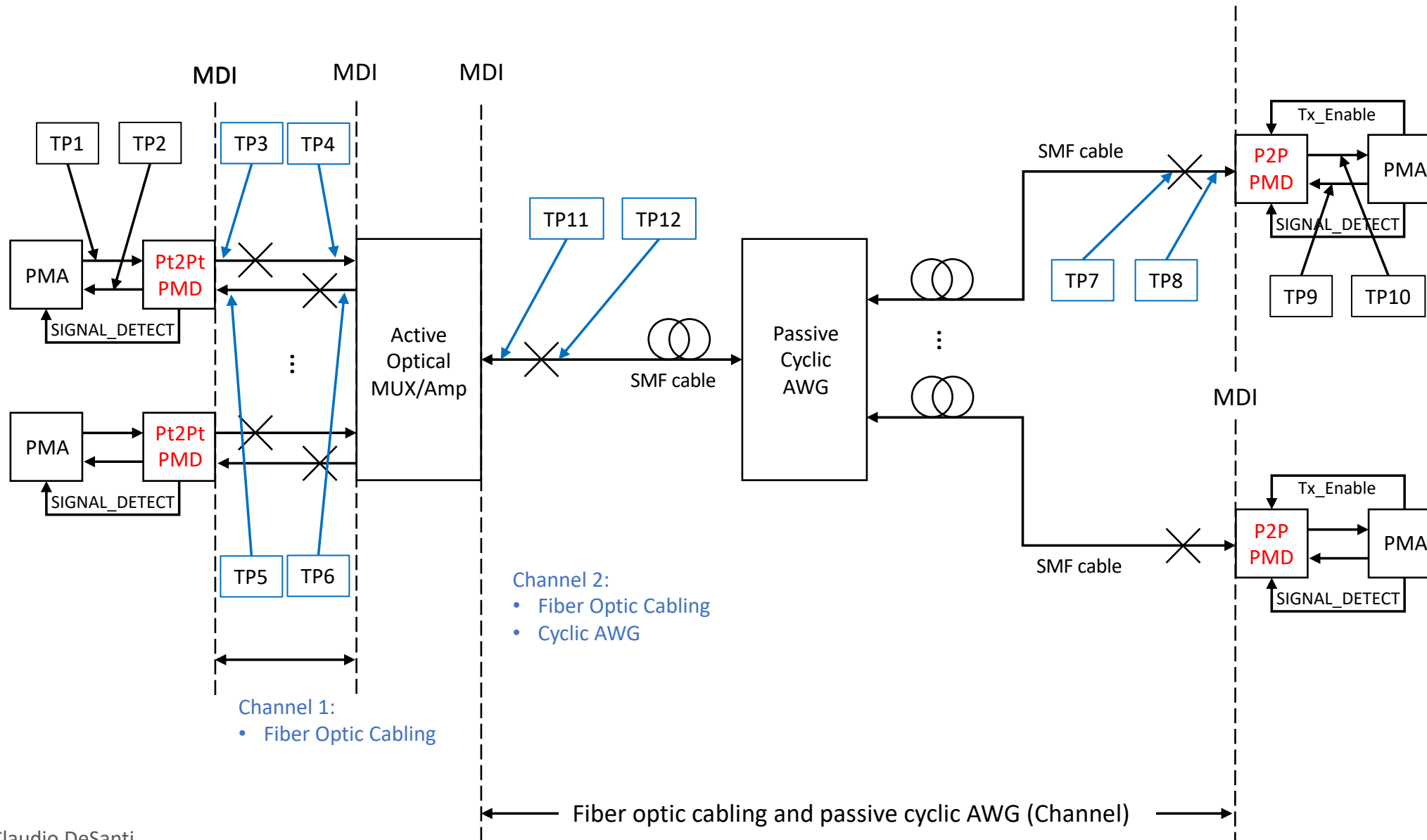
Super-PON PMD – Residential (1)



Super-PON PMD – Point to Point



Super-PON PMD – Point to Point (1)



Agenda

- PMD Refinements
- 2.5G-EPON Upstream Speed Considerations

Speed Considerations (From Last Presentation)

- For residential support, an EML laser in the OLT and a DML laser in the ONU allow:
 - 10Gb/s downstream – 2.5Gb/s upstream
if the MUX/Amp **does not** contain dispersion compensation
 - 25Gb/s downstream – 10Gb/s upstream
if the MUX/Amp **does** contain dispersion compensation
- For point-to-point support, EML lasers on both ends allow:
 - 10Gb/s symmetric if the MUX/Amp **does not** contain dispersion compensation
 - 25Gb/s symmetric if the MUX/Amp **does** contain dispersion compensation
- The 2.5Gb/s Ethernet speed is already defined for UTP cabling and is being defined for backplane operations
 - IEEE 802.3bz and IEEE P802.3cb
- Defining it for optical operations seems a very doable effort
 - Down clocking the 10Gb/s specification
 - Enables to leverage for Ethernet the existing 2.5Gb/s GPON optical ecosystem

2.5G Ethernet

- It is defined in IEEE 802.3bz as 2.5GBASE-T
 - By downclocking 10GBASE-T and simplifying its PCS (FEC)
- XGMII now supports the 2.5Gb/s mode of operation:

Change item a) in the list following the fourth paragraph of 46.1 to include 2.5 Gb/s and 5 Gb/s rates as follows:

The XGMII has the following characteristics:

- a) It is capable of supporting at least one of the following rates of operation: 2.5 Gb/s, 5 Gb/s, or 10 Gb/s-operation.

46.1.1 Summary of major concepts

Insert item i) after the last item in the list under 46.1.1 as follows:

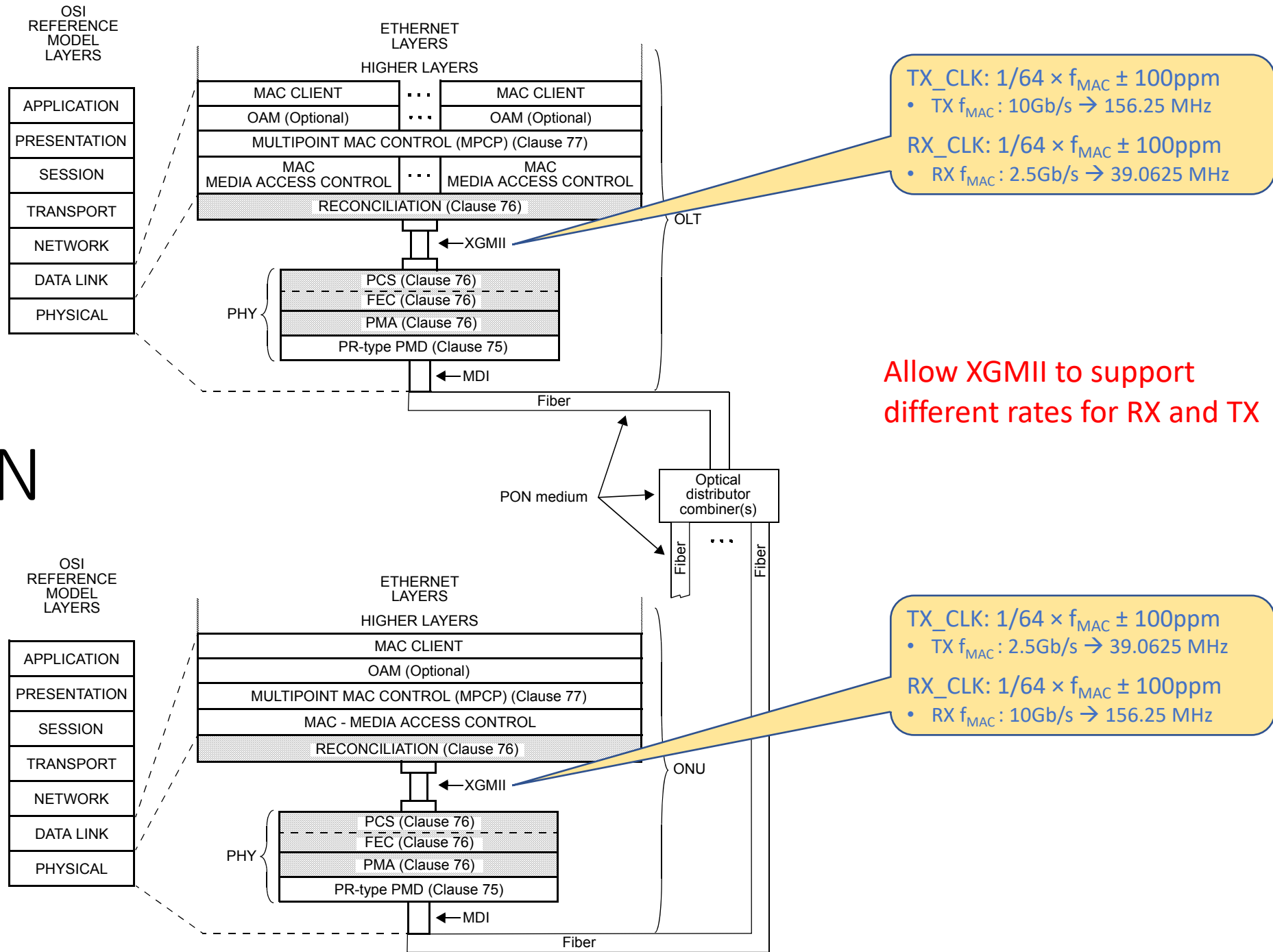
- i) The XGMII is rate scalable and may support rates of 2.5 Gb/s, 5 Gb/s, and 10 Gb/s.

46.1.2 Application

Change the second paragraph of 46.1.2 as follows:

This interface is used to provide media independence so that an identical media access controller may be used with all 2.5GBASE, 5GBASE, and 10GBASE PHY types.

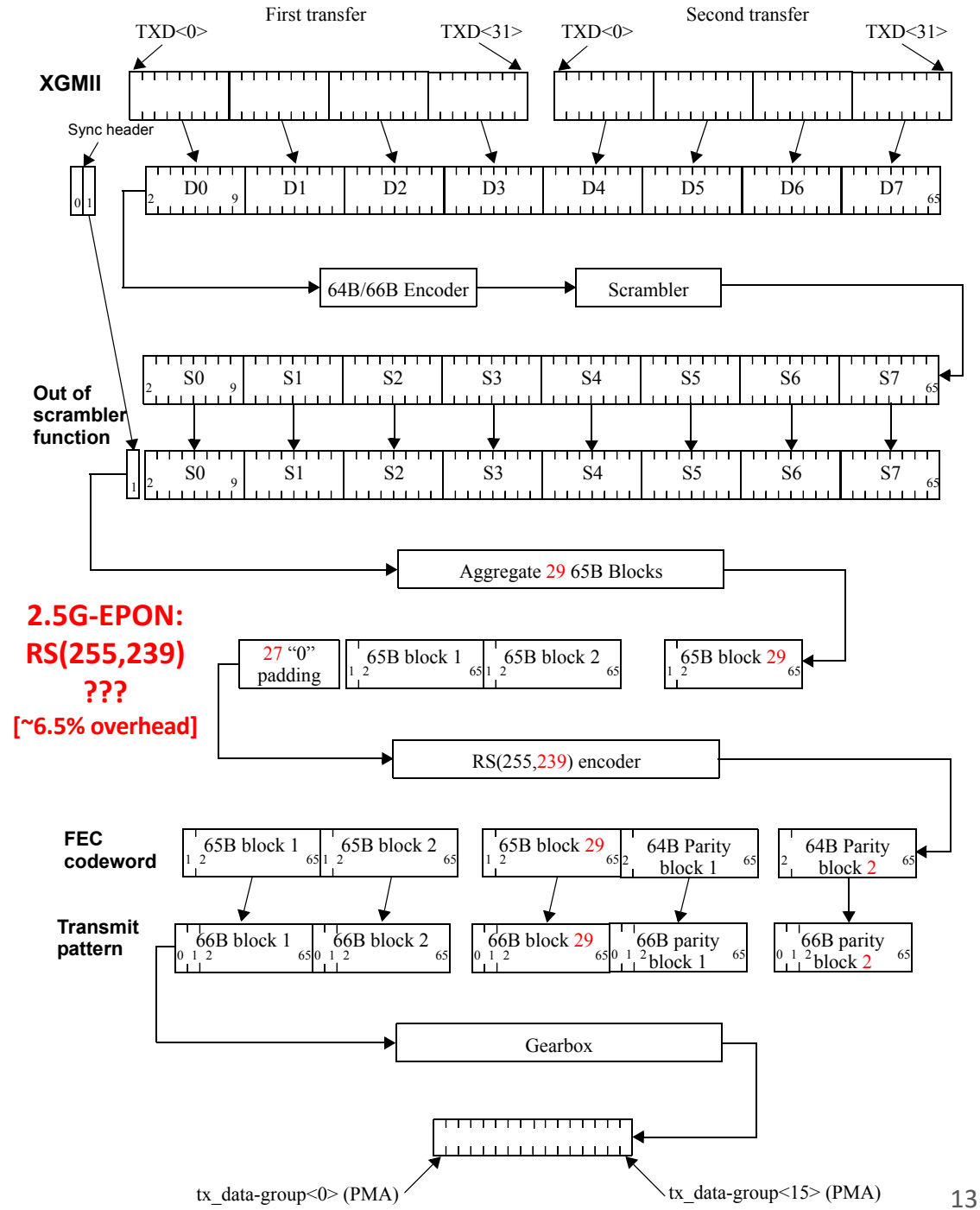
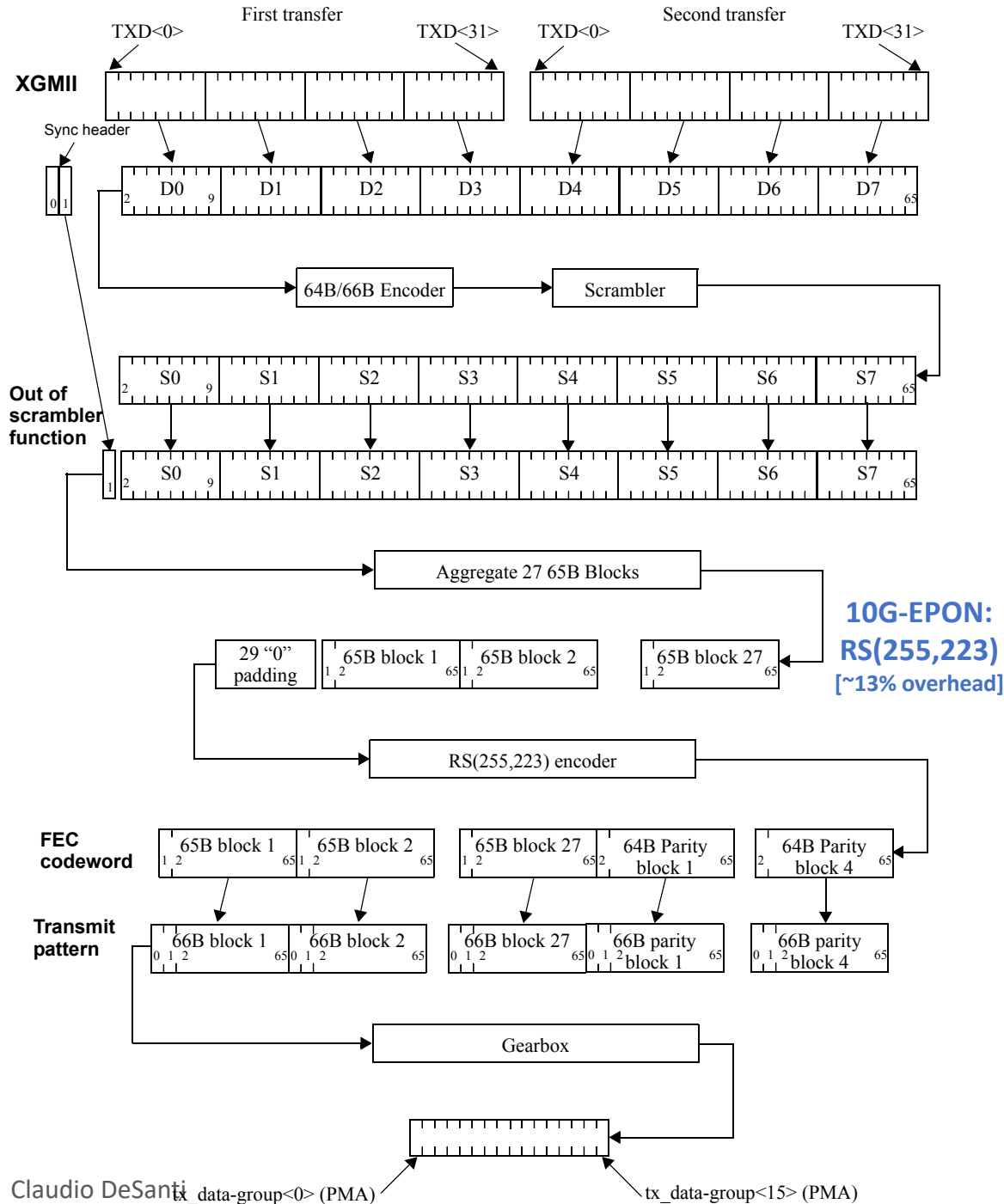
2.5G-EPON (upstream)



Allow XGMII to support different rates for RX and TX

2.5G-EPON FEC Considerations (1)

- 10G-EPON uses RS(255, 223) as FEC downstream and upstream
 - ~13% overhead
 - ~7.2 dB coding gain
- ITU-T XG-PON (~10Gb/s downstream, ~2.5Gb/s upstream) uses:
 - RS (248, 216) downstream (a truncated form of RS(255, 223))
 - RS (248, 232) upstream (a truncated form of RS(255, 239))
- The RS(255, 239) code has:
 - ~6.5% overhead
 - ~5.9 dB coding gain
- Does it make sense to use RS(255, 239) for 2.5G-EPON (upstream)?
 - For Super-PON 10G downstream / 2.5G upstream asymmetric configuration



2.5G-EPON FEC Considerations (2)

- Changing the FEC means do a new implementation for 2.5G-EPON
 - To get a 6.5% reduction in overhead
- Given the large availability of 10G-EPON implementations, it is better to stick to the 10G-EPON FEC
 - Then 2.5G-EPON is just a downclock of 10G-EPON
 - Plus maybe two bits for discovery...

802.3av Discovery

Discovery Information Field in the REGISTER_REQ MPCPDU

Table 77-6—REGISTER_REQ MPCPDU Discovery Information Fields

Bit	Flag field	Values
0	ONU is 1G upstream capable	0 – ONU transmitter is not capable of 1 Gb/s 1 – ONU transmitter is capable of 1 Gb/s
1	ONU is 10G upstream capable	0 – ONU transmitter is not capable of 10 Gb/s 1 – ONU transmitter is capable of 10 Gb/s
2–3	Reserved	Ignored on reception
4	1G registration attempt	0 – 1 Gb/s registration is not attempted 1 – 1 Gb/s registration is attempted
5	10G registration attempt	0 – 10 Gb/s registration is not attempted 1 – 10 Gb/s registration is attempted
6–15	Reserved	Ignored on reception

Discovery Information Field in the DISCOVERY GATE MPCPDU

Table 77-3—GATE MPCPDU discovery information fields

Bit	Flag field	Values
0	OLT is 1G upstream capable	0 – OLT does not support 1 Gb/s reception 1 – OLT supports 1 Gb/s reception
1	OLT is 10G upstream capable	0 – OLT does not support 10 Gb/s reception 1 – OLT supports 10 Gb/s reception
2–3	Reserved	Ignored on reception
4	OLT is opening 1G discovery window	0 – OLT cannot receive 1 Gb/s data in this window 1 – OLT can receive 1 Gb/s data in this window
5	OLT is opening 10G discovery window	0 – OLT cannot receive 10 Gb/s data in this window 1 – OLT can receive 10 Gb/s data in this window
6–15	Reserved	Ignored on reception

802.3ca Discovery

Discovery Information Field in the REGISTER_REQ MPCPDU

Table 144–2—Discovery Information Fields

Bit	Flag field	Values
0	ONU is 1G upstream capable	0 – ONU transmitter is not capable of 1 Gb/s 1 – ONU transmitter is capable of 1 Gb/s
1	ONU is 10G upstream capable	0 – ONU transmitter is not capable of 10 Gb/s 1 – ONU transmitter is capable of 10 Gb/s
2	ONU is 25G upstream capable	0 – ONU transmitter is not capable of 25 Gb/s 1 – ONU transmitter is capable of 25 Gb/s
3	Reserved	Ignored on Reception
4	1G registration attempt	0 – ONU transmitter is not capable of 1 Gb/s 1 – ONU transmitter is capable of 1 Gb/s
5	10G registration attempt	0 – ONU transmitter is not capable of 10 Gb/s 1 – ONU transmitter is capable of 10 Gb/s
6	25G registration attempt	0 – ONU transmitter is not capable of 25 Gb/s 1 – ONU transmitter is capable of 25 Gb/s
7-15	Reserved	Ignored on Reception

Table 144–3—Discovery Information Fields

Bit	Flag field	Values
0	Reserved	Ignored on Reception
1	OLT is 10G upstream capable	0 – OLT does not support 10 Gb/s reception 1 – OLT supports 10 Gb/s reception
2	OLT is 25G upstream capable	0 – OLT does not support 25 Gb/s reception 1 – OLT supports 25 Gb/s reception
3-4	Reserved	Ignored on Reception
5	OLT is opening 10G discovery window	0 – OLT cannot receive 10 Gb/s data in this window 1 – OLT can receive 10 Gb/s data in this window
6	OLT is opening 25G discovery window	0 – OLT cannot receive 25 Gb/s data in this window 1 – OLT can receive 25 Gb/s data in this window
7-15	Reserved	Ignored on Reception

Discovery Information Field in the DISCOVERY_GATE MPCPDU

Possible 2.5G-EPON Discovery

Discovery Information Field in
the REGISTER_REQ MPCPDU

Bit	Flag field	Values
0	ONU is 1G upstream capable	0 – ONU transmitter is not capable of 1 Gb/s 1 – ONU transmitter is capable of 1 Gb/s
1	ONU is 10G upstream capable	0 – ONU transmitter is not capable of 10 Gb/s 1 – ONU transmitter is capable of 10 Gb/s
2	ONU is 25G upstream capable	0 – ONU transmitter is not capable of 25 Gb/s 1 – ONU transmitter is capable of 25 Gb/s
3	ONU is 2.5G upstream capable	0 – ONU transmitter is not capable of 2.5 Gb/s 1 – ONU transmitter is capable of 2.5 Gb/s
4	1G registration attempt	0 – ONU transmitter is not capable of 1 Gb/s 1 – ONU transmitter is capable of 1 Gb/s
5	10G registration attempt	0 – ONU transmitter is not capable of 10 Gb/s 1 – ONU transmitter is capable of 10 Gb/s
6	25G registration attempt	0 – ONU transmitter is not capable of 25 Gb/s 1 – ONU transmitter is capable of 25 Gb/s
7	2.5G registration attempt	0 – ONU transmitter is not capable of 2.5 Gb/s 1 – ONU transmitter is capable of 2.5 Gb/s
8-15	Reserved	Ignored on Reception

Discovery Information Field in
the DISCOVERY_GATE MPCPDU

Bit	Flag field	Values
0	OLT is 1G upstream capable	0 – OLT does not support 1 Gb/s reception 1 – OLT supports 1 Gb/s reception
1	OLT is 10G upstream capable	0 – OLT does not support 10 Gb/s reception 1 – OLT supports 10 Gb/s reception
2	OLT is 25G upstream capable	0 – OLT does not support 25 Gb/s reception 1 – OLT supports 25 Gb/s reception
3	OLT is 2.5G upstream capable	0 – OLT does not support 2.5 Gb/s reception 1 – OLT supports 2.5 Gb/s reception
4	OLT is opening 1G discovery window	0 – OLT cannot receive 1 Gb/s data in this window 1 – OLT can receive 1 Gb/s data in this window
5	OLT is opening 10G discovery window	0 – OLT cannot receive 10 Gb/s data in this window 1 – OLT can receive 10 Gb/s data in this window
6	OLT is opening 25G discovery window	0 – OLT cannot receive 25 Gb/s data in this window 1 – OLT can receive 25 Gb/s data in this window
7	OLT is opening 2.5G discovery window	0 – OLT cannot receive 2.5 Gb/s data in this window 1 – OLT can receive 2.5 Gb/s data in this window
8-15	Reserved	Ignored on Reception

Summary

- 2.5G-EPON upstream appears to be very doable
 - A downclock of 10G-EPON
 - Allow XGMII to have different RX_CLK and TX_CLK
 - Assign two bits in the REGISTER_REQ MPCPDU and in the DISCOVERY GATE MPCPDU for discovery
 - Specify the optical PMD parameters
- Probably a couple of pages in addition to the PMD specification
- With the exception of the 2.5Gb/s speed, Super-PON would be a PMD-only project
 - Similar to 802.3bk

Thank you