100G EPON Architectures and Reference Models

Yuxin (Eugene) Dai

Cox Communications

IEEE Interim meeting 100G EPON TF, January 2016

Atlanta GA, USA

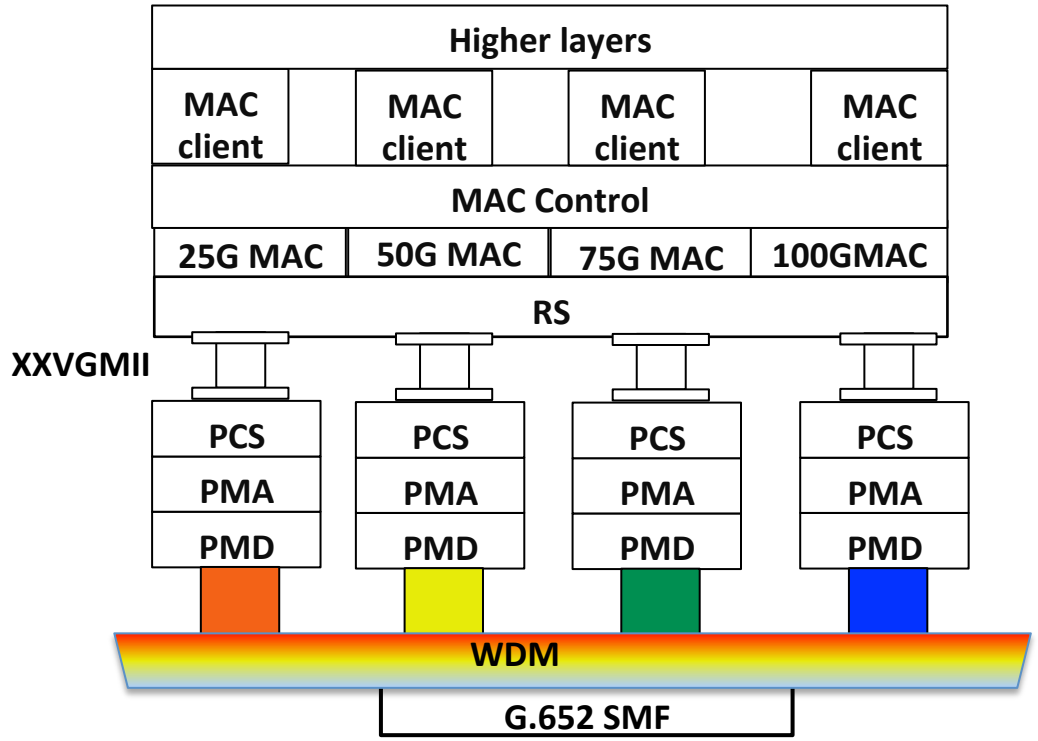
Outline

- 100G EPON channel bonding architectures
- 100G EPON system reference models

Bonding choices for 100G EPON

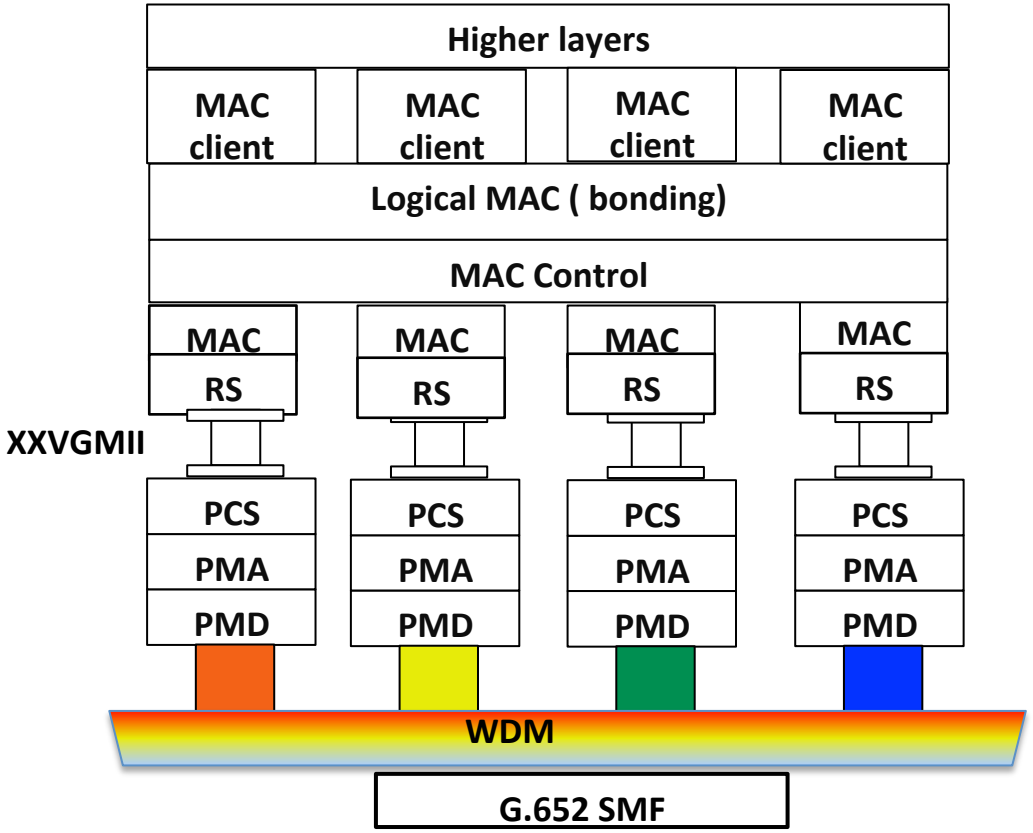
- PHY layer bonding – higher or lower PCS layer
  - Used at 40G/100G and 400G Ethernet
  - Rigid architecture
  - May not feasible for P2MP topology with mixed generations, ie. mixed 25Gb/s, 50Gb/s… 100Gb/s ONUS
- Reconciliation Sub-layer bonding
  - Less rigid than PHY layer bonding, may work with mixed generation ONUs
  - However, it is still an inflexible architecture
  - May have issues with traffic balancing between lanes and rate adaptions
- MAC layer bonding
  - Most flexible architecture
  - Haven't discussed so far; it needs to be investigated

100G EPON Reference Model I – RS layer bonding



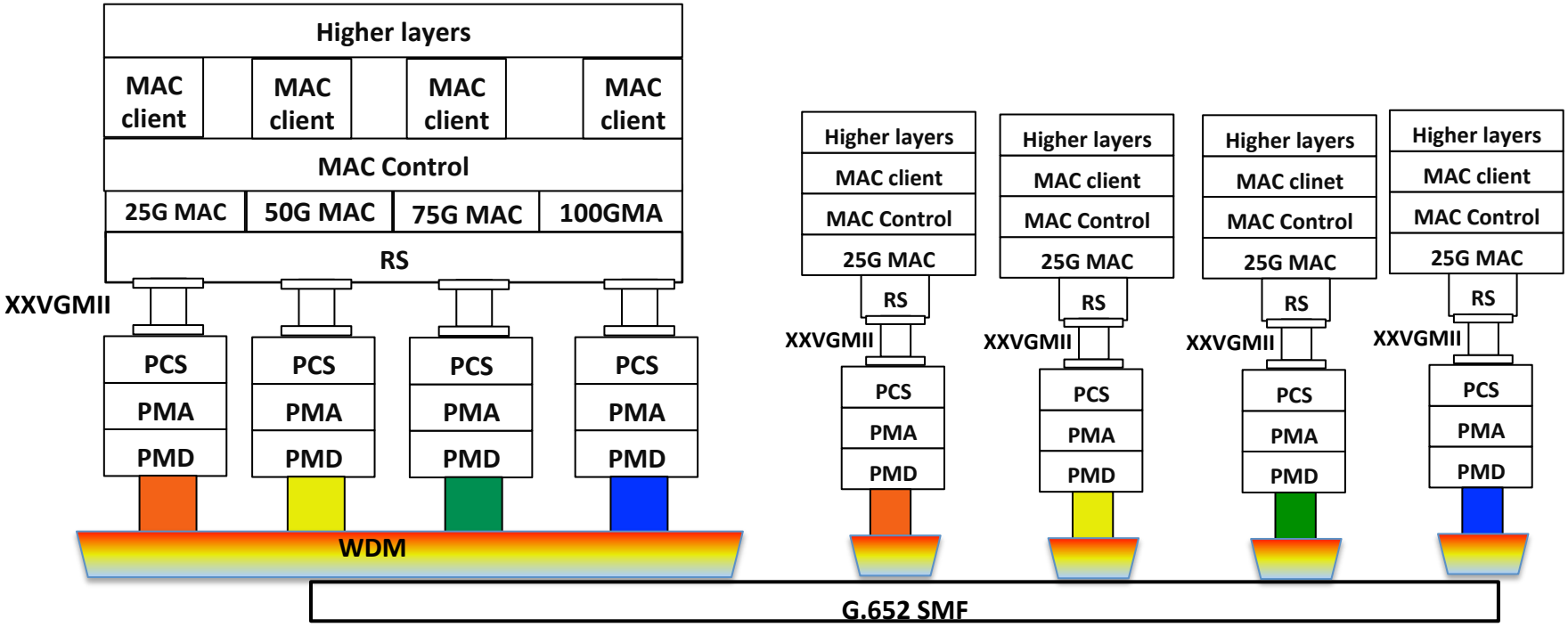
- 25G, 50G 75G and 100G have their own MACs
- Channel bonding occurs at a common RS layer
- RS layer bonding is a bonding between MAC and PHY layers bonding
- Complication at OLT, ie. OLT needs have 25G to 100G MAC initially in order to support growth
- Traffic balancing and rate adaption may be problems, and needs future study

100G EPON Reference Model II – MAC layer bonding



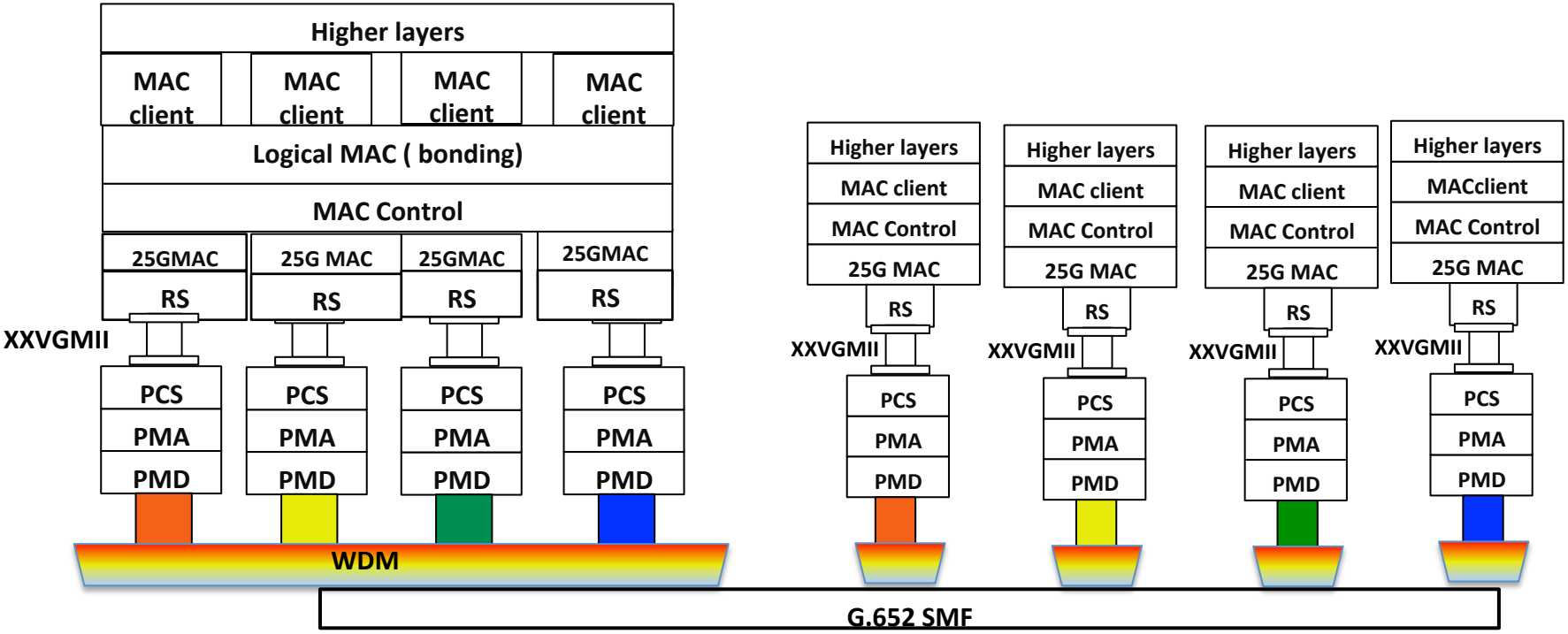
- Channel bonding occurs at Logical MAC sub-layer; it's a MAC layer bonding
- Four lanes have separated and are identical to 10G MAC and RS.
- Each lane follows 10G EPON rate adaption mechanism
- Most flexible architecture

100G EPON with 25Gb/s ONU Reference Model I



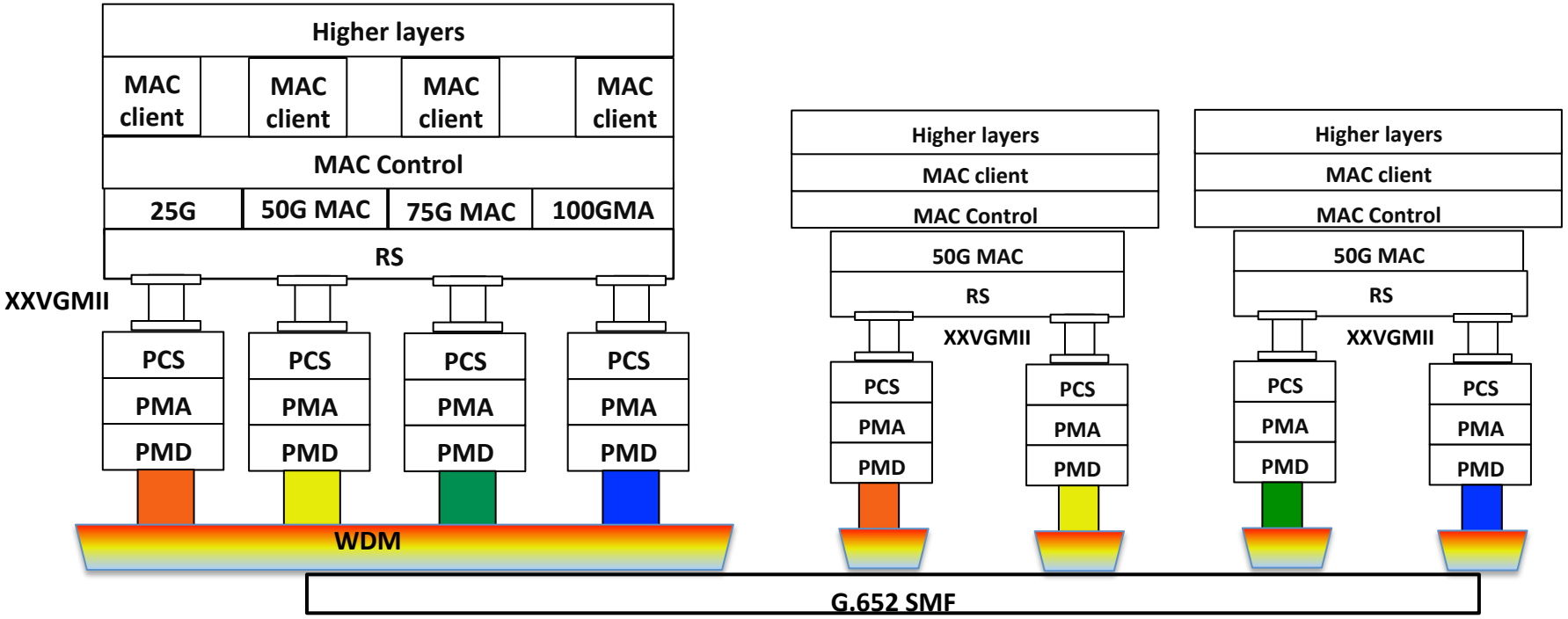
- Initial deployment could start with Red PON with 32 to 64 Red 25 Gb/s ONUs
- Yellow, Green and Blue PONs could be added for “pay-as-grow”
- The system has 100Gb/s aggregated capacities
- RS layer bonding is disabled
- The 50G, 75G and 100G MAC at OLT may never be used

100G EPON with 25Gb/s ONU Reference Model II



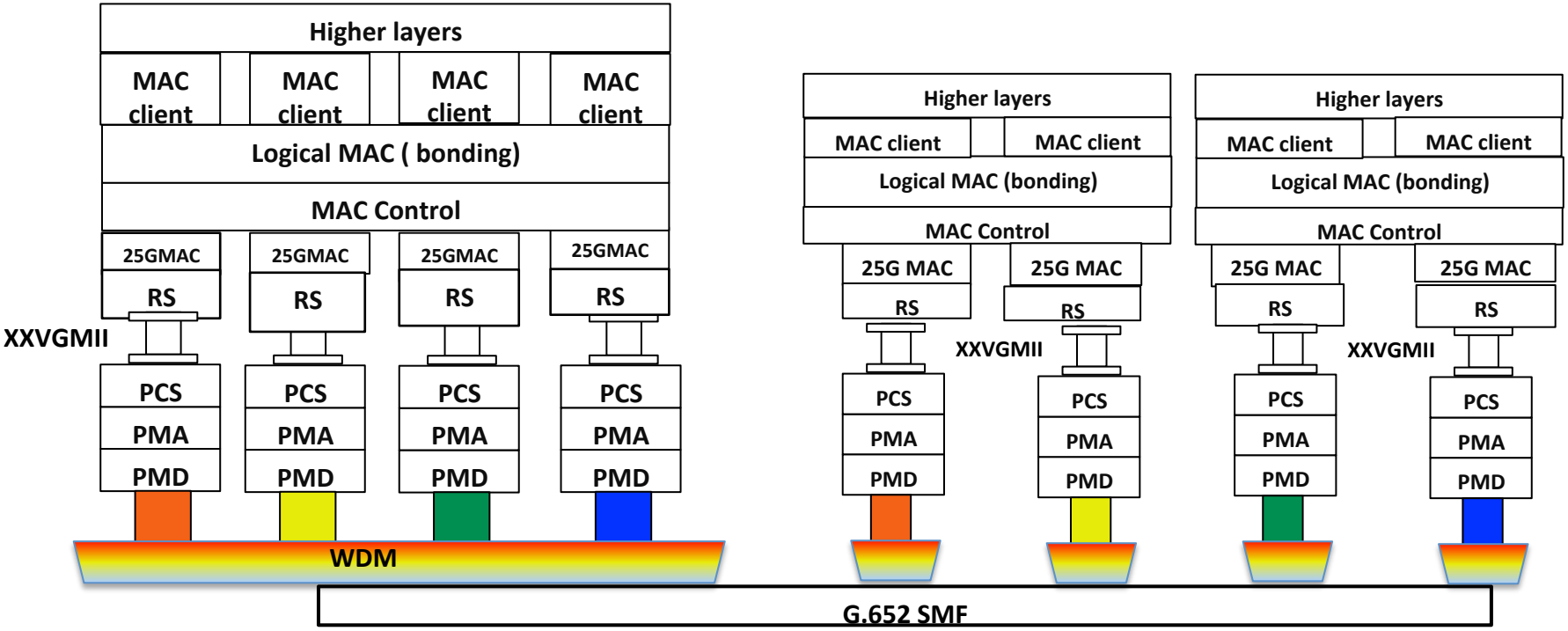
- Initial deployment could start with Red PON with 32 to 64 Red 25 Gb/s ONUs
- Yellow, Green, and Blue PONs could be added for “pay-as-growth”
- The system has 100Gb/s aggregated capacities
- MAC layer bonding is disabled
- The OLT is simpler and cost may be lower compared with the previous case

100G EPON with 50Gb/s ONU Reference Model I



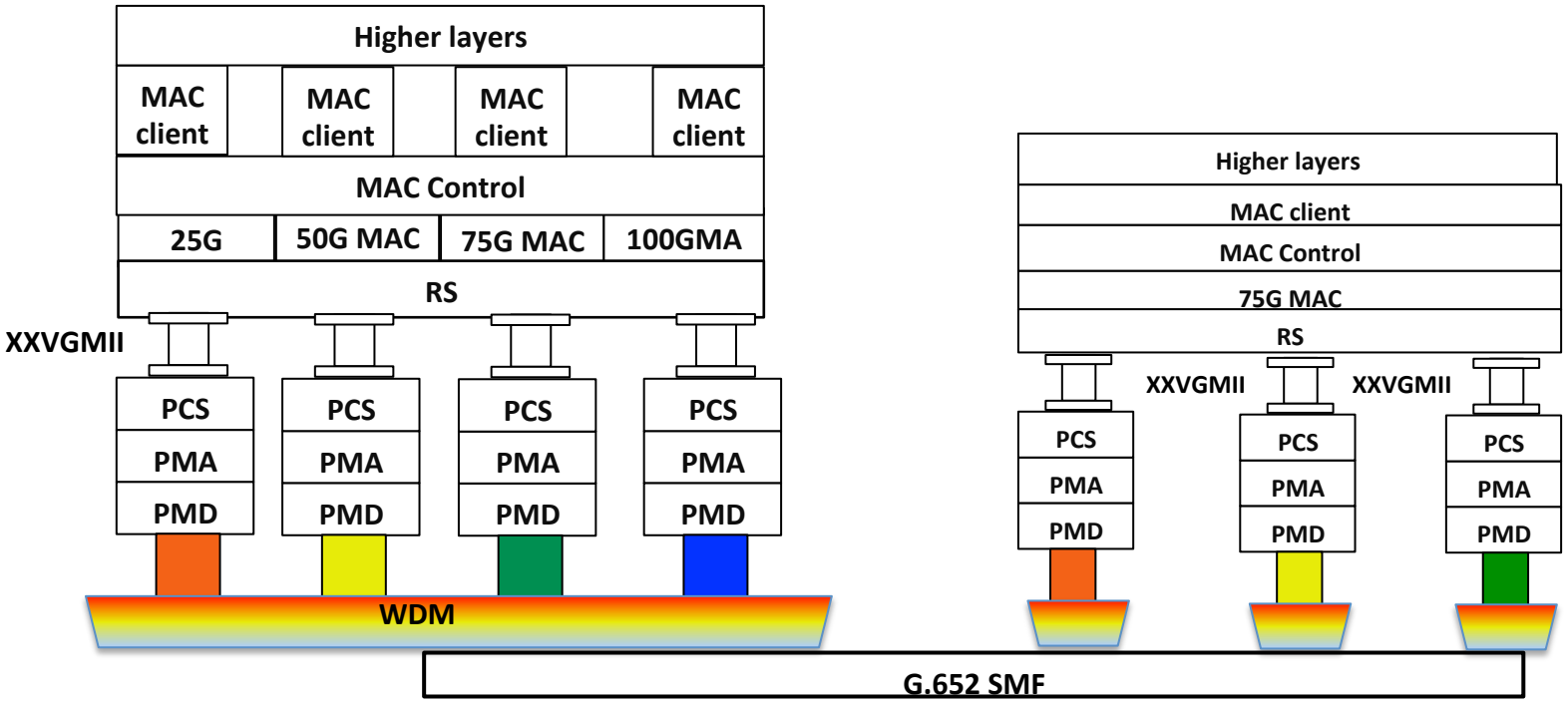
- Two types of 50Gb/s ONUs are needed with color combinations that use all the colors. Could be defined in the standard.
- Do not need to exhaust all color combinations

100G EPON 50Gb/s ONU Reference Model II



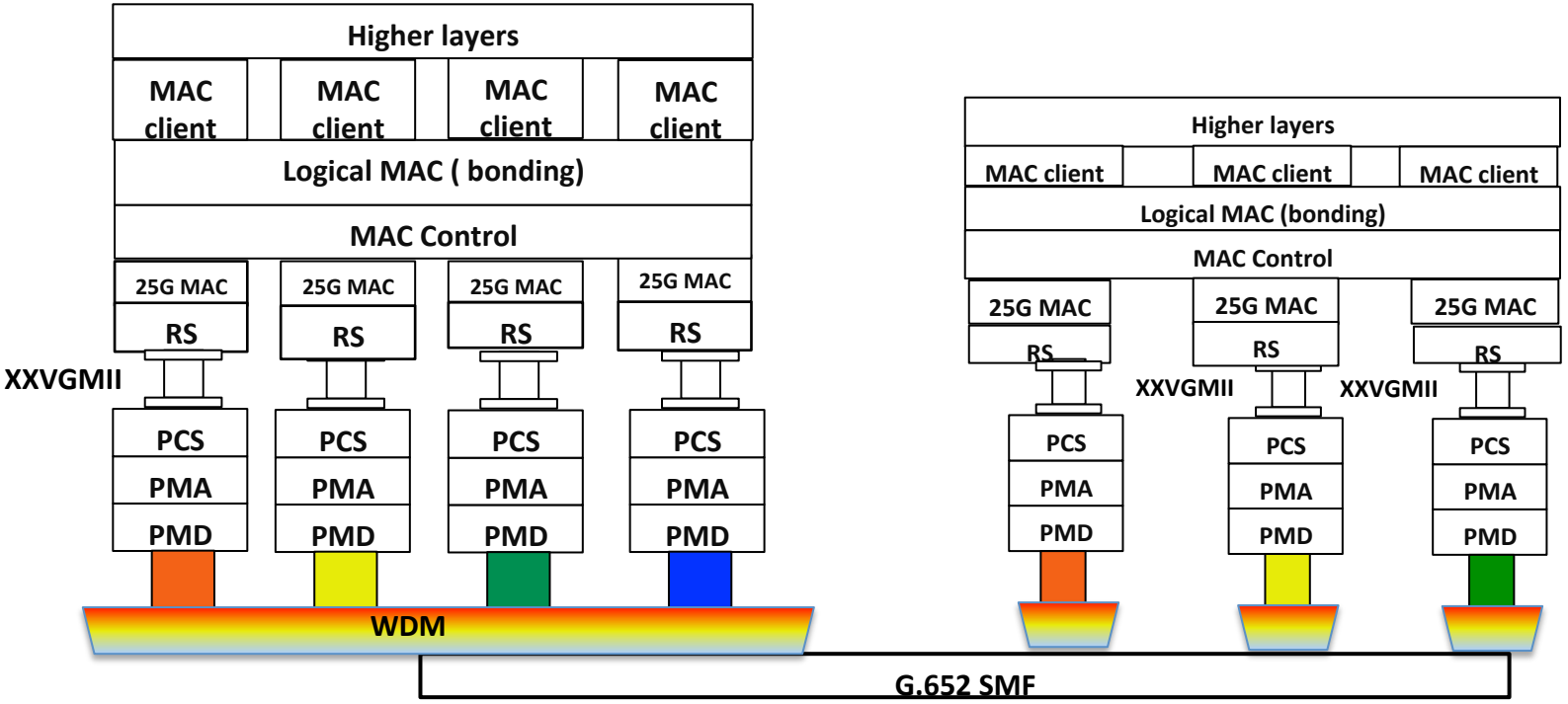
- Two types of 50Gb/s ONUs are needed with color combinations that use all the colors. Could be defined in the standard.
- Do not need to exhaust all color combinations
- The 50Gb/s ONU can work as bonded or un-bonded
- Un- bonded use-case may be for MDU as a new type of MUD
  - Two separated optical channels for additional security

100G EPON 75Gb/s ONU Reference Model I



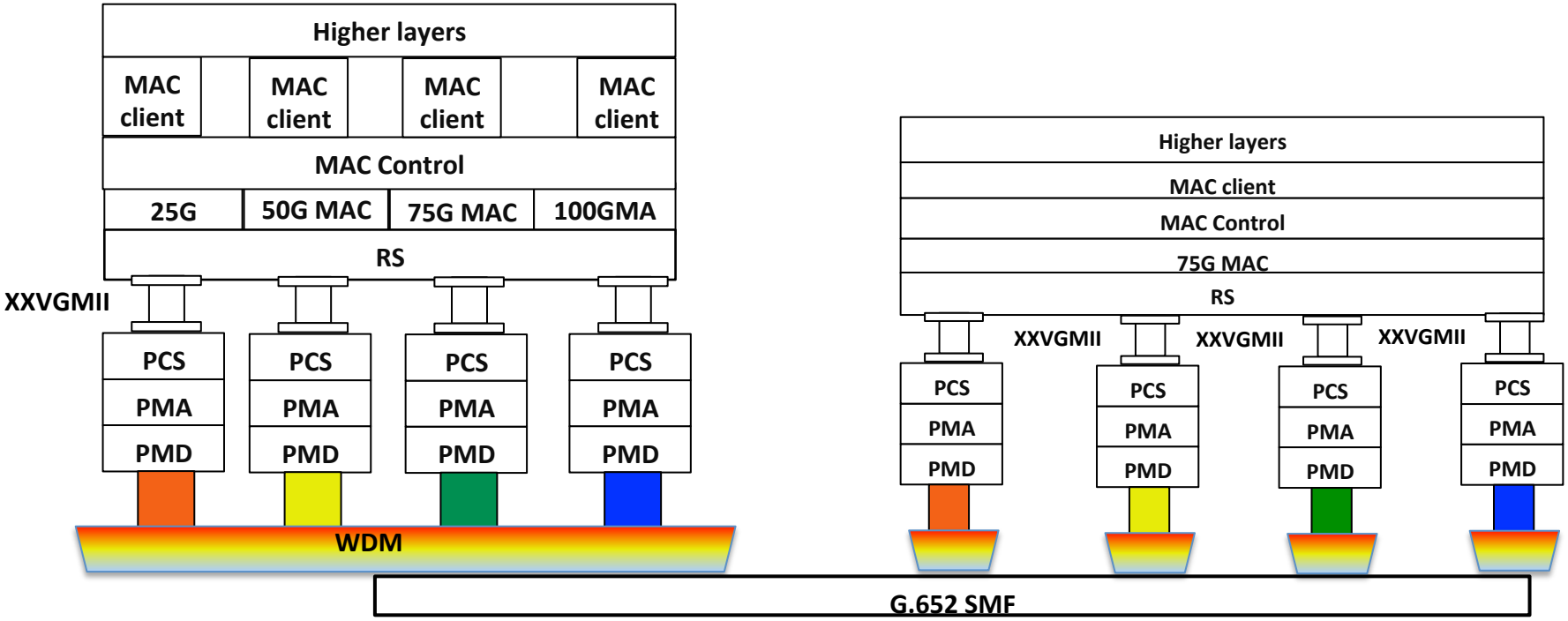
- It seems only one type of 75Gb/s ONUs is needed with 3 colors that could be defined in the standard.
- Different color combinations do not seem to have benefits
- 75 Gb/s ONUs alone cannot balance 4 lanes
- The traffic may be be balanced with a mix of 75Gb/s ONUs with 25Gb/s ONUs

100G EPON 75Gb/s ONU Reference Model II



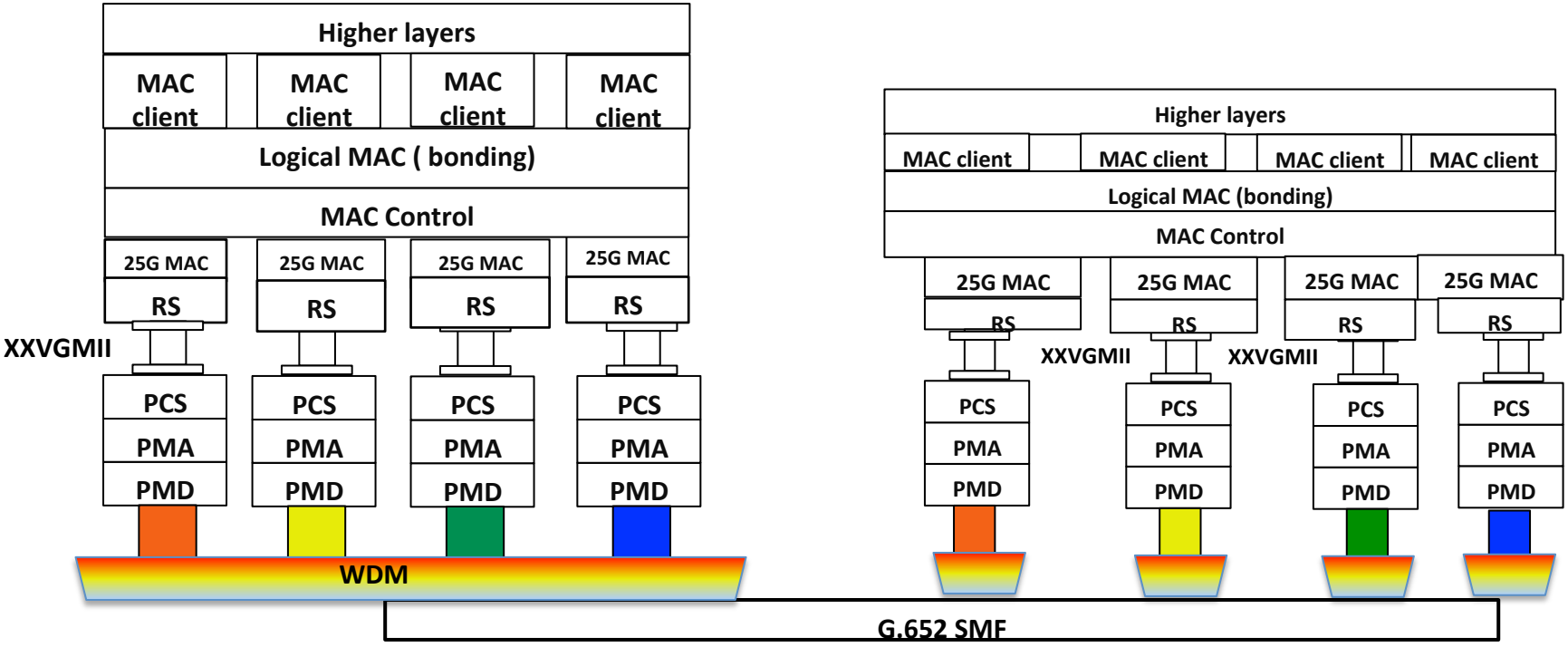
- It seems only one type of 75Gb/s ONUs is needed with 3 colors that could be defined in the standard.
- Different color combinations do not seem to have additional benefits
- 75 Gb/s ONU can be used in bonded or un-bonded ways
- Un-bonded ONU can be used as a new type of MDU ONU
  - Three separated channels provide additional securities

100G EPON 100 Gb/s ONU Reference Model I



- Only one type of 100Gb/s ONUs with 4 colors
- 100 Gb/s ONUs alone can balance 4 lanes

100G EPON 100 Gb/s ONU Reference Model II



- Only one type of 100Gb/s ONUs is needed with 4 colors
- 100 Gb/s ONU can be used in bonded or un-bonded ways
- Un-bonded ONU can be used as a new type of MDU ONU
  - Three separated channels provide additional securities

Conclusions

- MAC layer channel bonding has several benefits and needs to be considered as a candidate
- 100G EPON consisting of only 25Gb/s ONUs in a pay-as-grow architecture should be considered
- Performance of RS bonding and MAC bonding need further study

Thanks

Eugene.dai@cox.com