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# 100G EPON Architectures, Wavelength Plans and Line Codes


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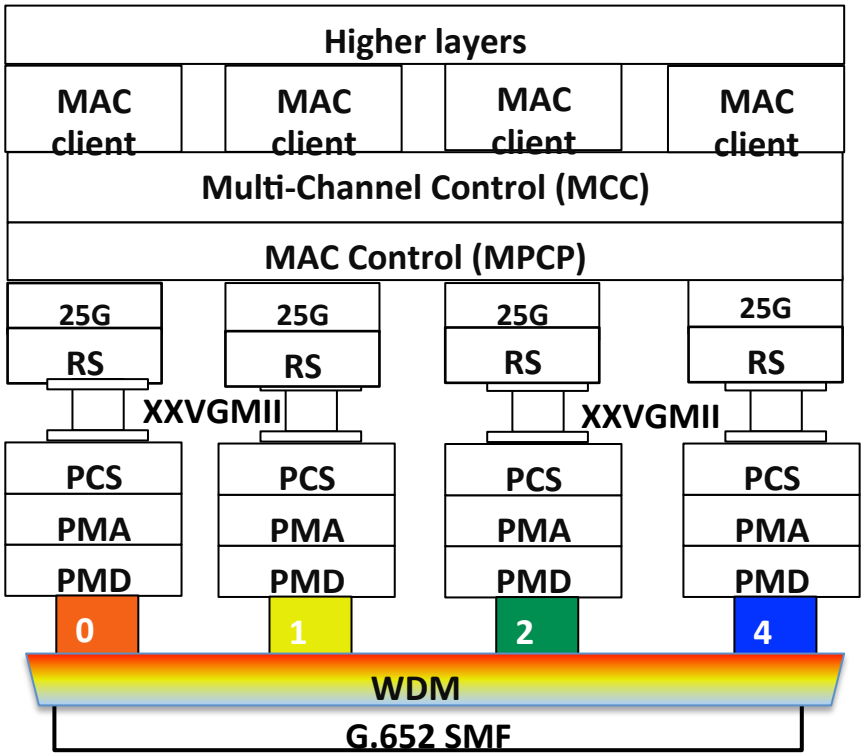
# Outline

- 100G EPON 1+3 architecture
- Wavelength plan and line code(modulation) for 1+3 100G EPON
- 100G EPON 1+4 architecture
- Wavelength plan and line code(modulation) for 1+4 100G EPON
- Common wavelength plan with NGPON2

# 100G EPON 1+3 architecture

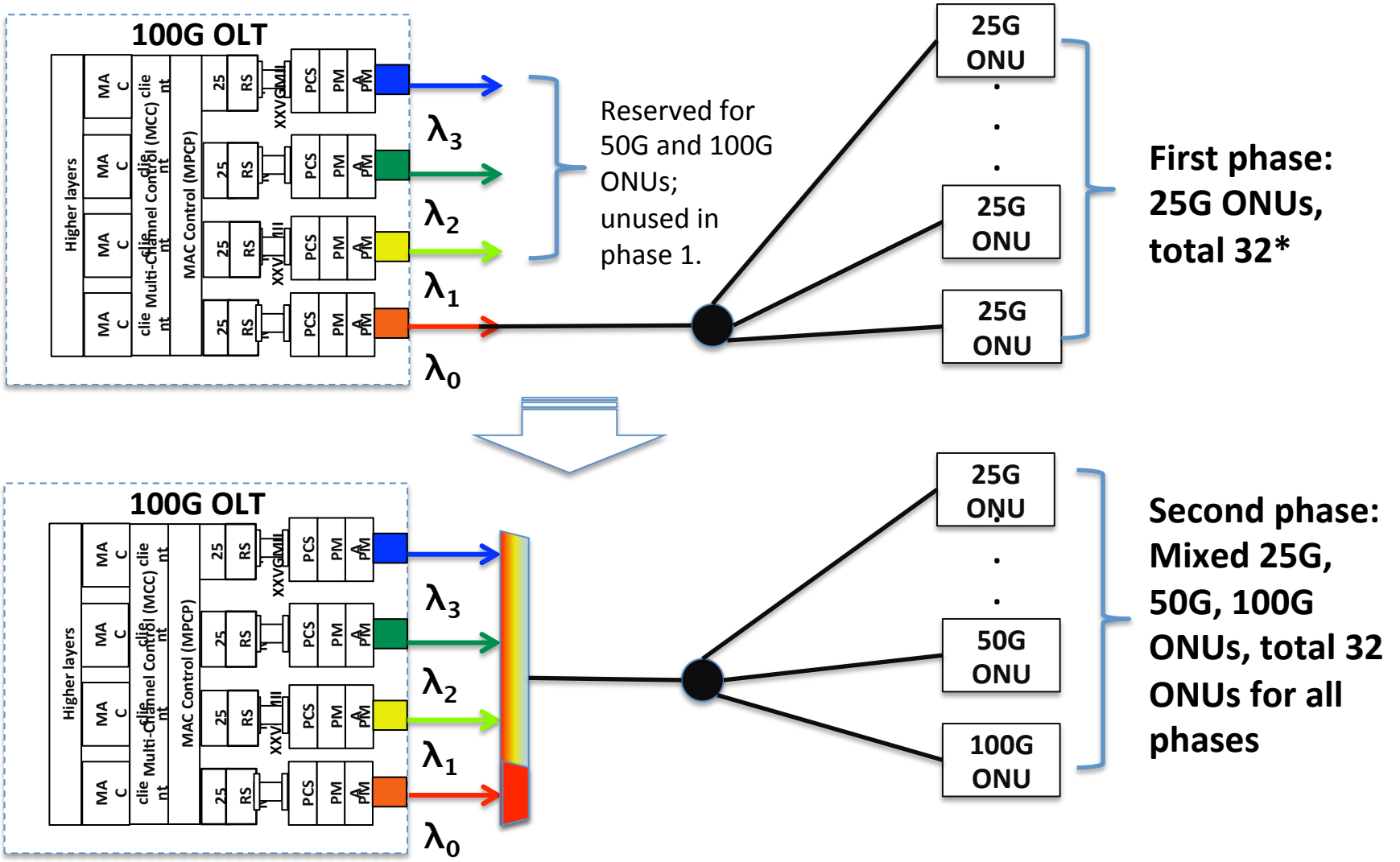



**1+3 architecture assumes**

- First 25G channel on lane 0 deploys initially
- 25G ONUs can only be on lane 0*
- Lane 1,2 and 3 are reversed for 50G and 100G ONUs at later time

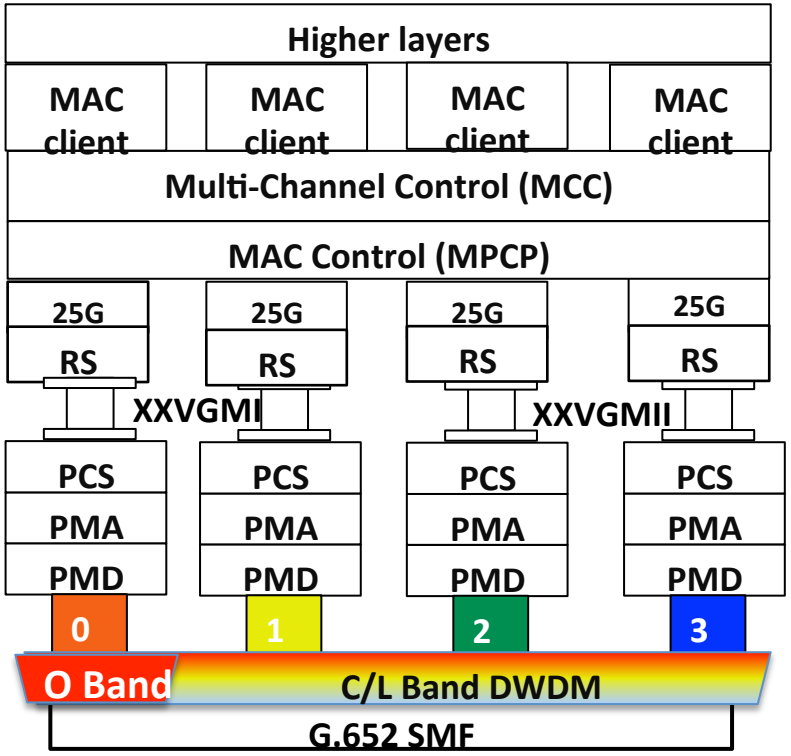
* Fixed lane association of 25G, 50G ONUs came from RS sub-layer bonding model; with MAC control sub-layer bonding this limitation is unnecessary (but we are not going to expend the discussion here).

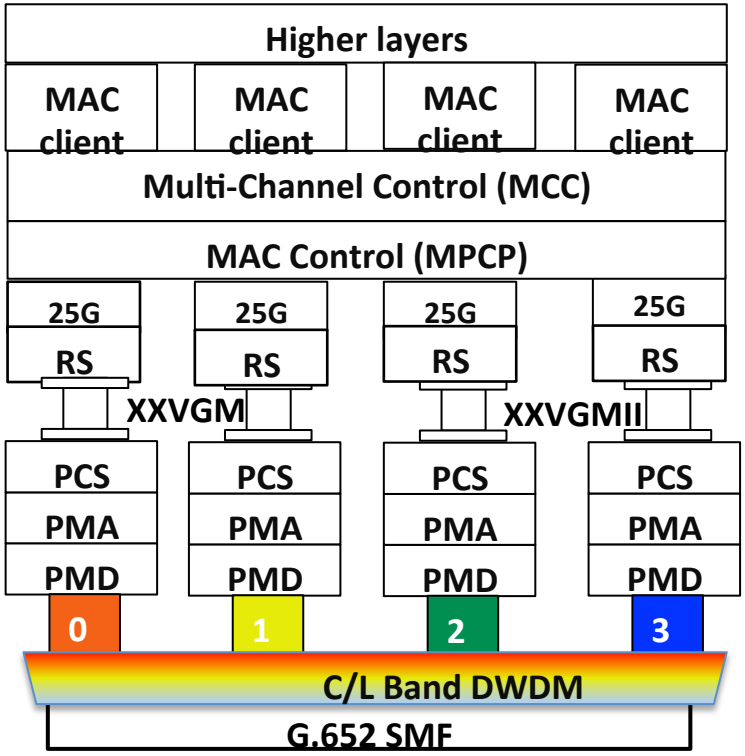
# 100G EPON 1+3 deployment scenarios




* Assuming 32 ONUs is maximum for given power budget and ODN reach

# Wavelength plans for 1+3 architecture




**Wavelength plan option 1:**

- **The 1st 25G in lane 0 operates in O band in both US and DS (10nm or 20nm band)**
- **Lane 1 to 3 operate in C/L band (DWDM)**

**Wavelength plan option 2:**

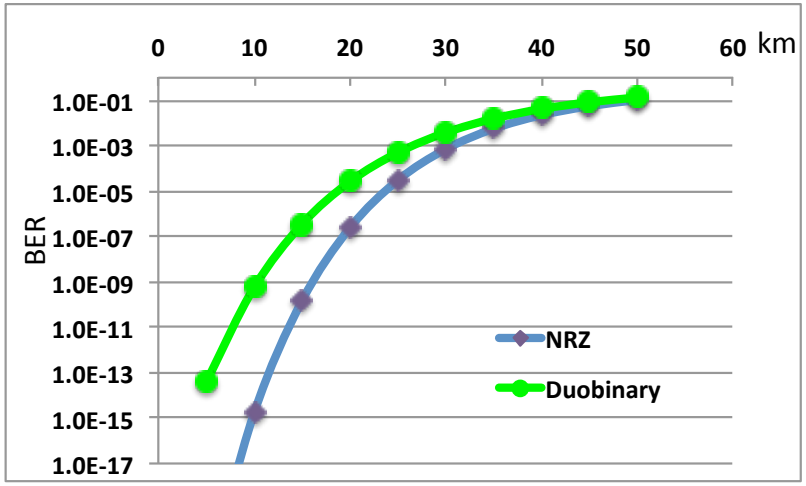
- **Lanes 0 to 3 operate in C/L band (DWDM)**

# Wavelength plans for 1+3 architecture (continuous)

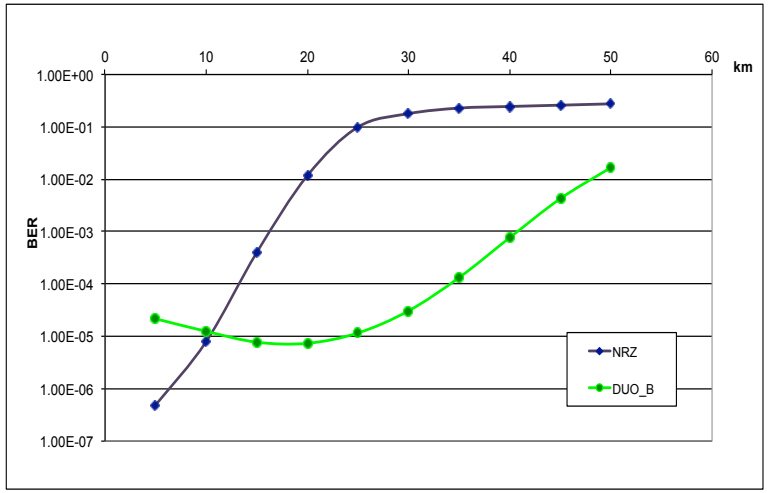
- **Option 1: Pro & Con**
  - **Pro: The cost of initial 25G channel is low due to the wide band optics in O band without dispersion compensation**
  - **Con: Lane 0 in O-band and lanes 1 to 3 in C/L band have different dispersion characteristics, may result in mixed dispersion compensated and non-compensated channels in a WDM system or different line codes**
- **Option2: Pro & Con**
  - **Pro: Lanes 0 to 3 have same dispensation characteristics**
  - **Con: The initial deployment cost of 25G channel (C-band DWDM) is higher compare to option 1**

# Line codes for 1+3 architecture

O Band BER --- Fiber length




C Band BER --- Fiber length

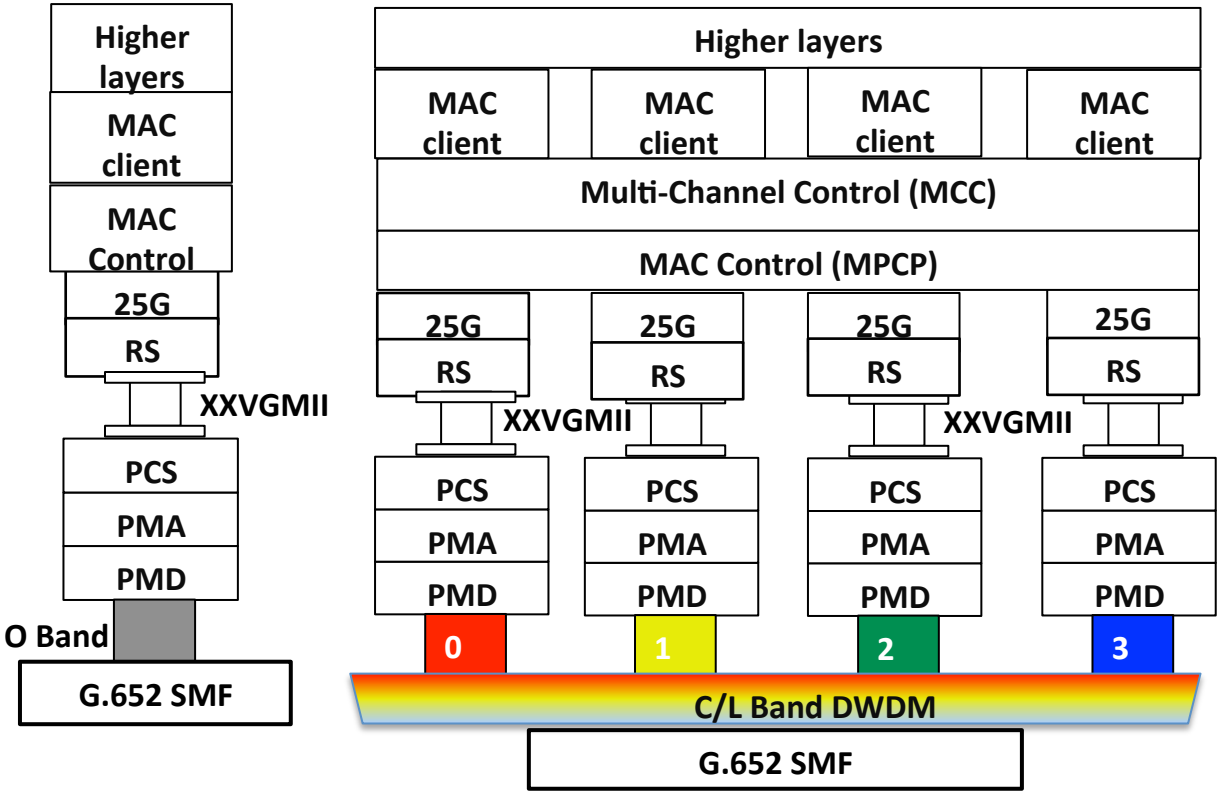



- **Optimum line codes for wavelength plan option 1**
  - **Lane 0 in O-band: NRZ modulation**
  - **Lanes 1 to 3 in C/L band: duobinary modulation**
- **Optimum line codes for wavelength plan option 2**
  - **Lanes 0 to 3: duobinary modulation**

# 1+3 architecture discussions

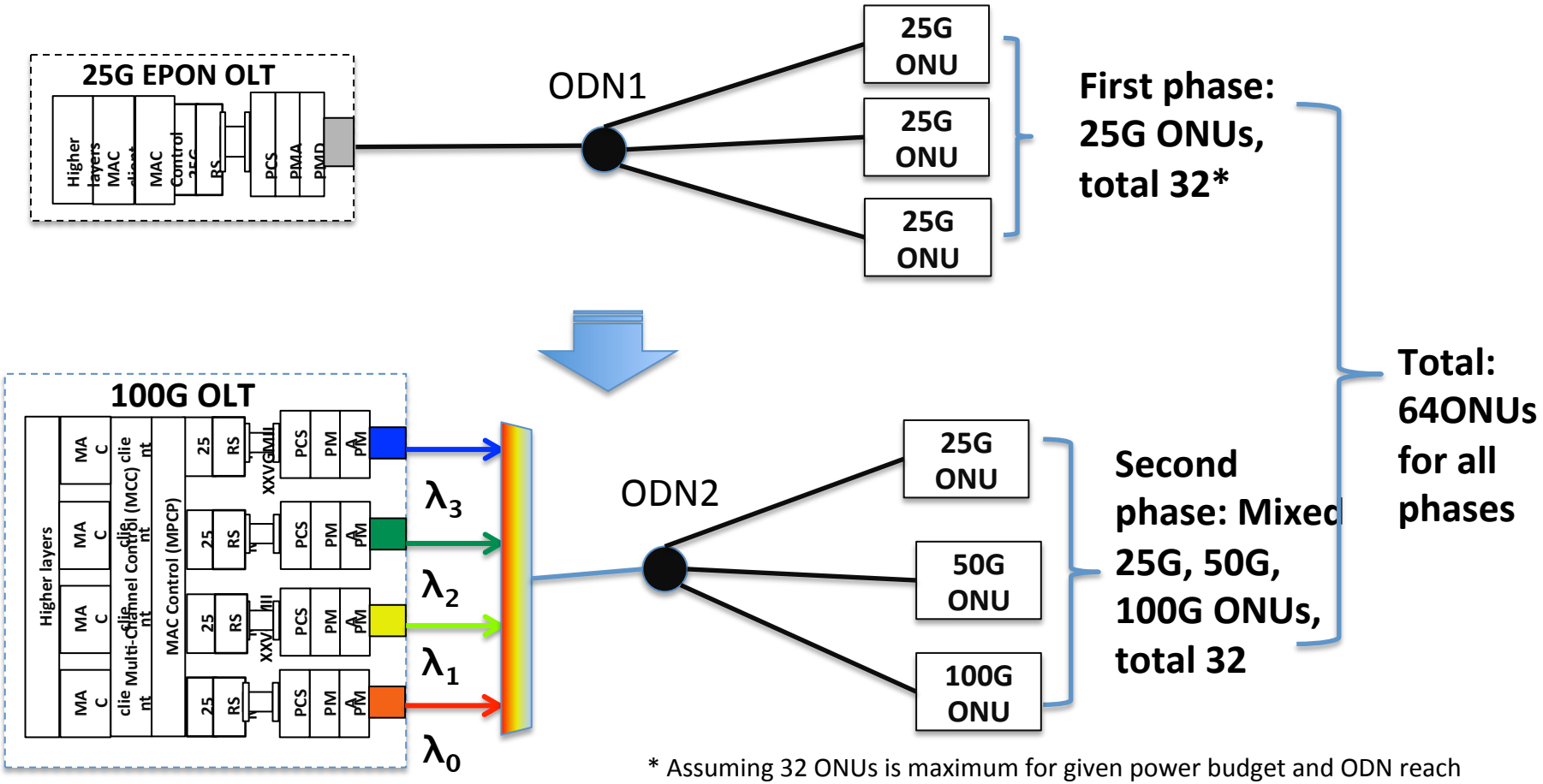
- **Option 1 enables low cost 25G channel in O-band for initial deployment, but has challenge in dispersion compensation and choosing of line codes**
  - **Dispersion: Mixed wide band and narrow band WDM channel with very different dispersion characteristics**
  - **Options for line codes:**
    - **The optimum choice is NRZ for lane 0 and duobinary for lanes 1 to 3 (lower BER and avoiding dispersion compensation), the draw back is that 2 types of line codes are used for one WDM system**
    - **Or, choose NRZ or duobinary for all lanes (not optimized or mixed CD compensations))**
- **Option 2 makes dispensation compensation (or not to compensate), choosing of line code and system design easier, but does not allow low cost initial 25G channel deployment**

# 100G EPON 1 + 4 architecture A




- **The first single 25G EPON is in O band channels (10nm or 20nm) in both upstream and downstream**
- **The 50G and 100G ONUs are on a different ODN**

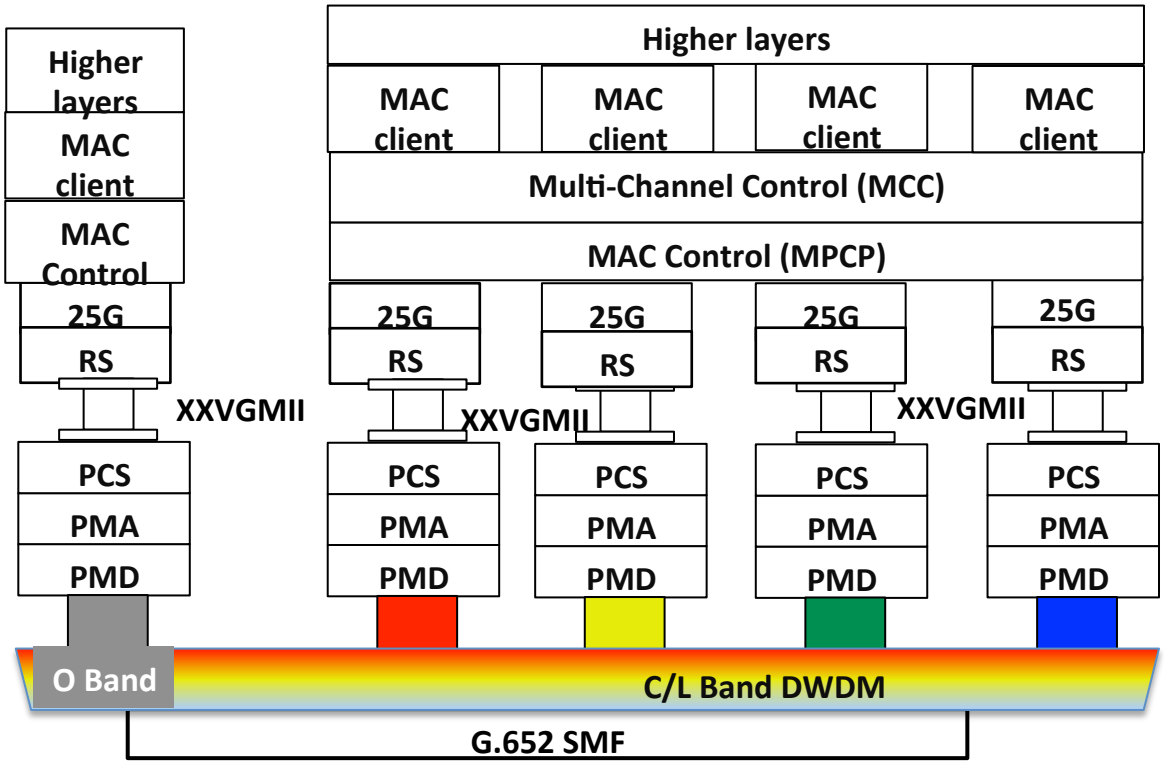
# 100G EPON 1+4 architecture A deployment scenarios




* Assuming 32 ONUs is maximum for given power budget and ODN reach

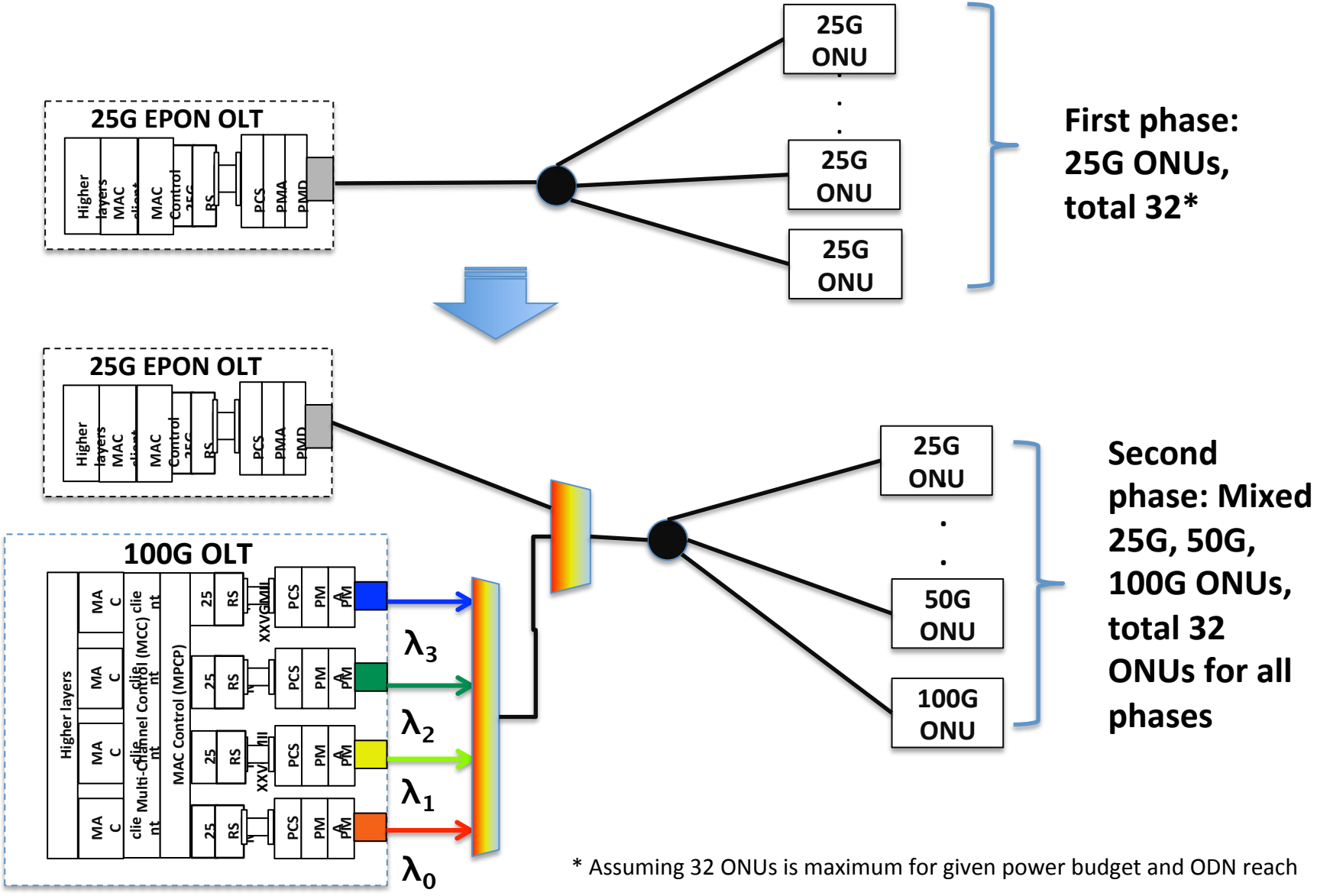
**The 1+4 architecture A allows low cost O-band 25G ONUs to scale separately from the more expensive C/L band DWDM 50G and 100G ONUs**

# 100G EPON 1+4 architecture B




- First 25G EPON is in O band channels (10nm or 20nm) in both upstream and downstream
- The 50G and 100G system is added to the same ODN at later time

# 100G EPON 1+4 deployment scenarios




* Assuming 32 ONUs is maximum for given power budget and ODN reach

# Wavelength Plan and line codes for 1+4 Architectures

## Wavelength plan and line codes

- The single channel 25G system uses O-band wide channels (10nm or 20nm) for both upstream and downstream
- The single channel 25G system uses NRZ modulation for best performance
- The 4-channel 50G, 100G system operates in C/L band DWDM channels (100GHz or 200GHz)
- The 4-channel system uses duobinary modulation for best performance

**Benefits of 1+4 architecture**

- Enable low cost 25G ONUs to scale separately from the more expensive 50G and 100G ONUs
- Optimize line codes for single 25G system and 100G systems.
- May allow extended reach in the future without adding dispersion compensation

# Common Wavelength Plan with NGPON2

- A common wavelength plan conserves wavelength resources
- A common wavelength plan in C/L bands facilitates migration to WDM PON in the future
- NGPON2 reserves C-band 1524nm to 1544nm for upstream and L-band 1596nm to 1609nm for downstream

Option 1: In 100G EPON 1+4 architecture, the 4-channel system operates in C-band with 4 pairs of NGPON2 channels from 1524nm to 1544nm in upstream and downstream.

Option 2: In 100G EPON 1+4 architecture, the 4-channel system operates in C-band with 4 NGPON2 channels from 1524nm to 1544nm in upstream and in L-band with 4 NGPON2 channels from 1596nm to 1609nm in downstream. Option2 conflicts with RFoG

# Conclusions

- 100GEPON 1+4 architecture is preferred
- Low cost 25Gb/s system operates in O-band (10nn or 20nm) channels in upstream and downstream
- The O band 25Gb/s channels use NRZ modulation
- The 4-channel system operates in C band with 4 pairs of NGPON2 DWDM channels in upstream and downstream
- The 4-channel system use duobinary modulation

# Straw poll/Motion 1

## Adopt 1+4 architecture for 100G EPON

# Straw poll/Motion 2

**Low cost 25Gb/s system operates in O-band (10nn or 20nm) channels in upstream and downstream**

# Straw poll/Motion 3

**The 4-channel system in 1+4 architecture (or 3-channel system in 1+3 architecture) operates in C band with 4 pairs (or 3 pairs) of NGPON2 DWDM channels in upstream and downstream**

# Straw poll/Motion 4

**The 4-channel system in 1+4 architecture use duobinary modulation**


# Thanks

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