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25G/50G/100G EPON wavelength plan

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This contribution is based in part on input from multiple optical component suppliers.

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25G EPON

Cost-optimizing 25G EPON: wavelength plan

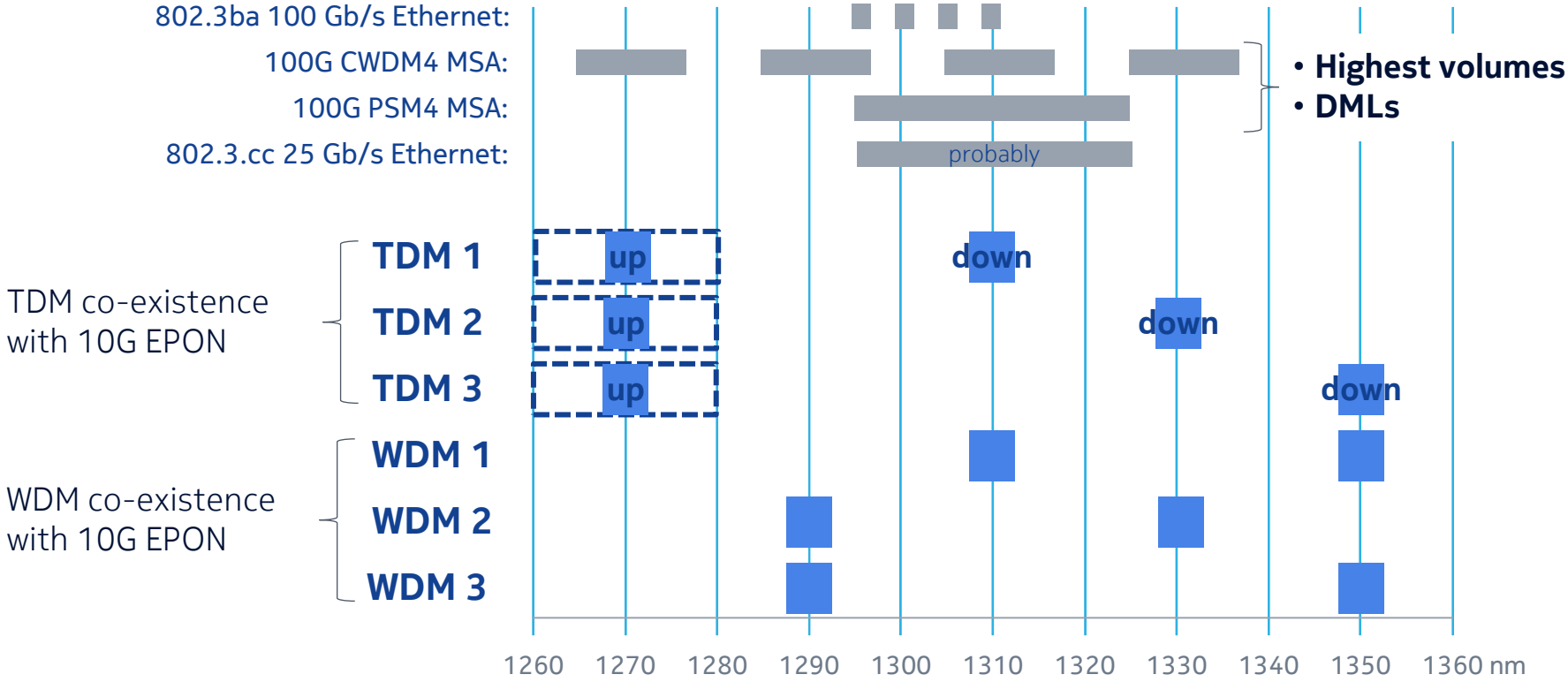
- Of 25/50/100G EPON, 25G EPON will have
  - the highest volumes,
  - the most aggressive cost target and
  - the earliest time-to-market requirement.
- Therefore we should
  - leverage high volume 25G data center components, in particular 25G DMLs and EMLs
  - for risk mitigation, spec 25G EPON to allow for both DML (lower cost, higher power) and EML (higher ER)
  - avoid dispersion compensation
- Therefore, 25G EPON should operate in the O-band

25G EPON wavelength plan: criteria

1. Maximize use of existing 100G and 25G Ethernet wavelengths
2. To mitigate risk, keep both DML (lower cost, higher power) and EML (higher ER) options open, for both OLT and ONU
3. Probably will need to cool DMLs for maximum power: assume 5 nm spectrum?
4. Maintain ≥ 35 nm between down/up λs for low cost 45° diplexer

25G EPON wavelength plan: 6 possibilities meeting the criteria

For reference: Ethernet 25G ecosystem λs



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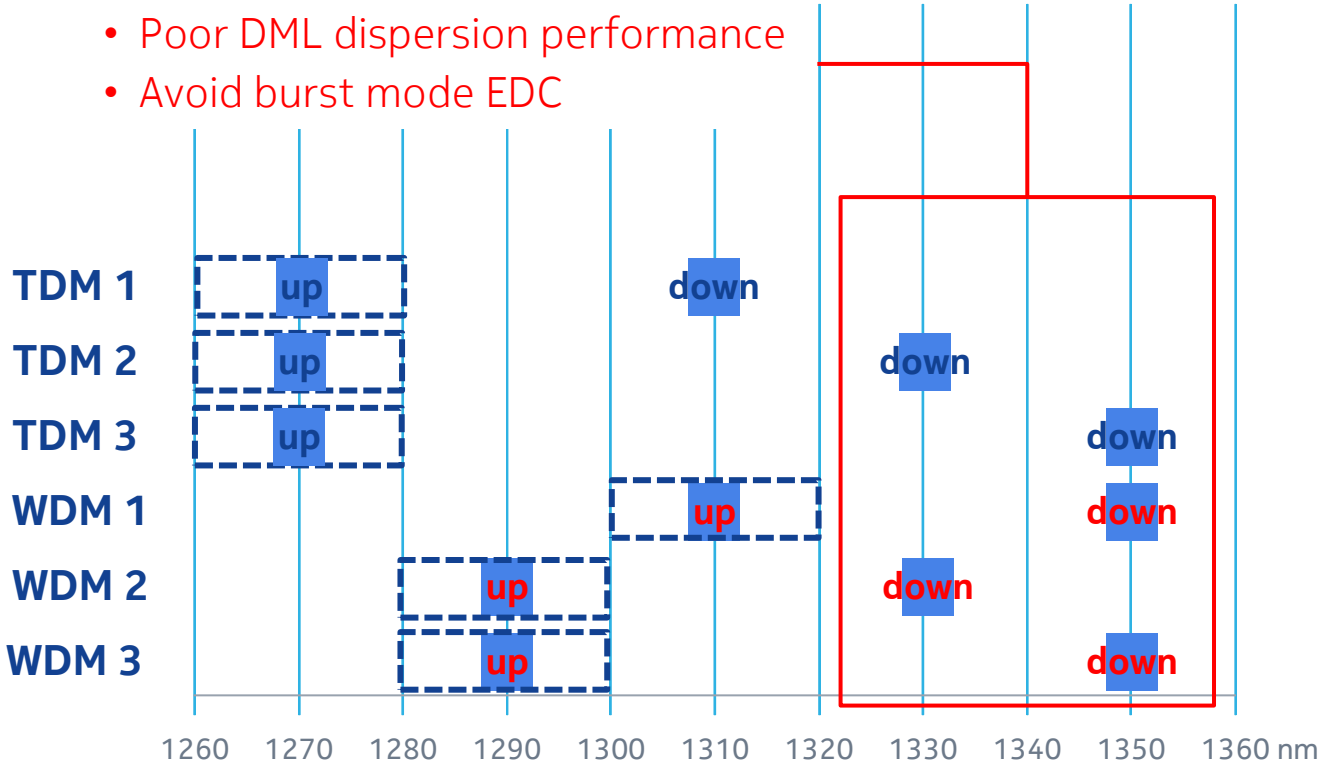
Priority: preserve the lower cost DML option for the ONU
6 valid options:

- Poor DML dispersion performance
- Avoid burst mode EDC



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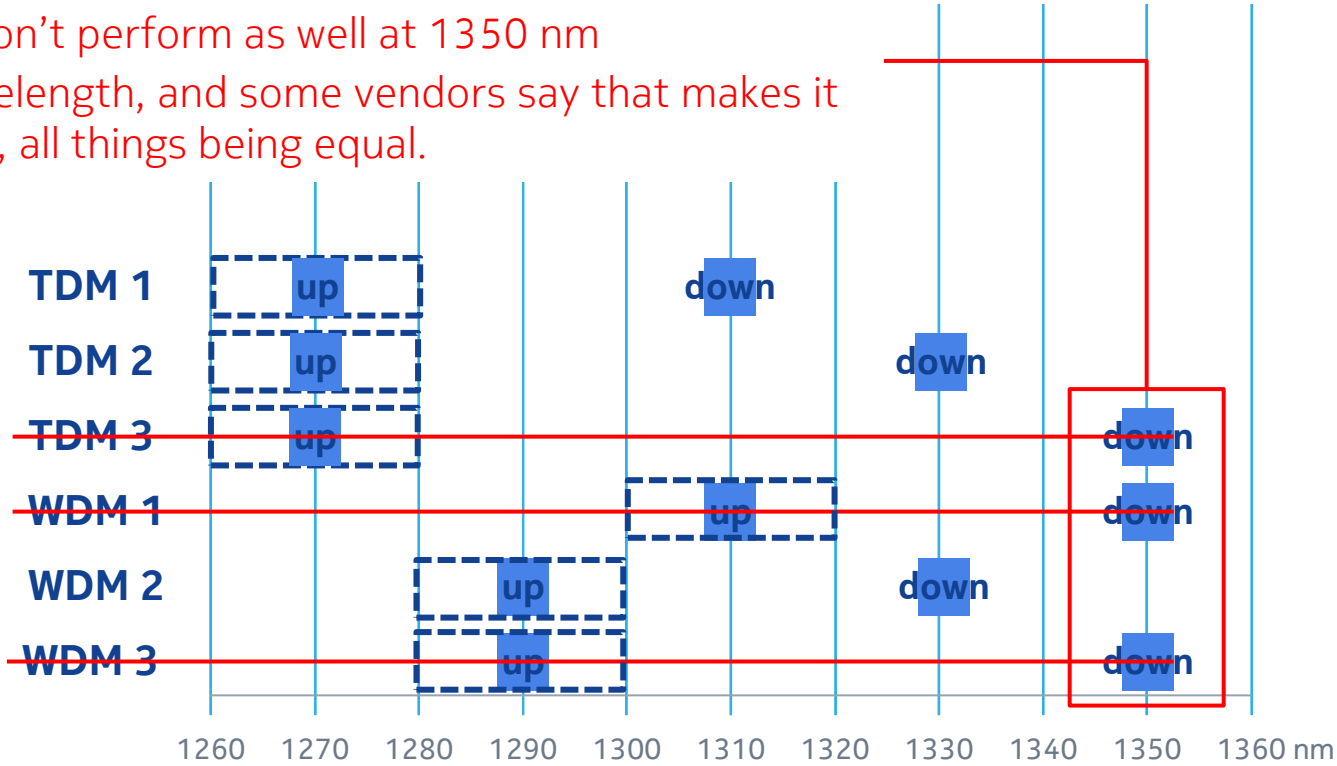
Narrowing the options: eliminate potentially problematic 1350 nm

- With OLT DML, too much dispersion for ONU EDC?
- Some DMLs don't perform as well at 1350 nm
- It's a new wavelength, and some vendors say that makes it less preferred, all things being equal.



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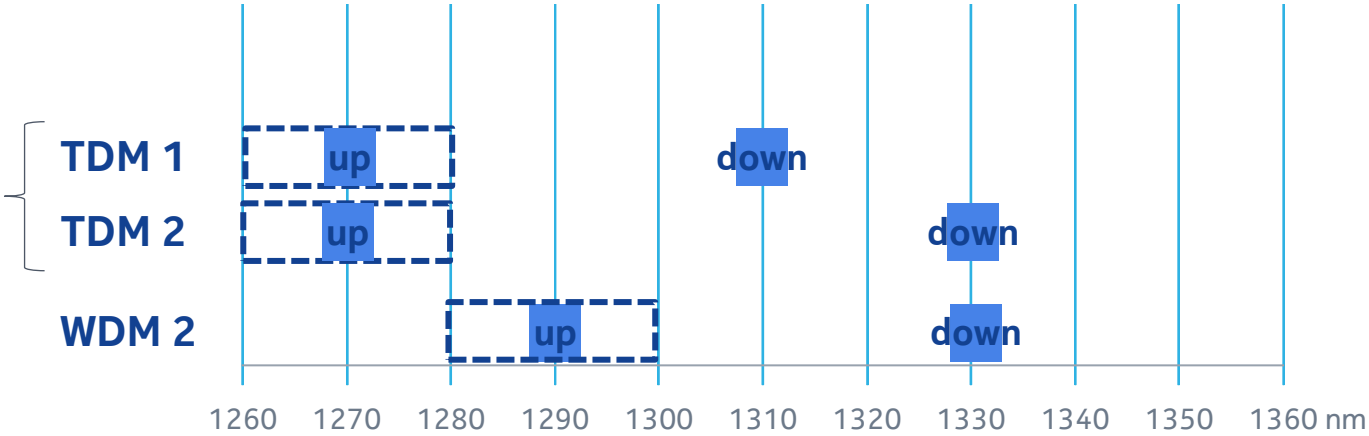
3 best options remaining

Extended criteria:

1. Maximize use of 100G and 25G Ethernet wavelengths: O-band
2. To mitigate risk, keep both DML and EML options open for both OLT and ONU
3. If only cooled DMLs can meet power requirements, then 5 nm spectrum
4. Maintain ≥ 35 nm between down/up λs for low cost 45° diplexer
5. Priority: preserve the lower cost DML option for the ONU
6. Eliminate potentially problematic 1350 nm

TDM co-existence with 10G EPON

WDM co-existence with 10G EPON



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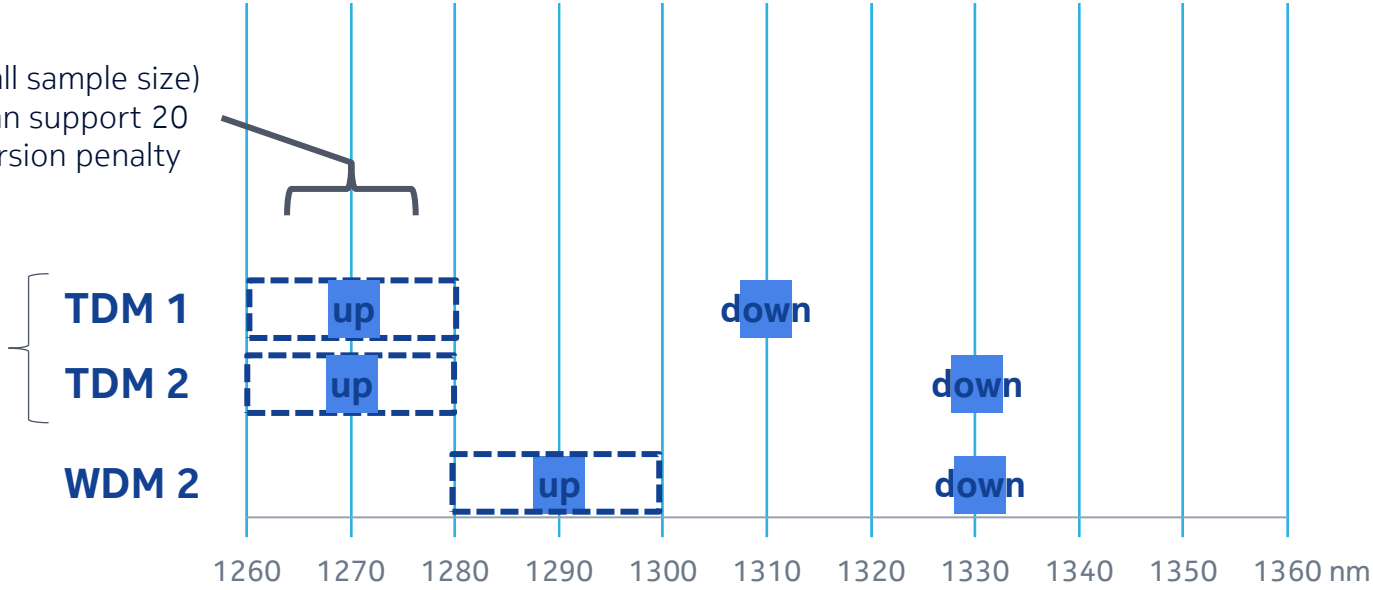
Final choice depends on additional considerations

1. Does the Task Force prefer TDM or WDM co-existence with 10G EPON? (there are pros and cons of each)
2. DML dispersion performance over 20 km at 1270 nm needs more study.

Data from Finisar (small sample size) indicates that DMLs can support 20 km with minimal dispersion penalty

TDM co-existence with 10G EPON

WDM co-existence with 10G EPON



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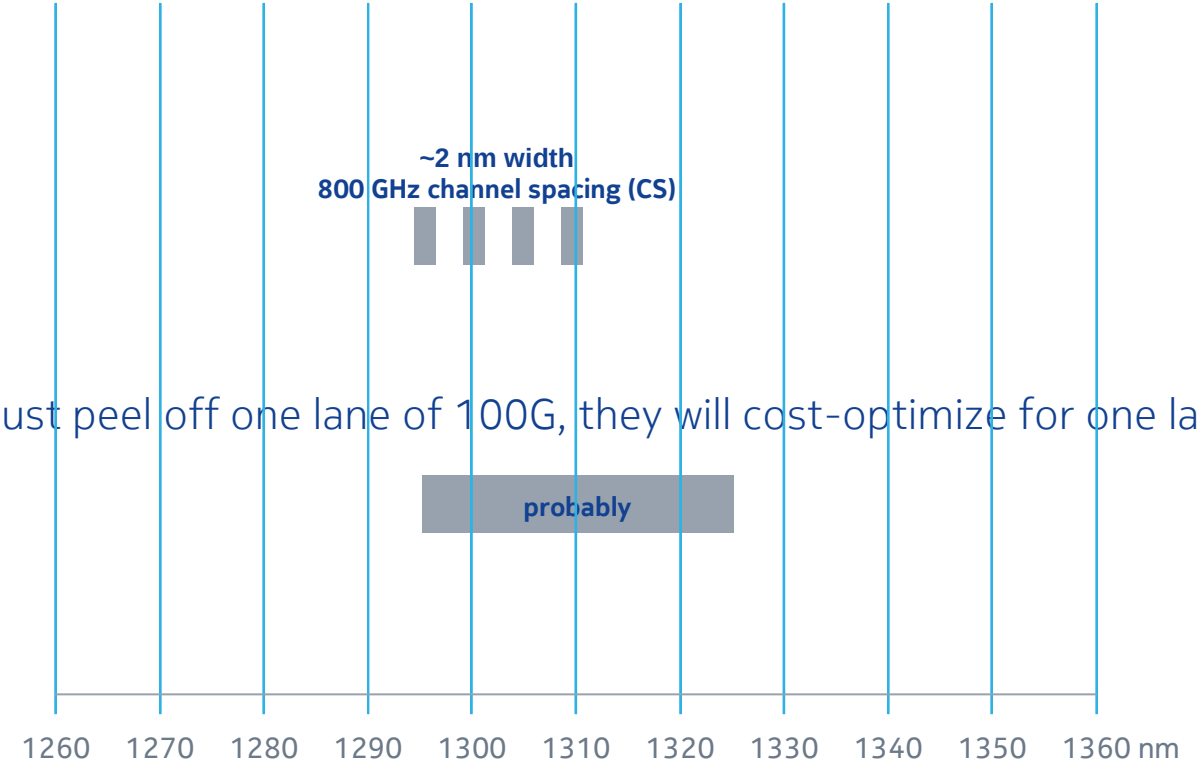
50G/100G EPON

Q: Do we want to also put 50/100G wavelengths in the O-band?
A: Not if it adds significant cost to the 25G EPON.

Consider what 25G Ethernet did

100G Ethernet, -LR4, -ER4



For 25G Ethernet, IEEE will <u>not</u> just peel off one lane of 100G, they will cost-optimize for one lane:

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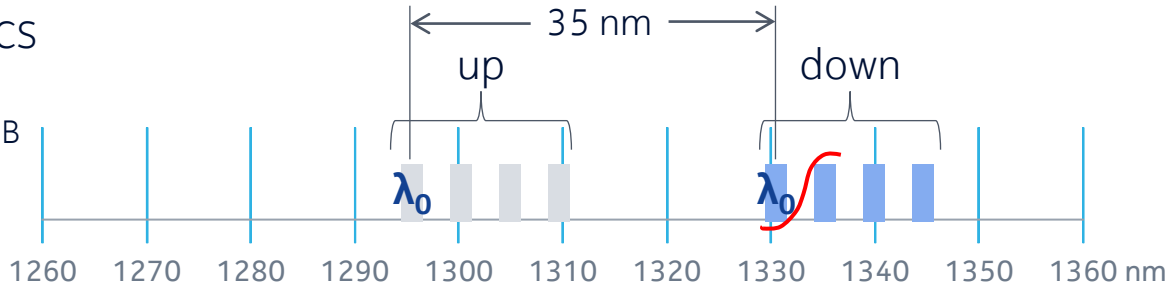
Consider all 25/50/100G wavelengths in the O-band: impact on 25G PON

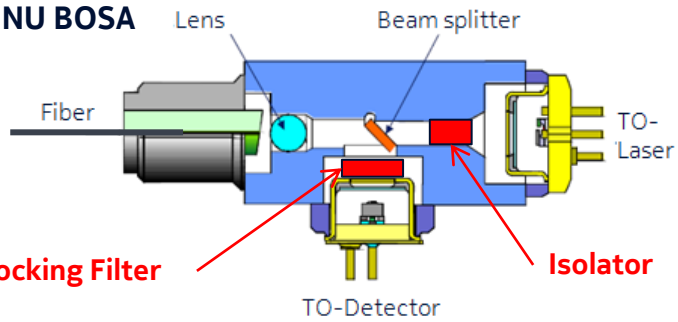
Example: use 100G Ethernet 800 GHz CS

- Upstream: use 100G Ethernet λs
- Downstream: same CS and maintain ≥ 35 dB DS/US spacing for low cost 45° diplexer



Impacts on 25G EPON:

1. Close CS requires a sharp WBF
- What is the added cost?
- What is the added insertion loss?



2. To support close CS
- Lower laser yield
- May need isolator (cost + ~0.5 dB insertion loss)

3. On the OLT side, a 1:4 WM will have ~2.5 dB insertion loss (cole_3bs_02b_0914)

Since we are trying to avoid optical amplification for 25G EPON, every dB counts!

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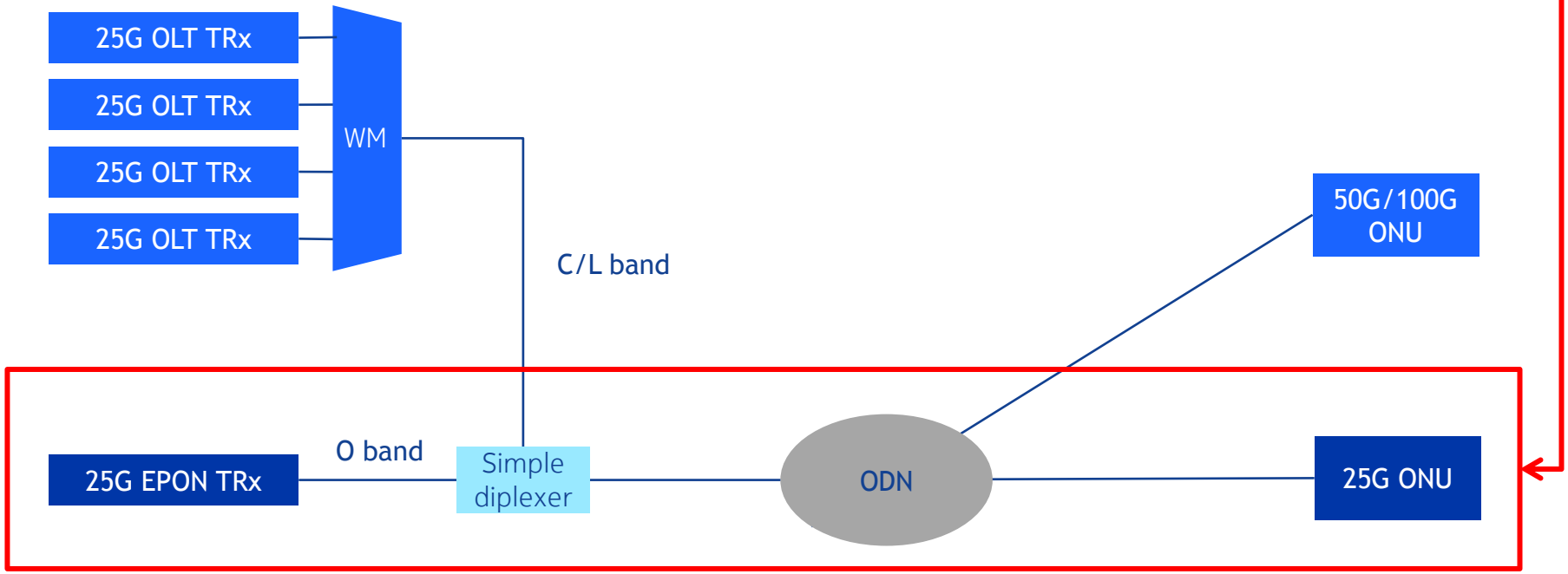
Low cost optimized 25G EPON: what it looks like



Avoid pushing cost on 1st gen 25G EPON to accommodate later 50G/100G EPON

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Why the C/L bands make sense for the 50G/100G EPON

- Keeping 50G/100G EPON λs out of the O-band will allow for cost optimization of 25G EPON
- 50G/100G EPON will not be a low cost system: it's for premium subscribers and services
- 50G/100G EPON in the C/L band:
  - 50G/100G EPON will need optical amplifiers. The C/L band allows for the EDFA option.
  - More dispersion, but dispersion compensation will probably be affordable
  - There will probably be activity in the C-band for 25 Gbaud lasers (e.g. Inphi DWDM)
  - NG-PON2 wavelengths might be considered
  - There is probably more room for additional channels, if desired.
  - For operators who care, there will be an option for coexistence with GPON and GEPON
- The 50G/100G EPON time-to-market requirement will be later, so there will be more time to develop components and technologies for the C/L band.

Conclusions

Conclusions

- 25G EPON should be optimized for low cost and earliest time-to-market
  - Therefore 25G EPON should operate in the O-band
  - And 50G/100G EPON should operate in the C/L bands (may be more suitable anyway)
- 25G EPON O-band wavelength plan: 3 options. Need to answer:
  - TDM or WDM co-existence with 10G EPON?
  - DML dispersion performance over 20 km at 1270 nm needs more study.

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