Brief consideration about loss budget and wavelength allocation

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Introduction

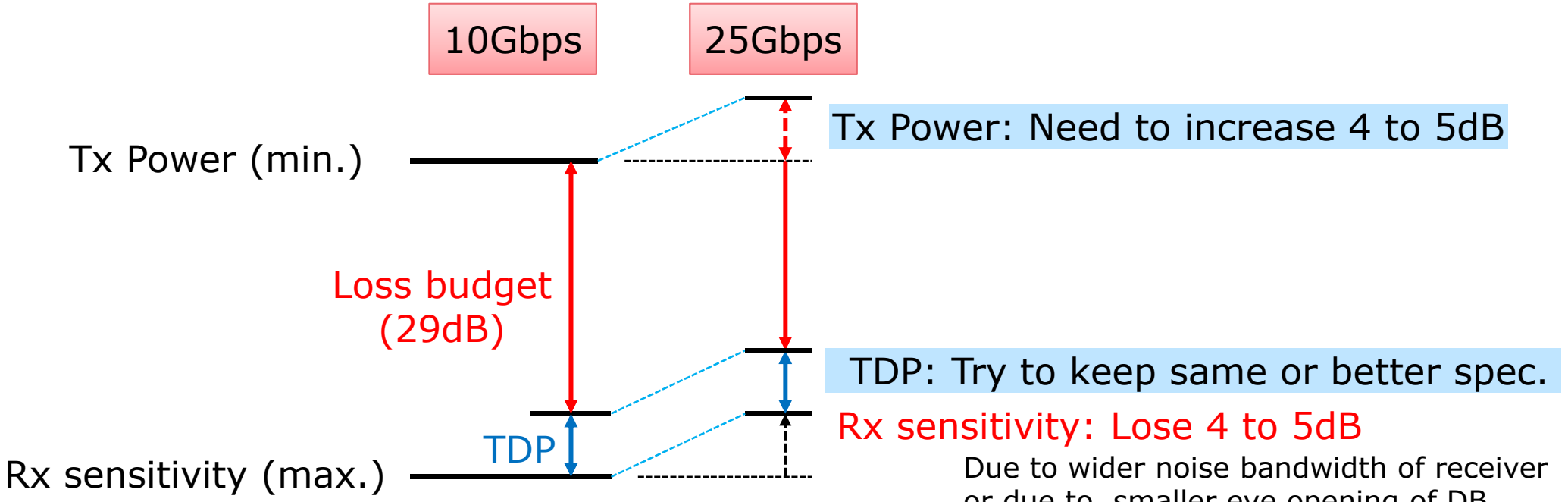
- 29dB loss budget with 25Gbps/lane is important & challenging.

- This presentation shows,
  - ✓ Transmitter Power (Tx Power) and Transmitter and Dispersion Penalty (TDP) of each transmitter types.
  - ✓ Chromatic dispersion value of each wavelength bands.
  - ✓ Wavelength allocation example in O-band.

29dB loss budget with 25Gbps

Reminder of "umeda_3ca_1_0316.pdf"

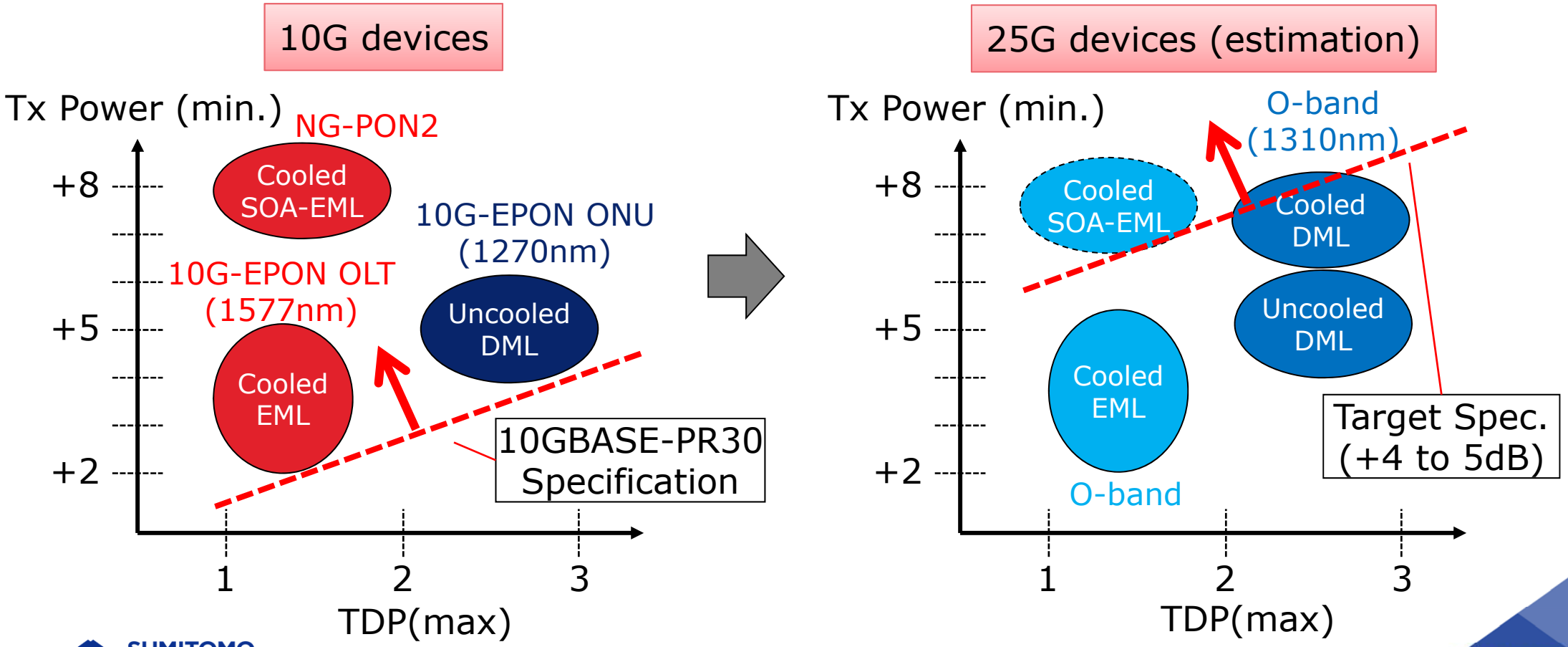
- Our target loss budget is 29dB, same as 10GBASE-PR30
- 25Gbps either NRZ or Duobinary (DB), we lose 4 to 5 dB receiver sensitivity from 10Gbps.
- We have to raise 4 to 5 dB transmitter output power and keep or reduce TDP.
  - ✓ Need high power and low TDP transmitter
  - ✓ Wavelength allocation is also important to achieve low TDP



Tx Power & TDP of current Tx devices

Reminder of "umeda_3ca_1_0316.pdf"

- 10G-EPON(10Gbps) : Cooled EML (OLT) and Uncooled DML (ONU) are used.
- 100G-EPON(25Gbps) : Need higher power devices. 25G devices are in O-band now.



Chromatic dispersion effect

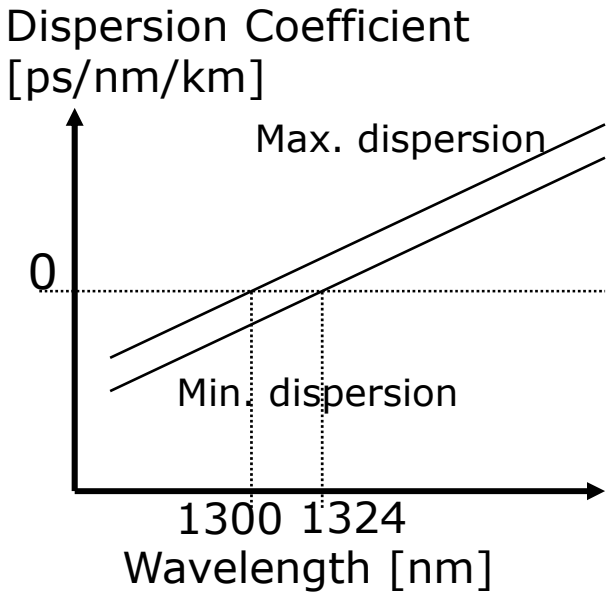
- Fiber dispersion effect
  - ✓ Allowed Inter Symbol Interference (ISI) in time slot fraction: ε

    $\varepsilon \propto L \cdot B^2$ where L: Fiber length, B: Bit rate

    Reference: ITU-T G. supplement 39

  - ✓ Dispersion effect of 25Gbps NRZ at 20km ≒ 10Gbps NRZ at 125km
- Dispersion value of ITU-T G.652 A&B cable;

Use "3av_0809_linkmodel_v2_3_power_budgets.xls" for calculation

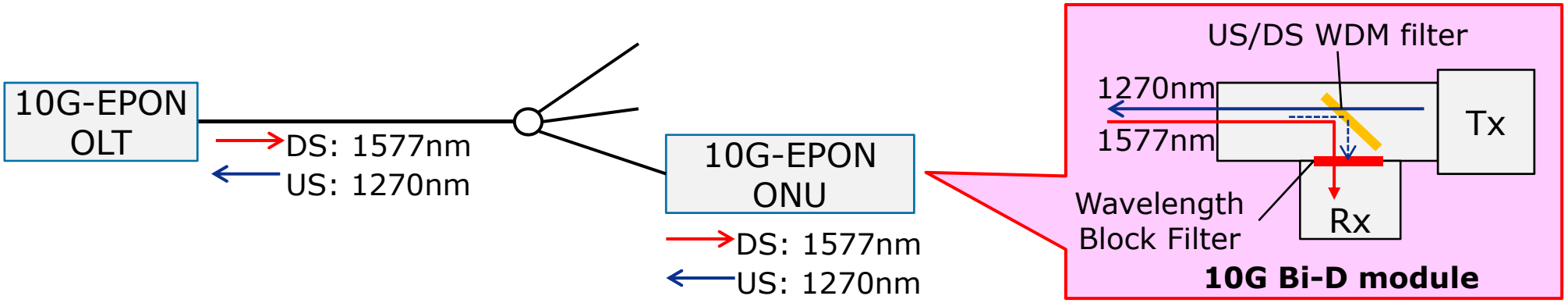


λ	Dispersion (at 20km)	25G dispersion effect, relative to 10G	25G Tx type and usability (dispersion perspective)	
[nm]	[ps/nm]		DML	EML
1270	-107	1.27um 125km	need study	NRZ
1300	-46	1.27um 54km	(NRZ without EDC)	NRZ
1330	54	1.55um 19km	(NRZ without EDC)	NRZ
1350	88	1.55um 30km	need study	NRZ
1490	291	1.55um 100km	-	need study
1550	364	1.55um 125km	-	need study

Efficient use of O-band is a key to economical NG-EPON system

Wavelength allocation
-US/DS gap, Rx guard band -

- Existing access network and ONU Bi-D module structure.



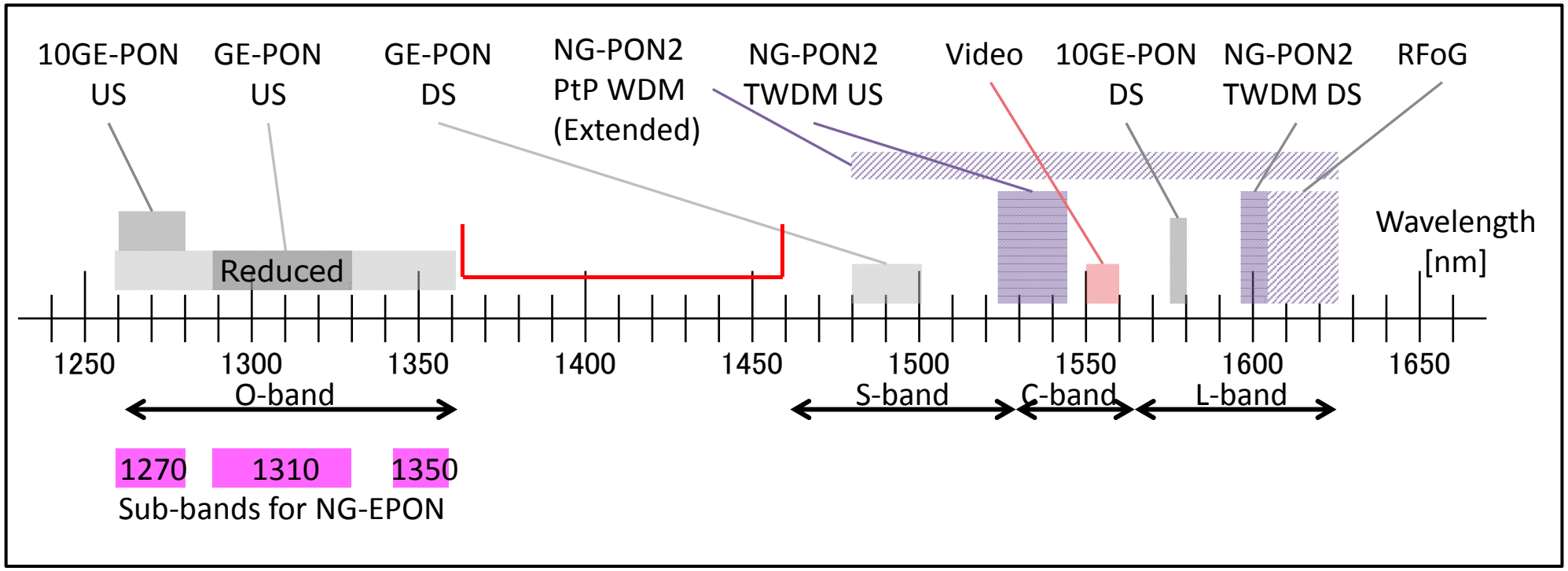
- Large part of system cost comes from ONU, keep familiar and economical Bi-D structure for NG-EPON ONU as far as possible.

Light coupling scheme of Bi-D	US/DS Gap	Rx guar band
Non-collimated light	>35nm	>10nm
Collimated light	>20nm	>5nm

This brings us efficient wavelength usage

Wavelength allocation in O-band

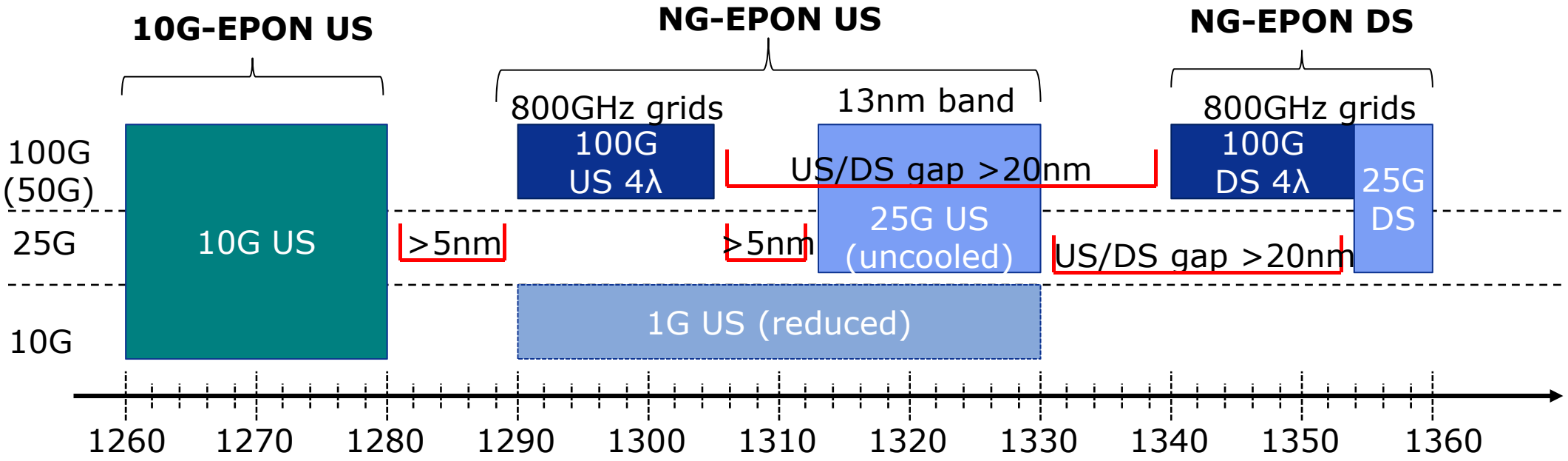
- Wavelength allocation of current access system - reminder
  - ✓ Three NG-EPON candidate sub-bands in O-band



Wavelength allocation in O-band, example 1

ONU Bi-D: use collimated light coupling

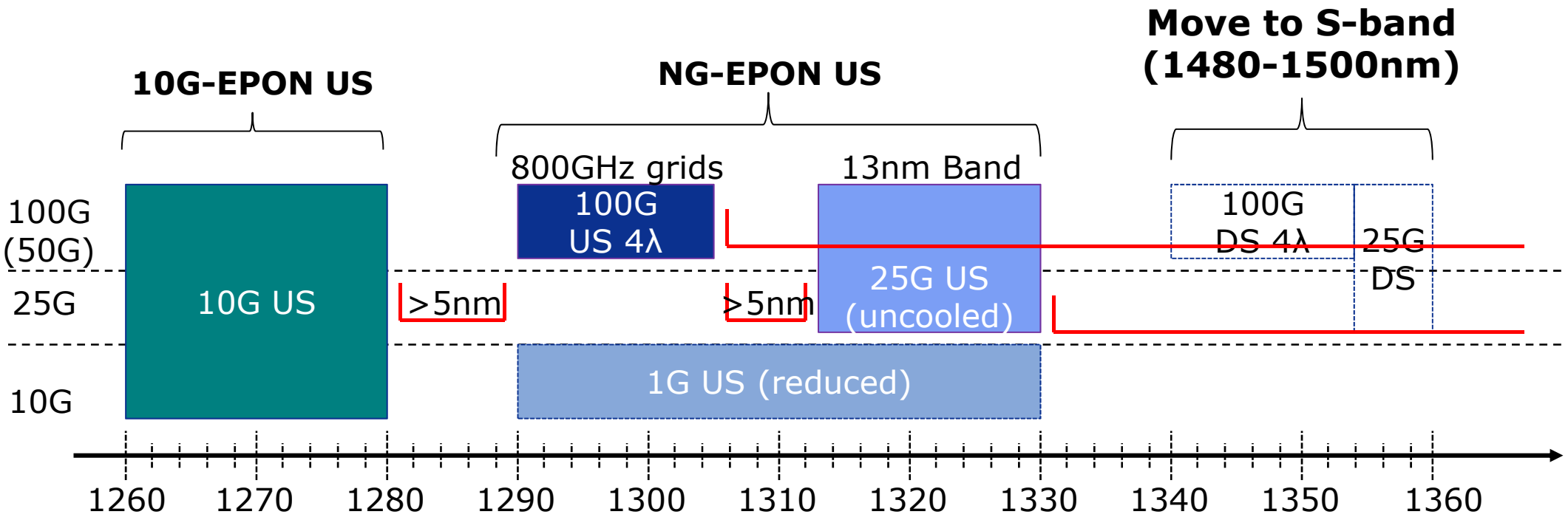
- Allocation example 1: US and DS in O-band
  - ✓ Place 25G specific bands to pursue economical system
  - ✓ 100G US: Reuse some of 100GbE/400GbE wavelength lanes



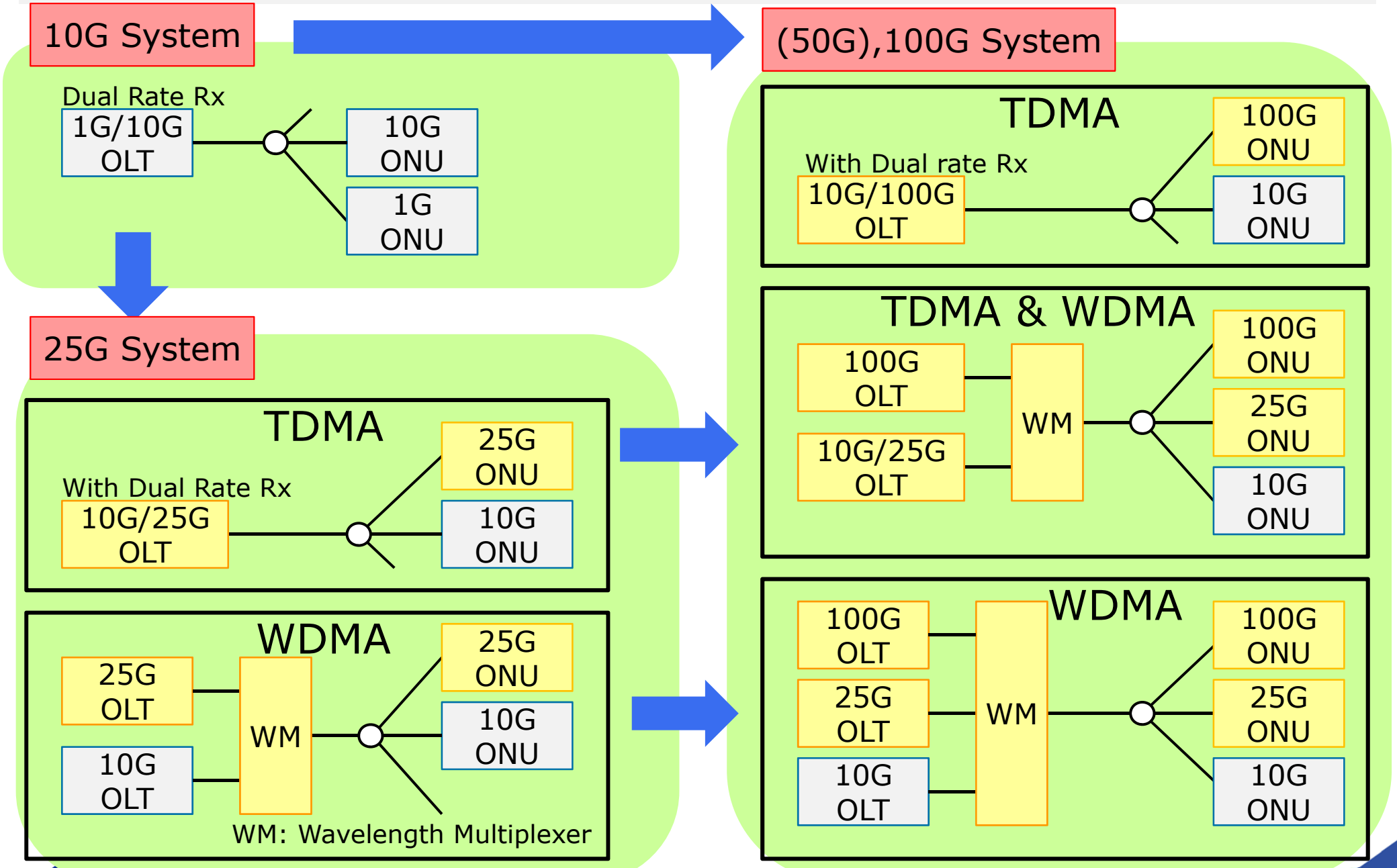
Coexistence	10G	25G	50G (use 2λ of 100G)
25G System	TDMA, WDMA		TDMA, WDMA
100G System	TDMA, WDMA	TDMA, WDMA	TDMA

Wavelength allocation in O-band, example 2

- Allocation example 2: US in O-band, DS in S-band
  - ✓ If S-band is economically usable in terms of dispersion management, NG-EPON DS can be placed in S-band.
  - ✓ Need further study on TDP (and Raman crosstalk to Video-DS)



Coexistence and migration example



Summary

- 29dB loss budget; Need high power and low TDP transmitter
  - ✓ SOA-EML; Good candidate
  - ✓ DML, EML; Need further study

Reference: "umeda_3ca_1_0316.pdf"

- Low TDP; Need efficient use of O-band
  - ✓ Use of S,C,L-band need further study
  - ✓ 10G, 25G and (50G) 100G can coexist in O-band

    [One example]

    25G: Place specific bands

    100G US: Reuse 100GbE/400GbE wavelength lanes

Thank you