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25G/50G/100G EPON wavelength plan B

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Straw Poll # 1	
The 802.3ca standard shall specify wavelengths for 25G, 50G, and 100G systems in O-Band.	
Yes:	15
No:	0
Not enough information:	9

Those voting "Not enough information" in Straw Poll #1 suggested the following information is needed to make a decision.

1) Exact (detailed) wavelength plan including support for coexistence (TDM or WDM).
2) Full cost comparison between all O-Band and other solutions.
3) More consensuses in presentations.
4) Dispersion compensation analysis of all solutions.
5) Full power budget for full 100G system (including mux losses) and what is needed to close the gap.

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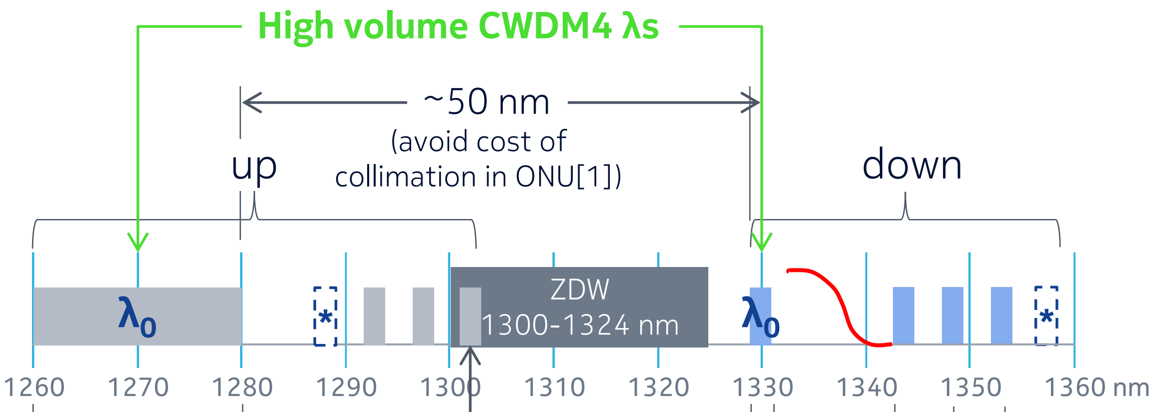
All-O-band: Plan B

Wavelength Plan Inventory as of 7/27/16

	A	B	C	D	E	F	G
ds0	O	O	O	S/C/L	O	O	
ds1	O	O	S/C/L	S/C/L	S/C/L	L	
ds2	O	O	S/C/L	S/C/L	S/C/L	L	
ds3	O	O	S/C/L	S/C/L	S/C/L	L	
ds4	none	O or none	S/C/L or none	none	none	L	
us0	O	O	O	O	O	O	
us1	O	O	S/C/L	O	O	C	
us2	O	O	S/C/L	O	O	C	
us3	O	O	S/C/L	O	O	C	
us4	none	O or none	S/C/L or none	none	none	C	
author	JJ+FE+YG #1	EH #1	EH#2	JJ	DL	ED	

kramer_3ca_5_0716.pdf

Plan B: All wavelengths in the O-band, but accommodating a low cost 25G EPON



*λ_4, if 1+4

- Tighter OLT filtering

- 20 nm to allow for lowest cost ONU: uncooled DML
- TDM co-existence

Max. one channel in ZDW region

(To prevent FWM, avoid ZDW to be centered between two channels)

800 GHz CS (except with US and DS λ_0), conforming to industry norm

≥10 nm CS allows for low cost WBF [2]

(keep on 800 GHz grid for AWG implementation)

All channels (except US λ_0) use 100GBASE-LR4/ER4 operating width (37 GHz, ~2 nm).

(DS λ_0: narrow operating width will add incremental cost to 25G EPON, but will ease 100G OLT filter implementation)

[1]funada_3ca_1_0316 (>35 nm), liu_3ca_2_0516 (>40 nm)
[2] liu_3ca_3_0716

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Power budget

Assumptions

- 100G mux and demux nominally add ~2.5 dB insertion loss each.
- A cost-optimized 100G EPON puts all optical amplification in the OLT
- Downstream TDP = 1.5 dB, upstream TDP = 3 dB (same as 10G EPON, but to be confirmed)
- PR30 loss budget
- There will be 1 dB FEC coding improvement in the downstream relative to 10G EPON (to be confirmed)
- 1 dB improvement in PR30 APD receiver performance vs. 10G EPON + 5 dB penalty for 25G (per NeoPhotonics yield analysis, in harstead_3ca_1a_0516.pdf.)
- Launch power values from harstead_3ca_2a_0716.pdf

	AVP_{min} (dBm)	ER (dB)
EML	5	8
cooled DML	8	6

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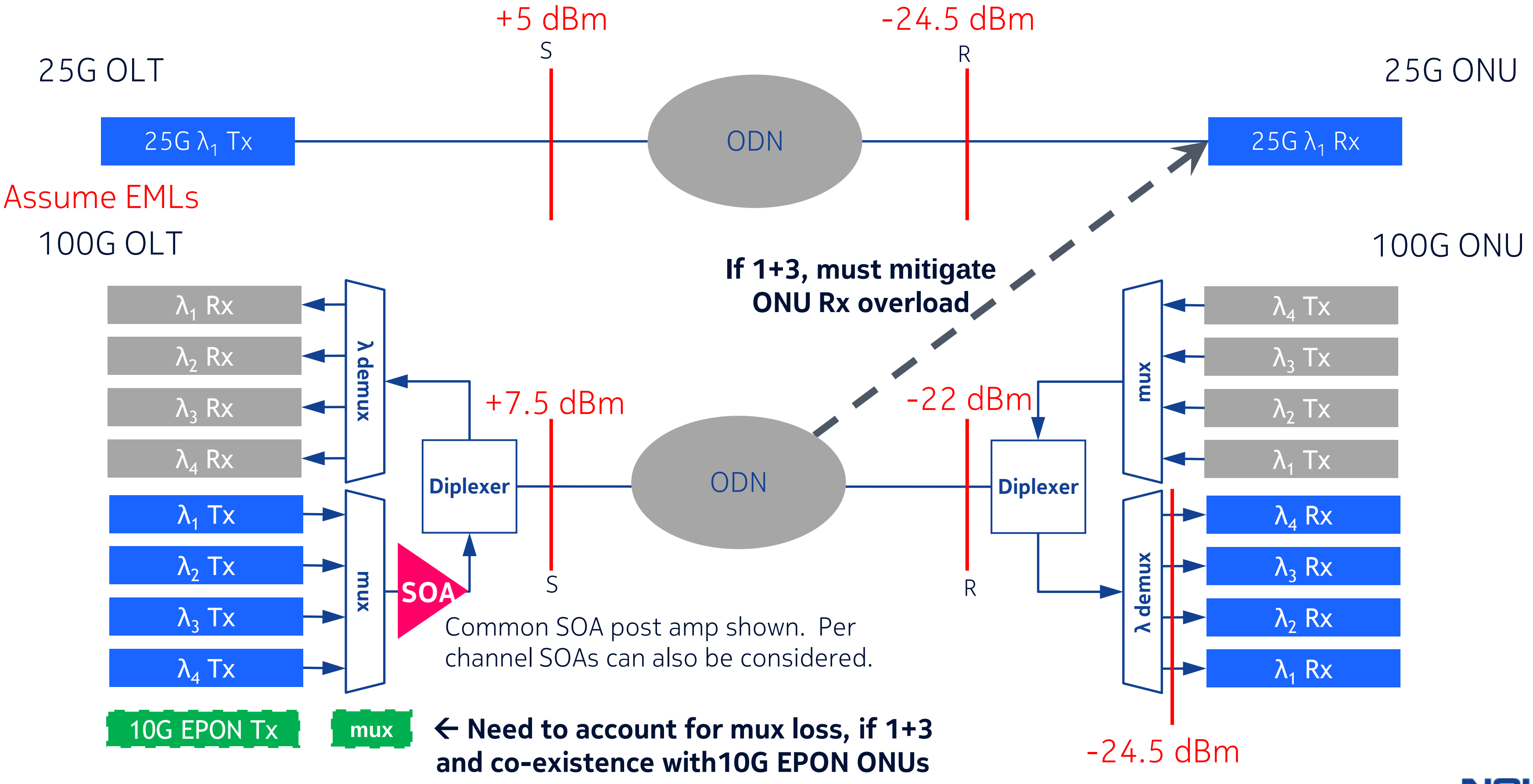
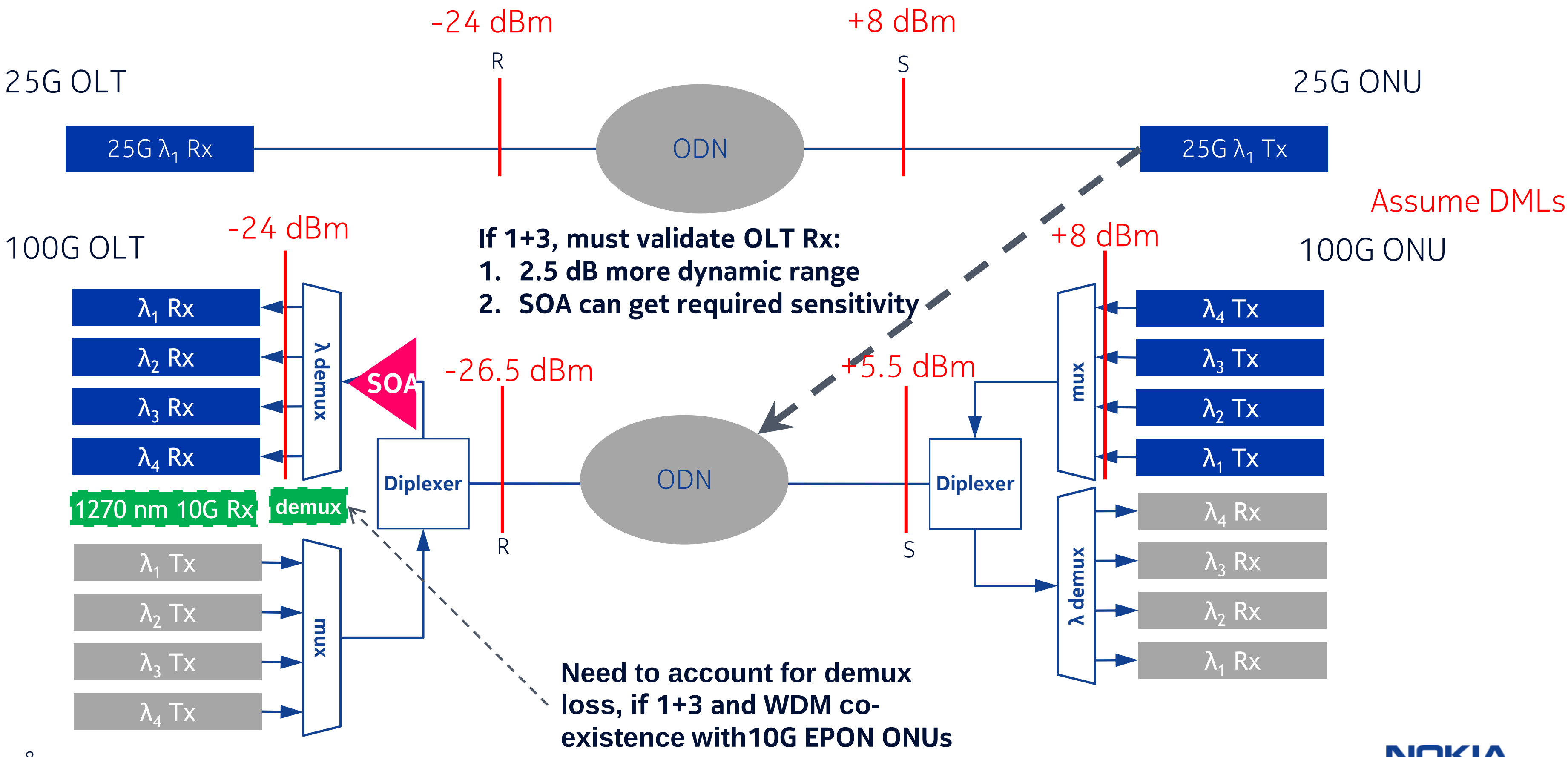
Downstream optical levels (per harstead_3ca_1_0916).

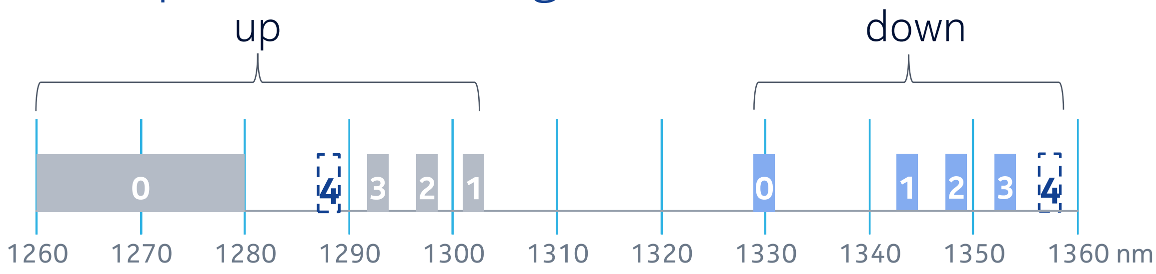


Upstream optical levels (per harstead_3ca_1_0916).



Center frequencies/wavelengths

Plan B: Center frequencies/wavelengths



Wavelength (nm)	Frequency (THz)	1+3 Plan	1+4 Plan
1260-1280		US 0	US 0
1288.32	232.7		US 4
1292.77	231.9	US 3	US 3
1297.24	231.1	US 2	US 2
1301.75	230.3	US 1	US 1
1328.87	225.6	DS 0	DS 0
1343.16	223.2	DS 1	DS 1
1347.99	222.4	DS 2	DS 2
1352.85	221.6	DS 3	DS 3
1357.76	220.8		DS 4

Guidelines:

- Other than US λ_0 , use frequencies on DWDM grid
- Upstream: put λ_1 and λ_2 at longest wavelengths to ease cost of 50G filtering.
- Downstream: put λ_1 and λ_2 at shortest wavelengths to minimize 50G TDP

Adjustments can be made for finer optimization

100G OLT SOA pre-amp implementation, if 1+3

Plan B: 100G OLT SOA pre-amp implementation, if 1+3

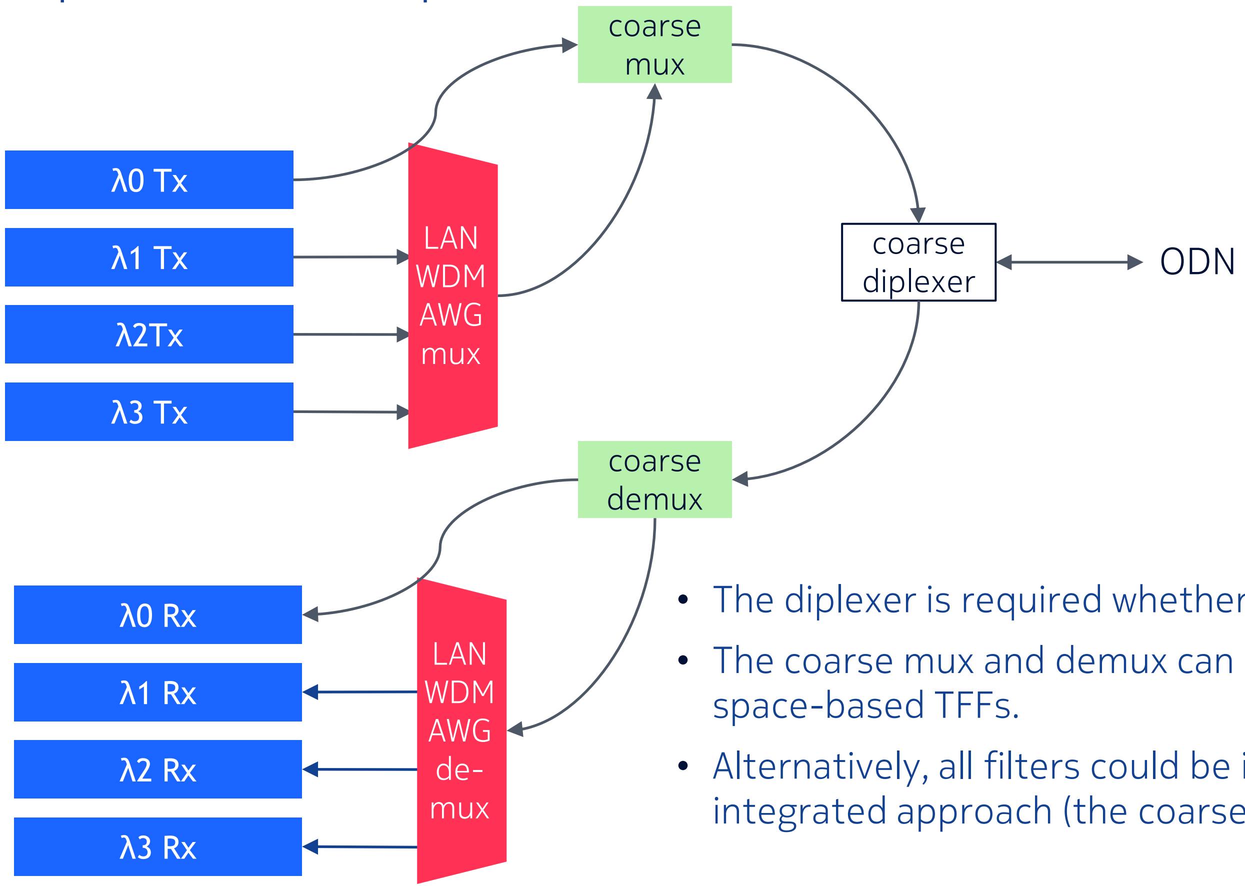
Input from Tomoyuki Funada, Sumitomo:

1. SOA bandwidth:
   - SOA gain and P_{sat} have wavelength dependency, therefore Plan B might need two pre-amp SOAs in order to cover all 4 upstream wavelengths 1260-1300. This will require more investigation.

2. Wider operating wavelength range of upstream λ0
   - λ0 has a 20 nm wide wavelength operating range. This will require a 20 nm pass band allowing 20 nm of SOA ASE noise. This will limit the OLT λ0 receiver sensitivity improvement that can be obtained with the SOA preamp*.

*maybe to only 1-2 dB better than APD

Plan B: possible filter implementation (1+3)



- The diplexer is required whether 1+3 or 1+4
- The coarse mux and demux can be fiber based or free-space-based TFFs.
- Alternatively, all filters could be implemented in a fully integrated approach (the coarse filters as MZIs.)