

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

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From July Task Force meeting:

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 consensus 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.

Updates in this comparison

1. Prior versions

- “25G/50G/100G EPON wavelength plan comparisons (modified during presentation)”
[harstead 3ca 4b 0916.pdf](#)
- “Wavelength plan comparison update” emailed to STDS-802-3-NGEPON@LISTSERV.IEEE.ORG
26 Sept.

2. In this version

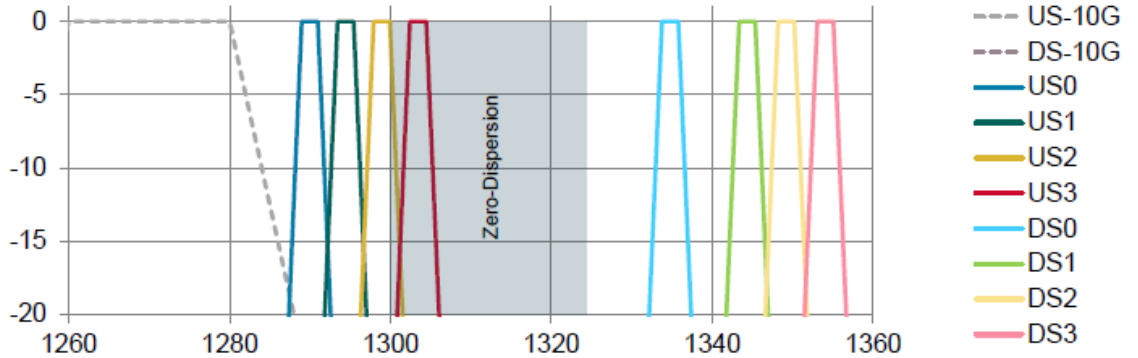
- Reduced scope to remaining wavelength plans A, B, C, D per motion #7 in Fort Worth meeting
- Consider cost criteria alone, and other criteria (e.g. technical risk) separately

3. Comparison is for PR30 loss budget.

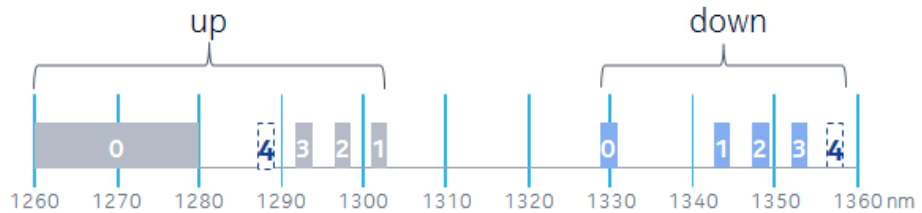
- PR20, if important, will require a modified comparison

Review: Plans A, B (all O-band)

Plan A
[johnson_3ca_1_0916.pdf](#)

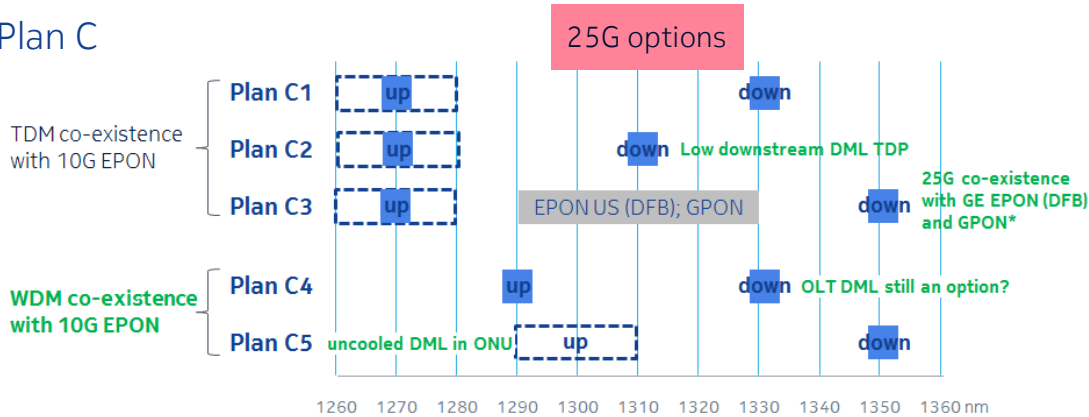


Plan B
[harstead_3ca_2_0916.pdf](#)

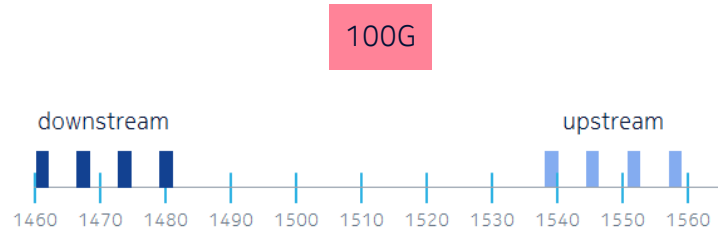


Review: Plans C, D (multi-band)

Plan C

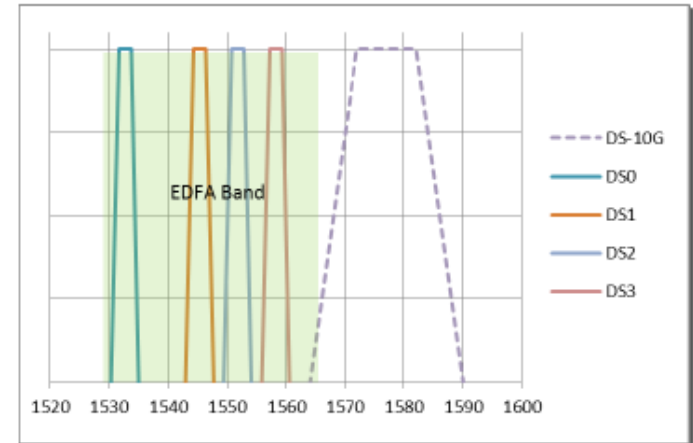
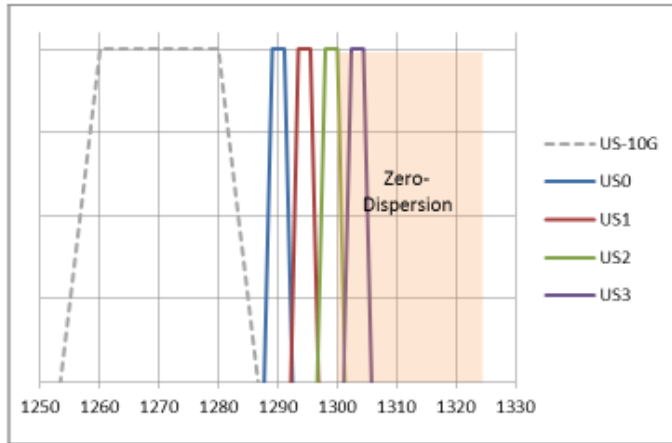


[harstead 3ca 3 0916.pdf](#)



Plan D

[johnson 3ca 2 0916.pdf](#)



Cost criteria and weighting: 25G OLT and 25/25 ONUs,

	Impacts on 25G EPON			
criteria	Allow uncooled 25G DML in ONU	O-band laser in OLT	OLT does not require a separate 10G Rx	No dispersion compensation >10km
un-normalized weights	2.0	1.5	1.0	1.0
explanation	Biggest cost lever in 25/25 ONUs. Requires 20 nm. For PR30 feasibility is t.b.d.	Leverage data center ecosystem. Probably lower cost and faster time to market.	True for TDM co-existence (harstead_3ca_2_1116). Demux and 10G Rx affects size, power, cost.	Importance will vary by operator. But where required it will add cost and operational complexity.

Cost criteria and weighting: 100G OLT and 100/100 ONUs, PR30 loss budget

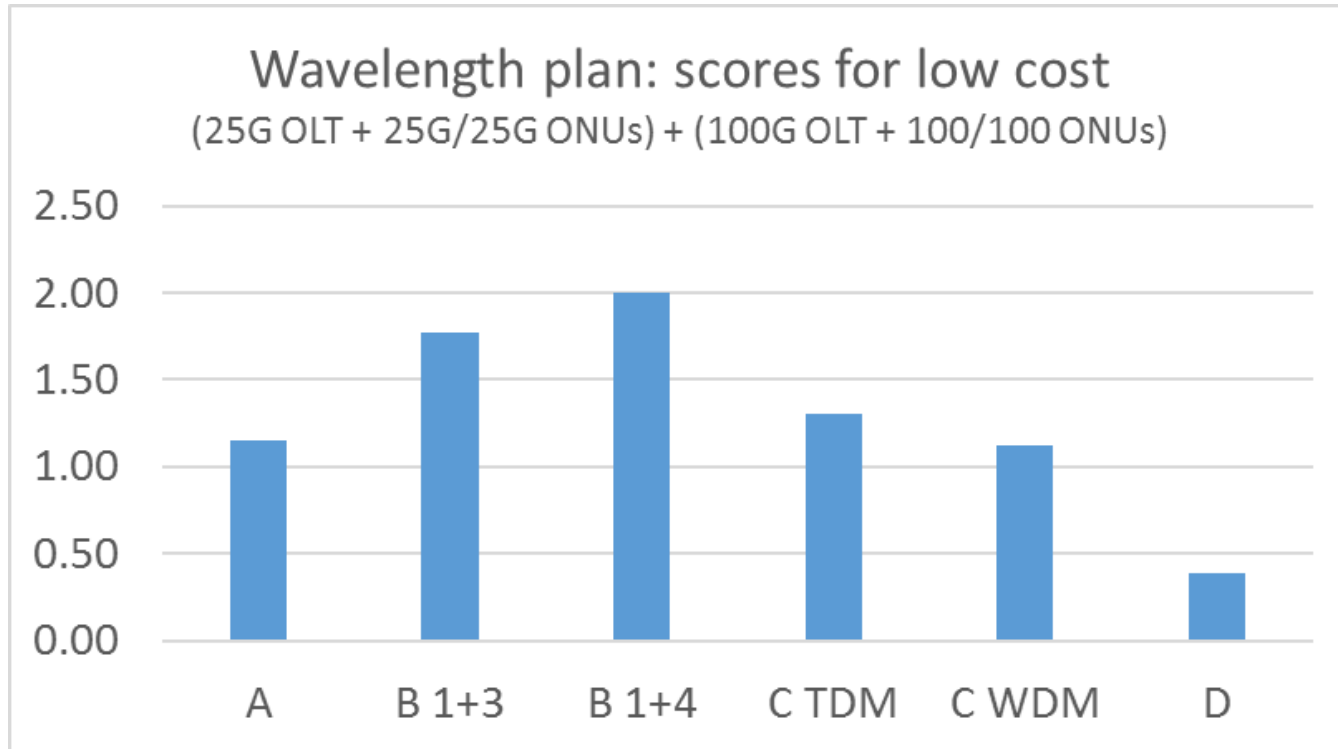
	Impacts on 100G EPON					
criteria	O-band laser in ONU	O-band laser in OLT	All uniform passbands for AWG	OLT does not require a separate 10G Rx	OLT does not require a 10G EML Tx	No dispersion compensation >10km
un-normalized weights	5.0	1.0	1.0	1.0	2.0	3.0
explanation	Leverage data center ecosystem. Probably lower cost and faster time to market. Higher weight than for OLT.	Leverage data center ecosystem. Probably lower cost and faster time to market.	Allows for single AWG demux and single AWG mux implementation . 1+4 only (harstead_3ca_2_1116).	False for 1+3 with WDM co-existence (harstead_3ca_2_1116). Demux and 10G Rx affects size, power, cost.	To support 10G EPON ONUs on same ODN. False for 1+3 (harstead_3ca_2_1116). 10G EML Tx and mux affect size, power, cost.	Importance will vary by operator. But where required it will add cost and operational complexity.

Scoring the wavelength plans: achieving low cost

			Impacts on 25G EPON				Impacts on 100G EPON					
criteria			Allow uncooled 25G DML in ONU	O-band laser in OLT	OLT does not require a 10G Rx	No dispersion compensation >10km	O-band laser in ONU	O-band laser in OLT	All uniform passbands for AWG	All narrow passbands for 25G upstream	OLT does not require a 10G Rx	OLT does not require a 10G EML Tx
Raw scores	1+x	xDM										
A	1+3	WDM	0	1	0	1	1	1	0	0	0	1
B 1+3	1+3	TDM	1	1	1	1	1	1	0	1	0	1
B 1+4	1+4	TDM	1	1	1	1	1	1	1	1	1	1
C TDM	1+4	TDM	1	1	1	1	0	0	1	1	1	0
C WDM	1+4	WDM	1	1	0	1	0	0	1	1	1	0
D	1+3	WDM	0	0	0	0	1	0	0	0	0	0

Achieving low cost: normalized results

Equal weight for 25G and 100G



Other factors

	25G upstream $\lambda 0$ doesn't share capacity with 10G	25% more aggregate downstream and upstream capacity	Don't require 25 and 100G OLT line cards connected w/ filter element	Worse SOA preamp performance for wide demux passband	EDFA risk mitigation of SOA preamp in 100G OLT	EDFA risk mitigation of SOA post amp in 100G OLT	25G PON co-existence with GPON
Plan	True for plans with TDM co-existence with 10G EPON. Impact of sharing: harstead_3ca_2_1116.	1+4 plans offer 125G vs. 100G for 1+3 (neglecting 10G channel sharing of TDM co-existence)	Required for 1+4. Will require budgeting ≤ 1 dB in ODN; will require extra fiber handling.	20 nm passband (for uncooled DML) has higher SOA preamp ASE. Only affects 100G OLT. Ref: harstead_3ca_2_1116.	It's possible that an SOA preamp will not give the required performance. Option for EDFA.	It's possible that an SOA post amp will not give the required performance. Option for EDFA.	Required if a common PHY is targeted with ITU-T, and ITU-T requires GPON co-existence
A	✓	✗	✓	✓	✗	✗	✗
B 1+3	✗	✗	✓	✗	✗	✗	✗
B 1+4	✗	✓	✗	✓	✗	✗	✗
C TDM	✗	✓	✗	✗	✓	✓	✓
C WDM	✓	✓	✗	✓	✓	✓	✗
D	✓	✗	✓	✓	✗	✓	✗

Conclusions

- Plan B (1+3) has the potential to provide the lowest cost solution, but has more risk to be resolved
 - In particular, in the 100G OLT, the technical feasibility of the sensitivity of a 20 nm wide pre-amp receiver needs to be evaluated and resolved, especially for SOA preamp
 - Plan B (1+4) could be a fallback– provides the 2nd lowest cost option.
- Plans A and B are dependent on SOA performance for 100G OLT, a technical risk to be resolved.
 - Multi-band plans C and D provide for some risk mitigation with EDFA if required
- More generally, both plans B and C (TDM), relying on TDM co-existence, provide the lowest cost options
 - but require sharing of the 25G upstream λ_0 capacity with 10G upstream
 - This is more than made up for with higher 1+4 aggregate downstream and upstream capacity, at least for 50G and 100G ONUs
 - On the other hand, all 1+4 plans require a filter element to connect separate 25G and 100G line cards, while 1+3 plans do not.
- Plan C overall is the 2nd most cost-effective plan, and has the greatest flexibility to address all the other factors/ risks except one– it requires the filter element to connect separate 25G and 100G line cards
 - Only Plan C3 supports 25G PON co-existence GPON– may be required for convergence with ITU-T.
 - A modified C3 would be required for 100G PON co-existence GPON

High level summary comparison table

Plan	Low cost	1+3 operations	Need to resolve technical risk	Unshared upstream $\lambda 0$	25% higher aggregate capacity (1+4)	wild card: GPON CE
B 1+4	#1		medium		true	
B 1+3	#2	true	higher			
C TDM	#3		lower		true	true
C WDM	#4		lower	true	true	
A	#5	true	medium	true		
D	#6	true	lower	true		

Next steps

- Show for 100/100 OLT + (25/10 and 25/25) ONUs
- Show for 10 km reach
- Show for PR20
- Possibly include Ge/Si APD lower performance in S/C bands

NOKIA