
PSM4 vs. WDM: A Broader Silicon Photonics Perspective

Contributors:

Mehdi Asghari, Kotura

Samir Desai, Kotura

Arlon Martin, Kotura

PSM4 vs. WDM: A Broader Silicon Photonics Perspective

Supporters:

- Yurii Vlasov, IBM
- Douglas M Gill, IBM
- Tek Ming Shen, Huawei
- Xueyan Zhang, Huawei
- Atul Sharma, Volex

PSM4 vs. WDM: Background

- At the last meeting, welch_01_0313_optx presented “PSM4 vs. WDM: A silicon photonics perspective”
- That analysis and summary is not supported by other players in the industry nor by previous presentations to this task force
- The authors of this presentation have a number of significant disagreements with welch_01_0313_optx
- This presentation addresses a few of the most glaring differences
- PSM4 may be a viable alternate to SR4, but it is not the only solution

Summary of the claims made in the previous presentation

Summary

- Is CWDM really five times the cost of PSM4? →
 - Is the link budget hurdle really 7-10+ dB? →
 - Is PSM4 the only solution that can fit in a QSFP form factor? →
- PSM4 the lowest cost solution at under $\frac{1}{4}$ the cost of either WDM alternative
 - CWDM actually has the highest cost floor of any possible solution (using silicon photonics)
 - Five times the cost of PSM4
 - 20% higher cost than LR4
 - WDM solutions pose dramatic link budget hurdles compared to PSM4
 - CWDM Penalty: 7 – 10+ dB worst than PSM4
 - PSM4 is the only solution that can fit into a QSFP form factor
 - Depending on host system specification, could even be as low as class I power consumption

CWDM QSFP solutions cost about the same as PSM4 solutions

- Welch_01_0313_optx ignores critical points made in the other previous presentations:
 - martin_02_0912_optx for cost comparisons to SR4 and LR4
 - vlasov_01_1112_optx for laser and packaging cost comparisons
 - shen_01_0113_optx for PSM4 and CWDM package and cabling comparison
- Since most suppliers would use the same BOM and assembly for PSM4 and WDM, here is a summary QSFP cost comparison:

	PSM4	CWDM	Comments
Laser	t	4u	$4u > t$
Electronics & pkg	v	v	same cost
Connector	w	x	$w > x$
TOTAL	$t + v + w$	$4u + v + x$	Small delta dependent upon laser

- In addition, welch_01_0313_optx ignores the key cost advantage of WDM solutions: lower cabling, connectors, and patch panel costs

Silicon photonics solutions can meet the proposed Tx and Rx specifications for either PSM4 or CWDM

- For Tx, OMA at Max TDP, is roughly the same:
 - -3 dBm for CWDM and -2.6 dBm for PSM4
- For Rx, Receiver sensitivity is roughly the same: about -7 dBm for each
- The link budget “hurdle” is not 7-10+ dB
 - Kotura has demonstrated, in production, on chip losses of 2.1 dB for the Mux, and 1.7 dB for the DeMux, or less than 4dB total.
 - See B. J. Luff et al. (Kotura) and M. Boudreau et al. (Santur), *Silicon Photonic Filters for High Speed Data Transmission Applications, IEEE ECOC proceedings, 2010, Tu.5.C.3*
 - See martin_01_0712_optix for description of mux for different channel plans
 - See http://www.ieee802.org/3/ba/public/mar08/cole_02_0308.pdf for a nice description and comparison of losses of Mux from various technologies and vendors, including silicon photonics
 - None of the WDM supporters are proposing solutions that cost 7 to 10+ dB!
- welch_01_0313_optx fails to mention their own potential 6 dB link budget “hurdle”
 - Splitting a single laser into four parallel channels add a minimum of 6 dB loss, so the PSM4 link budget hurdle could actually be **worse** than WDM solutions using four lasers
- The link budget “hurdle” is probably more vendor dependent rather than technology dependent

WDM silicon photonics solutions may consume about .5W more than PSM4 solutions, but still less than QSFP max

- Most silicon photonics suppliers will use commercial electronics products, the same as those used for 100G SR4 or 100G PSM4

	PSM4	CWMD	Notes
Laser	150-200mW	600-800mW	Assumes 1 laser for PSM4 and 4 lasers for CWDM
Driver, TIA, CDR	1500-2500mW	1500-2500mW	Same electronics for PSM4 and CWDM
TOTAL	1750-2700mW	2100-3200mW	Both < 3.5W

- These solutions fit well within the 3.5W envelope of the QSFP package
 - In particular, they don't consume 4.758-5.880W referenced by welch_01_0313_optx
 - There is a migration path to 2W or less

Summary

- For <100 meters, PSM4 may offer a viable alternative to SR4
- Beyond 100 meters, CWDM is more cost effective than PSM4 because of higher fiber cost
- For CWDM in silicon photonics
 - The cost delta, if any, depends on the cost of the lasers and the connectors
 - The link budget “hurdle” is not a concern
 - The power consumption fits well within the 3.5W QSFP spec
- The welch_01_0313_optx presentation seems to highlight vendor dependencies rather than technology limitations