

4 λ x 100G and 8 λ x 50G Relative Power Consumption

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Importance of Low Power Consumption/Module

- Reductions in power consumption translate into
 - The ability to support more servers/data center
 - ✓ Higher power consumption results in lost opportunity because fewer servers can be supported
 - Lower operating expenses for power dissipated in the modules and the power required for cooling
- Small reductions in power consumption per module have a significant impact specially in large data centers which can have 500,000 Transceiver modules per data centers.

Power Consumption

Column added after original submission

Assumptions

	8x50G NRZ 16nm	8x50G NRZ 28nm	8x50G PAM4 28nm	4x100G PAM4 Duplex Cooled 16nm	4x100G PAM4 Uncooled 16nm
Reach	2km	2km	2km	2km	2km
Wavelengths	LAN-WDM	LAN-WDM	LAN-WDM	CWDM	CWDM
Cooled Lasers	Cooled/TEC	Cooled/TEC	Cooled/TEC	Cooled/TEC	Uncooled
Modulation	EML/EA	EML/EA	EML/EA	EML/EA	EML/EA or DML
DSP/CDR	DSP/CDR	DSP/CDR	DSP/CDR	DSP/CDR	DSP/CDR
Technology	16nm	28nm	28nm	16nm	16nm

Power Consumption Comparison

	8x50G NRZ (Watts) 16nm	8x50G NRZ (Watts) 28nm	8x50G PAM4 (Watts)	4x100G PAM4 Duplex Cooled (Watts)	4x100G PAM4 Duplex, Uncooled (Watts)
Tx	6.1	6.1	6.0	3.5	2.9
Rx	2.4	2.4	1.6	1.4	1.4
DSP/CDR	2.0	4.0	4.8	4.2	4.2
Misc	0.4	0.4	0.4	0.3	0.3
Total	10.9	12.9	12.8	9.4	8.8

Operating Cost Savings from Power

Replaces slide in the original submission
This one is based on 16nm, 8 x50G NRZ and 16nm, 4 x100G PAM4

Cost

Transceiver	Power/Transceiver (Watts)	Hrs/day	kWh/day	\$/kWh	\$/day	\$/yr	Units per data center	\$/day	\$/year Transceiver	\$/Year Cooling	Total \$/year
8 x50G NRZ, 16nm	10.9	24	0.262	0.090	0.024	8.594	500,000	11,772	4,296,780	1,718,712	6,015,492
4 x100G PAM4, Uncooled 16nm	8.8	24	0.211	0.090	0.019	6.938	500,000	9,504	3,468,960	1,387,584	4,856,544

Savings

	\$ Saved
Savings /Year	1,158,948
Savings /5 Years	5,794,740

- Assumes energy for Cooling is 40% of consumption
- Note: Does not include the capital expenditure for additional cooling equipment

Summary

- Power Consumption is strongly dependent on the number of Lasers
- 24% more power needed for 8λ solution than 4λ solution
- 4λ solutions will avoid lost opportunity costs
- 4λ solutions enable operating cost savings

Operating Cost Savings from Power

Replaced slide from original submission
This one is based on 28nm, 8 x50G NRZ and 16nm, 4 x100G PAM4

Power/Transceiver (Watts)	Hrs/day	Energy/day (kWh/day)	\$/kWh	\$/day	\$/yr	Units/data center	Total transceiver \$/day	Total transceiver \$/year	Total Cooling \$/Year	Total \$
12.9	24	0.3096	0.09	0.027864	10.17036	500,000	13,932	5,085,180	2,034,072	7,119,252
9.4	24	0.2256	0.09	0.020304	7.41096	500,000	10,152	3,705,480	1,482,192	5,187,672
									Energy Savings /Year	1,931,580
									Energy Savings /5 Years	9,657,900

- Assumes energy for Cooling is 40% of consumption
- Note: Does not include the capital expenditure for additional cooling equipment