



OPTICAL MODULE POWER ESTIMATES FOR 400GBE

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Supporters

- Pravin Patel – IBM
- Scott Sommers – Molex
- Brian Welch – Luxtera
- Arlon Martin - Mellanox

Technical Feasibility of 400GbE Modules

- 400GbE is feasible in a number of different module types including:
 - 4 X CFP2 – up to 48W at 12W/module
 - 4 X CFP4 – up to 24W at 6W/module
 - 4 X QSFP28 – up to 18W at 4.5W/module
 - CDFP – up to 10W
- The main limitation for these module types is what PMD they can support and how much power can be dissipated
- Let's investigate...



Possible Solutions for 400GbE Objectives

Base assumptions about how many fibers are needed

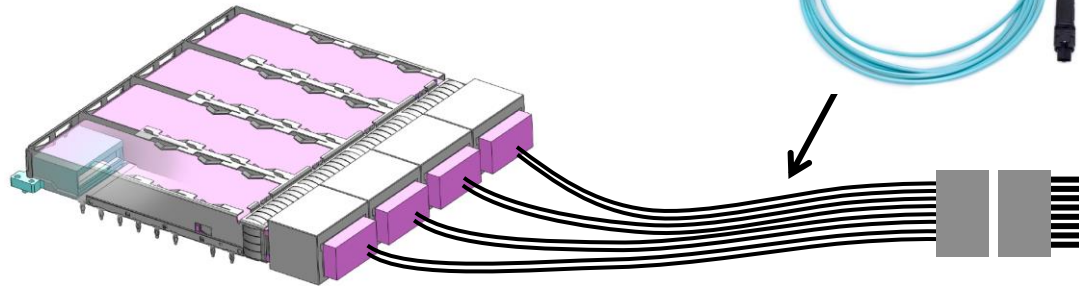
- 100m on MMF – likely similar to 4X100GBASE-SR4 and uses 32 fibers
- 500m on SMF – Possibly based on 4XPSM4 MSA, but final solution could have less than 32 fibers
- 2km on SMF – Power levels likely between the 500m and 10km solutions– but could be different if this is a duplex (not 8 fiber) SMF solution while 10km is a parallel (8-fiber) SMF solution
- 10km on SMF – likely similar to 4X100GBASE-LR4 and use 8 fibers



2 vs 8 Fiber Solutions

Big Differences between these two solutions

4 100GBASE-LR4
CFP4s or QSFP28s

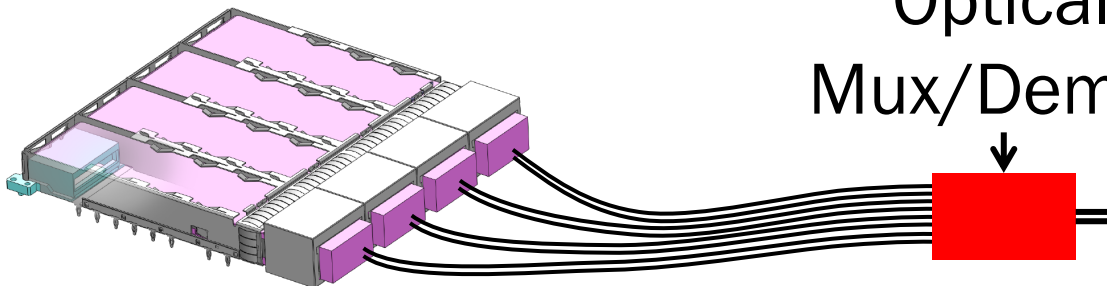


4X4 Wavelengths

Existing
Products

8 fibers to
Cable Plant

4 new CFP4s or QSFP28s



8 or 16 Wavelengths

Non-Existing
Products

2 fibers (Duplex)
to Cable Plant

Module Power

- Estimates for 400GbE module power can be derived from estimates of the power of 4X100GbE modules for most new objectives

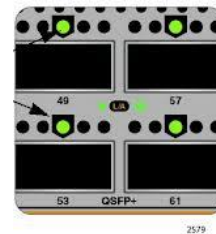
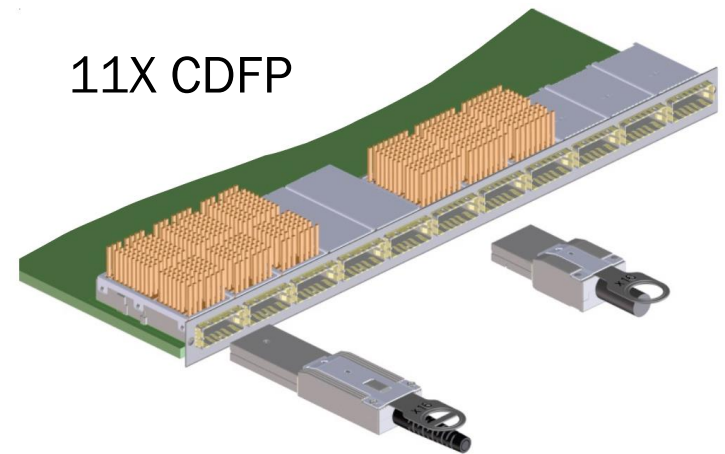
	Power per 100G PMD	Power Estimate for 400G PMD
100GBASE-SR4	1-4W	4-16W
100GBASE-PSM4	1.5-4.5W	6-18W
400GBASE-2km	4-8W?	16-32W?
100GBASE-LR4	3-12W	12-48W

- Some lower powers might not be achievable until a few years after the standard is released = 2020+

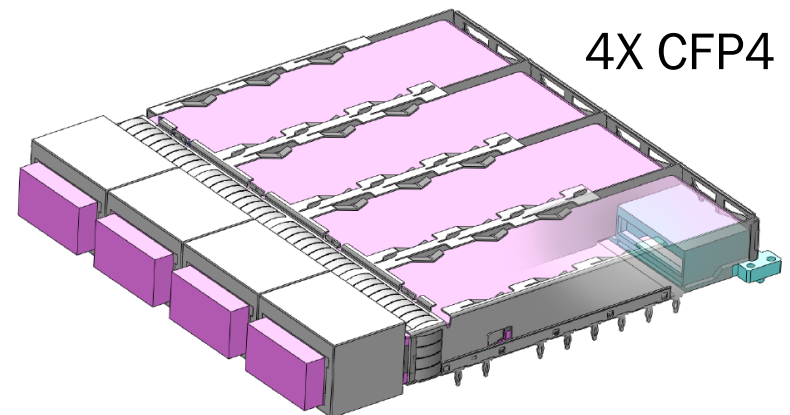


Options for 400GbE

- CDFP – supports up to 10W
- 4 X QSFP28 – supports up to 18W at 4.5W/QSFP28

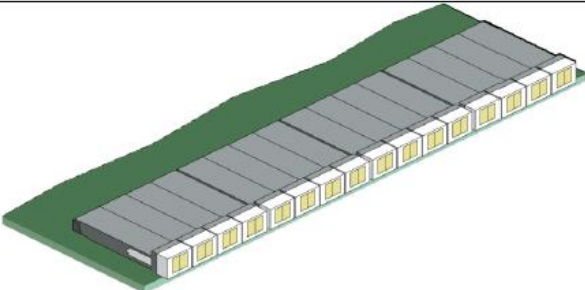

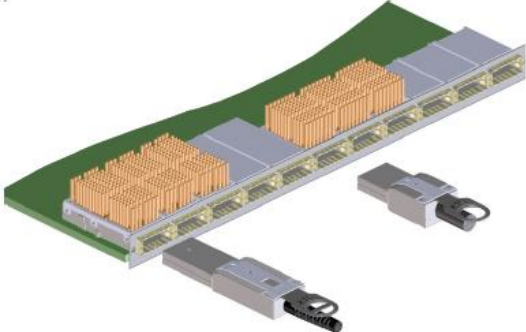



- 4 X CFP4 – supports up to 24W at 6W/CFP4 or 40W at 10W/CFP4
- Is there a need for a larger module like CFP?




CDFP MSA

- The CDFP MSA has released an FAQ at:
- <http://cdfp-msa.org/31205-FAQ-CDFP-Rev-5.pdf>

	<p>16 CFP4 Modules - 1.6 Tb/s</p> 
	<p>11 CDFP Modules - 4.4 Tb/s</p> 

Module Dimensions for Cooling

This is the column used for calculations on next page



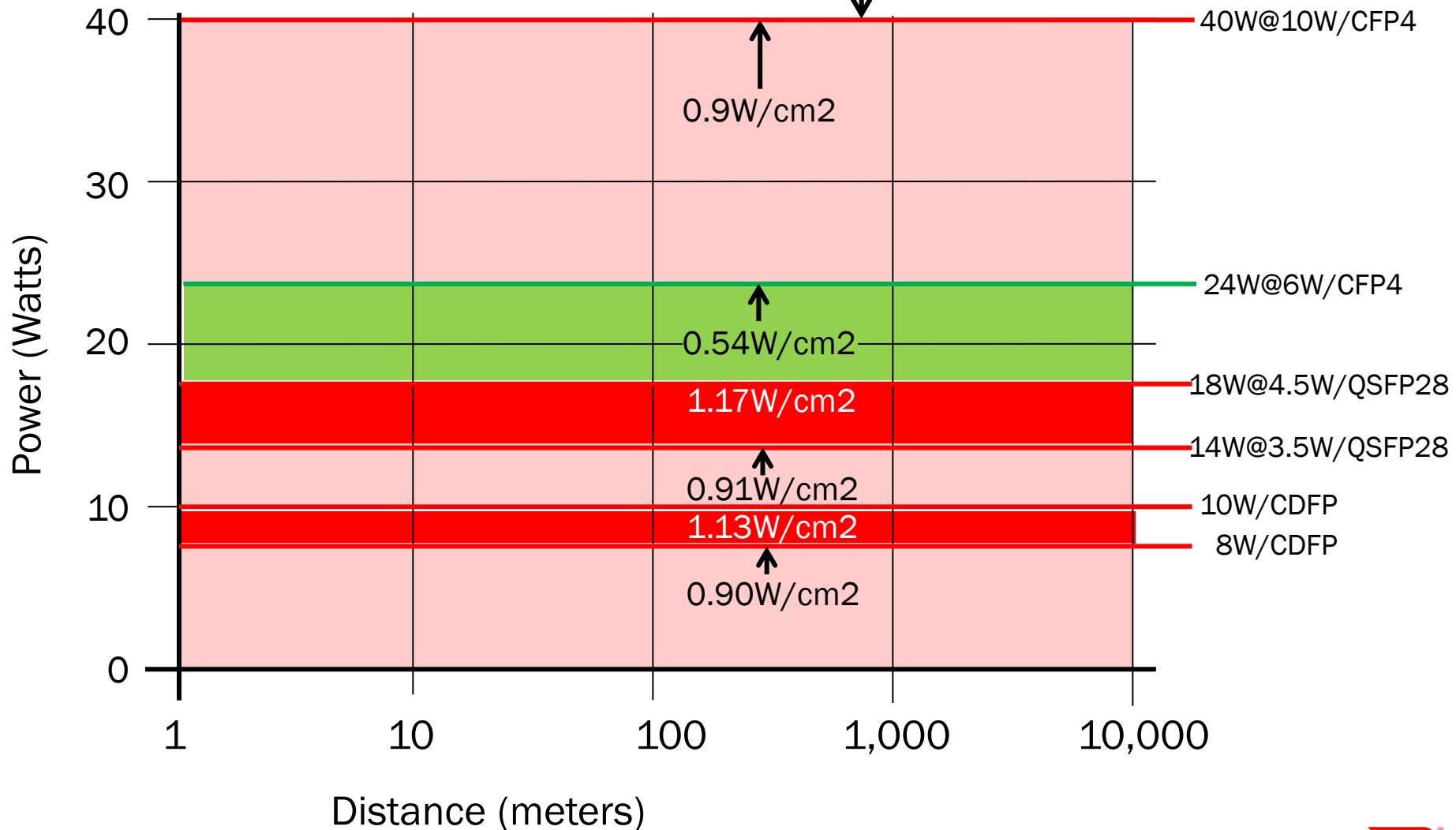
Form Factor	Top of Module Width (mm)	Top of Module Depth (mm)	Top of Module Area (mm ²)	Heat Sink Interface Width (mm)	Heat Sink Interface Depth (mm)	Heat Sink Interface Area (mm ²)	Heat Sink % Increase
SFP+	13.55	47.5	644	9.55	34.5	329	
CXP	21.2	28.45	603	21.2	16	339	3%
QSFP+	18.35	52.4	962	12.5	30.7	384	13%
XFP	18.35	69	1266	13.8	48	662	73%
CFP4	21.5	76	1634	16.6	66.7	1107	67%
CFP2	41.5	91.5	3797	71	37.8	2684	142%
CFP	130.25	75	9769	73.6	96.4	7095	164%
CDFP	Not Yet					885	

Source: Multiple MSAs



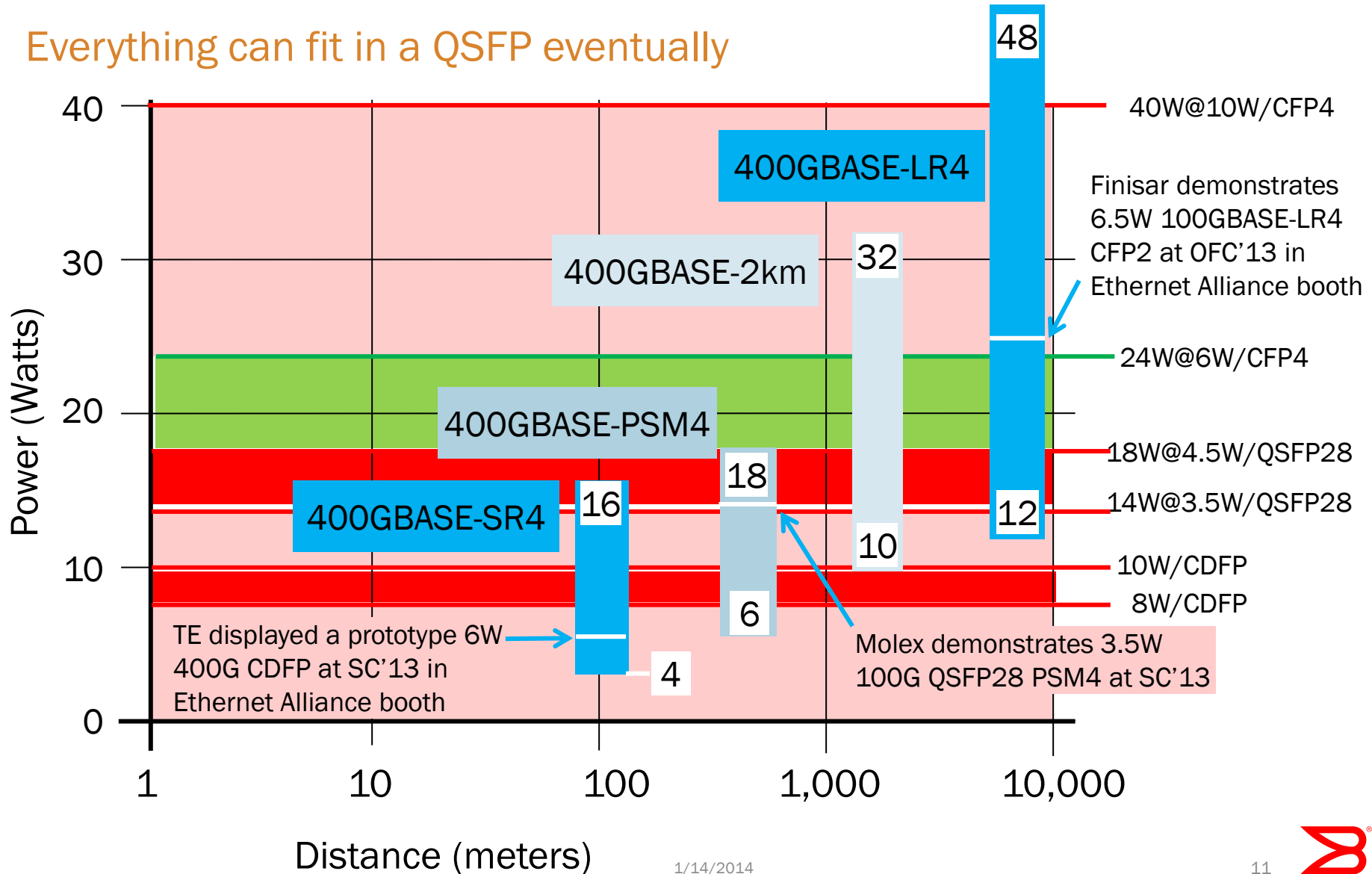
Power Density of Modules

Each line shows the power density of the module = $\frac{\text{Power}}{\text{Area of Heatsink Interface}}$



PMD Power vs Modules

Everything can fit in a QSFP eventually



Technical Feasibility of 400GbE Modules

- Up to 500 meter PMDs should fit in a CDFP in 2017
- If 100GBASE-LR4 can drop to 4W, the industry could support all of the 100GbE PMDs with 4 QSFP28s or CFP4s
 - A duplex SMF 2km or 10km 400GbE solution would require an external optical mux/demux that is unlikely to be accepted by the task force
- The re-use of 100GbE modules could make 400GbE very low cost and offer good return on investment



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THANK YOU

