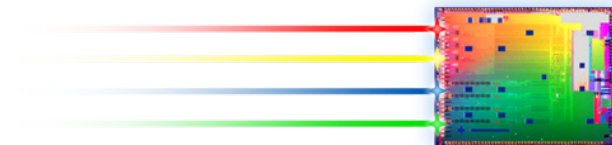


System level cost comparisons of 100G variants for 100-500m data center installations

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What matters to the end user?

- This presentation considers the decision making process used by the data center architect.
 - Overall lowest cost of installation
 - Overall lowest cost of operation
 - Density
 - Future requirements

Installation cost components

- Infrastructure
 - Cables
 - Connectors
 - Patch panels
 - Cable trays
 - Cable pulls
- Module cost

Cost of operation

- Power dissipation
 - Cost for power/cooling
- Cost of floor space

Intangible criteria

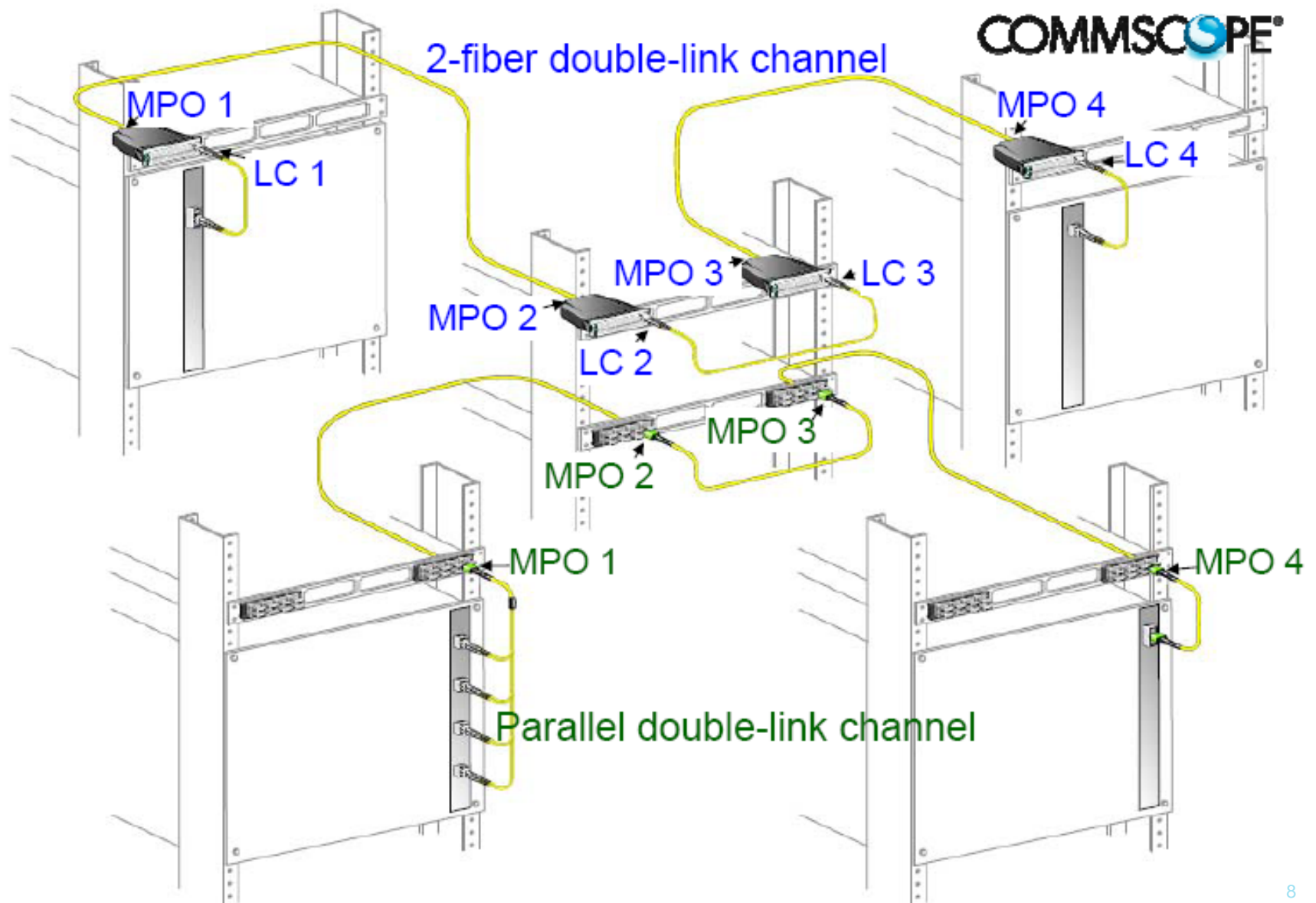
- Future proof
 - Will it support 400G in the future?
- Density
 - # of ports in a 1U slot
- Flexibility
 - Can it be used to support 10G and/or 40G and/or 100G?

- Cables
 - PAM, CWDM, DWDM, DMT all use duplex SMF fiber
 - PSM4 uses 8 fiber ribbon
- Connectors
 - PAM, CWDM, DWDM, DMT all use duplex LC
 - PSM4 uses 8 fiber MPO
- Patch panels
 - PAM, CWDM, DWDM, DMT all use duplex LC connectors patched to MPO ribbon fiber
 - PSM4 uses 8 fiber MPO connectors
- Installation
 - PAM, CWDM, DWDM, DMT all use duplex SMF fiber
 - PSM4 uses 8 fiber ribbon

System level cost comparison assumptions

- All costs are based on end user costs (Cost to data center)
- Note: This presentation attempts to answer the question 'CPL does not account for channel PDF weighting on total deployment costs' presented in kolesar_01a_0512 (page 5)

Double-link cabling channels



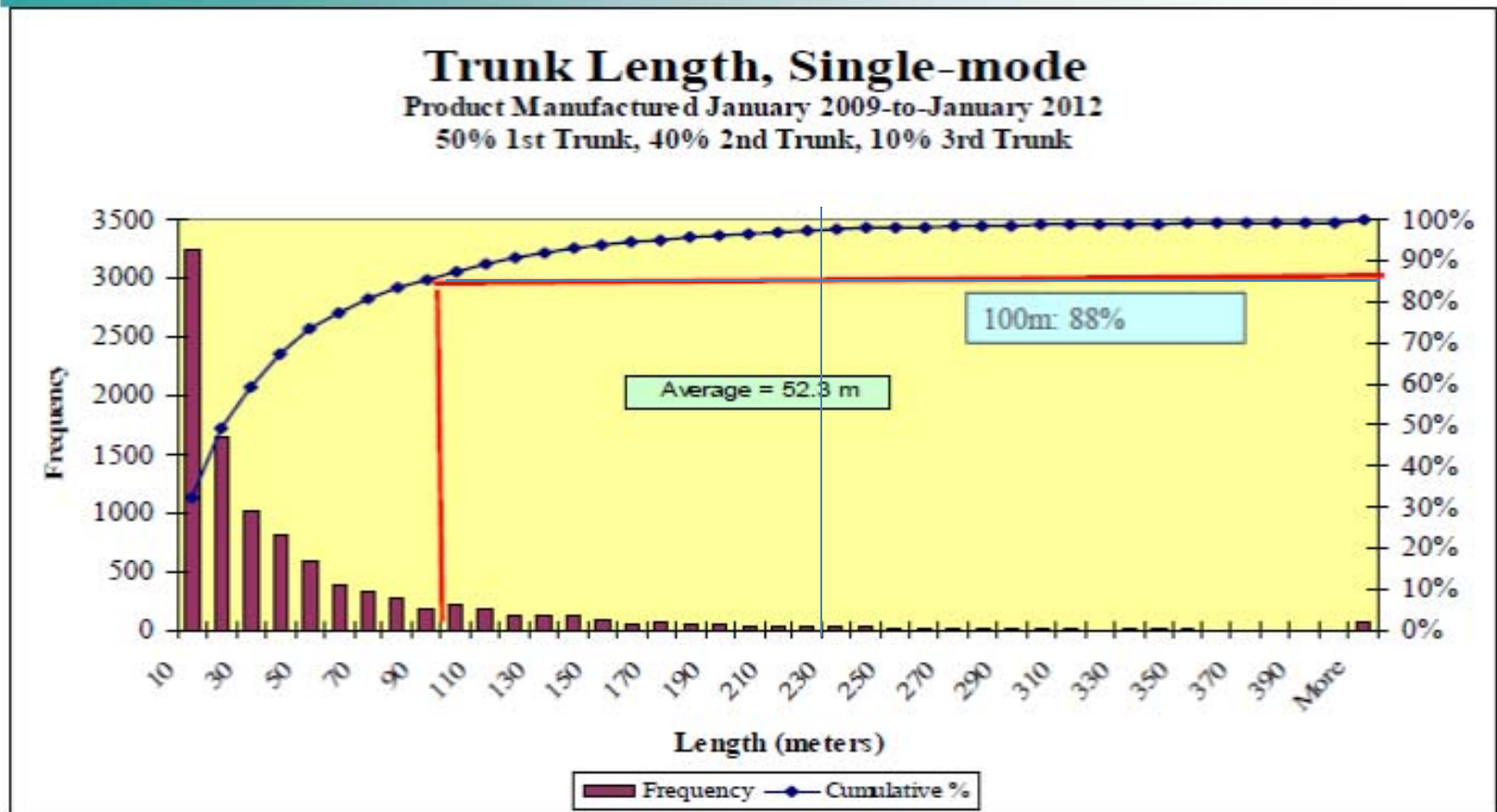
Data center sw-sw double link lengths and market size¹

SMF link length	Percentage of total SMF links deployed in Data center	
100	2	
110	2	
120	2	
130	2	
140	1	
150	1	
160	1	
170	1	
190	1	
200	1	
230	1	
240-350	0	
>350	1	

1: Correlates well with Kolesar_01a_0512

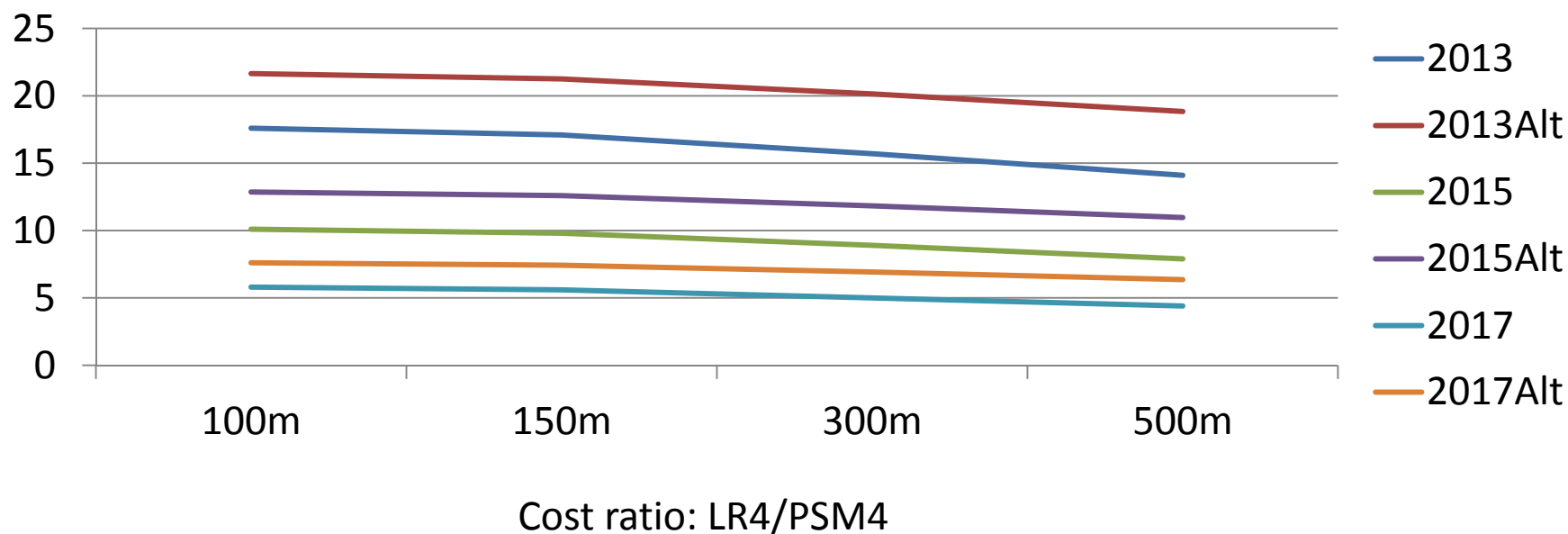
Data Center SMF links

Data Center Single-mode Cable Length Distribution

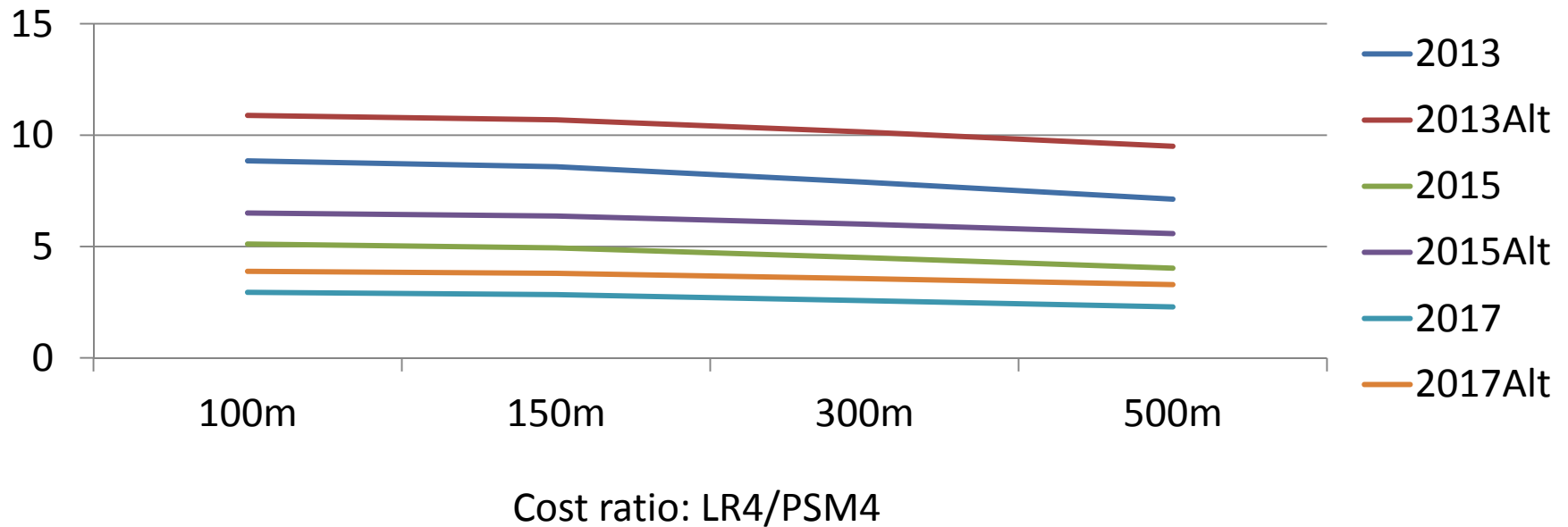


Source: Corning Cable Systems

Total installation cost ratio of LR4 vs PSM4 using 2013 CFP cost for 2013 module cost



Total installation cost ratio of LR4 vs PSM4 using 2013 CFP2 cost projections for initial cost



Total Operating Cost comparison (TOC)

- LR4:
 - CFP2 = 9-12W
- PSM4
 - QSFP = 2.5-3.5W
- End user cost of power (TOC) = 2x-7x module power
 - Cost of power supplies cooling etc.
 - Cost of power = .11/kwhr*
 - 4yr lifetime = \$46-\$162 cost savings/module
 - Assuming a 36 port switch: TOC savings for PSM4 modules = \$1,656-\$5,832
 - *Electricchoice.com: average cost of electricity in the US .1153/kw hr in 2010