

Proposed Copper Cable Objective for 400G per lane

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Supporters and Contributors

- Supporters:

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- Leesa Noujeim, Google
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- Rich Mellitz, Samtec
- Scott Sommers, Molex
- Matt Brown, Qualcomm
- Joel Goergen, Cisco
- Tobey Li, MediaTek
- Priyank Shukla, Synopsys
- Rick Rabinovich, Keysight
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- Mabud Choudhury, Genuine Optics
- Alex Levin, Microsoft
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- Mike Li, AMD
- Kapil Shrikhande, Upscale AI

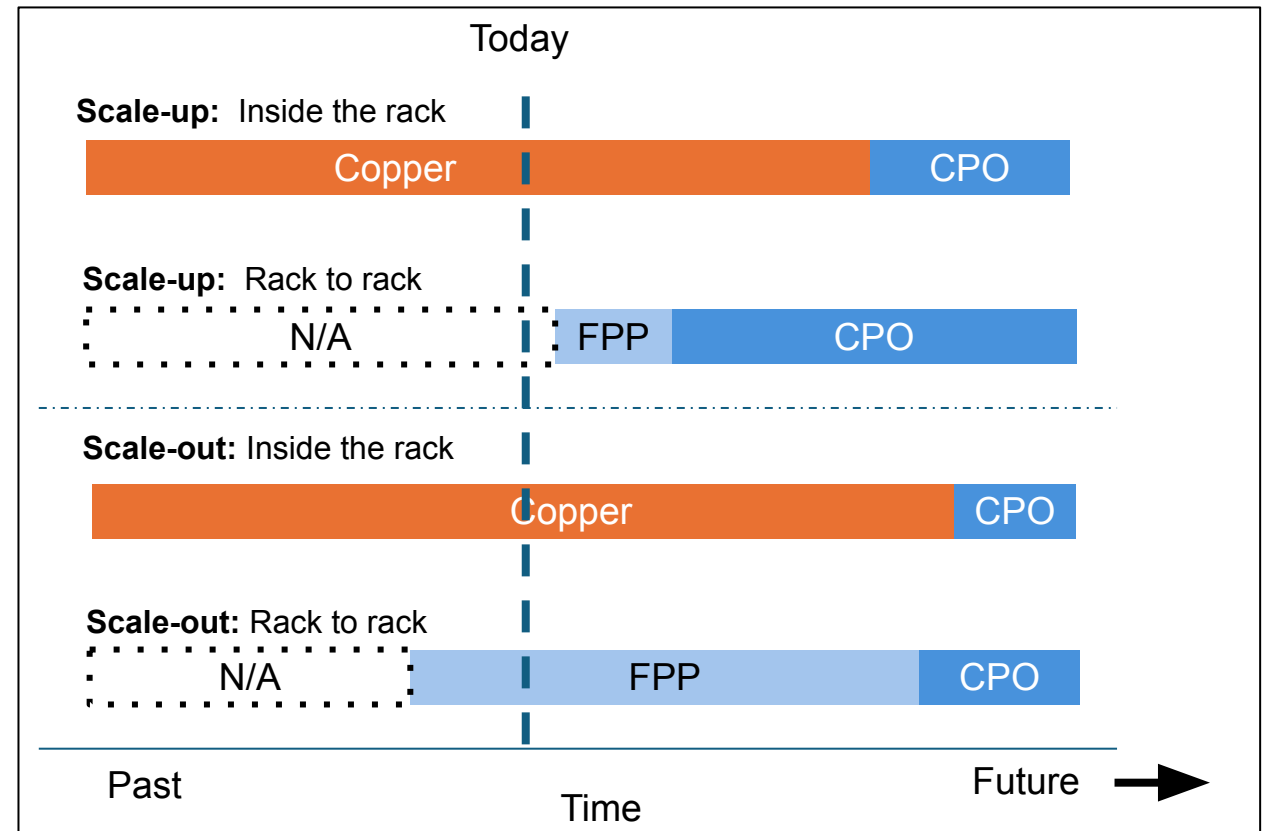
- Ali Ghiasi, Ghiasi Quantum
- Adee Ran, Cisco
- Mike Dudek, Marvell
- Adam Healey, Broadcom
- Xiang He, Huawei
- Mark Kimber, Semtech
- Femi Akinwale, Intel
- Toshiaki Sakai, Socionext
- Norm Swenson, Point2/Nokia
- Paul Brooks, Viavi Solutions
- Pavel Zivny, Lumilens

- Referencing slides by:

- Kent Lusted, Synopsys
- Alan Weckel, 650 group
- Sam Kocsis, Amphenol
- Leesa Noujeim, Google

I/O Transitions for AI

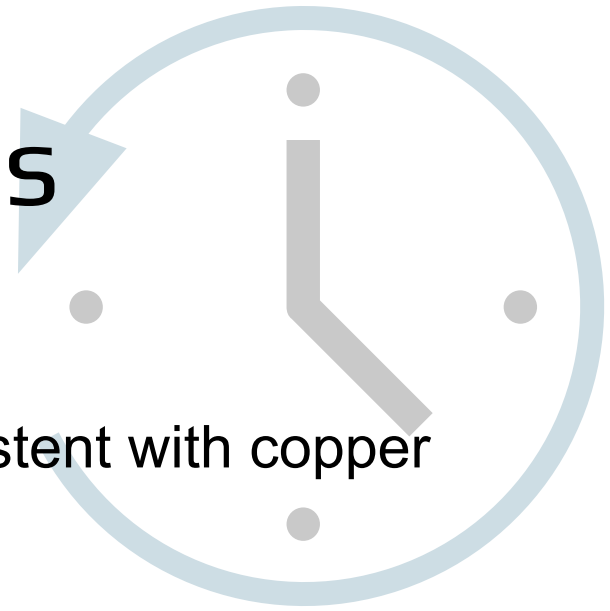
- Current and future transitions involve Copper, front panel pluggable (FPP) optics, and CPO/NPO
- Copper dominates inside-the-rack connections today but shifts toward optics over time
- Rack-to-rack connections transition from pluggable to CPO
- Market requires both copper and optical PMDs @ 400G



Based on AI Networking: What do scaleup and scaleout really mean for networking demand, Alan Weckel (650 Group), https://www.ieee802.org/3/ad_hoc/E4AI/public/25_0327/weckel_e4ai_01_250327.pdf

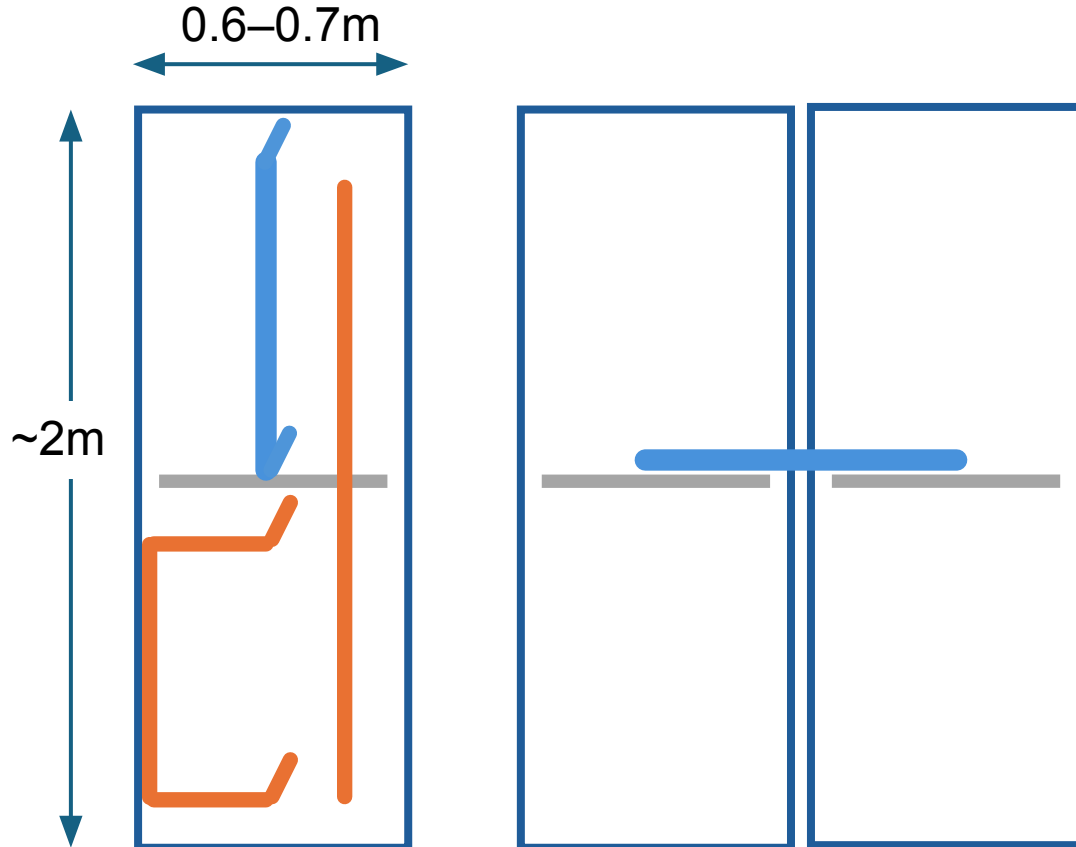
Requirements for BOTH electrical and optical PMDs

Historical Copper Cable Objectives



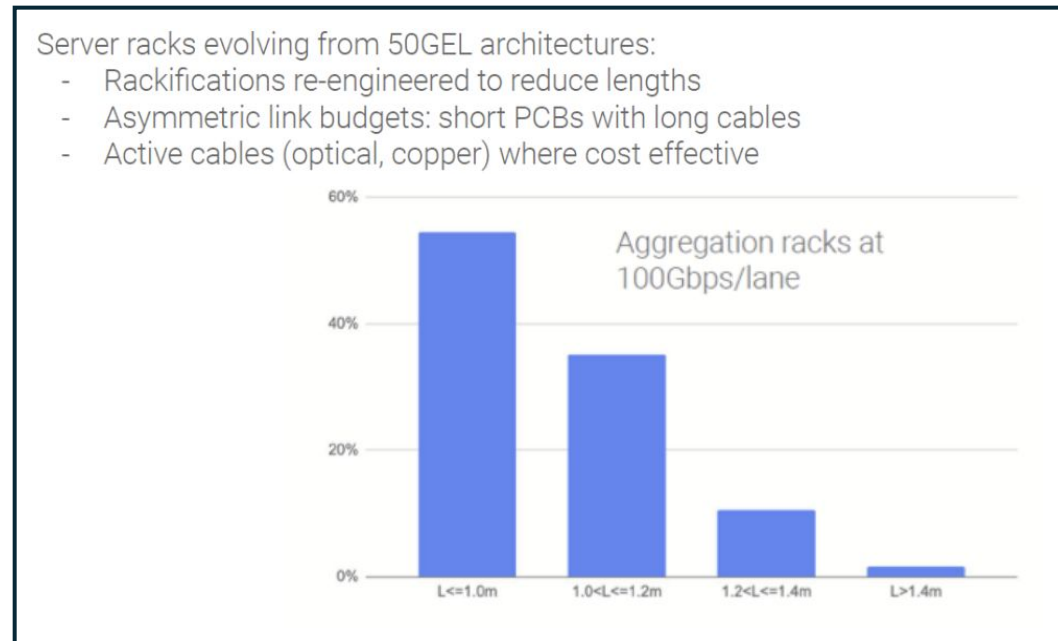
- 802.3bj
 - Define a 4-lane 100 Gb/s PHY for operation over links consistent with copper twin-axial cables with **lengths up to at least 5m.**
- 802.3cd
 - Define single-lane 50 Gb/s PHYs for operation over copper twin-axial cables with **lengths up to at least 3m.**
- 802.3ck
 - Define a single-lane 100 Gb/s PHY for operation over twin-axial copper cables with **lengths up to at least 2 m.**
- 802.3dj
 - Define a physical layer specification that supports 200 Gb/s operation over one pair of copper twin-axial in each direction with **a reach of up to at least 1 meter.**

Length Need is Unavoidable

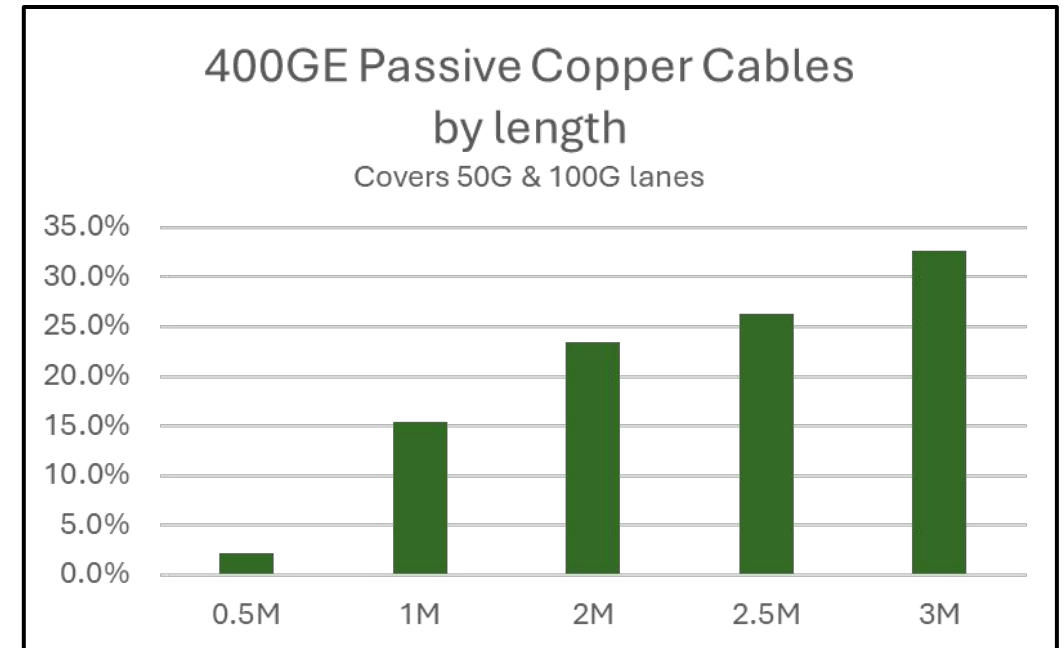


- Rack sizes remain the same
- In-rack utility
 - Middle to top/bottom intra-rack reach
 - Middle to middle+ for side by side rack to rack reach
- Remember the cable direction change
 - 26 AWG requires 1.7" bend radius
 - Commonly 4-6" perpendicular distance is used for cable management
- Length affects Broad Market Potential
- Suggests 1m is minimal target

Cable Length Utilization



End User view of rack architecture, minimizing cable lengths
https://www.ieee802.org/3/B400G/public/21_07/tracy_b400g_01a_210729.pdf (slide 7)

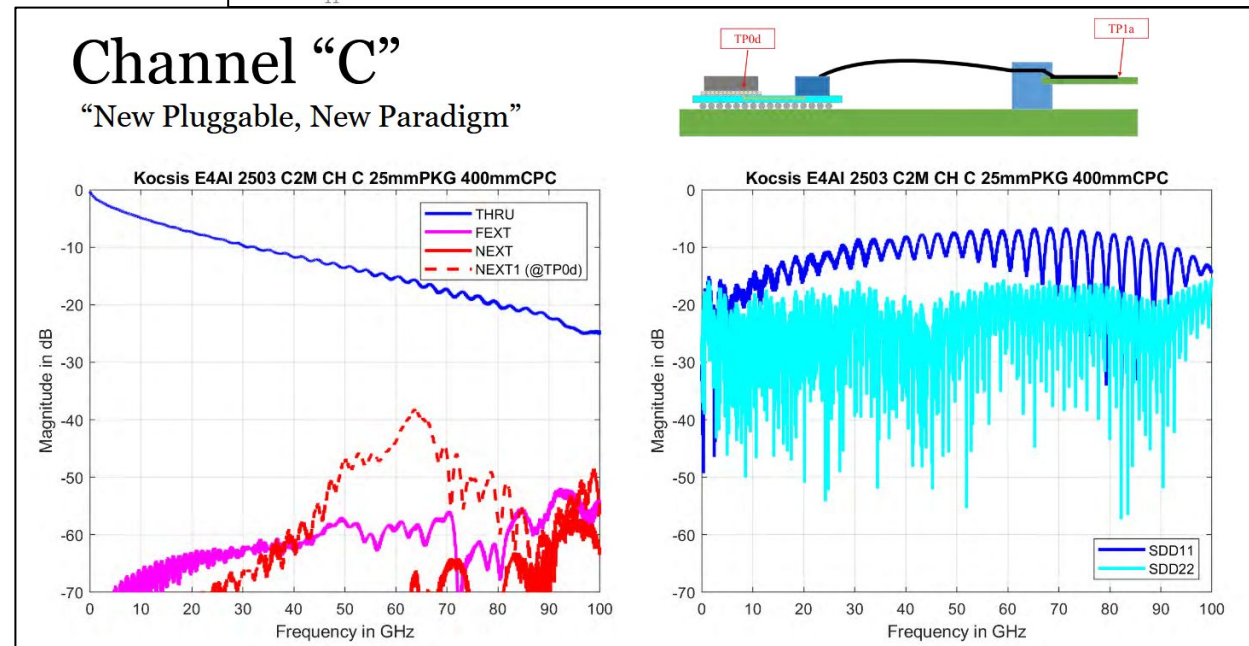
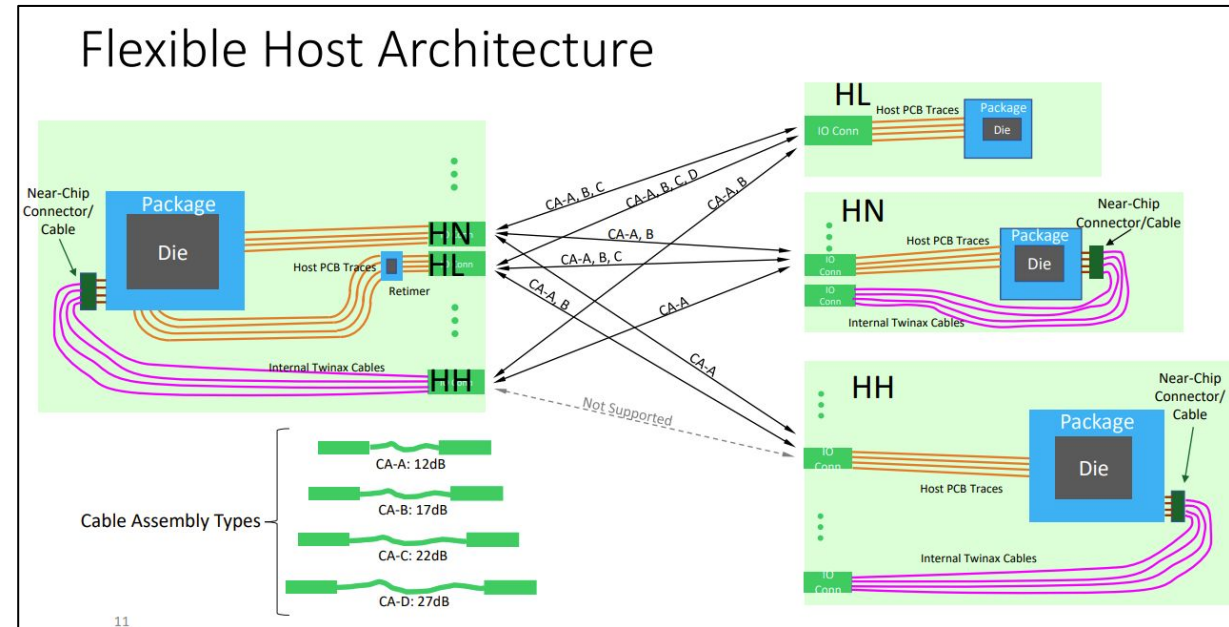


Beth's research data

- Rising Nyquist and ASIC limitations are driving engineering creativity at all levels
- 1m as the longest target remains important for market need

Toolbox

- IEEE P802.3dj added length options based on intra-board loss
 - Not all variations have to meet the reach goal
- Tools to discuss in TF
 - Host granularity
 - Connector improvements
 - Channel improvements
 - Modulation
 - Active cables
 - Others?



Considerations

- Active Copper Cables (ACC) are often used to sizably extend the reach of copper
 - If this tool is used, the target length will need to increase
- AI growth is imminent and having a passive copper solution is of value
- Other objectives are coming in future projects

Summary

- **The length objective assumes front panel to front panel**
- 1M objective has reasonable broad market potential
 - This is based on interconnection details
 - Not every host configuration has to achieve this
- Innovation is already in works to achieve this with passive copper
 - Decision making on the technical details is for task force
 - Ideally, active cables can achieve 2-3M (also needed in the industry)
- Recommend to adopt Copper Cable Objectives



Proposed Objectives for Adoption

- Define a single-lane, 400Gb/s PHY for operation over twin-axial copper cables with lengths up to at least 1 meter.
- Define a two-lane, 800Gb/s PHY for operation over twin-axial copper cables with lengths up to at least 1 meter.
- Define a four-lane, 1.6Tb/s PHY for operation over twin-axial copper cables with lengths up to at least 1 meter.

*The objective length assumes the length of an external cable, such as front panel to front panel