

In Support of 200G over 1 pair MMF Objective:  
Broad Market Potential (BMP)  
& Economic Feasibility (EF)

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NGMMF Study Group  
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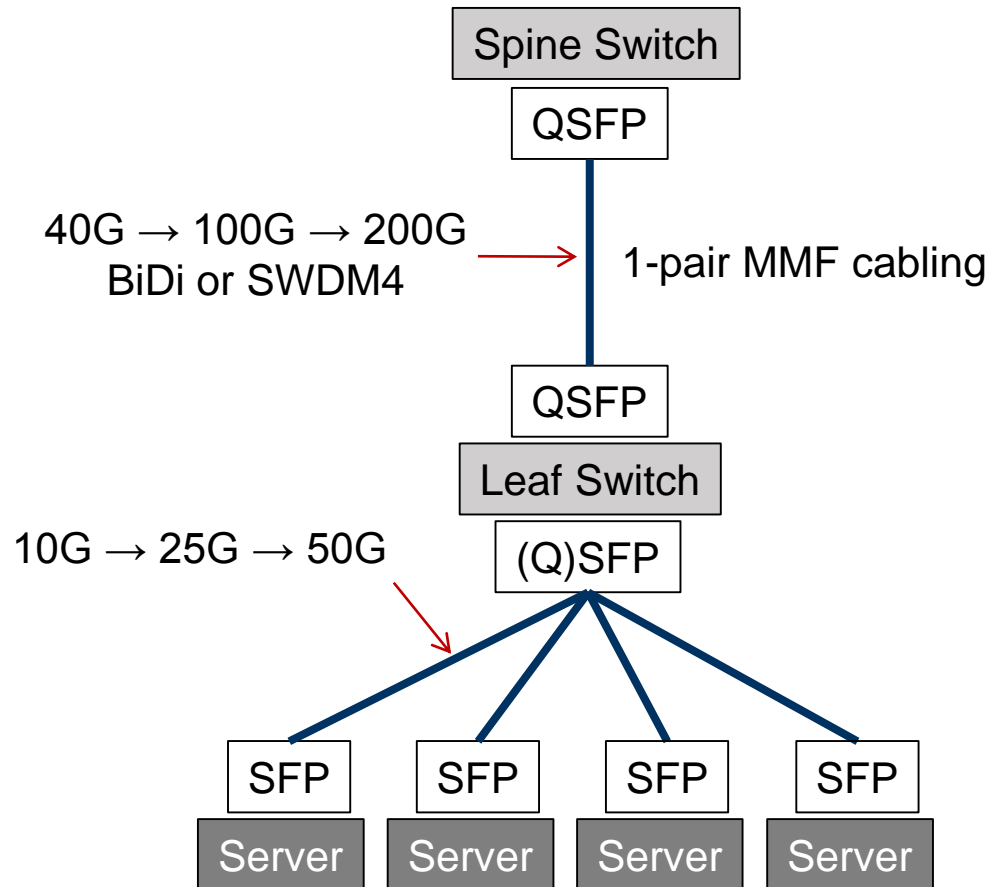
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- Daryl Yeoh, Westpac Australia
- Arthur Zhen, GDS China Ltd.
- Zhang Jiangping, China Cache
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- Zhang Sheng An, ICBC Beijing
- Li Chong Hui, Minsheng Bank China
- Nick Bonadi, Mulvey and Banani Int'l, Canada
- Justin Cooley, Qualcomm IT Engineer, Staff
- Oscar Kramer, Qualcomm IT Engineer, Staff
- Dan Seiberling, Qualcomm IT Engineer, Sr
- James Deese, Wells Fargo
- Mathew Deatherage, Principal network engineer, Qualcomm, USA

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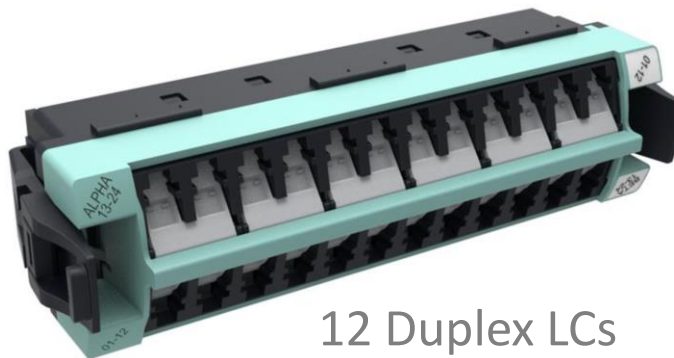
# Duplex uplinks enable re-use of existing infrastructure as server speeds increase and contention ratios drop



- Contention ratios (the ratio of aggregate server data rate versus total uplink data rate from an access switch) are declining to improve application response.
- There is a requirement to maintain low contention ratios as server attachment speeds increase.
- Server speeds will increase in the shorter term from 10G to 25G.
  - 200G uplinks needed in the same timeframe.
- Providing a solution over 1-pair infrastructure lowers the cost of upgrade and lowers upgrade complexity.
- This is a generic upgrade scenario
  - Broadly applicable to numerous customers.

# Cost & complexity introduced when switching to parallel optics

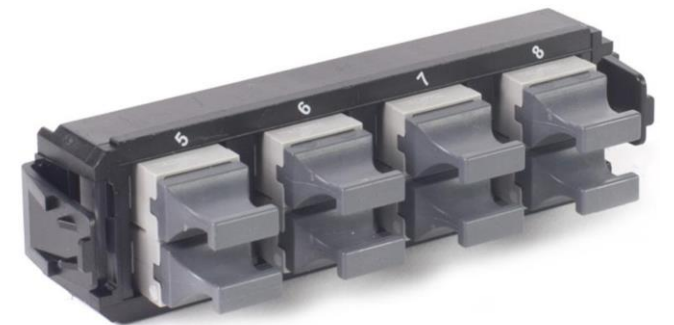
- Common duplex deployments are based on 2x12f MPO to 12-port duplex LC modules
- Switching to parallel optics requires investment in more trunk cables and increasing floor space requirements for additional patch panels
- MPO port densities are lower than duplex LC port densities and require more patch panel space
  - Option 1: re-map w 2x12f MPO to 6x8f modules → 4x trunk count and 2x module count increase
  - Option 2: convert to MPO pass-through → 6x trunk count and 1.5x more panel space
- Higher trunk count → additional room in pathways
  - Option to deploy 8f trunks → mixed 12/8f trunking = added complexity



12 Duplex LCs



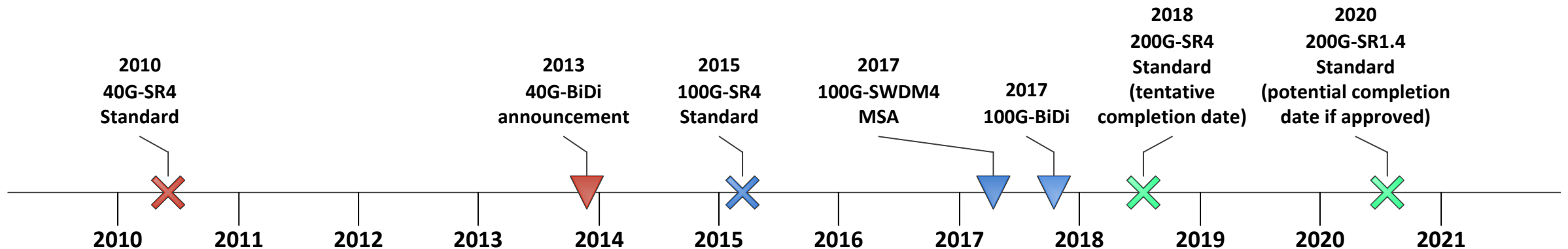
6x8f MPO module



8 MPO "pass-through"

# Conclusions supporting BMP and EF

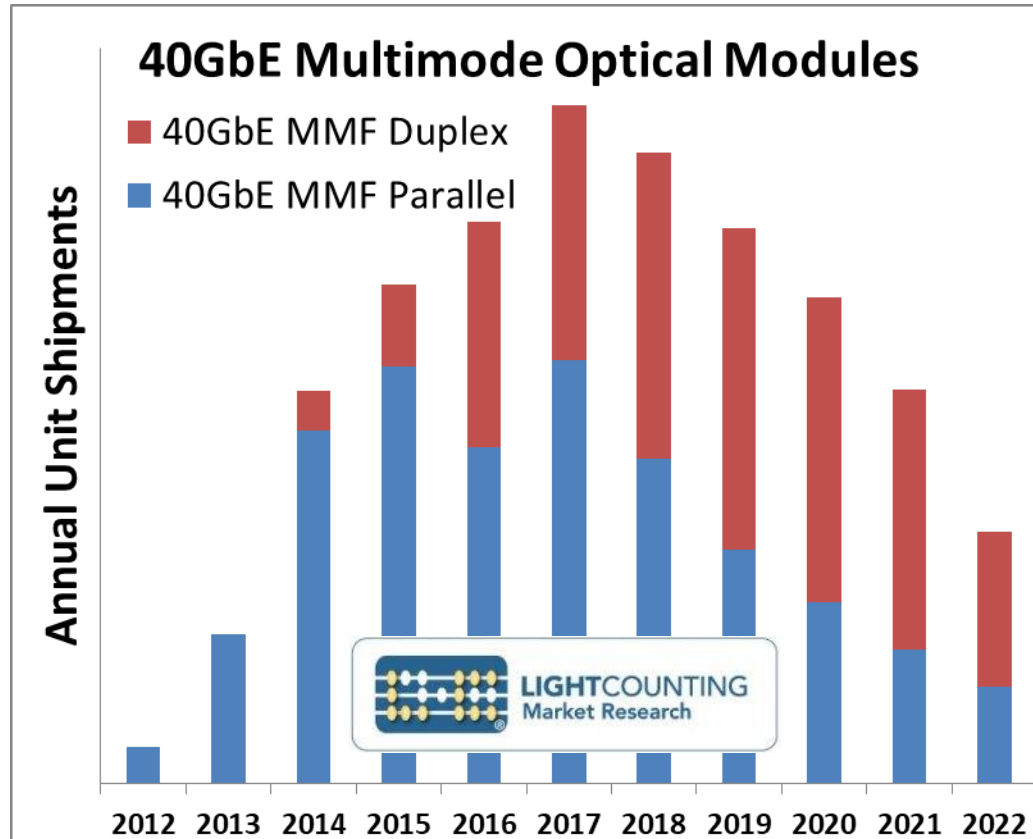
- 200G uplink solutions are needed to support server data rate upgrade path
  - Uplink from ToR or MoR has volume -> drives down cost -> broadens market appeal
- Defining a 1-pair (duplex) solution for 200G will lower cost
  - enables lower cost upgrades for customers with 1-pair uplink cabling infrastructure
  - removes upgrade hurdles by eliminating the need for cabling change
  - retains existing operational paradigm, lowering operational costs
- 200G duplex in 2020 is well timed
  - Follows 3-year cadence from 40G duplex (2014) to 100G duplex (2017)



- Follow through on commitment to 200G by standardizing a 1-pair MMF solution
  - Enhance Ethernet's overall BMP and EF

# Backup Slides

# Broad Market Potential for MMF Duplex has been firmly shown with the introduction of 1.2 and 1.4 optics



- Until 40GbE, all multimode Ethernet modules were duplex
- SR4 configuration helped launch the 40GbE market
- Duplex MMF still a desired solution, quickly reaching 38% of the 40GbE MMF market in 2017

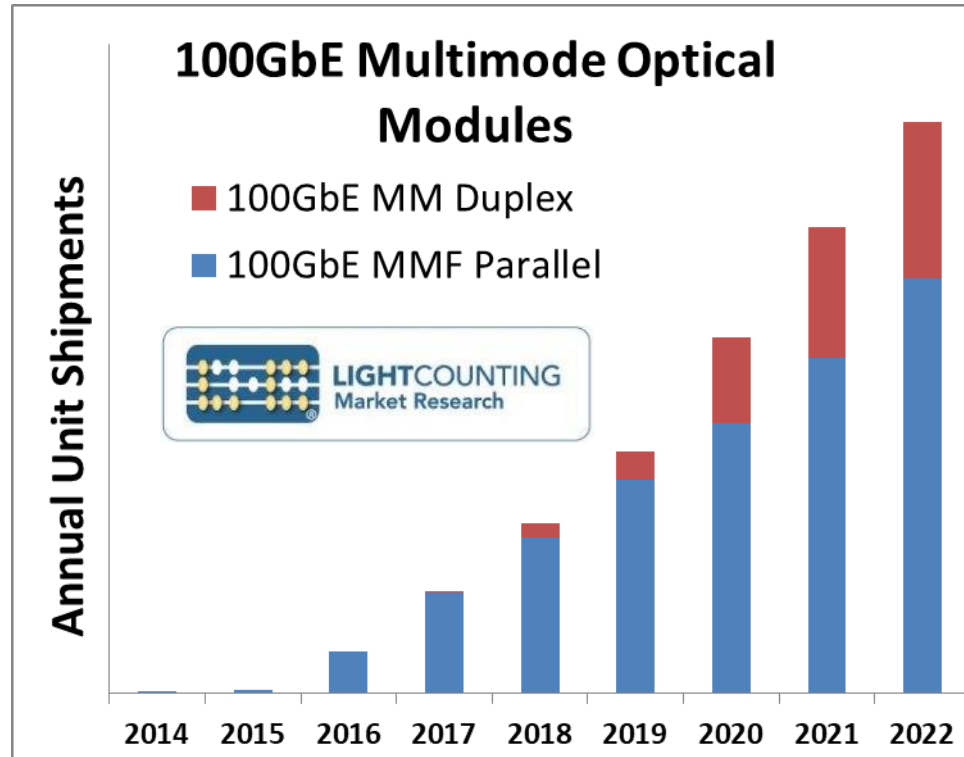


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# Broad Market Potential for MMF Duplex has been shown historically with 40G and is predicted for 100G



At 100GbE:

- SR4 configuration again helped launch the market
  - SR10 never widely deployed
- Duplex MMF still a desired solution
  - Projecting a 27% share of the 100GbE MMF market by 2022

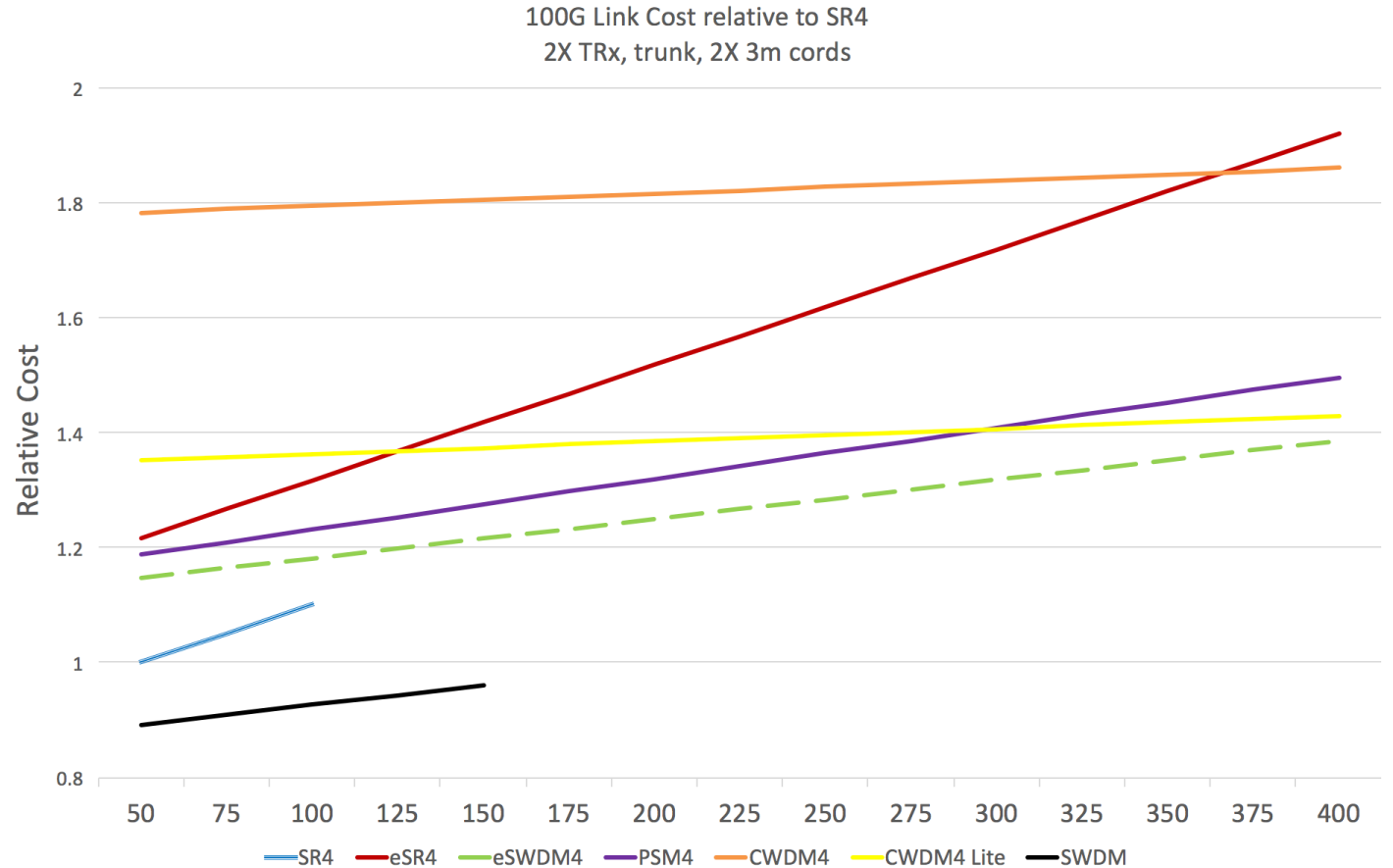
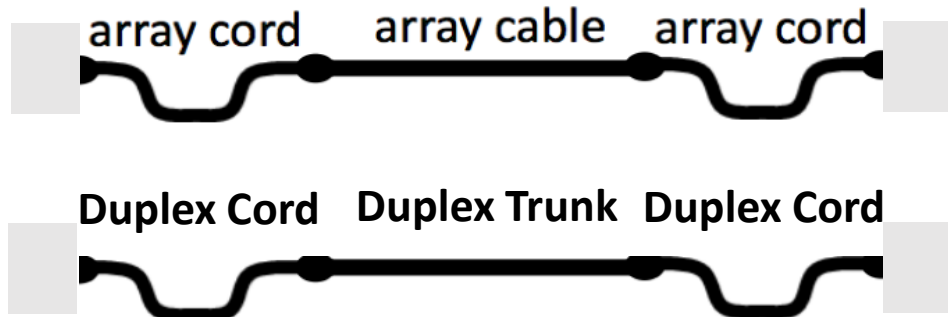


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# Relative link costs for 100G applications show duplex cabling supports BMP

- Link cost includes 2X Transceivers  
1 Trunk, 2 Cords and 2f or 8f
- Parallel:Duplex Connector costs  
1.7 – 2.1X
- MM:SM per fiber meter 2.3-3.1



eSWDM4– est. reach target announced

Data source –  
industry interviews,  
colleagues and  
industry experts