



# Future of VCSELs in Data Centers

Healthy Market Indefinitely

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# VCSELs Could Remain Dominant for Decades



- Mature, reliable, efficient, & cheap for short-reaches
- Historically, low-obsolescence rates of solutions in data communications space
  - > Copper
  - > 1G
  - > VCSELs
    - Relatively new technology
- Heavy past investment in multimode fiber for many years to connect servers
  - > Vast majority of data center operators adverse to abandoning plant
- Cost is defining parameter in most cases

# Cost Advantages of VCSELs over Single-Mode Alternatives



- VCSEL cost estimates (# of VCSELs on a wafer is > 3X )
  - > Chips can be as low as 20 cents on 3-inch wafer
    - Generally from 44 cents to \$1 yielded
  - > Total Cost of a 10G SFP VCSEL based transceiver is about 16
- Expected movement closer to duopoly in US will keep pricing pressures down
  - > Projected continuation of under-capacity will ensure supply

Average Price Comparison (USD)		
	MM	SM
10G (SFP)	25	50
40G (QSFP)	100	380
100G (25X4)	500	4,500



# Latest Technology Development Favor VCSELS



- Distances & speeds
  - > Compelling with present 400m at 10G for Om4 & able to reach 100m at 25G
    - With 4x25G, room to increase 2 orders of magnitude in many cases
    - Typically, >80% of deployment is within 100 meters in enterprise space
- Small movement to SMF in very long term for enterprise space
  - Greater lengths at higher capacities
  - Not restricted to point-to-point
  - Enables switching capability
- No widespread viability of SI photonics for active components
  - > Optical loss
  - > Low volumes keep cost high

# Thank You



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