

Chapter-7

Data Center Architectures and Opportunities for Silicon Photonics

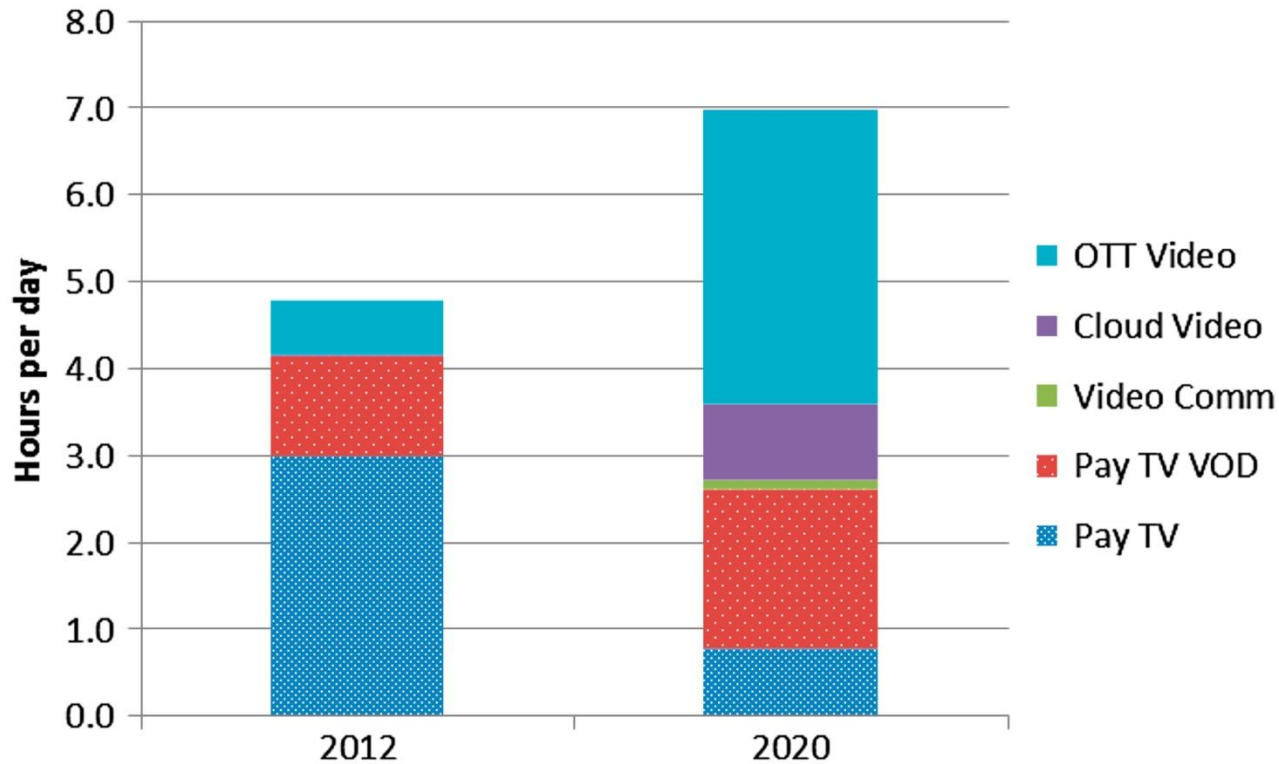


Figure 7.1: The ongoing transition from traditional TV programs (linear TV) to Internet-delivered video. Note: OTT refers to over-the-top—in this case video, typically from an Internet content provider that rides over an operator’s network—while VOD refers to video on demand. Adopted from Market Realist.

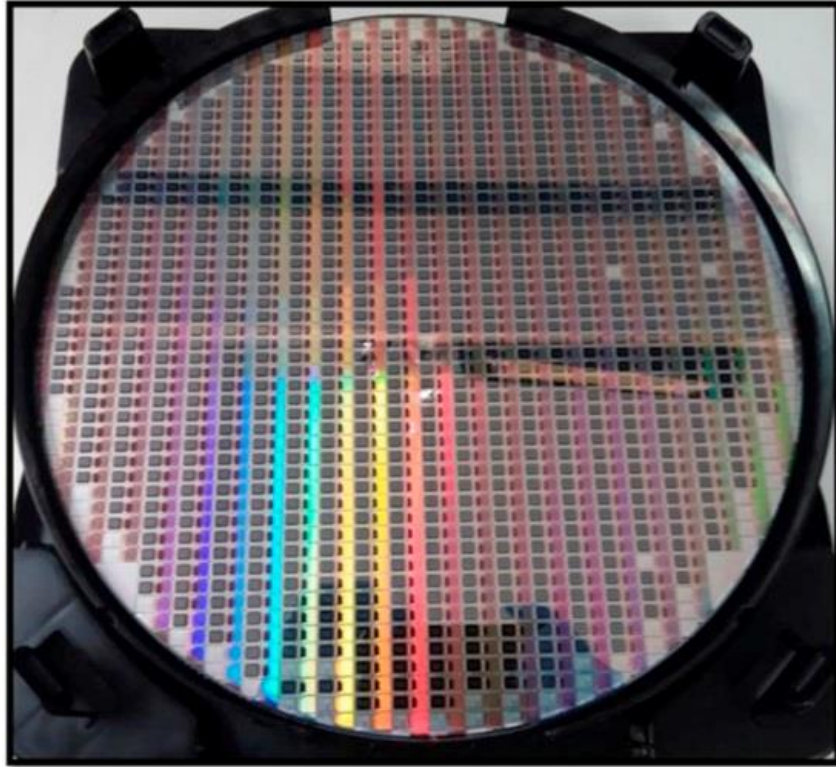


Figure 7.2: Wafer of Luxtera's 100G PSM4 silicon photonics-based optical engines.
From Luxtera.

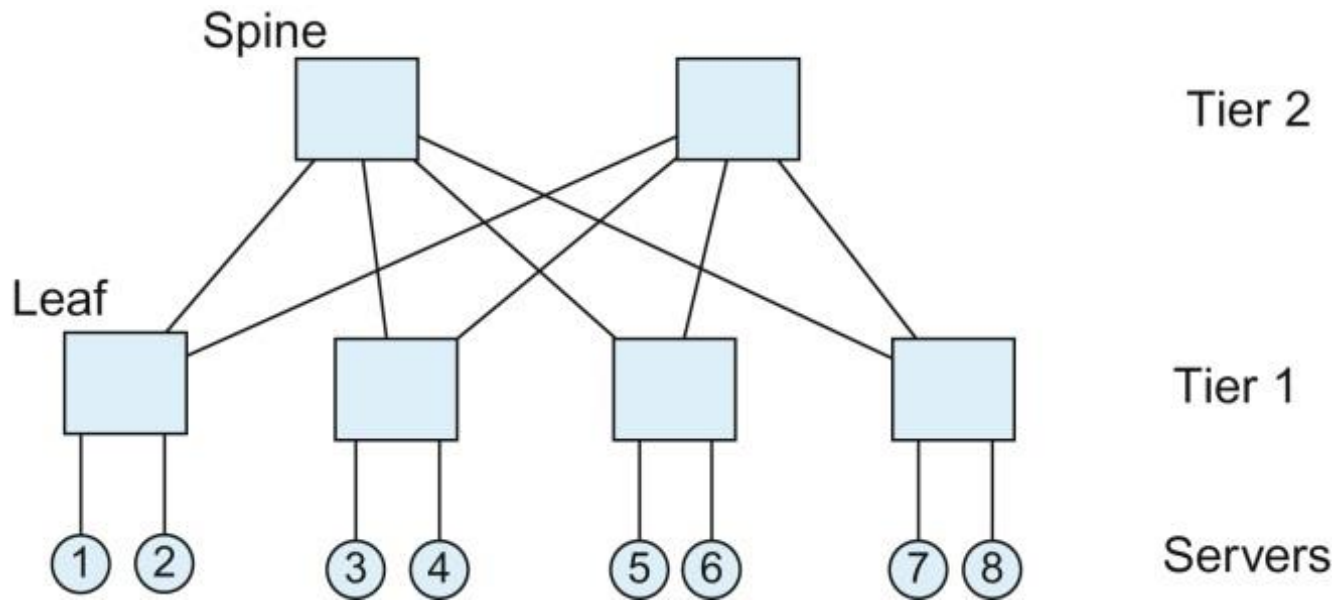


Figure 7.3: A simple leaf-and-spine architecture linking eight servers.

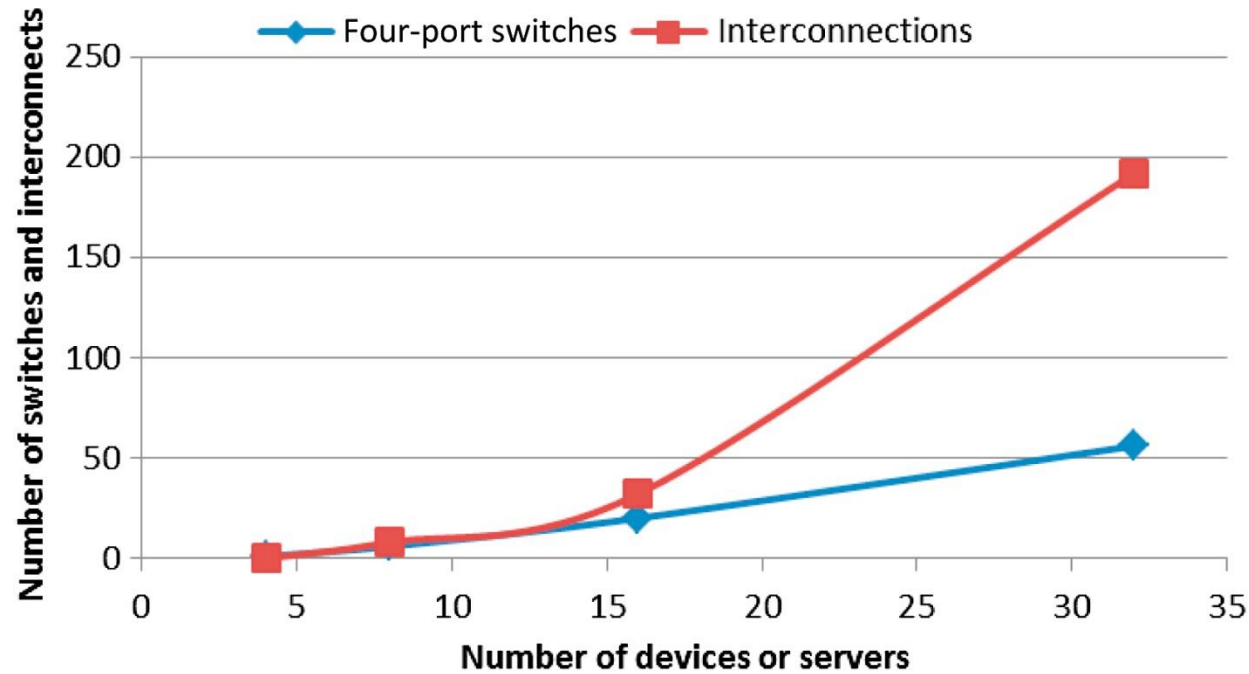


Figure 7.4: Impact of server count on the number of four-port switches and interconnects in a leaf-and-spine architecture.

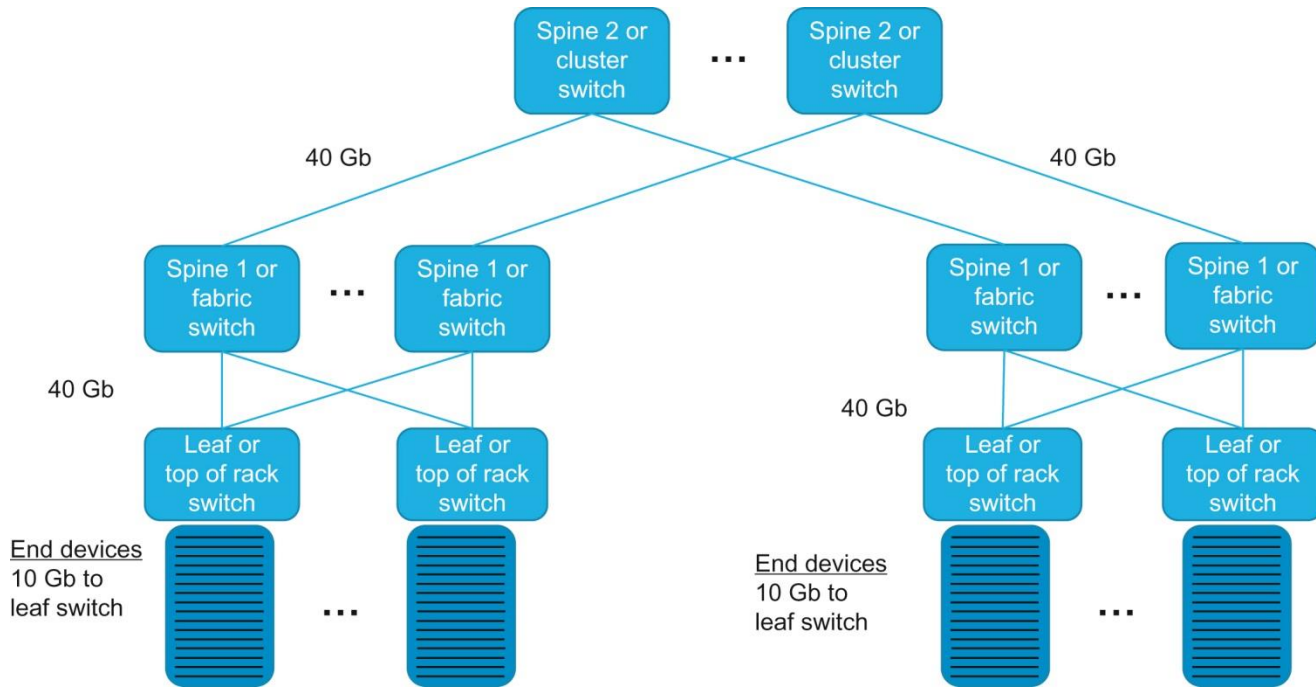


Figure 7.5: A three-tier leaf-and-spine architecture as described by Facebook. Modified from Facebook.

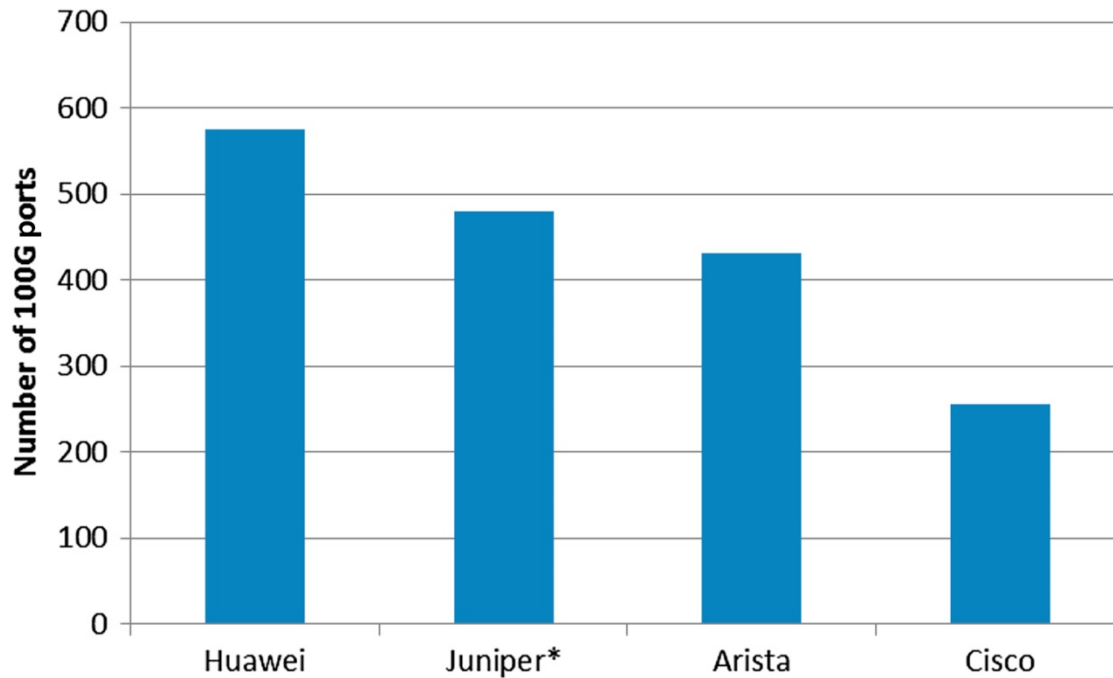


Figure 7.6: A selection of the highest-port-count 100-Gb Ethernet switches available commercially. Juniper announced, not shipping as of 3Q2016. Data from company reports.

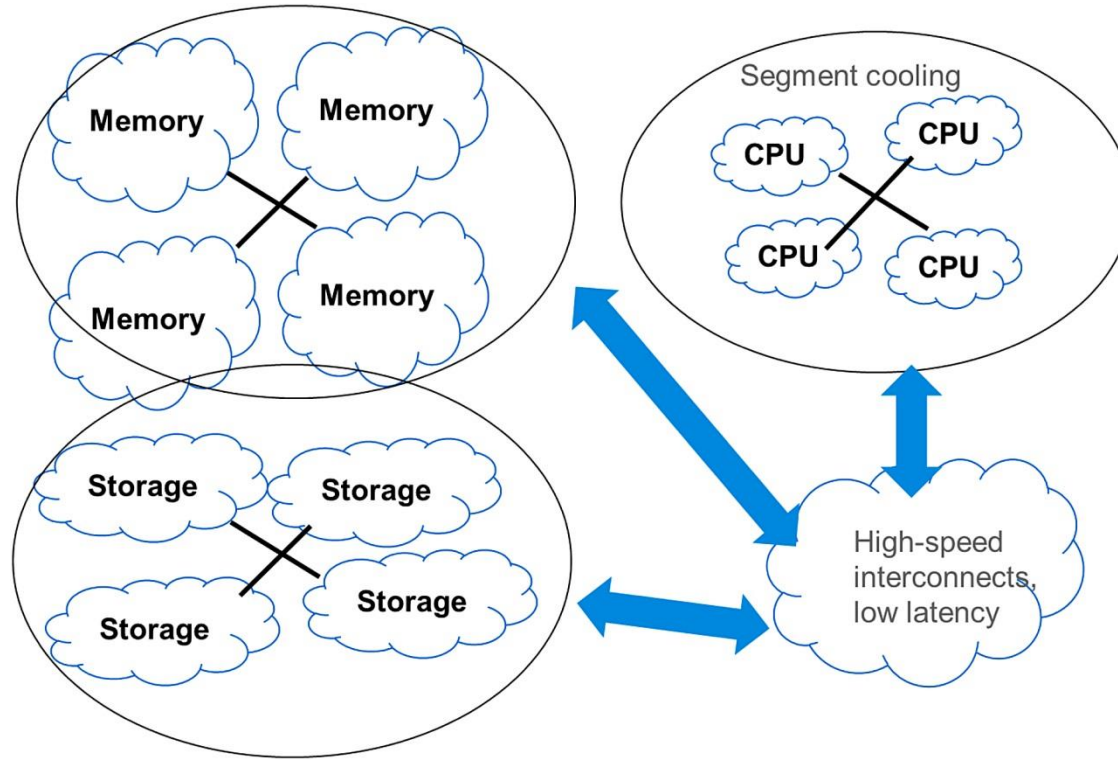


Figure 7.7: Device-specific environmental conditioning enabled by disaggregation.

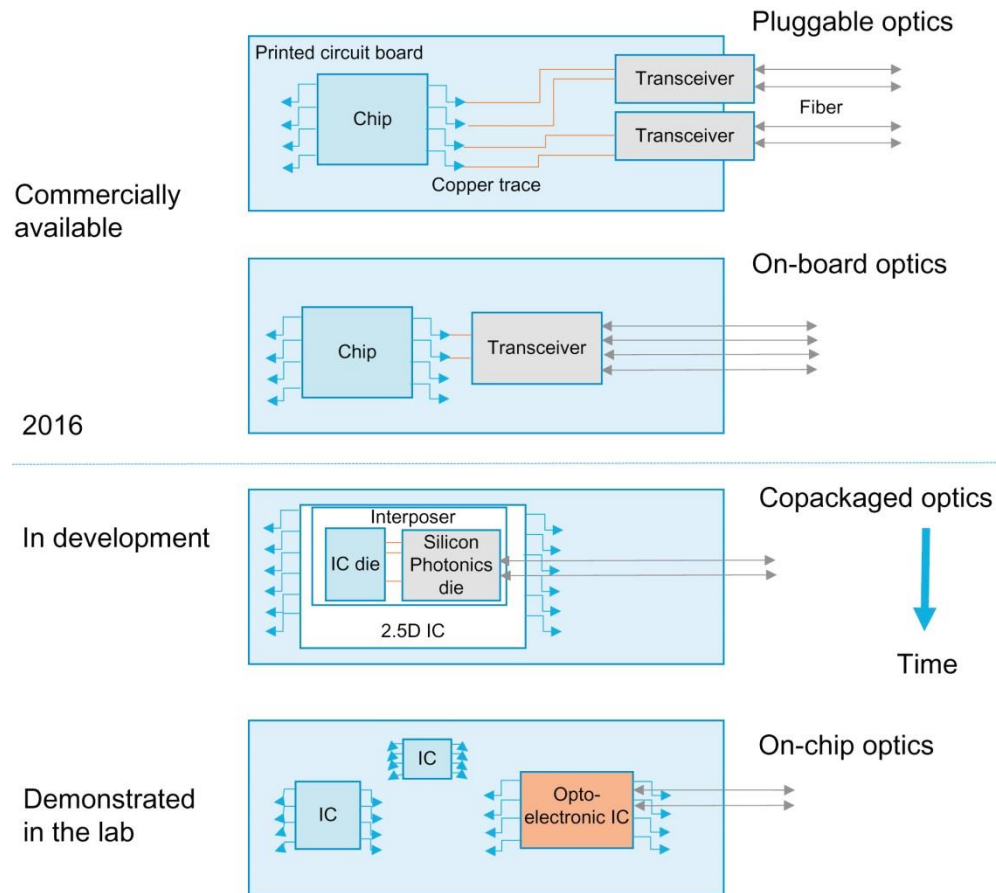


Figure 7.8: The evolution of system optics: From pluggables modules to on-board optics to copackaged optics to on-chip optics.

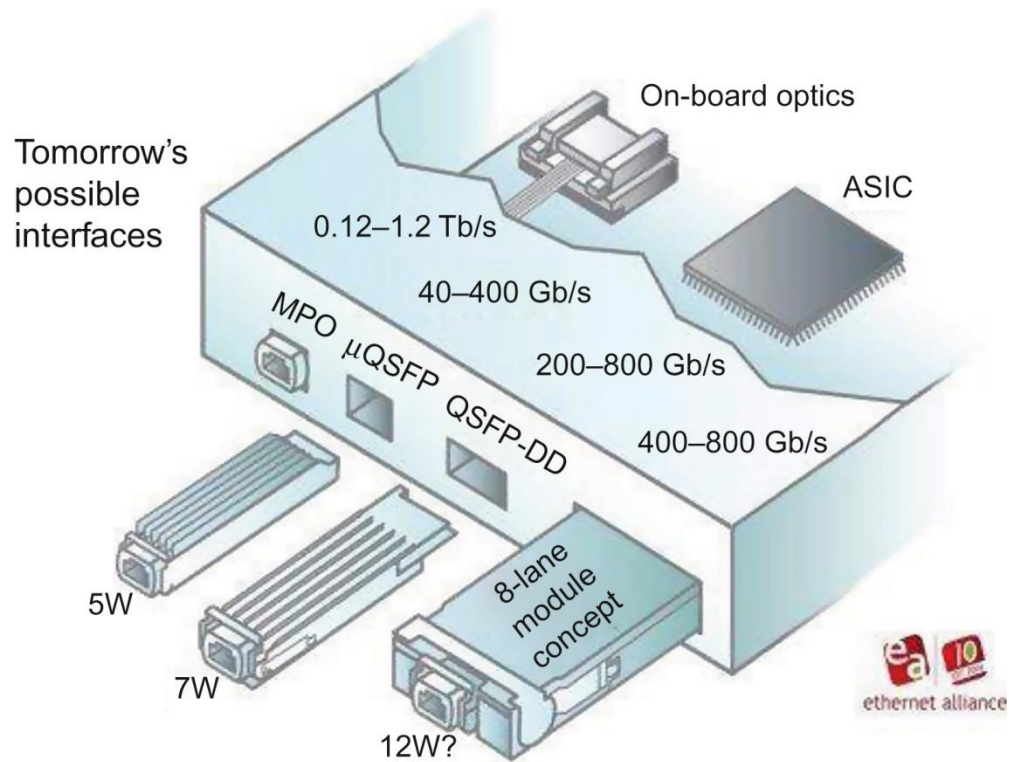
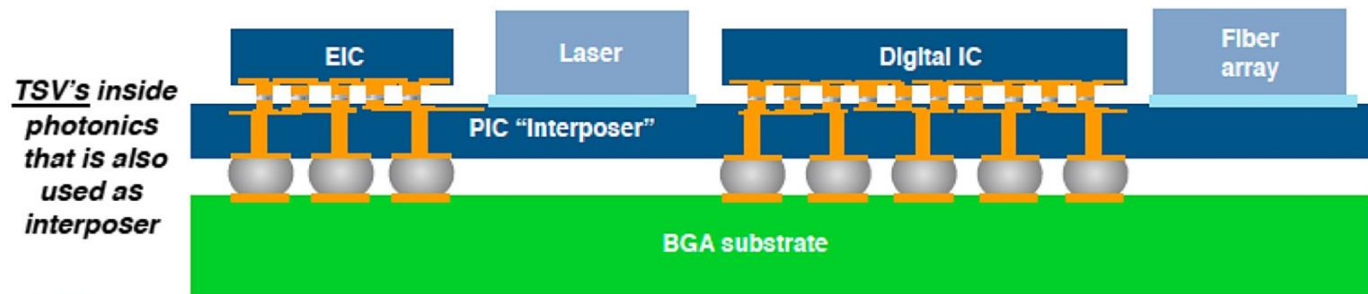


Figure 7.9: Solutions being developed for next-generation switches. From Ethernet Alliance.



EIC & DIGITAL IC assembled with μ -Copper pillars an active PIC "Interposer"

Figure 7.10: Photonic integrated circuit interposer. TSV is a through silicon via, a vertical electrical connection approach, EIC refers to an electronic integrated circuit, PIC is photonic integrated circuit, and BGA is a ball grid array. From r STMicroelectronics. Used with permission.

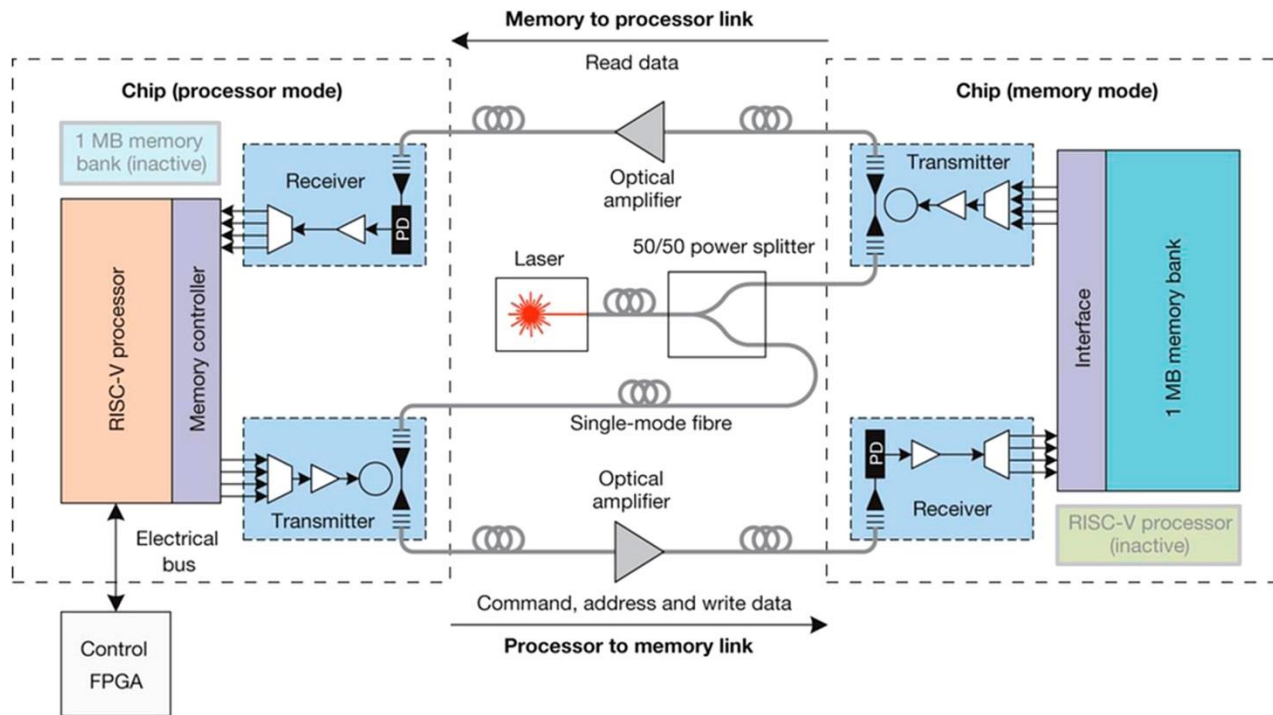


Figure 7.11: Optical interconnection integrated with microprocessors. Reprinted by permission from Macmillan Publishers Ltd: Chen Sun et.al., Single-chip microprocessor that communicates directly using light, *Nature* 528, 534538 (24 December 2015), copyright 2015.