

XR Optics

Innovative Point-to-Multipoint Coherent that Slashes Aggregation Network TCO

Introducing Point-to-Multipoint Coherent with Digital Subcarriers

Many networks, including metro aggregation, are inherently hub and spoke, with a large number of spoke devices (e.g., cell site, fiber node, RPD, DSLAM, OLT, etc.) connecting to a smaller number of hub devices (router, EPC/NGC, CMTS/CCAP, BNG, etc.). However, as shown on the left of Figure 1, conventional optical technology provides a point-to-point wavelength between two locations, with each end required to operate at the same speed (1G, 10G, 25G, 100G, etc.), and two transceivers required for each connection, one at each end. This mismatch results in a large number of inefficiently used optical transceivers and router ports, and multiple layers of packet aggregation, resulting in both high CapEx and OpEx.

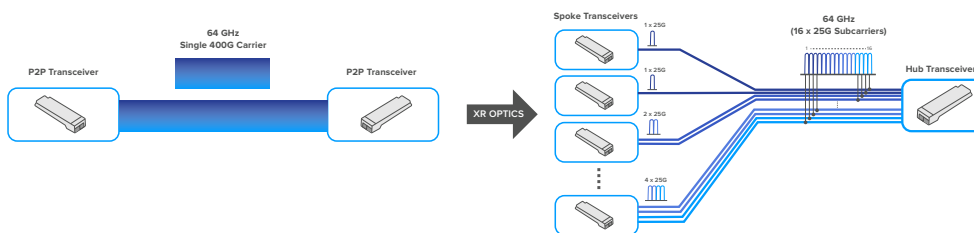


Figure 1: Point-to-multipoint coherent with 25 Gb/s digital subcarriers

Digital subcarrier technology takes a single-carrier wavelength and divides it up into multiple lower-bandwidth subcarriers generated by a single coherent laser/transceiver leveraging advanced digital signal processing. For example, a 16 GHz 100G wavelength could become four 25 Gb/s subcarriers and a 64 GHz 400G wavelength could become 16 x 25 Gb/s subcarriers, with each subcarrier having a symbol rate of 4 GBaud with 16QAM modulation while occupying 4 GHz of spectrum. These subcarriers can now be assigned to different endpoints, as shown on the right in Figure 1. XR optics implements this concept in industry-standard pluggable form factors such as SFP28, QSFP28, QSFP-DD, OSFP, and CFP2.

Ideal for Hub-and-Spoke Applications, Including 5G X-Haul, Cable DAA, and Next-Gen PON

XR optics provides an ideal solution for many inherently hub-and-spoke use cases. These include 5G fronthaul, where multiple radio units (RUs) connect to a distributed unit (DU); 5G midhaul, where multiple DUs connect to a centralized unit (CU); and 5G backhaul, where the CU or converged cell site (RU/DU/CU) is backhauled to the mobile core (NGC). Cable MSO examples include DAA, where many Remote PHY devices (RPDs) connect to a virtual Converged Cable Access Platform (vCCAP), or many Remote MAC-PHY devices connect to a router. Other possible use cases include backhaul for next-generation passive optical technologies such as XGS-PON and NG-PON2, and high-speed business services.

KEY BENEFITS OF XR OPTICS

MINIMIZE the number of optical transceivers with the ability to aggregate multiple spoke devices onto a single hub transceiver

MAXIMIZE router efficiency, density, and simplicity by replacing large numbers of low-speed ports with far fewer high-speed ports, and with the ability to use these same high-speed ports as both aggregation and network interfaces

ALIGN CapEx with actual bandwidth requirements while still maintaining the ability to quickly adapt to changing bandwidth demands and traffic patterns

ELIMINATE intermediate packet aggregation stages while leveraging larger, more efficient switching devices at centralized sites

REDUCE OpEx in terms of power consumption, footprint, the number of aggregation sites, product support costs, and truck rolls

Dramatically Reduce the Number of Optical Transceivers

Compared to scenarios where access nodes are connected directly to the hub router with conventional point-to-point WDM optics, the total number of optical interfaces reduces from $2N$ to $N + 1$, while the number of optical interfaces at the hub location can be reduced by a factor of up to 16 with a 400G interface and 25G subcarriers, and up to 32 with an 800G interface and 25G subcarriers. At the hub site, this can deliver CapEx savings of up to 80%, power savings in excess of 80%, and space savings in excess of 90%.

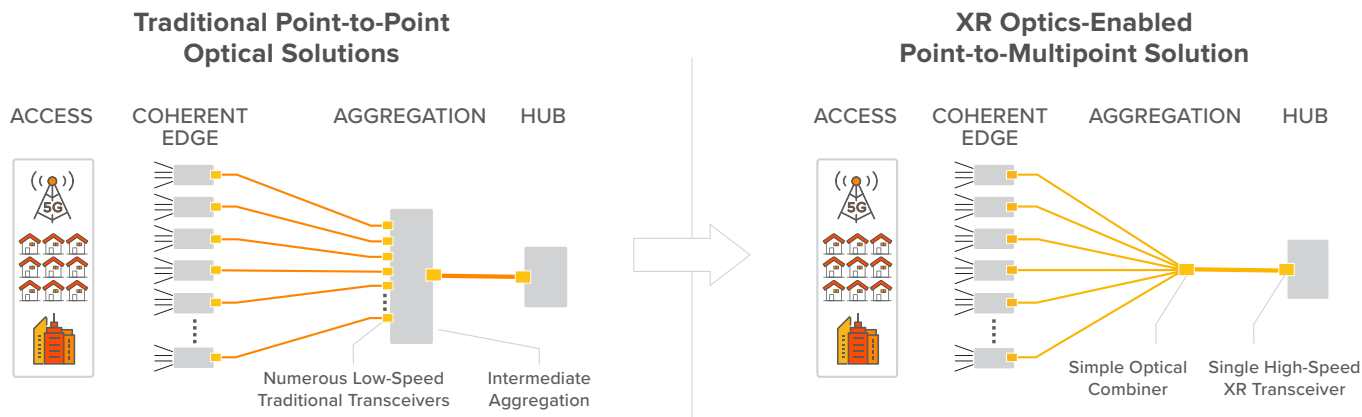


Figure 2: Reduce the number of transceivers and eliminate intermediate aggregation

Eliminate Aggregation Stages and Leverage Larger, More Efficient Aggregation Devices

XR optics provides the option to simplify the aggregation infrastructure by consolidating packet aggregation at a smaller number of sites with larger, more efficient packet aggregation devices, eliminating intermediate stages of aggregation. Intermediate aggregation stages provide two key functions: interworking different interface speeds (25G \leftrightarrow 100G and 100G \leftrightarrow 400G) and statistically multiplexing packet traffic. With XR optics, the need to interwork different interface speeds goes away, and statistical multiplexing can be centralized at the hub location, leveraging the economies of scale of the latest multi-terabit network processors and fabric ASICs.

Maximize Router Efficiency, Density, and Simplicity

Router CapEx, footprint, and power consumption are all optimized by more efficiently using router slots and ports. A large number of low-speed ports (i.e., SFP+, SFP28) can be replaced by a far smaller number of high-speed ports (i.e., QSFP-DD, OSFP), maximizing router faceplate density and processing efficiency. XR optics can also greatly simplify the hub router, as the same high-speed ports (i.e., 400G QSFP-DD or OSFP) can be used for both high-speed router-to-router network interfaces and for aggregating multiple access nodes, with up to 16 access nodes per 400G port based on 25 Gb/s subcarriers.

Align CapEx and Actual Bandwidth and Adapt to Changing Traffic Demands

By decoupling transceiver speed and bandwidth, XR optics enables the hub interfaces to more closely match actual bandwidth requirements rather than the sum of spoke transceiver speeds. Bandwidth to each access node can be sized based on current peak utilization rounded up to the nearest subcarrier value (i.e., 25 Gb/s) rather than expected future peak utilization rounded up to the next highest available line rate. This can save substantial CapEx at the hub site in terms of both transceivers and router ports. Decoupling transceiver speed and bandwidth also provides the ability to quickly add or move bandwidth as traffic patterns change, while also significantly reducing the number of truck rolls and improving end-user service quality.

Reduce Operational Costs, Including Power, Space, Product Support, and Truck Rolls

Reducing the number of hub optical transceivers, maximizing router efficiency and simplicity, and eliminating intermediate stages of packet aggregation will significantly reduce power consumption and footprint. Additional OpEx savings relate to the product support costs paid to the equipment vendor, which are typically charged as a percentage of the initial price, and truck rolls, which are significantly reduced for bandwidth upgrades and reassignments. Other OpEx costs related to the amount and types of equipment, including planning, installation, commissioning, management, and maintenance, will also be reduced.