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From GPON to 100G-PON: Building Flexible Broadband Networks for the Future

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In the rapidly evolving landscape of modern connectivity, faster, more reliable broadband networks are required to meet the growing needs of data-intensive applications. As demand for high-speed connectivity grows exponentially, providers must adapt their infrastructure to meet changing requirements without being locked into rigid vendor ecosystems. Cloud-native, virtualized broadband solutions provide a pathway to achieve these goals by enabling flexibility, reducing technology dependencies and accelerating service delivery.



Current State of Broadband: A Landscape in Transition

As competition heats up from wireless solutions like FWA (cellular) and Starlink (satellite), fiber-to-the-home (FTTH) continues to stand out as the gold standard for delivering high-speed, reliable broadband. While GPON (1-2.5G) FTTH networks have been the foundation, many operators are now layering in XGS-PON (10G) for enhanced performance. With Combo-PON enabling seamless coexistence of GPON and XGS-PON on the same fiber, the 10G PON technologies like XGS and 10G EPON are expected to dominate deployments in the near term.

Looking ahead, the broadband industry is buzzing with contenders vying to define the next generation of standards, including 25GS-PON, 50G-PON, 100G-PON and Coherent PON (CPON). Amid this rapid evolution, the objective remains clear: operators need to be able to deploy a mix of technologies without significant operational overhead. While these technologies offer steppingstones toward future-ready networks, CPON emerges as a potential halo technology, promising transformative capabilities that could redefine broadband connectivity.

Gaining Versatility in a Rapidly Evolving Broadband Landscape

To stay competitive amidst these advancements, operators are looking beyond hardware and embracing virtualization and cloud-native solutions for greater flexibility.

A virtualized core enables operators to deliver high-speed broadband services over any type of connection, seamlessly integrating fiber and DOCSIS networks. This convergence allows operators to efficiently utilize a unified architecture and infrastructure, providing enhanced broadband services to diverse locations. By adopting a unified solution, operators can maximize the value of their existing network investments while achieving significant cost savings across their operations. A virtualized core also empowers operators to manage the entire network from a single user interface, simplifying operations and reducing complexity. Furthermore, virtualization lowers power consumption and reduces physical space requirements in data centers, making it a cost-effective and sustainable choice. The flexibility offered by a virtualized core is critical, enabling operators to quickly adapt to shifting market demands without the need for costly infrastructure upgrades.

Cloud-native, virtualized broadband solutions empower operators to roll out new technologies such as XGS-PON and 25G-PON, swiftly and without disrupting existing infrastructure. These solutions accelerate service rollouts by automating provisioning and monitoring, streamlining configuration processes and minimizing the need for manual intervention. Additionally, they help reduce capital expenditures by leveraging off-the-shelf hardware and software, minimizing upfront investments while optimizing long-term operational costs. By enabling rapid deployment, cloud-native solutions allow operators to maintain a competitive edge while delivering the superior speeds consumers demand. Through embracing cloud-native architecture and virtualization, operators can future-proof their networks to seamlessly accommodate emerging technologies like 100G-PON and beyond.

Strategically Deploying PON Solutions to Reduce Churn and Optimize Existing Networks

While virtualization lays the groundwork for flexibility, strategic passive optical network (PON) deployments further enhance network performance and subscriber satisfaction. The rapid growth of fiber broadband has driven a transformation in PON deployments, presenting broadband service providers and operators with challenges as they seek to maintain a competitive edge and increase revenue. As fiber networks advance to 10G and even 25G speeds, substantial infrastructure upgrades and investments are becoming essential. Simultaneously, operators must find ways to stand out in a crowded market by offering more than just faster speeds. Success hinges on delivering a broad range of features and services designed to address the specific needs of both consumers and businesses.

Strategic deployment of technologies like XGS-PON and 25G-PON allows operators to minimize churn, optimize legacy networks and expand reach. By adopting PON, operators can deliver symmetric, high-speed broadband to meet the growing demands of consumers and businesses. Combo-PON solutions, which allow new technologies to coexist alongside existing GPON systems, help reduce costs and accelerate network upgrades. Additionally, deploying long-range

optics enables operators to extend service to underserved areas, improving both accessibility and network coverage. Providers who embrace scalable PON strategies are better equipped to manage demand surges while ensuring seamless service quality for their subscribers.

Unlocking Agility with

an Open ONU Strategy Ensuring seamless interoperability between network components is critical to delivering reliable service. PON deployments rely on the integration of Optical Line Terminals (OLTs) and Optical Network Units (ONUs). ONUs, which connect the fiber network to end-user devices, are crucial for enabling differentiated service offerings. Fiber networks are anchored by the OLT on the provider's end and the ONU on the subscriber's end. However, misalignment or interoperability issues between these two components can lead to poor user experiences and additional costs for service providers, underscoring the importance of ensuring seamless compatibility across the network.

In a PON deployment, a lack of full interoperability between the ONU and OLT can result in subscribers viewing their service as inadequate. To prevent this, operators must guarantee that the connection between these components not only meets current bandwidth needs but also has the flexibility to evolve and support future service demands seamlessly.

One of the biggest challenges for operators is vendor lock-in, which limits innovation and drives up costs. An Open ONU strategy for fiber broadband deployment — allowing any optical network unit (ONU) or optical network terminal (ONT) to work with any optical line terminal (OLT) — enables operators to overcome this hurdle by decoupling hardware and software. Operators can choose ONU vendors based on performance, cost, and availability without being tied to specific OLT (Optical Line Terminal) systems.

This approach fosters competition, allowing market dynamics to lower the cost of in-home equipment while improving service quality. Furthermore, it streamlines integration by using cloud-native tools to unify diverse ONU ecosystems, ensuring interoperability and simplifying operational complexity. By embracing an open ONU strategy, operators can eliminate vendor lock-in, speed up the rollout of high-speed broadband services, take advantage of competitive ONU pricing, and streamline the process of network upgrades and evolution.

Cost Considerations When Designing a Next-Generation Broadband Network

Efficient cost management, combined with strategic technology adoption, ensures operators can deliver cutting-edge services while maintaining profitability. With construction costs accounting for approximately 70 percent of an operator's capital expenditure, streamlining network deployment is paramount. Flexibility to “deploy anywhere” plays a critical role, allowing operators to optimize outdoor networks and leverage optical design budgets to adapt to diverse geographic layouts. Even though most operators may not require long distances, extended range ensures flexibility to serve various network configurations while accommodating future growth.

Compact, high-density equipment also significantly reduces costs by minimizing the need for large buildings, cutting construction expenses. Similarly, virtualization within the network core supports smaller footprints, further driving efficiency.

The second largest expense, around 15 percent of capital expenditure, is in-home equipment. This underscores the importance of Open ONU strategies, which empower operators to select the best-priced, most effective options for equipment like Wi-Fi devices, avoiding vendor lock-in and ensuring optimal performance.

Legacy monolithic OLT solutions, while familiar, come with hidden operational costs. High power consumption, which varies regionally, often ends up exceeding the equipment's original cost over a five- to 10-year span. Modern low-power OLTs, which can reduce power consumption by up to 50 percent, mitigate this expense while boosting efficiency. Coupled with advanced analytics, these solutions enhance network reliability and optimize truck rolls by addressing issues virtually or preemptively, driving down operational costs and ensuring subscriber satisfaction.

In Conclusion

The broadband industry stands at a pivotal moment, driven by the relentless demand for faster, more reliable connectivity. Operators face the dual challenge of meeting current market expectations while preparing for a future defined by data-intensive applications and next-generation technologies. By leveraging cloud-native architecture, embracing virtualization and adopting strategies like Open ONU and scalable PON deployments, operators can achieve the flexibility required to thrive in this competitive landscape. As the transition from GPON to technologies like XGS-PON, 25G-PON, and beyond accelerates, investing in adaptable solutions will enable providers to meet consumer and business demands while ensuring their networks are ready for the next era of connectivity.