10G PON Empowers Operators

Enabling a wider range of applications and customers
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Ovum view
10G PON OLTs will become the dominant OLT technology in late 2021, and port shipments will exceed 85% of all PON OLT port shipments by 2024, according to Ovum’s Wireline Broadband Access Equipment Forecast. In parallel, 10G PON ONTs/ONUs are forecast to reach 50% of all PON ONT/ONU shipments by 2024. CSPs are adopting 10G solutions to support higher-bandwidth applications and services for residential and nonresidential customers. These applications and services range from higher bandwidth to the home to support 4K TV content and cloud-based virtual reality (VR) to smart city applications, and from enterprise services to private networks. Furthermore, 10G PON supports network slicing and fulfills regulatory open access network requirements.

PON is the standard broadband access technology widely deployed throughout the world, with over 50 million OLT ports shipped since 2008. Similarly, the 10G PON ecosystem is healthy, with numerous vendors supplying components and equipment. The costs and ease of deploying and upgrading PON have improved considerably. Several vendors now support zero-touch provisioning and intelligent network operations, along with smart Wi-Fi, improving the customer experience and lowering the total cost of ownership (TCO) for CSPs.

Key messages
- 10G PON supports revenue-generating services and applications for residential, enterprise, campus, and smart city customers. In addition, 10G PON enables CSPs to be competitive with 1G and 10G bandwidth service offerings.
- The 10G PON ecosystem is robust. PON component and equipment vendors are prepared. In addition, vendors have developed technologies that ease the upgrade to 10G without interruption to subscribers, all while achieving capital expenditure (capex) and operational expenditure (opex) savings.
- 10G PON is the next-gen PON solution of choice. 10G PON technology is standardized and based on the success of earlier generations of PON solutions.
- 10G PON supports network slicing, fulfilling regulatory open access network requirements. In addition, network slicing enables CSPs to virtually segment the network to meet the differing requirements of services and customers.
- Now is the time for network upgrades to 10G PON, with 10G ONT/ONU upgrades following over the next several years.

Summary
In brief
Next-gen PON is here, with large-scale adoption throughout the world. 10G PON is supporting new revenue streams for communications service providers (CSPs) while expanding service offerings and quality of experience (QoE) for customers. Although the drivers of 10G PON are diverse, the ecosystem is complete and stable, ensuring a reliable supply for deployments by CSPs.
Bandwidth demand continues to grow

Momentum toward 1G and beyond

More and more CSPs are offering 1G and 10G residential services, as shown in Figure 1. More than 270 CSPs offer 1G FTTH services today, compared to just 100 CSPs in mid-2017. 1G offerings around the world include CSPs in

- Asia-Pacific: China, Japan, India, Indonesia, and New Zealand
- the Americas: Barbados, Brazil, Canada, and the US
- more than 40 countries in Western Europe, Eastern Europe, the Middle East, and Africa.

Currently, 16 CSPs support symmetrical 10G FTTH services, as shown in Figure 1, with seven of them offering this service at less than $100 per month.

Residential broadband subscribers are migrating to higher-tier bandwidth offerings. This migration is due to the availability of fiber-based higher-speed options, increased bandwidth needs, the use of the cloud for storage and services, and competition. Ovum forecasts that more than 50% of consumer broadband subscribers will be on connections of 100Mbps or higher in 2023, as shown in Figure 2.
Campus-wide networks such as universities and hospitals, along with enterprises, have moved to cloud-based services, which require bandwidth upgrades. CSPs are supporting these trends, adding cloud connect services and bandwidth-on-demand capabilities.

**Key drivers of 10G PON**

**Home entertainment**

Higher-bandwidth networks are enabling CSPs to support revenue-generating cloud-based VR services for residential customers. These enable a variety of experiences, such as in-home theatre style experiences, immersive live concerts, sporting events, and travel, for example. Cloud-based VR gaming has lower in-home storage and processing requirements, thereby lowering the costs for residential customers. Lower costs mean residential customers are more likely to subscribe to cloud-based VR services. In addition, a gamer using a cloud-based VR service from a CSP has a wider variety of games and applications at their disposal, which increases their loyalty to the CSP. More customers and improved loyalty lead to faster network monetization for CSPs.

**Cloud-based VR for the home**

One strong application scenario is cloud-based VR live broadcasting of sporting events such as football and basketball playoff games, the World Cup, or the Olympics. Another example is enabling fans to virtually meet their idols. Subscribers are willing to pay significant fees for these experiences; after all, a subscription or one-time fee will be significantly lower than the cost of a ticket and travel. However, QoE must be superb in order to provide the subscriber with what feels like a real-life experience, whether it is sitting on the sideline of a game or interacting in real time with an idol.

High-quality, cloud-based VR experiences require at least 200Mbps bandwidth to the home and are a strong driver of 10G PON network upgrades. As shown in Figure 3, superb VR experiences need at least 120 frames per second (fps) per eye, along with 4K content and high bandwidth and throughput speeds.

![Figure 3: Content requirements for mobile VR devices vs. dedicated VR devices](source: Ovum)

Home-based broadband demand is increasing, with 4K content for 4K TVs, multimedia multiplayer online gaming, and dedicated VR applications. While the adoption of 4K TVs and the availability of 4K content vary by country, the adoption trend is strong. In some countries, the next step – 8K – is close behind. In parallel, more and more homes are adopting dedicated VR systems. Figure 4 highlights Ovum’s forecasts for dedicated home VR devices and the installed 4K TV market.
The enterprise: private and campus networks

10G PON is enabling CSPs to offer specialized networks and generate new revenue streams through dedicated private networks and campus-wide PON-based LANs. CSPs are providing the following:

- Dedicated private networks that meet specialized service-level agreement (SLA) requirements for various vertical industries, such as financial services and government. CSPs are supporting end-to-end networks and cloud-based services on 10G PON networks. These private networks and their associated services are large and growing revenue opportunities for CSPs.

- Campus-wide optical LANs, enabling easy bandwidth upgrades and capex and opex savings compared to traditional LANs. These campus-wide opportunities represent new revenue sources for CSPs across a wide range of market segments, including universities, hotels and resorts, hospitals, manufacturing facilities, and retailers.

Campus-wide optical LANs (also known as passive optical LANs or POLs)

In the higher education market, students and educators are seeking technologies that improve learning outcomes through cloud-based applications. Consequently, applications based on VR are growing in importance, providing students with experiences and hands-on training that are otherwise difficult and costly to obtain. These new educational approaches require advanced communications networks throughout university campuses.

As shown in Figure 3, dedicated VR devices require massive streams of high-quality content. Imagine the amount of bandwidth required to stream 20 or 30 high-quality interactive VR experiences to a classroom. 10G PON–based networks easily support the hundreds of Mbps required by high-quality VR headsets and applications. Consequently, universities are adopting PON-based LANs, providing campuses with easy-to-upgrade, high-capacity fiber communications networks that connect classrooms, labs, administrative and security offices, dorms, and auditoriums.

PON-based LANs save campuses money and space compared to traditional active Ethernet LANs. An optical LAN uses less cabling and fewer racks and switches than a traditional LAN. The passive network in a POL saves energy, since less power and cooling are required. In addition, optical cabling is smaller, thereby reducing the amount of physical space needed for cabling. A POL can easily cover a campus area of up to 40km. POLs are based on carrier-grade “five nines” PON equipment, providing improved reliability along with redundancy, security, and management features.

Enterprise cloud-based applications and services push bandwidth demand

Enterprises are rapidly moving to cloud-based applications and computing as they take advantage of new applications and the capex and opex savings associated with greater use of the cloud. Figure 5 summarizes Ovum’s forecast for cloud transition in the government, healthcare, and higher education markets. Cloud-based networks require higher bandwidth and symmetrical speeds, thereby driving upgrades to 10G PON.
The smart city, the giga city
Numerous cities around the world have announced smart city initiatives with partners including network operators. Municipal governments are using PON networks to support smart city services, taking advantage of PON’s point-to-multipoint architecture and coverage capabilities to deliver services to their residents, visitors, and employees. With support from Shanghai Telecom, the Shanghai municipality has upgraded to 10G to support numerous smart city services, including

- traffic sensors and cameras for improved traffic flow and road safety
- sensors for monitoring public infrastructure, and, when necessary, reporting broken fire hydrants, power outages, and missing manhole covers
- the Citizen Cloud, a cloud-based platform that aggregates and streamlines municipal government services for residents.

Video surveillance
Smart city applications require high bandwidth and wide-area coverage. One such application is video surveillance, whether at traffic lights and mass transit entrances or large sporting and entertainment events. 10G PON is enabling end-to-end video surveillance networking with ONTs placed in or next to high-definition cameras. Streaming video is transferred to the cloud on 10G PON uplinks, where it can be analyzed immediately and then stored. High-definition cameras enable facial recognition in poorly lit conditions, and widescreen aspect ratios support wider coverage areas with fewer cameras. Both features are important for security and safety but require tremendous bandwidth and processing capabilities. Consequently, CSPs are supporting this smart city application with 10G PON and cloud-based services. PON networks can reach long distances, thereby streamlining network design and operations.

The network slice and fixed access network sharing (FANS)
10G PON supports advanced network slicing and FANS. CSPs use network slicing to virtually divide their PON-based access network for different types of customers or applications. For example, a CSP might choose to support residential customers on one slice and an enterprise or campus customer on another slice. This approach enables it to assign different bandwidth and latency parameters to different slices. 10G PON enables more bandwidth for allocation to the various slices.

A very important feature of FANS is its ability to fulfill regulatory open access network requirements. Many incumbent operators are required to meet regulatory unbundling requirements, meaning that they must share their access network with competitors. Virtual network slicing eliminates many complications encountered with legacy approaches, while 10G PON provides enough bandwidth to support multiple virtual networks. Consequently, open access is less costly to the incumbent operator when 10G PON is deployed.

Figure 5: Global forecast, cloud transition spend by selected vertical, 2017–21

Source: Ovum
The 10G PON ecosystem is ready

A strong and smart ecosystem
The 10G PON ecosystem is robust, with optical subcomponents and modules, chipsets, networking equipment, and customer premises equipment (CPE) devices available.

Smooth upgrades
CSPs are concerned about the costs and ease of upgrade to 10G PON. They are looking to preserve their large investments in central office equipment, customer equipment, and the optical distribution network (ODN). Leading vendors have developed PON Combo optical modules, combining the optics of PON and 10G PON into a single module with a WDM1r filter. This module provides an easy upgrade path for CSPs; they can upgrade to 10G PON without changing OLT platforms and blades. Essentially, 10G PON network bandwidth can be provided on existing equipment without requiring more chassis, which is a huge benefit in crowded central offices. In addition, no changes to the underlying ODN, whether splitters or fiber cabling, are needed.

On the CPE side, existing ONTs/ONUs do not have to be upgraded when OLTs are upgraded to 10G. CSPs can choose when to upgrade existing ONTs/ONUs to 10G devices based on customer requirements, service offerings, and competition.

Intelligent networking
Another key requirement is end-to-end intelligent networking, including the ODN, the cloud, the customer, and the customer’s devices. End-to-end intelligence enables CSPs to build and manage smarter networks, supporting faster service deployments along with improved QoE for a wider range of customers and applications. CSPs are seeking intelligent 10G PON solutions to support faster network monetization through higher-revenue-generating customers and lower churn rates.

Service providers are ramping up deployments
10G PON network deployments by CSPs are underway around the world. Shanghai Telecom, a major operating unit of China Telecom, and So-net in Japan (operated by Sony Networks) have announced their upgrades. Deployments have begun in more than 20 provinces in China, but most have not been announced.

Based on confidential discussions with CSPs and vendors, Ovum expects strong growth in 10G PON OLT port shipments compared to the previous generation, as shown in Figure 6. Over time, 10G XGS-PON will become the dominant OLT technology, providing 4x downstream bandwidth and 8x upstream bandwidth compared to traditional GPON.

Figure 6: Global forecast, OLT port shipments, 10G PON vs. non-10G PON, 2016–24

Source: Ovum
On the customer-premises side, CSPs are providing 10G ONTs/ONUs when needed, such as for business services. As cloud-based VR and low-latency gaming applications continue to develop, 10G-to-the-home will be needed for higher-end users. Consequently, Ovum is forecasting strong growth in 10G PON ONT/ONU ports, as shown in Figure 7.

The leading PON equipment vendor: Huawei

Huawei is the leading PON equipment vendor in terms of global market share. It reached 40% market share for total PON equipment revenues in 2018, followed by Nokia with 20%. Huawei shipped more than 50% of global 10G PON OLT port shipments in 2018.

Huawei’s MA5800 access platform is supporting PON deployments for more than 90 CSPs around the world. The platform won the award for “Best Fixed Broadband Innovation” at Broadband World Forum 2016. Huawei designed it to support smooth upgrades to 10G PON without touching the ODN or network management system (NMS). Furthermore, network upgrades can be completed without interrupting service on the customer’s ONU/ONT.

Huawei designed the MA5800 to offer low TCO while supporting scalability with high port density based on its Flex-PON 2.0 design. This design enables support for multiple types of PON and easy upgrades, such as Shanghai Telecom’s massive network upgrade to 10G PON and its support for Shanghai’s giga city applications.

Key features of the MA5800 platform include

- 200G per-slot throughput performance
- non-blocking for 16-port XGS-PON card
- 16,000 concurrent 4K users with “0” waiting time for video starts
- high uplink capacity with 24×10GE and 2×100GE aggregation
- low power consumption, compliant with the European Union’s Code of Conduct on Energy Consumption of Broadband Equipment, version 7.0
- SDN access, enabling the physical access network to be virtualized and partitioned logically, along with easy cloud-based services provisioning.

Recent technology developments include Huawei’s Class D optical module, supporting a 1×64 split ratio with a reach of 22km, which is 10km beyond the reach of Class C+. This enables CSPs to extend 10G PON further, reaching remote homes and campuses. Huawei has demonstrated 50G PON on the MA5800 platform, matching the ITU-T standardization efforts.
Huawei is well known for its intelligent ONT/ONU solutions and zero-touch provisioning. Several CSPs have demonstrated zero-touch ONT provisioning through the cloud using Huawei’s network cloud engine (NCE), which enables the subscriber to plug in the ONT/ONU, thereby eliminating costly technician visits.

In addition, Huawei is a leader in smart Wi-Fi solutions, enabling operators to improve customer loyalty and decrease the number of customer complaints and service calls by ensuring superb 4K video and cloud-based VR applications throughout the home. Huawei’s SmartWi-Fi solution enables operators to build premium broadband networks that can be managed, visualized, operated, and maintained using artificial intelligence (AI) data analytics.

Conclusions

The time for 10G PON deployments is now

10G PON is enabling CSPs to generate new revenue streams from both residential and nonresidential customers. It provides a competitive advantage to CSPs competing with OTT players. In parallel, 10G PON provides a platform for CSPs choosing to cooperate with OTTs on selected services and applications. The move to 10G enables CSPs to capture these new revenue streams now while future-proofing their networks for customer-side upgrades.
ABOUT OvUM

Ovum is a leading global technology research and advisory firm. Through its 180 analysts worldwide it offers expert analysis and strategic insight across the IT, telecoms, and media industries. Founded in 1985, Ovum has one of the most experienced analyst teams in the industry and is a respected source of guidance for technology business leaders, CIOs, vendors, service providers, and regulators looking for comprehensive, accurate, and insightful market data, research, and consulting. With 23 offices across six continents, Ovum offers a truly global perspective on technology and media markets and provides thousands of clients with insight including workflow tools, forecasts, surveys, market assessments, technology audits, and opinion. In 2012, Ovum was jointly named Global Analyst Firm of the Year by the IIAR.

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