Independent market research and competitive analysis of next-generation business and technology solutions for service providers and vendors

HEAVY READING WHITE PAPER

100G PON Is Closer than You Think

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INTRODUCTION: GETTING READY FOR 100G PON

Not long ago, it was a big deal for fixed-line providers to offer 1Gbps service to their broadband subscribers. With most broadband providers offering maximum speeds of only 300–500Mbps over their fiber-to-the-premises (FTTP) or hybrid fiber-coax (HFC) networks, 1 Gig service seemed incredibly fast and almost instantaneous to most residential and business customers.

Fast forward to today, and multi-gig services are rapidly becoming the norm for cable, telco, and fiber providers. In fact, a 2022 survey of 760 fixed broadband service providers across the globe by Omdia, a sister company of Heavy Reading, found that an impressive 60% of them now offer 1Gbps or higher speeds, up from 45% just three years earlier. And, zeroing in on North America, the study revealed that a whopping 88% of fixed-line providers now offer at least 1 Gig speeds to their residential subscribers while 16% offer multi-gig services.

As a result, multi-gigabit services have moved beyond the early adopter phase and are rapidly becoming a more mainstream option. To cite one prominent example, AT&T is rolling out symmetrical 2 Gig and 5 Gig services in all its fiber markets as part of its "Gigillionaire" campaign. Similarly, Consolidated Communications is deploying a symmetrical 2 Gig service under its new Fidium Fiber brand, while Google Fiber plans to launch 5 Gig and 8 Gig tiers in early 2023.

It is not surprising that communications service providers (CSPs) are moving so quickly to roll out multi-gig services to their broadband customers. Leveraging the symmetrical bandwidth benefits of XGS-PON technology over FTTP lines, they are seeking to stay ahead of the rapidly rising bandwidth demand curve, as well as remain competitive with rival cable and wireless providers that are also boosting their broadband speeds dramatically.

It is also not surprising that, given these marketplace trends, service providers are starting to look even further ahead to the ever faster iterations of passive optical network (PON) technology briskly coming down the pike—even as they begin to deploy 10G PON in their regions. Take 25G PON, for example. This next-gen version of PON is emerging from the test labs and starting to appear in early field trials and deployments throughout the world, especially in the Asia Pacific region.

Or take 50G PON. Since the ITU approved the standard last year and major optical equipment vendors like Nokia, Huawei, and Ciena are conducting trials of the technology, 50G PON is expected to follow 25G PON to the market as soon as 2023 or 2024. As a result, fixed-line providers need to prepare for more new waves of advanced PON technology as quickly as those versions become available.

Further, even 100G PON, once considered unthinkable, is not that far beyond the horizon anymore. In fact, with multiple vendors starting to test the technology's worthiness in their labs, some market experts predict that the world could see the first field trials of 100G PON technology as early as 2023. In other words, even though some technical feasibility issues must still be overcome, 100G PON may be coming sooner than you think.

Thus, as PON technology and fiber broadband networks continue to evolve swiftly while residential and commercial customer bandwidth consumption continues to soar, the time has come for CSPs to start thinking about their upgrade path all the way to 100G PON. The big question they face is not so much whether they will get there, but how they will do so. This paper addresses that critical question and discusses the best ways to get ready for the 100G PON future.

PON'S RELENTLESS GROWTH

Just how quickly is PON growing and spreading throughout the world right now? And how quickly is the equipment for it evolving? This section tackles those areas, drawing heavily on the latest equipment shipment figures and forecasts from Omdia.

Although it has developed into a mature technology, PON continues to grow by leaps and bounds. Equipment vendors have shipped more than 90 million optical line terminal (OLT) ports to service providers since the earliest version of PON was first introduced in 2008, according to the latest statistics compiled by Omdia. With the help of these OLTs, broadband providers serve at least 880 million fiber subscribers throughout the planet.

As a result, PON annual equipment shipment revenue keeps soaring to new heights, with the overall global market rising from about $7bn in 2020 to $8.5bn in 2021. Omdia projects that this meteoric growth will continue at least through 2027, the end of the firm's latest forecast period. PON equipment shipment revenue will climb past the $10bn mark in 2022 and reach as high as nearly $19bn annually by 2027.

Even more notably, Omdia forecasts that next-gen PON variants like XGS-PON, 10G EPON, 25G GPON, and 50G GPON will increasingly account for the bulk of those equipment shipments and revenue. Indeed, the company's latest forecast calls for next-gen PON gear to account for slightly over half (54.2%) of all PON equipment revenue globally in 2023, up from almost 47% in 2022 and slightly over 36% in 2021. Omdia estimates also indicate that next-gen PON equipment will generate an estimated 83.1% of all PON revenue by 2027, as shown in **Figure 1**.

Figure 1: PON equipment revenue growth

($m)	2021	2022	2023	2024	2025	2026	2027	CAGR (2021–27)
Next-gen	3,247	4,916	6,549	8,756	11,079	13,443	15,662	30.0%
Non-next-gen	5,698	5,591	5,543	5,206	4,689	3,953	3,176	-9.3%
Total	**8,945**	**10,507**	**12,092**	**13,962**	**15,768**	**17,396**	**18,838**	**13.2%**
Next-gen	36.3%	46.8%	54.2%	62.7%	70.3%	77.3%	83.1%	
Non-next-gen	63.7%	53.2%	45.8%	37.3%	29.7%	22.7%	16.9%	
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	

Source: Omdia

Source: Omdia, DZS

Breaking down the equipment shipment figures by region, Omdia analysts estimate that XGS-PON OLT port shipments have already exceeded GPON OLT port shipments in North America, passing them in 2021. XGS-PON OLT port shipments will likely keep growing rapidly over the next five years, accounting for nearly all unit shipments by 2027.

Omdia projects that Western Europe will follow suit in late 2023 and show continued strong growth of XGS-PON gear after that. By 2027, XGS-PON OLT ports are expected to account for close to 90% of all port shipments in that region.

In the more advanced Asia Pacific region, Omdia forecasts next-gen PON equipment sales will take off even further as operators like China Telecom, China Mobile, Telefónica, and others carry out 10G OLT upgrades as well as upgrade optical network terminals (ONTs) and optical network units (ONUs) to 10G to support 1G and fiber-to-the-room (FTTR) initiatives. According to Omdia's research, operators will also deploy next-gen PON gear to support enterprises and smart cities, among other applications.

This data clearly indicates there is still no end in sight for PON's growth potential. And next-gen PON flavors like XGS-PON, 25G PON, 50G PON, and beyond will play a rapidly increasing role in that growth trajectory.

LEADING PON DRIVERS

So, what is driving all this PON growth? There are numerous factors to consider, as this section discusses.

First, and most obviously, there has been an explosive growth of FTTP over the last few years. As noted earlier, there are now more than 880 million fiber subscribers throughout the planet, with particular concentrations in parts of Asia, Europe, and North America. As a result, fiber has already overtaken cable as the world's leading fixed broadband technology—even before the oncoming wave of publicly subsidized fiber projects starts to build.

This point comes through clearly in the latest data from the Organization for Economic Cooperation and Development (OECD), which consists of 38 democracies with market-based economies. According to its data, fiber now accounts for 34.9% of fixed broadband subscriptions in OECD member nations, followed by cable at 32.4% and DSL at 27%. That historic shift occurred sometime in 2021 as fiber subscriptions increased by a sharp margin.

Second, due in large part to concerns about the Digital Divide, a tsunami of fresh public funding has been unleashed on the broadband landscape to subsidize more FTTP builds. In the US, for example, the federal government is shelling out more than $44bn in funds for broadband deployment in unserved and underserved areas—much, if not most, of which will be spent on FTTP lines. And that is on top of more than $9bn in broadband subsidies already being distributed under the federal government's relatively new Rural Digital Opportunity Fund (RDOF).

Another closely related PON driver is the growing trend among cable operators, telcos, wireless operators, and other broadband providers to upgrade the capacity of their existing networks. They are installing more fiber and running PON-powered services over it, regardless of whether they have the benefit of public subsidy programs. In the US, prime examples include Altice USA, Comcast, Charter, and WideOpenWest (WOW), all of which are investing heavily in fiber upgrades in their existing regions and/or laying down fiber lines in "edge-out" expansions into adjacent areas. Liberty Global, Vodafone, and Altice are following similar paths in Europe.

A fourth driver is the emergence of 5G mobile technology, which has fueled the rise of fixed wireless access (FWA) services that rely on FTTP and PON as their base. Although generally not competitive with fixed-line broadband in more densely populated urban and suburban areas, FWA is rapidly becoming a fixture in more rural, less populated regions, especially in poorer areas of the world.

In particular, the deployment of XGS-PON has been a major enabler of FWA. In Japan, for instance, Softbank is relying on XGS-PON to support its rollout of fixed wireless service throughout that island nation.

Notably, though, some operators are starting to go the other way, forsaking FWA for traditional fixed-line broadband networks because of the power of next-gen PON. In other words, next-gen PON appears to be both fostering fixed wireless technology in some areas and enabling fixed-line networks to compete better with it in others.

Fifth, there is the steady growth of bandwidth-intensive business services and applications that feed off all-fiber architectures and PON. The long and growing roster of such services and applications includes the following:

- Wireless backhaul
- xHaul transport, including fronthaul support for 5G small cells
- Midhaul
- Specialized services for both small-to-medium-sized businesses (SMBs) and enterprises
- Dedicated service licensing agreements (SLAs) for commercial customers
- Symmetrical services for enterprises, smart cities, and beyond
- Deployments of PON at the network edge for time-sensitive applications
- The growth of network slicing for internal use and wholesaling

This collection of applications could be an important driver for the higher order PON technologies above XGS/10Gbps because the cost per site/connection will be substantially higher per site—and probably per bit as well, at least initially.

One last driver is the rise of new bandwidth-intensive consumer-oriented services and applications like 4K/8K video, augmented/virtual reality (AR/VR), videoconferencing, e-gaming, telehealth, lightfields, home security, the overall connected home, and the metaverse. All these seemingly futuristic services and applications are pushing broadband providers to make more bandwidth available to their customers through higher orders of PON.

POTENTIAL CATALYSTS FOR 100G PON UPGRADES

With all these and possibly other drivers in play, the prospects for 100G PON seem quite bright. By embracing these prospects, service providers can start charting a smooth path to the highly interactive, closely connected future.

What might this hyper-connected future enabled by 100G PON look like? In the short term, even with high splits, it will be difficult to find sustained use by residential/consumer users that load a hypothetical 100G optical distribution network (ODN). But, over the longer term, there are many possibilities.

For one thing, 100G PON should enable the development and flourishing of the highly anticipated and much discussed metaverse, a virtual world that will mimic aspects of the physical world using technologies such as VR, AR, artificial intelligence (AI), social media, and digital currency. With such huge amounts of bandwidth at their disposal, people could actually be able to "live" and move around freely in this virtual world without any physical constraints, similar to the holodeck of *Star Trek* fame.

For another, 100G PON will foster utility-like, gigabit-class connectivity for all users. Optimal broadband performance will become commonplace for consumers and businesses rather than a rarity or a luxury for the chosen few.

Third, 100G PON will enable the rise and spread of very complex networks for both businesses and consumers. These networks will allow multiple concurrent services to run on the same access network simultaneously.

Looking beyond the current 5G mobile service, 100G PON will also support the development and deployment of future, even more powerful generations of wireless services, such as 6G and beyond, over the rest of the decade. In other words, advances in PON technology will take mobile service to a much higher level than ever before.

Fifth, 100G PON will foster the long sought full convergence between wireline and wireless networks. Among other things, that convergence of networks will spur the development and deployment of much more robust FWA services throughout the world.

In addition, 100G PON will enable the development and growth of embedded services on access networks. In turn, these embedded services will enable providers to embrace open technology on their networks.

Moreover, 100G PON will support the massive information downloads required by autonomous vehicles, as well as ultra-high definition (UHD) video conferencing and the concurrent use/streaming of multiple devices consuming 8K UHD and AR/VR/XR in the home. Multiplying concurrent devices by extremely high bandwidth services results in very high requirements very quickly.

Finally, 100G PON could very likely be used for the uplink or interconnection of various network elements, such as OLTs serving XGS or 50G PON subscribers; remote PHY devices in the DOCSIS networks; or an alternative to DWDM or Metro Ethernet-type services. Like mobile xHaul applications, these are applications that are more likely to fully load the ODNs/ interfaces that support 100G.

CONCLUSION

As illustrated in this paper, the broadband access network will only continue to get faster and faster with the development and deployment of each new generation of PON. These speed increases will put much greater pressure on the middle mile of the network and drive advances in transport technology all the way down to the network edge.

Clearly, the broadband industry's traditional approaches to bandwidth expansion cannot prepare its networks to support 100G speeds today. These approaches simply stop working at some point. CSPs need new technological solutions to provide the necessary bandwidth and support the higher order services that are envisioned.

That is why CSPs need to figure out their best path for getting to 100G now, including implementing platforms that could support upgrades to 50G and 100G PON. With such 50G- and 100G-ready platforms in place, operators could write off the costs of the equipment before the end of its depreciation cycle and avoid costly forklift upgrades and other headaches.

Once they chart that path, operators can start taking steps toward reaching that goal and remaining competitive with rival providers through the rest of this decade and beyond.