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Narrowband EPON and 50G PON WDM coexistence efficiently ensures PON ecosystem evolution

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Ensuring 50G PON coexistence

50G PON is the latest and highest bandwidth PON FTTP technology which is now commercially available and which operators are beginning to deploy. One challenge is to ensure the coexistence of EPON and 50G PON technologies on the same PON tree. This is made more difficult because wideband EPON ONTs use a wide range of wavelengths (1260-1360nm) that overlap with 50G PON on both upstream (1286nm) and downstream (1342nm) directions.

To resolve this challenge a couple of approaches are possible. Narrowband EPON terminals could be used which would ensure that there was no clash of wavelengths with 50G PON systems. We term this approach narrowband EPON and 50G PON wavelength division multiplexing (WDM) coexistence. Alternatively wideband EPON terminals could be used. In this case the wavelengths for EPON and 50G PON would still overlap on the upstream but the technologies could coexist by using different time slots with so called time division multiplexing (TDM). On the downstream 50G PON could use the 1366nm wavelength which is not part of the ITU-T standard for the technology. This wavelength would not clash with those used by wideband EPON ONTs. This article discusses the benefits of the narrowband EPON and 50G PON WDM coexistence method.

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Narrowband EPON and 50G PON WDM coexistence will ensure the normalization of EPON and GPON technologies in the 50G PON era

Historically the PON industry has been divided between GPON standards (defined by the ITU-T) and EPON standards (defined by the IEEE). This has led to high costs related to research and development, supply chain, deployment, and operations and maintenance. As new PON technologies come to market it is beneficial to converge the GPON and EPON families, for example, to ensure that for new PON technologies a single set of equipment can be used that can coexist with either legacy GPON or EPON technologies. This can limit ecosystem fragmentation and allow FTTP operators to benefit from economies of scale. The narrowband EPON and 50G PON WDM coexistence solution allows the same 50G PON equipment to be used to ensure coexistence with either EPON or GPON technologies.

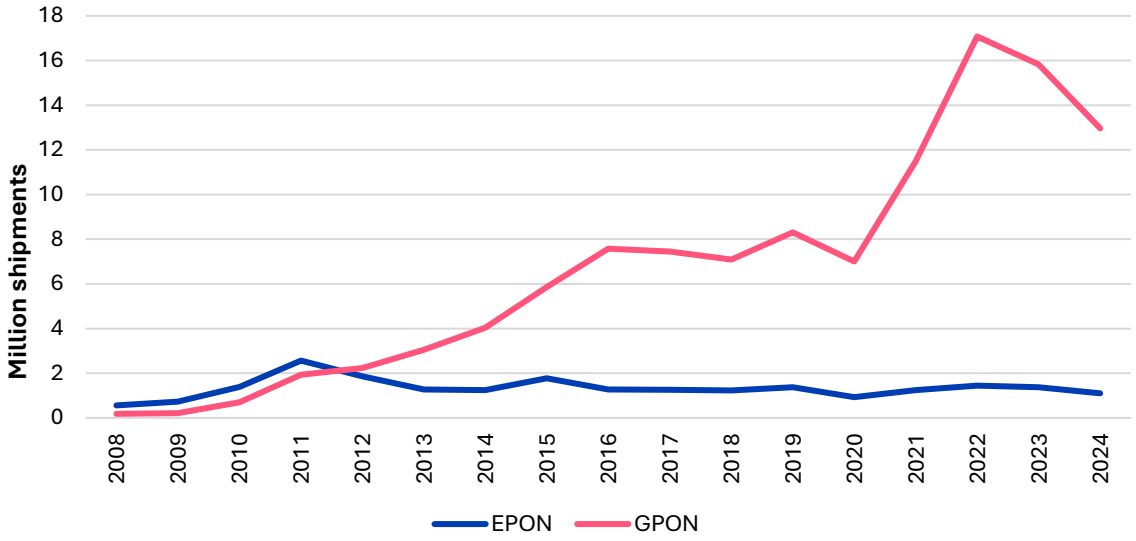
While 50G PON systems are commercially available, planning is already taking place for further higher capacity PON technologies. To this end, research on 200G PON has already begun and use of the 1367nm and 1335nm wavelengths for the technology has been a point of discussion. This is important because these wavelengths would be available for use in a scenario where 50G PON and EPON coexistence was ensured by using the narrowband EPON and 50G PON WDM coexistence solution. In other words, ensuring EPON and 50G PON coexistence by using narrowband EPON ONTs today will continue to deliver convergence benefits into the future.

If the wideband EPON and 50G PON TDM solution is used, then the occupied wavelengths (1366nm) would overlap with these proposed 200G PON wavelengths. The ability to evolve to 200G PON in the future would therefore be constrained.

EPON is already declining and so changes to 50G PON to ensure coexistence of the technologies should be kept to a minimum

The EPON family of technologies represents only a small and declining proportion of the global PON market. This is demonstrated by global OLT port shipments of the EPON and GPON families (see figure 1). In 2024 the EPON share was only 8% compared to 14% in 2019. It might therefore make sense not to dedicate too many resources to amending the latest 50G PON technology to ensure coexistence with a declining segment of the market.

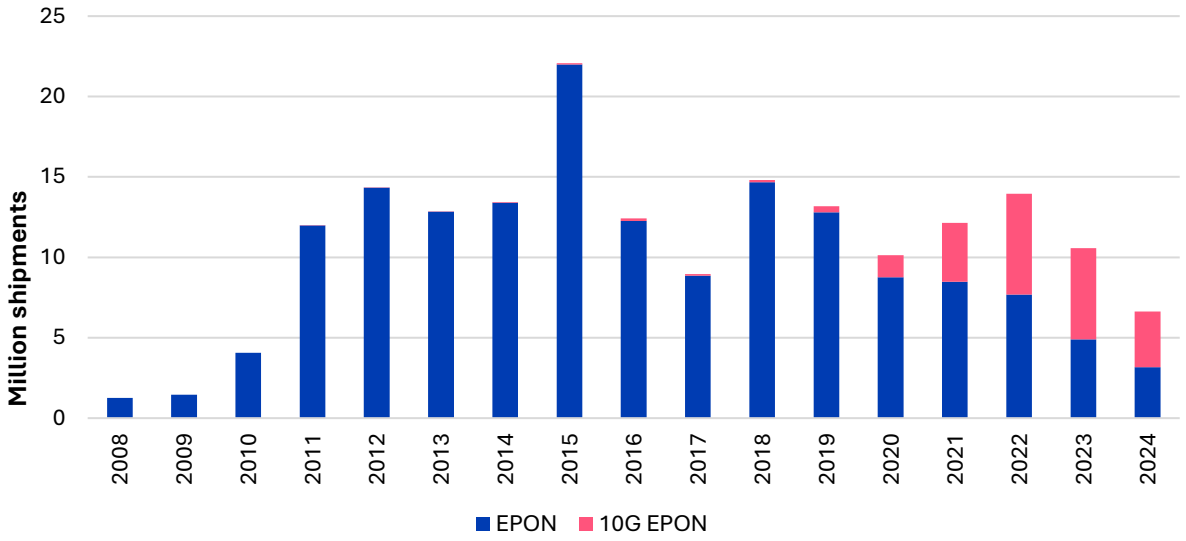
Figure 1: EPON family and GPON family total global OLT port shipments, 2008-2024



Source: Omdia

Another aspect to consider is that EPON is becoming less relevant over time in terms of the number of subscribers using ONTs supporting this technology. One indication of this is EPON and 10G EPON ONT shipments in the Chinese market. 10G EPON now accounts for the majority of shipments (see **Figure 2**) and some of the remaining EPON shipments are for FTTR sub-units where the connection to the property is using 10G EPON. The decline in relevance of EPON ONTs means that the challenges involved in supporting the coexistence of EPON and 50G PON will naturally fade away over time. More EPON subscribers will migrate to 10G EPON ONTs, for instance, as demand for connections with speeds of 1Gbps and above grows. In this way it could be argued it is better not to dedicate too many resources to accommodate the declining EPON market by making alterations to 50G PON, the latest commercially available PON access technology.

Figure 2: EPON and 10G EPON ONT shipments, China, 2008-24



Narrowband EPON and 50G PON WDM coexistence does not constrain performance

Narrowband EPON and 50G PON WDM coexistence will ensure optimal network performance. 50G PON upstream bandwidth can go up to 42Gbps, while, with the wideband EPON and 50G PON TDM coexistence solution, upstream bandwidth will be constrained. Upstream bandwidth is constrained because of the overlap of upstream wavelengths which means EPON and 50G PON will be assigned different time slots and will transmit in turn. In addition, narrowband EPON and 50G PON WDM coexistence means there will be benefits to 50G PON latency with network latency of around 0.26ms and maximum latency of 0.42ms. Using downstream wavelengths for 50G PON of 1342nm also resolves potential challenges around the so-called water peak effect. Higher wavelengths from 1360-1460nm are not used, which benefits performance as these wavelengths are prone to increased signal attenuation and would also require the use of customized high-powered lasers.

With the narrowband EPON and 50G PON WDM coexistence method network security is also ensured because the narrowband EPON and 50G PON technologies are using independent downstream and upstream wavelengths which therefore do not impact each other.

Narrowband EPON and 50G PON WDM coexistence enables initial 50G PON coverage with low cost ODN network upgrades

The use of narrowband EPON and 50G PON WDM coexistence means there will be a single 50G PON solution. This is important because a single 50G PON solution, regardless of whether the technology is coexisting with the GPON or EPON family of technologies, will clearly help deliver economies of scale and reduce fragmentation and the resulting equipment costs. If components for 50G PON need to be customized in order to ensure coexistence with the EPON family of technologies, it is plausible that the resulting OLT cost will be 30% higher and the ONT cost 20% higher.

Nevertheless, narrowband EPON and 50G PON WDM coexistence still leaves the challenge of how to accommodate the existing wideband EPON ONTs that are already in the field. The first point to note is that as discussed above this challenge is lessening over time in the sense that EPON ONT shipments are declining. Many of the EPON ONTs that are being deployed today are also already narrowband EPON ONTs. China Unicom, for example, prohibits the installation of new wideband EPON ONTs. Over time some of the wideband EPON ONTs that remain in the field will be upgraded to 10G EPON in line with subscriber demands and, even if this does not happen, will reach end of life and need replacing. This may be the case because some of these devices are already likely to have been deployed many years ago since EPON deployments in China began in 2005.

To accommodate those wideband EPON ONTs that do remain in the field for now operators can install patch cords and new splitters or fiber access terminals to separate the PON trees that are serving 50G PON ONTs and those serving existing wideband EPON ONTs. This method requires existing spare fibers, but many operators have already installed these. The fact existing fibers are often available limits the costs of this coexistence strategy. Costs can also be kept low because skilled labor is not required to perform the re-cabling work and also because the re-cabling is not a time intensive activity.

Appendix

Omdia Commissioned Research

This piece of research was commissioned by Huawei.

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