Next Generation FTTx PON in China

WHEN WILL CHINA TAKE THE LEAD IN 10G-PON?

EPON & GPON shipments have been running around 100 million per annum over a similar time period which makes FTTx PON by far the largest market for optical transceivers and components. However, the FTTx PON market only started to gain significant momentum during the 2000's when service providers globally began transitioning from older APON (155Mbps) and BPON (622Mbps) technologies to EPON (1.25Gbps) and GPON (2.5Gbps). EPON was standardised by the IEEE and based on the popular Ethernet standards protocol used in computer networking whilst GPON was standardised by the ITU, built on the success of BPON and aimed at Telecom service providers. EPON was first to volume and adopted as the leading FTTx technology in Japan. It also leveraged Ethernet Datacom optical component economies of scale to get an early market advantage but was eventually succeeded by GPON as this proved to be a more robust and flexible solution for major global telecoms operators and service providers. GPON was given a massive boost by the rapid adoption and deployment of FTTx PON in China, to the point where some Telecoms vendors switched over from EPON to GPON or deployed both technologies. By 2017 China accounted for 81% of global ONU/ONT port shipments and annually deployed well over 80 million units (Fig 1).

China has dominated the FTTx PON market since the beginning of this decade for multiple and complimentary reasons. Firstly, the Chinese government encouraged the deployment of FTTx technologies via financial sponsorship and significant infrastructure planning to connect its vast population and fast-growing cities to broadband internet. Secondly, China had become the world's factory for optoelectronics systems and components ensuring it had the supply chain in place to drive FTTx

Although the datacom market has been a major growth driver for optical transceivers over the last decade the largest market for optical transceivers by volume, is the FTTx market and specifically China's domestic FTTx market, writes **Christian Rookes**, vice president, marketing at UK-based HiLight Semiconductor.

costs down and manufacture the large volumes required. Thirdly, China's system equipment vendors became the dominant global providers of PON technologies and equipment with Huawei and ZTE continuously driving equipment and component costs down whilst innovating key component technologies. Examples of such innovations are the development of BOSA-on-Board ONUs (Optical Network Units) where the optical transceiver module is replaced by discrete BOSA (Bi-directional Optical Sub-Assembly) optics and PMD (Physical Medium Dependent) chips directly mounted onto the ONU main circuit board and replacing expensive avalanche photodiode receivers with lower cost and easier to manufacture Super TIA (Transimpedance Amplifier) receivers.

TRANSITION TO NG-PON

10Gbps PON technologies were developed and standardised in the early part of this decade but so far have not been deployed in significant volume mainly due to the comparative cost of 10G-PON versus EPON/GPON and a lack of significant market demand. The IEEE and ITU have competing Asymmetric and Symmetric 10G standards that build on EPON and GPON respectively. The IEEE has 10G-EPON whilst the ITU released XG(S)-PON, in addition, the ITU also published a next generation NG-PON2 standard that aims to bring tuneable optical wavelength technology to PON. Right now, it looks like the ITU's XG(S)-PON will again be the dominant standardised PON deployed in volume as it provides the most efficient upgrade path from GPON. Whilst some service providers in the US have committed to NG-PON2, it is yet to be seen if tuneable optical components can be manufactured cheaply and reliably enough to enable this technology to be deployed at scale.

MARKET DRIVERS

Whilst EPON/GPON services have been able to provide sufficient bandwidth for residential subscribers to date, the battle to

provide them with higher rate services is underway. Residential customers are starting to demand, and willing to pay for, higher bandwidth services such as HDTV and connecting up multiple high bandwidth consuming WiFi devices in a household. There are several major non-residential applications too: Business customers want higher speeds and network security, therefore the ability to provide customers with dedicated wavelengths and virtual networks is increasing; NG-PONs can be used to link wireless mobile networks in both front-haul and back-haul applications. The network operators themselves want the ability to upgrade their networks to PON technologies that will be sufficient and flexible for many years to come.

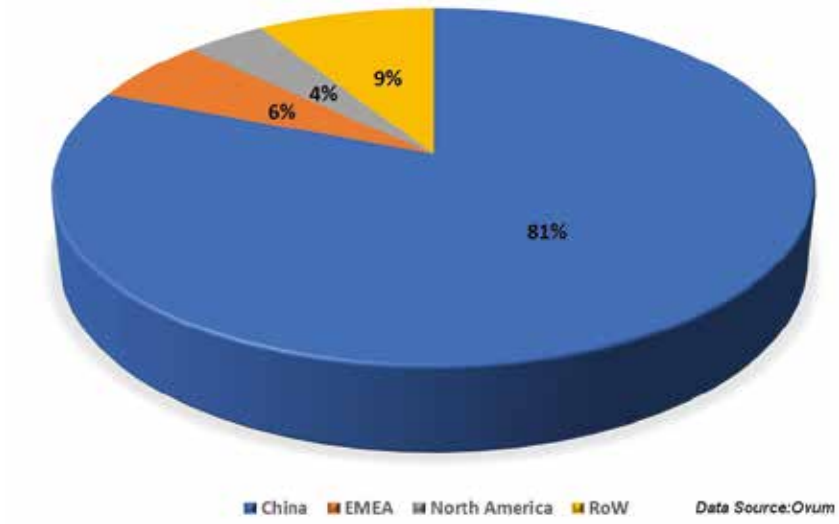
COMMERCIAL AVAILABILITY

10Gbps optical components have been widely available for many years and successfully deployed in traditional telecoms and enterprise datacoms networks, however the cost of 10G-PON optics need to be reduced closer to the cost of today's GPON optics in order to make volume deployment a reality, and eventually reach parity. Of course, whilst economies of scale must be reached, the ability to supply 10G-PON technologies in volume should not be taken for granted and also requires investment: producing 10G lasers and avalanche photodiodes in high volume will require sufficient fab capacity and high production yields to enable FTTx scale economics. Further innovation will be required across the supply chain to reach the required price points.

Designing and manufacturing electronic and optical components at 10Gbps for PON volumes is not an insignificant task: High speed interconnect signal integrity issues, power consumption, receiver optical sensitivity, WiFi 'EMI' interference, laser optical performance, low cost tuneable transmitters and receivers, flexible user interfaces and software upgradability are all problems that must be solved and require innovation from silicon chip designers, optical device manufacturers, hardware assembly fabricators and system equipment vendors.

The silicon and optical device technology now exists to build complete ONU and even OLT functions into single SFP+ and XFP MSA form-factor sized transceiver modules enabled by the availability of low power silicon MACs (Media Access Controller) in chip scale packaging. ONU equipment designers are working on transitioning from optical transceiver based ONUs to full BOSA-on-Board component technology, aided by PMD silicon vendors providing low power chips with highly integrated functionality, such as dual-loop laser transmitter control, on-chip microcontrollers with memory and high sensitivity receivers to reduce the technical manufacturing burden on equipment makers.

Fig 1: Global FTTx PON ONU port shipments, 2017



WHY CHINA WILL CONTINUE TO LEAD

China's rapid adoption of FTTx PON technologies and infrastructure can be attributed to the country's desire to be a world leader in internet connectivity coupled with a pragmatic approach to technology adoption, i.e. using the most cost effective PON technology available at the time (EPON) and then changing to a more effective technology (GPON) when the economics made sense but then also innovating costs down.

China is now home to three leading FTTx PON system equipment makers globally (Huawei, ZTE and Fiberhome) and remains the largest market for wireline broadband subscribers. This author believes China will continue to dominate the FTTx PON market due its incumbent market size, pragmatic approach to technology adoption, component level innovation and supply chain leadership. The deployment of wireless 5G mobile technology will likely be another area in which China becomes a global leader and, to do this, China will no doubt take a pragmatic approach to re-using and deploying new PON technologies to achieve country wide 5G coverage – it will be interesting to see this play out.

OUTLOOK AND CONCLUSIONS

Central office upgrades to 10G-PON OLTs began several years ago and have recently ramped above an initial 1 million per annum milestone. On the other hand, ONU deployments, which end up at double digit multiples of OLT volumes, have really only just started. Within the next few years 10G-PON will become more widely adopted worldwide and China will again lead the world in FTTx PON as it transitions to 10G-PON. Early volumes are likely to consist of asymmetric technology for residential use and symmetric for business use. In the long term symmetric XGS-PON will likely be the dominant technology driving volume. Whilst the current US-China trade disputes have adversely affected the FTTx PON technology supply chain and customer base, companies headquartered outside of the US can likely benefit from China's increasing trend to move away from US silicon and optical componentry. A China-dominated FTTx PON market will drive innovation in optical components, silicon, assembly techniques, software, and systems. For those companies that can provide innovative solutions that help to reduce power, reduce cost and improve performance, and which can in turn drive volume growth, the outlook is increasingly positive.