Pushing bandwidth limits and moving towards optical networking 2.0

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According to a new GSMA study, the number of 5G connections globally will reach 1.3 billion by 2025, covering 40 percent of the world's population. And the number of 5G connections will reach 1.4 billion by 2025. 5G will bring key growth opportunities for immersive personal services such as VR, AR, and live streaming. It will revitalize the enterprise market and power new business models for fields like vehicles, drones, and smart manufacturing.

Today, more than 967 million households have broadband access, and 286 operators in 49 countries provide gigabit broadband services. What's more, the emergence of smart home appliances and related services will promote new business models centered on homes.

The fast development of innovative 2C, 2B, and 2H services will drive the CT industry to enter a new development era. However, existing optical networks are unable to support the fast growth of these services and severely hamper the business growth of operators.

The development of bandwidth-driven transport networks faces severe challenges

In the 2C field, due to unlimited data plans becoming more common, operators are finding that revenue is not increasing at the same rate as data usage. In the 2B field, operators face increasing challenges from cloud service providers (CSPs). Specifically, in addition to being unable to match the flexible

provisioning of enterprise services and on-demand services offered by CSPs, operators cannot make the most of their advantages in network connections, and the strategic market of enterprise digitalization is shrinking. In the 2H field, bandwidth is increasing, but user experience is not improving. As a result, end users are not interested in the emerging services of operators. The bandwidth-driven business model can no longer support the business growth of operators. On the contrary, it exacerbates problems, such as the lack of optical fiber and equipment room resources. Meanwhile, service diversity makes networks more complex, which in turn increases network O&M costs. This leads to OPEX accounting for 70 percent (and rising) of the TCO for a large number of operators.

In terms of transport network development, the development model of the industry is facing a bottleneck. In the past 10 years, operators have upgraded their basic transport networks from copper to all-fiber, solving the problem of limited network capacity. Deploying fiber optics access networks for broadband Internet access and WDM in transmission networks for large-capacity service transmission has enabled operators to increase network bandwidth from 512 kbps to 10 Mbps 100 Mbps and even 1 Gbps and 10 Gbps. After moving to all-fiber networks, optical transport network evolution will be achieved by progressively ramping up the single-carrier rate from 10 Gbps to 40 Gbps, 100 Gbps, and 200/400 Gbps. However, Shannon's theorem states that channel capacity (single-carrier rate) is limited by channel SNR (transmission distance) and channel bandwidth (effective spectral width). Thus, the single-carrier rate cannot be increased indefinitely. By increasing the optical network's single-carrier transmission rate beyond 200/400 Gbps, the Shannon limit is quickly approached. And at 200/400 Gbps, balancing transmission rate and transmission distance becomes extremely challenging. For optical access networks, the uplink and downlink rate of home networks are improving, from EPON/GPON, 10G EPON/10G GPON, XGS-PON. While focusing on improving bandwidth in the optical access network domain, operators failed to ensure end-to-end service quality. The root cause is that such a bandwidth-driven development model of transport networks can no longer support the business growth of operators.

Redefining optical networking

The global optical network industry is experiencing a generational inflection point. The upstream and downstream partners in the industry need to think about the development direction of the next-generation optical network, and the consensus of the industry is that the next-generation optical network must be constructed based on user experience.

We believe that the next-generation optical networks need to have the following three key features:

Bandwidth upgrade as per Moore's law of bandwidth: The capacity of optical network devices must go up and the per-bit cost must go down through technology innovation to meet the bandwidth requirements of innovative services.

Simplified sites: Networks need to be flattened and site integration needs to be improved to continuously reduce network construction costs, including those incurred from equipment room space, equipment and air conditioning power consumption, and manual fiber connection and grooming.

Evolution to autonomous-driving networks: Networks must be autonomous and intelligent to support the agile provisioning of new services, shorten the time to roll out new services, and achieve intelligent O&M, of which the latter implements accurate fault prediction and automatic fault locating to reduce OPEX and provide end-to-end O&M assurance for end users.

Future optical networks will no longer be dumb pipes. They will be key to ensuring optimal experience of end users. We need to shift our mindset

from bandwidth-driven and pipe-focused to experience-driven and user-focused, with the aim of flexibly allocating resources on optical networks based on user requirements. This enables the business success of operators while ensuring optimal user experience. To this end, Huawei proposes the concept of Optical Networking 2.0 (ON2.0).

Huawei's ON2.0 showcased at MWC 2019

Huawei is committed to building ubiquitous connectivity and expects the cooperation between upstream and downstream partners to jointly promote next-generation optical networks centered on user experience. With this in mind, Huawei launches the ON2.0 strategy to enable the generational evolution of the entire optical network industry in these areas: new speed, new site, and new smart O&M.

New speed: Single-carrier 200/400 Gbps will be a standard rate for the next generation of optical transmission, which will be pushed closer to the Shannon limit through chip and spectrum innovation. Symmetric 10G PON will be used as the next-generation optical access standard, and Wi-Fi home access with assured experience will be achieved through continuous innovation in the last mile such as ODN and ONT.

Huawei has launched the industry's first single-fiber Super C solution, improving fiber resource utilization by 50 percent. Huawei's Super 200G/400G solution uses the latest OptiXtreme series oDSP chips and supports rates ranging from 200 to 600 Gbps. The symmetric 10G PON ONT, which supports Wi-Fi 6, provides up to 10 Gbps of bandwidth in both uplink and downlink directions, zero-freezing Wi-Fi experience, and full-coverage with no blind spots, allowing home users to enjoy carrier-class Wi-Fi experience.

New site: The wide application of optical-electrical convergence and all-optical cross-connection will be promoted through continuous innovation in optical and electrical layers, and backbone and metro networks will be flattened to achieve unified transmission of 2C, 2B, and 2H services. Unified access over multiple types of media such as coaxial, copper, and optical cables will be implemented through innovations in technologies and platforms, supporting multiple PON access modes and significantly simplifying CO sites.

Huawei has launched the industry's first all-optical switching OXC product, which achieves zero fiber connection within the site, reduces the equipment room footprint by 80 percent and power consumption by 60 percent. In addition, Huawei uses its proprietary OTN+ chip to implement converged transport at different service granularities and in different 5G scenarios, such as 2B, 2C, and 2H. The chip reduces latency by more than 80 percent and improves bandwidth utilization by more than 30 percent, significantly reducing both the number of different devices required and O&M costs. Huawei also launched the industry's first 6-mode Flex-PON2.0 solution to help operators protect existing investments, reduce engineering and reconstruction costs, build simplified CO sites, and reduce TCO by 20 percent.

New smart O&M: Intelligent optical networks will be built, and automated and intelligent solutions will be developed to achieve automatic service provisioning and intelligent network O&M, which in turn will greatly shorten new service rollout, reduce network fault rate, and improve O&M efficiency and user experience.

Huawei has launched the industry's first intelligent home broadband O&M solution. The solution reduces onsite visits by 30 percent through accurate fault diagnosis, improves onsite troubleshooting efficiency by 20 percent through the online analysis of user-reported faults, and supports end-to-end network topology inference and network status playback for fast network fault location.

Huawei has also launched a premium private line solution, which ensures lifecycle O&M and shortens TTM by 20 percent through visualized management and analysis of network resources and fault prediction. The solution also uses an AI algorithm and vast fault expert database to perform deep machine learning, transforming O&M from passive reaction to proactive prevention. The solution supports one-click intelligent optimization, which, combined with alarm compression and root cause location, improves O&M efficiency by 30 percent. Huawei has also launched the Network Cloud Engine (NCE), the industry's first cloud engine that integrates management, control, and analysis functions to build a digital brain for networks and support lifecycle automation.

Accelerating the business incubation and innovation with ON2.0

In addition to ON2.0, Huawei is also promoting the business incubation for innovating optical network technology, realizing a closed loop of technology innovation, industry innovation, and business innovation. Huawei has worked with operators to formulate innovative business models in many new fields, helping them maximize their business value.

In the high-speed transmission domain, UAE's telecom operator Etisalat and Huawei jointly completed the industry's first pilot of a single-carrier 600G trial site in February 2019. This pilot cements Etisalat's leading position in transport network technological innovation, and verifies the readiness of single-carrier 600G technology for large-scale commercialization, supporting the development of emerging services of Etisalat. This innovative pilot has verified the planned items, particularly key performance indicators (KPIs), such as transmission performance, stability, and reliability indicators, which exceeded our expectations.

In the enterprise private line domain, Huawei helped China Mobile build the world's largest OTN premium private line network in November 2018. The premium private line network has optimal latency, wide coverage, high reliability, and the ability to support cloud-and-network synergy, helping China Mobile significantly improve the competitiveness of its private line products and expand its business in the high-value government and enterprise market.

In the premium broadband access domain, Huawei and China Mobile started joint innovation in February 2019. By using Huawei's intelligent home broadband O&M solution, China Mobile Beijing significantly improved user experience and O&M efficiency and reduced onsite visits and user churn rate.

Looking to the future, Huawei is also working with the world's leading operators to explore service scenarios for next-generation optical networks, launching NetCity joint innovation projects and using DevOps to quickly implement solutions and help operators maximize business value. We believe that there's still extensive room for development in the optical network industry and that ON2.0 will lead the industry into this new age of development. Huawei will work together with operators and industry partners globally to implement a new era of optical networks and build a fully connected, intelligent world.