Fiber Fuels Rising Broadband Speeds

Broadband speeds to consumers are now exceeding 50 Mbps, with some regions offering up to 100 Mbps. Monthly rates vary significantly in many regions of the world and can range from US$20 for speeds below 20 Mbps and may exceed $100 for higher speeds.[1] Broadband penetration rates also span a wide spectrum from 95 percent in South Korea and 76 percent in Canada, down to only 3 percent in Thailand. Many countries in Europe have penetration rates above 80 percent, while the United States' penetration rate is only 60 percent. From a consumer perspective, countries like South Korea, Japan, and India offer the best value in terms of Kbits per dollar. Meeting both the consumer and business demands for broadband services, while optimizing the total deployment costs, remains an ongoing challenge in the industry. Many operators have chosen to deploy multiple access technologies (e.g., very-high-bit-rate DSL, passive optical network [PON], Ethernet, cable, wireless) to offer a variety of broadband services to their subscriber communities.

To meet these growing broadband service demands, fiber optic distribution systems have been gaining favor for delivering triple-play consumer and Carrier Ethernet business service offerings. Optical cabling and associated cable management systems such as distribution frames and splicing methods have been perfected and made scalable for large-scale deployments. Controversy remains, however, on the best technology for lighting the fiber and delivering services. Among the choices are Ethernet Fiber-to-the-Home (E-FTTH), Ethernet Fiber-to-the-Building (E-FTTB), and gigabit PON (GPON / GEPON) distribution architectures.

When comparing these architectures, one must account for the various population distribution or demographic communities – urban, suburban, and rural. A comprehensive view should include all elements of the optical distribution network (ODN), including cables, structures, and outside plant apparatus, optical network terminal (ONT), and central office equipment, as well as Ethernet switch, optical line terminal (OLT), and aggregation edge router. The investment in the ODN accounts for a large majority of the deployment costs, and the network has a lifespance of 30+ years, but there is actually quite a small variation in costs among the three architectures. However, there are substantial differences in service flexibility and ability to accommodate the growing bandwidth requirements, which play a significant role in achieving lower total costs over the life of the system.

Ethernet FTTH and Ethernet FTTB both support any service with data rates from 1 Mbps to 1 Gbps without any ODN changes. Changing subscriber speeds does not affect other subscribers, and the bandwidth may be provisioned and guaranteed on a per subscriber basis. In the PON architecture, changing subscriber speeds affects all users, and bandwidth per subscriber is based on the number of "splits" on the OLT interface. Making speed changes for subscribers in the PON architectures adds capital expenses for additional splitters, fiber, and OLT ports with increases in operating expenses to rearrange splitters and accommodate additional OLT hardware.

The Ethernet-based architectures also support a "pay-as-you-grow" approach, with few or no unused switch ports at any given time. The Ethernet-based architectures allow for user isolation and per-subscriber security and control. The GPON system operates as a shared resource. Ethernet-based systems are adaptable to regulatory changes, such as local loop unbundling (LLU), whereas GPON systems would need to be rebuilt to accommodate these "open access" requirements. E-FTTB also supports ring-based connectivity to buildings, which offers higher-resiliency sub-50 ms recovery from link failures.

[1] Point Topic – June 2009

Using a fixed fiber approach for optical distribution architectures is preferred in some regions when the expected take-up rates are high, because one must install all of the fiber ODN as well as fully populate the Ethernet or PON equipment to support all potential subscribers. However, with typical service penetration rates over a five-year deployment period, Ethernet FTTH actually offers from 5% to 40% lower total cost per subscriber compared with GPON at fixed data rates from 20 to 60 Mbps, respectively. The Ethernet FTTB architecture offers a lower total cost of 20 to 30 percent, compared with GPON at fixed data rates from 20 to 50 Mbps, respectively.[2]

Employing the connectorized fiber distribution approach adds a nominal increase to the overall capital cost for all architectures due to the use of optical distribution frames. However, this approach is preferred when the expected take-up rates are unknown, because it offers a “pay-as-you-grow” approach for both Ethernet and PON architectures. With this approach, GPON offers 10 percent lower total cost than E-FTTH for fixed data rates of up to 20 Mbps, and has a higher total cost at data rates above 30 Mbps. Ethernet FTTB offers 15 percent lower cost than GPON at rates up to 25 Mbps and has similar costs above 50 Mbps.

If one increases the speed to 50 Mbps for some of the subscribers in the fourth year, Ethernet FTTH and Ethernet FTTB both offer 20 percent lower total cost than the GPON architecture over the five-year life cycle.

PON architectures are best suited for consumer services at fixed data rates below 25 Mbps and may also support broadband access for small businesses that do not require security, isolation, or guaranteed bandwidth agreements. Ethernet FTTH and FTTB architectures offer cost-effective broadband service flexibility, higher bandwidth, security, comprehensive fault isolation, and guaranteed service-level agreements to support consumer, telecommuter, and business services on the same Carrier Ethernet infrastructure. Ethernet and PON fiber architectures offer a compelling proposition that many service providers around the world are deploying to respond to the continual rise in broadband demands for consumer triple-play and Carrier Ethernet services.

PON architectures are best suited for consumer services at fixed data rates below 25 Mbps and may also support broadband access for small businesses. As 10 GEPON technology becomes more readily available and deployed, the potential subscriber data rates will certainly improve. However, the shared PON architecture does not provide the security, isolation, and guaranteed bandwidth agreements of many enterprise business services. Ethernet FTTH and FTTB architectures offer cost-effective broadband service flexibility, higher bandwidth, security, comprehensive fault isolation, and guaranteed service-level agreements to support consumer, telecommuter, and business services on the same Carrier Ethernet infrastructure. Ethernet and PON fiber architectures offer a compelling proposition that many service providers around the world are deploying to respond to the continual rise in broadband demands for consumer triple-play and Carrier Ethernet services.

[2] Network Strategy Partners – May 2007

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