

A White Paper from Telco Systems



The Advantages of Active Ethernet for FTTH Applications



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Fiber-to-the-Home/Business (FTTH/FTTB) Active Ethernet Solution

With VoIP and IPTV continuing to grow in popularity, traditional carriers are being challenged to find cost-effective solutions to deliver carrier-class triple-play services to their enterprise and consumer customers. Fiber is the key enabling media to support the higher bandwidth and new services, such as VoIP and VOD. Fiber enables providers to improve their competitiveness, achieve operating efficiencies, address the demand for faster Internet service, and pursue new revenue-generating opportunities such as digital video. Fiber to the home enables developers and builders to increase the value of the properties they are selling as well as to offer the home owners a service that also provides a residual income.

The FTTx market has seen a remarkable evolution over the past year.

- FTTH deployments passed over 3.6 million US homes as of February 2006, an increase of almost 1 million homes in only four months (Render, Vanderslide & Associates, 2006).
- The price of fiber is now below that of cable for broadband deployment (Point Topic, December 2006).
- Spending on fiber optic systems for broadband access will total \$77 billion over the next five years (KMI Research, December 2006).

Without an existing network in place, it is easier to justify an advanced broadband solution, such as FTTC or FTTH, in new neighborhoods. Furthermore, because trenches are already being dug in these neighborhoods for utilities to be run, service providers are able to piggyback by laying fiber alongside the utilities, reducing the cost of deployment. (In-stat, 2005)

New analysis has forecast a significant increase in FTTH subscribers, with average subscriber take rates exceeding 40 percent overall and more than 75 percent in some communities.

The Technology

FTTH is delivered using various technologies:

APON - ATM Passive Optical Network uses ATM for transport. Standardized by ITU in 1998, it is used primarily for small business applications.

BPON - is the same as an APON, with extra overlay capabilities for broadband services like video. BPON's ITU approval spec is G.983x. It supports data rates to 622 Mbps out to an endpoint and back from the customer to the service provider's remote aggregation point.

GPON - uses a different, faster approach (up to 2.5 Gbps in current products), encapsulating traffic in a version of the SONET-compatible Generic Framing Protocol (GFP).

EPON - Ethernet PON, which, as its name indicates, is a technique that uses Ethernet as the main transmission method for the PON. EPON runs at gigabit rates and has its own standardization process underway at the Institute of Electrical and Electronics Engineers Inc. (IEEE).

Active Ethernet - a technique that uses Ethernet as the main transmission method over fiber using active components. Active Ethernet runs gigabit rates.

Active Ethernet or PON?

While a large majority of FTTH deployments today are based on passive optical networking (PON), the advantages of point-to-point active Ethernet are well documented.

These include:

1. Active Ethernet is standards-based. Ethernet components that are 802.3 compliant offer full interoperability with other standards-based solutions from a broad base of vendors.
2. Since Ethernet is standards-based and is used universally, the cost of Ethernet-based products and components is decreasing rapidly. Residential and small business subscribers with FTTH service will benefit from the cost savings as service providers continue to deploy additional equipment.

3. Active Ethernet offers subscribers dedicated bandwidth based on their individual requirements and offers differential services for residential and business customers in the same area. In a PON network, the available bandwidth per subscriber terminal is shared with all other subscribers in that area without being able to give different service levels. The bandwidth is divided into 16, 32 or even in some cases to 64 subscribers resulting in service that at most provides (in optimal cases) 64Mbps, while an active Ethernet architecture could deliver using similar network 100Mbps or even 1Gig.
4. Active Ethernet supports a pay-as-you grow philosophy since new subscribers can be easily added to an active Ethernet network within the 100km geographic area at minimal cost. PON networks require one splitter for every 32 ONUs within the 20km service area and are cost-effective only when at least 26 ONUs are connected. Any scenario that results in either more subscribers than initially planned as or less than planned can result in a loss of money.
5. PON is limited to a radius of 20km from the splitter while active Ethernet is practically unlimited in reach.
6. Digital voice (VoIP) and video (IP video) services can be delivered using a single strand of fiber or over CWDM using up to 16 unique wavelengths over fiber pairs. This ability to provide dedicated bandwidth over a single fiber or fiber pair to multiple subscribers maximizes fiber capacity and keeps costs low.
7. Active Ethernet is easy to configure and plan. PONs requires detailed pre-planning to place splitters in the ideal location from the OLT that support the maximum number of subscribers and ensure that the ONU reaching the maximum number of subscribers.
8. Active Ethernet is easy to support. Because traffic is pure IP, no transition between protocols is required. Network management of all network elements is simple using off-the-shelf products and standards. Active Ethernet can send information to the NOC using SNMP, EFM OAM, MPLS, or any number of management protocols used by the provider. Passive splitters cannot transmit data so troubleshooting a problem requires dispatching a technician to the site – or multiple sites.
9. Active Ethernet enables differentiated service for residential and business customers in the same area, offering 100Mbps (or less) to the lower paying customers and up to 1Gig for the higher paying customers. PON doesn't support differentiated service for different users.
10. Active Ethernet traffic is symmetrical, using the uplink and downlink as needed by the traffic load. PON is asymmetric which might limit some applications.
11. Active Ethernet topology is flexible and can be built with ring redundancy as well as combination of other topologies. PON is built in a star topology without redundancy.

Why Telco Systems' Solution?

Telco Systems has developed a set of solutions to address migration strategies for service providers that enable them to cost-effectively develop a FTTx solution, while avoiding major capital expenditures and loss of revenue from legacy services. Telco Systems' active Ethernet solution offers unique advantages that make it the most efficient, reliable, and cost-effective solution available in the market.

Field-proven - Telco Systems' FTTH solution has successfully been deployed in the field for over 6 years with over 5000 end-users using it for voice, video, and data as the sole Access method. The same voice and data technology is being used at over 70,000 houses in the USA.

End-to-end Solution - Telco Systems offers end-to-end solutions from the customer premises CPE (EdgeGate product line with 2/4 FXS and 3-8 10/100BaseT customer facing ports), through aggregation switches (T5 Compact – 24 Fast of GigE customer facing ports and multiple 1Gig uplinks), and up to core-switching in central offices (CO).

Triple-Play Ready - Telco Systems' FTTH solution and its EdgeGate family of products, support integrated VoIP as well as various standards-based mechanisms, which ensure the voice, video, and data quality of service (for example IGMP to support video). If the customer chooses to start initially with existing RF video, an integrated RF converter is part of the CPE.

Reliability and Availability - The EdgeGate device offers the highest reliability in the market, and has been proven in the field to have the lowest failure rate. Telco Systems' aggregation switches support multiple topologies, and RSTP and MSTP based solutions ensuring the shortest convergence time in the industry (less than 50mSec).



Integrated Voice - The EdgeGate product line integrates VoIP connectivity, and supports all major VoIP protocols - SIP, and MGCP. EdgeGate CPE provides high-quality voice as it supports IEEE802.1p, voice priority, and TOS marking.

Flexibility - Telco Systems' EdgeGate CPE solutions are very flexible in network design and in the services that can be offered with transport of either 100Mbps or 1Gbps for future expansion in the same product, thus moving from 100M network/service into 1Gig doesn't require any electronics replacement. The EdgeGate CPE supports three to eight LAN ports and two to four voice ports. Multimode, singlemode and bi-directional (which uses one (1) fiber strand) fiber interfaces are also supported to suit fiber types and distances.

Telco Systems' end-to-end FTTH solution

EdgeGate CPE — The most efficient, flexible, and powerful CPE device in its class for the delivery of voice, video, and data. The EdgeGate CPE unit is temperature hardened and can be ordered either for indoor or outdoor applications. Several thousand units have been deployed worldwide in FTTH applications. This device supports various combinations of up to four analog voice lines and up to eight 10/100Mbps Ethernet ports, including 100/1000Mbps Ethernet uplinks. Using SIP or MGCP, the EdgeGate CPE unit allows users to easily make calls through the IP network while simultaneously using the gateway as a high bandwidth network connection.



Indoor and Outdoor Solutions - The EdgeGate units can be installed on the exterior of a building or in the controlled environment of residential and business subscribers. The product offers isolated technician and user access, as well as variety of indoor and outdoor power solutions.

Supports gradual deployment and installation processes – An EdgeGate device can initially be set up using only the enclosure and the fiber management. For deployment, the electronics can be installed at a later date at an established subscriber's location.

T5 Compact — This IP platform is a cost-effective, high-performance, ultra-compact Ethernet switch solution. It is a fully managed, non-blocking IP platform that supports a variety of interfaces that accommodate small-to-medium sized IP data communication requirements including Fast Ethernet and Gigabit Ethernet services. The T5 Compact offers 24 10/100/1000Mbps copper and fiber Ethernet ports in a single rack unit, with dual Gigabit fiber uplinks.

- a) Cost-effective, high-performance, ultra-compact IP solution
- b) Dense fiber configuration provides high capacity in a small space
- c) Choice of fiber uplinks
- d) Cost-effective port trunking capabilities
- e) Non-blocking architecture provides maximum data throughput

Active Ethernet Network

Telco Systems offers a wide range of active Ethernet solutions for FTTHome, FTTCurb, FTTBuiding, and FTTFNode. For additional information on these solutions, visit our website at www.telco.com, or call toll-free 800.221.2849, or email sales@telco.com.





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