Fiber to the Home: Technology Wars

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Traditional copper access networks, designed for basic telephony services, have enjoyed a new lease on life as high-speed Internet links, thanks to technologies such as ADSL2+[1] and VDSL.[2] These technologies, however, are limiting, and industry experts agree that taking fiber connections to each home is the only mechanism for enabling the next generation of broadband speeds and services in the long term.

The move to fiber to the home (FTTH) will be the most significant transition for the industry since the original rollout of copper networks more than 50 years ago. The financial stakes are high: the residential-access service market in Western Europe alone is roughly US$42 billion annually,[3] and those players who are successful at delivering FTTH services will capture this revenue. About $120 billion, however, will be needed to roll out fiber across 80 percent of the 167 million households in Western Europe.[4]

Today, there are two main technologies competing for FTTH. The first is gigabit passive optical network (GPON), in which passive optical splitters are placed at various points in the network to create a tree-like structure that allows up to 64 homes to share a single fiber. Many companies are using GPONs, such as Verizon in its fiber optic service (FiOS) rollout in the United States. Incumbent service providers in Europe, such as France Telecom, are also considering GPON networks.

The second technology is Ethernet point-to-point (PTP), which uses a dedicated, single fiber strand for each customer. While this solution costs more up front (more fiber strands deployed, larger points of presence, and so on), its performance is superior to that of GPON.

In this Economic Insight, we examine the merits of these two technologies to determine which solution offers service providers the best competitive advantage.

GPON: A Less-Expensive Option?

The cost difference between GPON and Ethernet PTP depends on three factors: the degree of civil works required to lay fiber, the density of the area in which deployment occurs, and the bandwidth required by each customer. The impacts of these factors on deployment costs—assuming that both technologies deliver enough bandwidth in the short term, and that the market share for both is identical—are illustrated in Figure 1.

Figure 1. Project Costs of Ethernet PTP versus GPON (the data represents the net present value of costs over 10 years for a large European city)

Variable and Hypothesis Being Tested	Scenario	PTP Cost ($M)	GPON Cost ($M)	PTP Cost as a % of GPON
Degree of civil works (when ducts are limited, GPON is favored)	· Plenty of ducts (little civil works needed for both)	137	130	+5%
	· Limited ducts (more civil works needed for PTP)	163	130	+25%
	· No ducts (civil works needed for both)	210	205	+2%
Customer density (as density falls, GPON's advantage increases)	· High-density urban areas	54	53	+3%
	· Low-density urban areas	84	79	+6%
Bandwidth (increased performance favors PTP)	· 10 Mbps upstream	137	130	+5%
	· 100 Mbps upstream	137	152	–10%

Source: Cisco IBSG Economics Practice, 2007

It is clear that both solutions have their advantages. The right-hand column in Figure 1 shows that GPON is favored when the number of ducts is limited or when customer density is low, whereas PTP is favored when end-user bandwidth is high.

File Transfer: PTP or GPON?

Ethernet PTP networks give each user a dedicated symmetrical link of 100 Mbps or more (1-Gbps PTP cards exist today, although costs generally prohibit residential use); GPON typically offers only 40 Mbps downstream[5] and 19 Mbps upstream.[6] Proponents of GPON, however, state that both technologies offer plenty of bandwidth for residential requirements, making the case that GPON offers enough bandwidth to support up to three HDTV streams into the home and one HDTV stream out of the home.

The sustained bandwidth needed for real-time applications, such HDTV, is only half of the FTTH story. Peak throughput for "bursty" applications, such as e-mail, is also important. If users want to e-mail a 30-minute, high-definition home movie (about 2.25 GB), they

would need extremely high throughput for the few seconds required to transfer the file. A GPON user confined to 19 Mbps upstream would have to wait 16 minutes for the upload to complete, whereas a 100-Mbps Ethernet PTP user would have to wait only three minutes (at 1 Gbps, file transfer would take as little as 18 seconds).

The need for high-peak bandwidth might occur faster than generally anticipated. A number of European service providers are starting to roll out 100-Mbps services, such as Numericable and Neuf Cegetel, both in France. In September, FTTH player Hong Kong Broadband Network Limited announced the withdrawal of its 10-Mbps service to focus on 100-Mbps, 200-Mbps, and 1-Gbps symmetrical services.

Ethernet PTP Helps Service Providers Differentiate

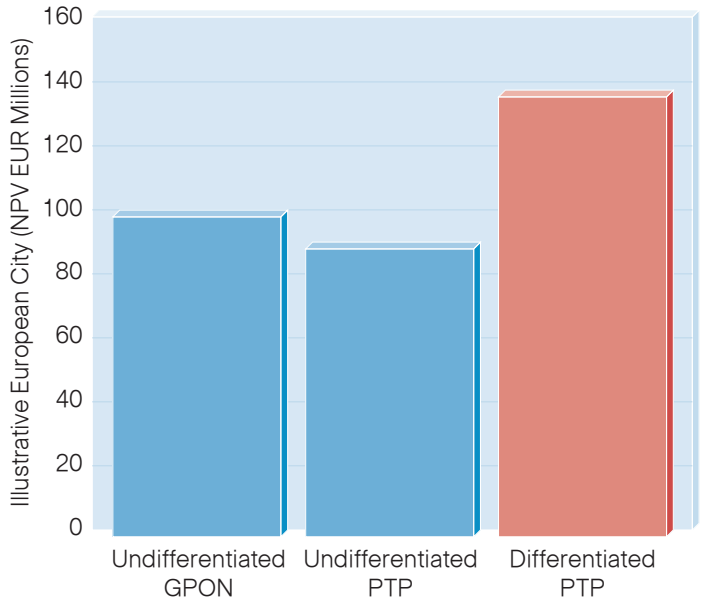
Ethernet PTP is the superior FTTH technology because it delivers higher peak speeds than GPON, VDSL, or other competing technologies such as DOCSIS 3, a communications interface for a data-over-cable system that enables high-speed data transfer to an existing cable TV.

Furthermore, PTP offers a simpler upgrade path to higher speeds in the future, since users can be upgraded independently of one another; with GPON and DOCSIS 3, all users share the same fiber connection and must be upgraded simultaneously. In urban markets where demands for higher density call for shared technologies, PTP networks will help service providers differentiate and innovate more easily than networks based on a shared infrastructure.

Service providers are already responding to the advantages of Ethernet PTP over shared technologies. In Paris, for example, both Free Telecom and Neuf Cegetel are deploying PTP networks as alternatives to France Telecom's GPON network. Free Telecom will offer 100 Mbps downstream and 50 Mbps upstream, capabilities that are difficult to replicate with GPON.

The competitive advantage of Ethernet PTP over GPON is illustrated in Figure 2. The Cisco® Internet Business Solutions Group (IBSG) modeled an example of a challenger in a European city with ducts for rent. We first analyzed the value of deploying GPON and Ethernet PTP technologies, assuming a market-standard offer with little in the way of competitive differentiation. Then we analyzed the impact that PTP's superior performance would have in creating a differentiated offering.

Figure 2. Net Present Value of FTTH Deployments for Ethernet PTP and GPON in Differentiated and Undifferentiated Scenarios



Source: Cisco IBSG Economics Practice, 2007

Based on our analysis, IBSG concludes that when PTP's ability to create a differentiated offering is factored in (as represented by the red bar), the net present value of PTP is almost 40 percent higher than undifferentiated GPON.

Conclusion

While the cost differences between Ethernet PTP and GPON are minor, they are overshadowed by PTP's ability to help service providers differentiate their offerings. PTP provides customers with superior peak performance today and a simpler upgrade to even higher speeds tomorrow. Ethernet PTP, by virtue of its simpler topology, should, therefore, be considered the technology of choice for service providers in competitive market situations.

Endnotes

1. Asymmetric Digital Subscriber Line
2. Very High Speed Digital Subscriber Line (also abbreviated as VHDSL)
3. This figure assumes a line access charge of €15 ($22) per month across 167 million Western European households, and an exchange rate of 1.4.
4. Telecom service providers will need to spend about $900 per home on average (Verizon quotes $800-$1,000; UK Broadband Stakeholders' Group quotes about $900).
5. A typical GPON tree offers 2.5-Gbps bandwidth downstream, shared among up to 64 customers; if all customers were downloading simultaneously, each would experience 40 Mbps. If only a fraction of customers were downloading simultaneously, the speeds would rise in proportion.
6. Each user on a GPON tree receives the same allocation of bandwidth based on the maximum number of users. A 64-user tree results in a peak upstream bandwidth of 19 Mbps per user.

More Information

The Cisco Internet Business Solutions Group (IBSG), the global strategic consulting arm of Cisco, helps Global Fortune 500 companies and public organizations transform the way they do business—first by designing innovative business processes, and then by integrating advanced technologies into visionary roadmaps that improve customer experience and revenue growth.

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