

# THE ECONOMICS OF FTTH

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Once considered a science fiction fantasy, or at least the imaginings of a few out-of-touch telecom aficionados, fiber to the home (FTTH) has emerged as the fastest growing broadband technology in the United States today. According to a study by Render, Vanderslice & Associates, FTTH will grow from its modest 180,000 homes passed in 2003 to more than one million homes passed in 2004. Other sources (Figure 1) also predict growth in worldwide FTTH subscribers in coming years.

Has FTTH's day finally come? Absolutely, and we are witness to only the infancy of what is an inevitable technology substitution curve. What's driving it? Bandwidth demand, certainly. The need for carriers, communities and developers to offer beneficial, and more competitive, services to consumers? Also true. But it's also about the numbers. Cost. The costs associated with FTTH have continued to drive downward while bandwidth and the need for competitive advantage continue to soar.

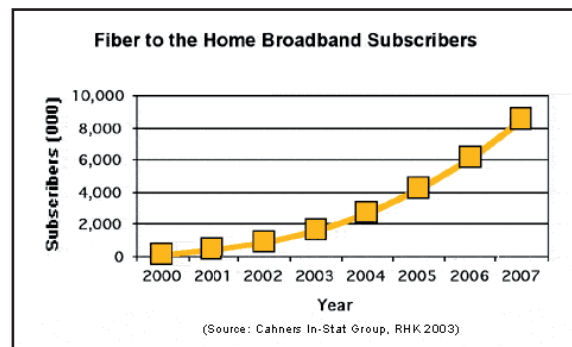


Fig. 1: FTTx subscribers are expected to increase at 220% compound annual growth rate (CAGR).

And still, there seems to be this persistent — incorrect — perception that FTTH doesn't make economic sense, that it is significantly more expensive than today's current technologies and any benefits are achievable only in the long-term. Think you can't afford to deploy FTTH? You can't afford *not* to. Not only has FTTH reached cost parity with competing legacy broadband network solutions in new builds, but it also holds the promise of a significantly improved broadband business case for the life of a given network in overbuilds. That's on top of the applications, available today, that are already beginning to clog current broadband networks, and the emerging applications that will fuel consumer demand for bandwidth.

Corning has developed a business case model that thoroughly examines the near-term and long-term economics of last-mile networks. This article will review the inputs that form the foundation of a robust business case model, provide an apple-to-apple economic comparison of FTTH, very high digital subscriber line (vDSL) and cable modem technologies, and conclude with a sensitivity analysis of specific variables presumed to most influence the business case for a last-mile network.

## Creating a Robust Economic Model

The economics of last-mile network deployment have changed significantly over the past few years, with fiber achieving cost parity with legacy copper and fiber-copper hybrid broadband solutions in greenfield scenarios and near parity in overbuilds. This can be attributed largely to the reduction in equipment costs — as FTTH networks are more widely deployed, economies of scale help to drive down the cost of network components. The 2003 request for proposal (RFP) by the regional Bell operating companies (RBOCS) for FTTH active equipment is having a similar effect.

But the growing sophistication of planning and business models for FTTH deployments has also shaped the economics of last-mile networks, as network operators become more and more mindful of their networks' cost and performance beyond the first year of installation and make their network decisions accordingly. You might say that the economics of the last mile are changing in part because more thorough cost analyses and practical deployment experience are dispelling incorrect assumptions and providing clarity around exactly what those costs are.

Corning's broadband economic model is the result of ongoing discussions with the industry's leading broadband engineering firms and equipment vendors to identify and thoroughly understand the variables that affect network installation and operating costs, revenue streams and profitability. The result is a robust model that provides apple-to-apple (like-to-like) comparisons and the long-term business case — that is, including, but also *beyond*, first-installed costs (FIC) — for fiber architectures versus vDSL and hybrid fiber coax (HFC) networks.

It is important to note that the model is not a technical model designed to create a “shopping list” of exactly which products to purchase and install for your network. Corning offers additional technical modeling capabilities for FTTH that can assist network operators in this regard. The model, while providing guidance on comparative first-installed costs, shows its true value in long-term cost analysis: beyond first-installed cost to the network's total cost and value over time, such as operation and maintenance costs, upgradeability and revenue capabilities. After all, broadband networks don't stop costing money once they've been deployed.

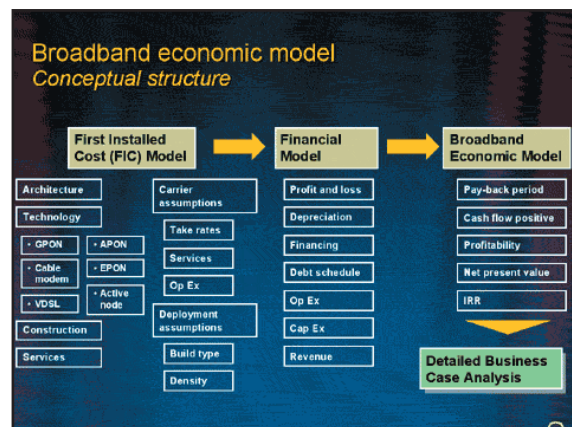


Fig. 2: Corning's broadband business case model includes a comprehensive series of “cost levers” that influence network economics, resulting in a broadband economic model that provides a detailed long-term business case analysis.

What makes the model unique is that while all wireline technologies are not created equal (optical fiber clearly outperforms all other technologies), the model allows the business case for each technology to be evaluated on a playing field level with others providing the triple play of services (voice, data and video). Each wireline technology is evaluated in a scenario in which they all provide the same level of services to the same number of subscribers, distributed over the same geography.

As seen in Figure 2, Corning’s broadband business case model includes input of a comprehensive series of “cost levers,” nearly 150 variables in all, that influence network economics, divided into three areas: first-installed costs, carrier assumptions and financial structure.

In the FIC portion of the model, inputs include construction variables, such as percentage of the network that will be aerial versus trenched cable, whether the headend will be newly built or repurposed, and installation expectations at the customer premises. Population density variables — residential versus business, single-family versus multiple dwelling unit (MDU) — are analyzed in detail here as well, as are the plans for service delivery, such as broadcast video and voice over IP, and the minimum bandwidth levels required for consumers and businesses.

In the carrier assumptions section, the model analyzes variables such as commercial and residential service “take rates” (penetration) and operational expenditures over the lifetime of the network. Such expenditures would include inputs such as the number of office and field staff, wage scales and benefits, equipment power requirements, and repair time and cost.

Finally, the network and the network operator’s financial plans are detailed, including consumer and business pricing structures and even discounts for bundled services. Some network operators qualify for unique financing options — such as a municipality’s access to bonds, or a rural local exchange carrier’s use of federal loan funds — compared with other entities, and these options are considered here as well. Myriad typical financial variables, including average cost of goods sold, growth and attrition rates, and rate of return and inflation rate, round out the financial section of the model.

The result is a broadband economic model that provides a detailed long-term business case analysis.

### Beyond the Money Spent: The Money Saved

In the following example, Corning used data from the 2000 United States census to provide a comparative business case for a typical midsized American community, which will deploy a broadband network via an overbuild of its existing network. Again, the model relies on specification and pricing data from leading broadband vendors for network equipment and installation. Three architectures for this community are evaluated: an FTTH passive optical network (PON), very high-bandwidth DSL (vDSL) and HFC. The model evaluates the network over a 15-year lifespan with the assumption that all three networks outside plant are completely built out at year 0.

This U.S. community has 28,555 residential subscribers and 2,358 business subscribers distributed over an area of 38.12 square miles. Figure 3 provides additional

**FTTH business case analysis**

Network Input Variables	
<b>Residential Variables</b>	
Penetration Rate	35%
Single Family Dwelling Units Total	28,555
1 Unit Detached	26,531
1 Unit Attached	1,198
Mobile Homes	826
<b>Low Density MDUs Total Units</b>	
2 Units	351
3 to 4 Units	1,229
<b>Medium Density MDUs Total Units</b>	
5 to 9 Units	1,108
10 to 19 Units	900
<b>High Density MDUs</b>	
20 or more Units	3619
Design Bandwidth (Mbps) per Apartment in High Density MDUs	5
High Density MDU Penetration Rate	100%
<b>Business Variables</b>	
Business Penetration Rate	35%
Business Units Potential	2,358
Business Units by Penetration Rate	825

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Fig. 3: Some of the nearly 150 inputs to Corning’s broadband economic model.

detail on how the residential population is distributed among various housing types in this scenario, residential and commercial penetration rate and bandwidth demands. Additional inputs of interest in this scenario include the percentage of reserve fiber in the network for the FTTH network (25 percent) and the percentage of aerial cable (65%).

As can be seen in Figure 4, the result is a net income in which the passive optical network makes more money over time than either legacy network and becomes profitable at the same time as the hybrid fiber coax network. In this scenario, the PON has a net income over the first 15 years of the network more than \$1.6 million higher than that of the HFC network, and nearly \$37 million more than the vDSL network. (In Figure 4 note that the curve in the first five years is not smooth — for all three technologies — as depreciation of equipment changes rapidly and subscribers are added during this time period.)

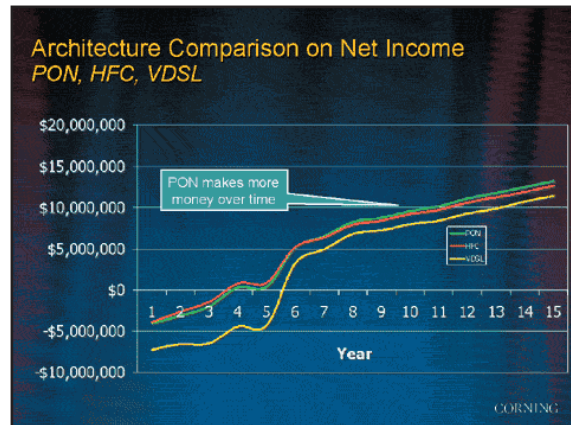


Fig. 4: Dispelling the myth — In this typical U.S. overbuild scenario, the FTTH network becomes profitable at the same time as an HFC network and a year sooner than a vDSL network.

What’s driving this? After all, many would expect the net income of an HFC or vDSL network to be higher than a FTTH overbuild, particularly in the first years of the network, because these more mature legacy architectures have lower first-installed costs. And in this scenario, this is true, as the FIC for the PON network was modestly higher (about 10 percent) than for HFC and nearly 25 percent higher than for vDSL.

The answer is seen in operational expenditure (opex) in Figure 5, which is where the first-installed cost advantage for HFC and vDSL networks is fleeting and soundly overwhelmed by their opex disadvantage compared with fiber. While the network equipment and components of legacy networks may be initially less expensive to deploy, they have a much higher cost on the network, both immediately and in the long term. These architectures require more repair and maintenance — i.e., labor, which is typically the greatest expense in any network — than fiber networks.

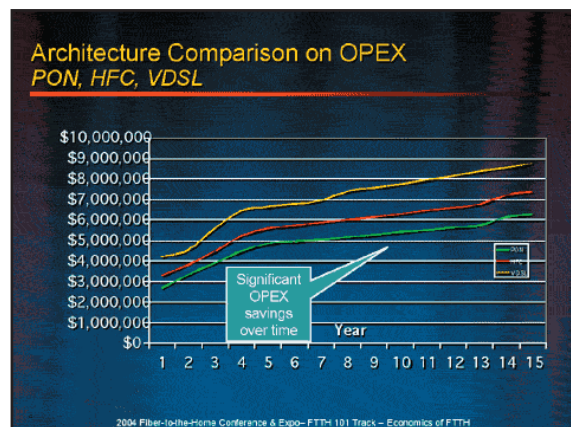


Fig. 5: Installing a legacy architecture can result in millions of dollars of additional operating expenses.

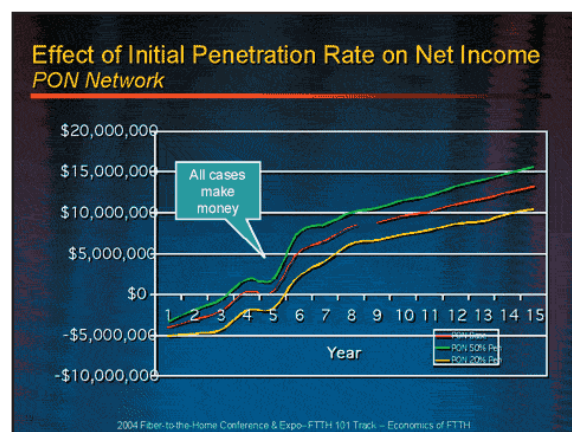
Depreciation of equipment (which favors PON and, to an extent, HFC, compared with vDSL) and greater power requirements add to the operational cost of these legacy networks. The result for the city in this example is a FTTH network that saves more than \$12 million in opex over 15 years compared with the HFC network, and more than \$31 million compared with vDSL.

## What's Affecting Your Business Plan?

Of interest to many network operators considering a FTTH network is the sensitivity of the business case to the many installation and operational variables, as have been captured within the Corning model. Intuitively, it is understood that if one variable is changed, the economic results may also change. In particular, network penetration rate, homes passed and outside plant considerations such as aerial versus buried cable are often thought to have a significant impact on the immediate and long-term profitability of a broadband network. Using the same U.S. community and inputs outlined previously, Corning has conducted a sensitivity analysis of these common variables.

### PENETRATION RATE

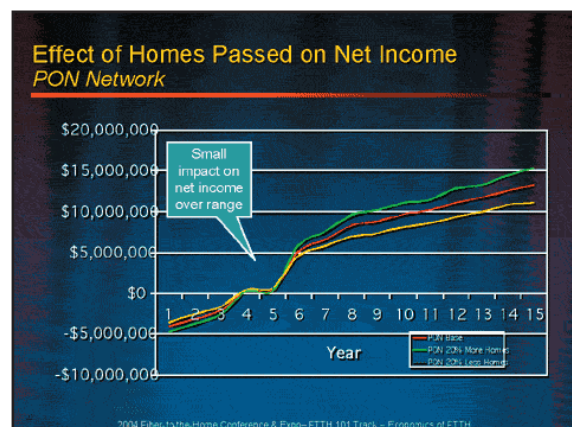
In the original scenario, an initial subscriber penetration rate of 35 percent was assumed; a fairly typical rate for most FTTH communities. As one might expect, increasing the initial penetration rate to 50 percent does increase net income over time and causes the network to achieve profitability about one year sooner than the 35 percent base case (year three versus year four). Decreasing the initial penetration rate to 20 percent likewise decreases the network's net income over time. Overall, initial penetration rate has a moderate impact on a FTTH network's net income, but a wide range of penetration rates achieves profitability within a few years of one another (see Figure 6).



**Fig. 6:** In this scenario from the Corning business case model, the PON always makes money regardless of the initial penetration rate of the network.

### HOMES PASSED

The number of homes passed does have an impact on profitability, but the net effect is relatively modest. In the base case, 28,555 residential dwellings were passed. Increasing the number of homes passed by 20 percent does not affect the timeframe for profitability (see Figure 7), though there is a moderate positive effect on net income over the 15-year operating window. Likewise, a 20 percent decrease in the number of homes passed by the network has a modest diminishing effect on net income over the 15-year period, but the network still makes money by year four as well.



**Fig. 7:** Homes passed has a modest effect on net income, but little to no effect on the timeframe for profitability.

## PERCENT AERIAL CABLE

Finally, the percentage of aerial cable can be seen to have a minimal impact on the network's net income — actually it has less impact on profitability than the initial penetration rate of the network. Where aerial cable does make a difference is in the initial first-installed cost of the network. In the base case, an aerial cable amount of 65 percent was assumed. Raise it to 90 percent and, while net income over time is barely affected, the first-installed cost per subscriber does reduce by about \$140. Reduce the aerial cable percentage to 40 and, again, net income is not appreciably influenced, but the cost per subscriber rises by about \$140. This makes sense, given the more costly, labor-intensive nature of burial cable installation as compared with aerial cable installation.

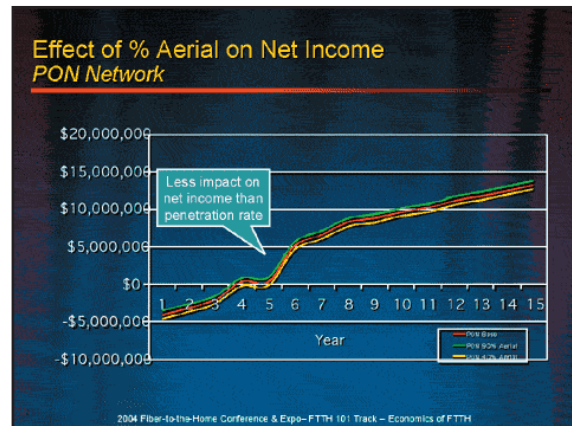


Fig. 8: Aerial cable has little effect on network profitability.

Outside plant considerations will continue to improve the already favorable economics for FTTH, as innovations in technologies for this portion of the network will further reduce first-installed and long-term costs of deploying fiber in the last-mile. Some vendors are tackling the notable labor costs required for access networks (labor accounts for about 40 percent of FTTH first-installed costs) with products that significantly reduce the time and technical skill required for installation (see the related article, Innovation Meets Application, in this issue of GuideLines® Online.) Reducing the number of active electronics, which contribute 45 percent of a FTTH network's first-installed costs, such as through power-optimized fibers and ultra-low-loss connectors, also has a significant impact on network costs.

As shown in the business case model here, operational expenditure clearly trumps first-installed costs when considering the economic business case of a last-mile network. While FIC is, of course, an important consideration in evaluating your network plans, the fact remains that opex savings for fiber networks overwhelm any initial installation savings seen in legacy broadband architectures.

If you are planning or considering a fiber-to-the-home network and would like to discuss economic modeling, contact Patrick Garvey at [garveypt@corning.com](mailto:garveypt@corning.com) or 607-974-4421.