

Designing Networks For Greenfield Communities

Coordinating design of the fiber plant with other utilities is easy – and cuts costs

By Mark Conner and Patricia Hanlon ■ *Corning Cable Systems*

In greenfield developments, optical fiber has become the clear choice over copper, with lower installed costs and superior information-carrying capacity. In new construction, why do real estate developers choose between traditional twisted pair copper/coax-based network infrastructures and a future-proofed, fiber-based network? Lower maintenance costs, for one. But also, homes in FTTH-connected communities command premium prices compared to homes in communities without optical connectivity. For a typical investment of about \$1,200 per home passed for FTTH, developers may expect to realize a premium between \$4,000 and \$15,000 per home sale.

Fiber's effect may have been partially masked by sharply rising home prices nationwide, but should become even more clear in the years ahead. Michael Render (Broadband Properties, June) and the city of Loma Linda (Broadband Properties, May) note the positive impact of fiber on home pricing, for instance. In short, FTTH offers developers and builders the opportunity to make more money per home, while offering the homebuyer an improved lifestyle. This article offers insight into the best ways to integrate FTTH design into the development process for maximum effect.

Understanding the basics of FTTH networks, both as a business case and as a design process, will help ensure successful FTTH network deployment.

Even though optical fiber deployment is becoming commonplace, designing the neighborhood fiber network often

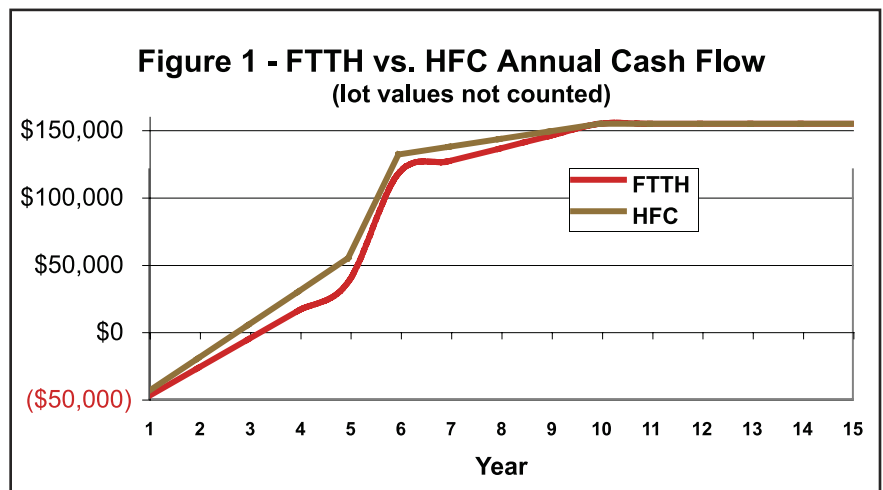


Figure 1. Cash flow on an annual basis, for FTTH and HFC networks in a 300-unit greenfield development. Both illustrate classic business models, starting out with negative cash flow and becoming profitable after three to four years.

comes late in the design process. Integrating FTTH network planning into the utilities construction plan, and allowing for minor modifications to lots and streets, will assist the developer to optimize for lowest cost, highest operating efficiency and simplest long-term maintenance.

For example, many of the more recent neighborhood designs are aimed at minimizing paved roads in developments. Because 98 percent of all developer-driven FTTH systems are placed in conduit according to Michael Render, and because primary conduit routes typically follow alongside the main roads, minimizing road lengths directly correlates with cost savings on all utilities' infrastructures. Proper long-term planning seamlessly blends network deployment into larger phased development neighborhoods.

The FTTH Business Case

A simple cash flow model — comparing FTTH to alternatives such as a hybrid-fiber coax (HFC) or an HFC-twisted pair combination — best illustrates the financial rewards for choosing FTTH. While HFC and FTTH can both provide triple play (voice, video and data), optical fiber networks offer significantly higher bandwidth — a hedge against having to overbuild the network in the future.

A cursory examination of revenues, content, construction and subscriber connection costs, as well as financing costs, facilitates analyses of cash flow for FTTH and HFC networks. A 300-home development that takes five years to build out will show similar cash flow for both FTTH and HFC, as illustrated in Figure 1.

However, the cash flow picture chang-

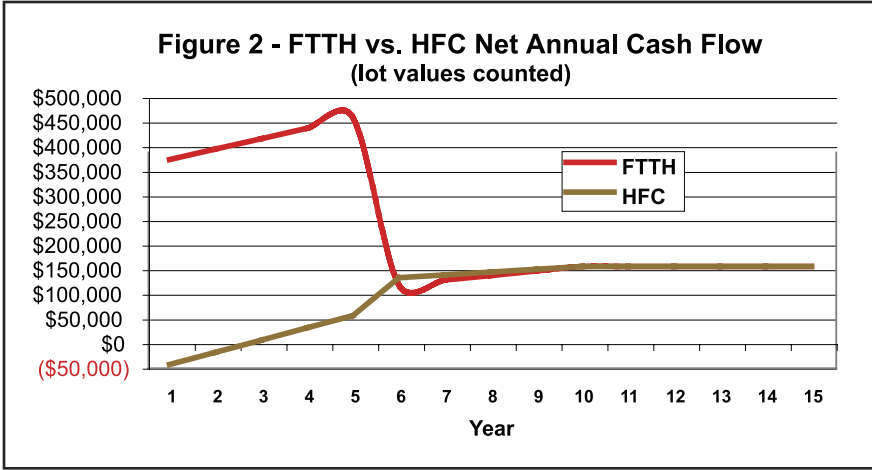


Figure 2. Cash flow on an annual basis, including the home price premium that the developer-builder can realize in the first five years (assumption that a \$7,000 home-sale price premium is obtained). The premium offsets the initial negative cash flow, producing, in this example, a cumulative additional cash flow of about \$2 million for the development.

es significantly when factoring in the FTTH home price premium that HFC lacks, as shown in Figure 2.

In networks where both HFC and twisted pair copper (for voice) are deployed, the initial costs are even higher, creating a more costly scenario than for the HFC-only approach. By evaluating the revenue and content costs, the infrastructure deployment costs and the FTTH home price premium, a clear advantage can be demonstrated for those who choose fiber to the home.

FTTH Network Basics

FTTH networks have three general architectures, depending upon the location of optical splitters or electronics in the network:

Central Switch Homerun architecture provides at least one fiber for each home passed (no splitting) back to a high-density central office (CO), headend (HE) or other centralized provider site.

Local Convergence architecture concentrates hundreds of subscribers

Minimizing fiber count does not save on network cost. Select an architecture that supports scaling of costs over time, as ... take rate increases.

in a neighborhood using optical splitters or electronics in one localized hub (local convergence point or LCP) to minimize the feeder fiber count that must reach back to the CO or HE.

Distributed architecture places the optical splitters or electronics at multiple locations along the system route (usually close to the subscriber) to minimize the fiber required throughout the network.

Minimizing fiber count does *not* save on network cost. Select an architecture that supports scaling of costs over time, as subscription (“take rate”) increases. Key high-investment elements, such as splitters and electronics, should be provisioned as homes are completed (pay as you grow), ensuring the most efficient use of these components.

While each architecture has its application, the Local Convergence Model, shown in Figure 3, provides an excellent balance between initial cable and hardware costs and the long-term scaling of splitter and electronics costs. Designing a network with minimal fiber can force investment in additional optical splitters and active components ahead of subscription and revenue growth. Even in greenfield deployments, people buy lots and build homes over time; very rarely does a 100 percent take rate occur on day one.

Choose your architecture with care! Future-proof with an architecture that provides flexibility and scalability. Technology changes, so whether you will operate the network, contract the operation or lease/sell to a system operator, make sure the architecture is most attractive to future technology and business plan advances.

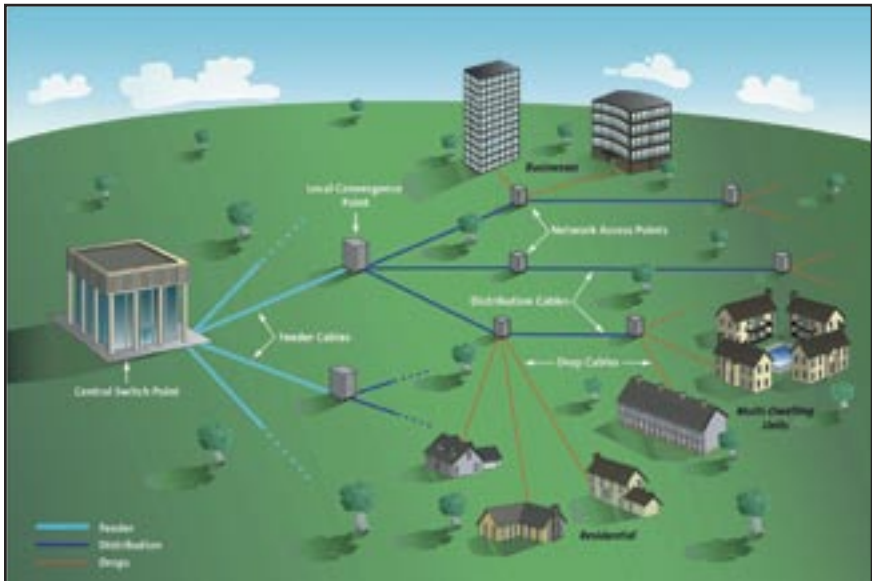


Figure 3. In the Local Convergence Model, the LCP contains a switch or all-passive splitting, in or near the neighborhood.

By integrating neighborhood and network design into a parallel, rather than serial, process, developers can maximize property values, profit margins, and quality of life.

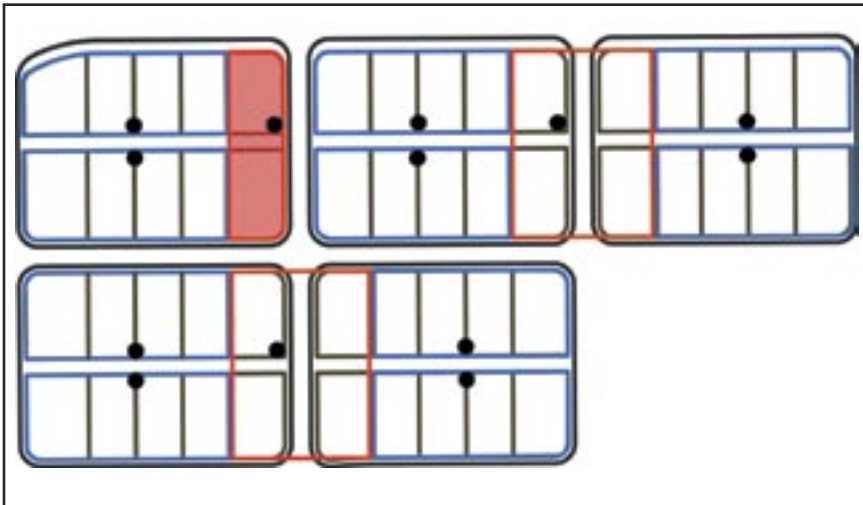


Figure 4. Non-optimized layout showing groups that require drop street crossings (red border) and underused group (solid red). Terminals are black dots.

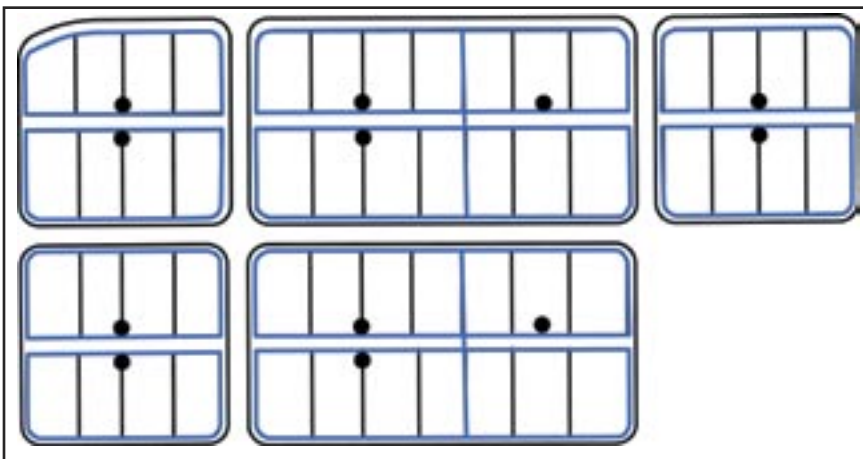


Figure 5. The same neighborhood with minor modifications: (1) No drop cables cross streets, (2) all groupings are 4 or 6 homes, (3) the design uses one less terminal, and (4) moving the street creates two additional lots.

Integrate FTTH and Neighborhood Design

FTTH network design typically begins with grouping subscribers into terminal (network access point, or NAP) serving areas, connecting them with distribution cables, and tying those cables into a properly sized local convergence point. A main feeder cable may then serve one or more LCPs. This first step of grouping subscribers (lots or homes) into terminal-serving areas is based on standard terminal sizes and standard fiber optic cable constructions (12-fiber increments are standard in the US). Depending on density, these areas may include 4, 6, 8 or 12 subscribers that will access ports on the same terminal.

Factors such as lot frontage and neighborhood design (grids, coving, cul-de-sac, and so forth) affect the required drop cable length and the ease of drop placement. High density developments may allow 8 or 12 subscribers to be served from one terminal, while low density may allow only 4 or 6 subscribers to be served per NAP. For a given density, one terminal size is typically used over and over throughout the neighborhood. This allows volume equipment purchases, ease of construction, and ease of maintenance.

After choosing a terminal size and grouping lots (or dwelling units) accordingly, the FTTH designer determines pathways for the distribution

cables leading to the LCP. The LCP is usually a cabinet that serves hundreds of subscribers. That cabinet may then be one of several served by a single feeder cable. This bottom-up approach minimizes splice plan complexity and simplifies documentation and system maintenance. Designers should avoid creating “orphan” subscribers, which are the odd single, fifth, seventh, ninth or 13th home in a terminal group, as they create non-dedicated ports in the field. Orphans, when they occur, are best placed close to the LCP instead of on the network periphery.

When possible (and without sacrificing aesthetics), neighborhood planners can lay out lots and streets to leverage common terminal sizes and cable counts, increasing network efficiency and minimizing complexity. An occasional non-dedicated port is not a significant cost in and of itself. In fact, lot layout and terminal sizing may be integrated in a way that evenly distributes non-dedicated ports throughout the network as part of a “sparing” philosophy. The intent of sparing is to allow for future unseen expansion and maintenance needs – placing these non-dedicated ports intentionally, as part of a long-term network plan.

Generally, streets, curbs and sidewalks are already in place before the builders complete the homes and add drop cables. Network designs that avoid street crossings (or provide pre-installed pathways for them) will benefit from simplified drop placement. Otherwise, additional directional boring and trenching may be required. To take advantage of joint trench opportunities, the developer can simultaneously install feeder and distribution

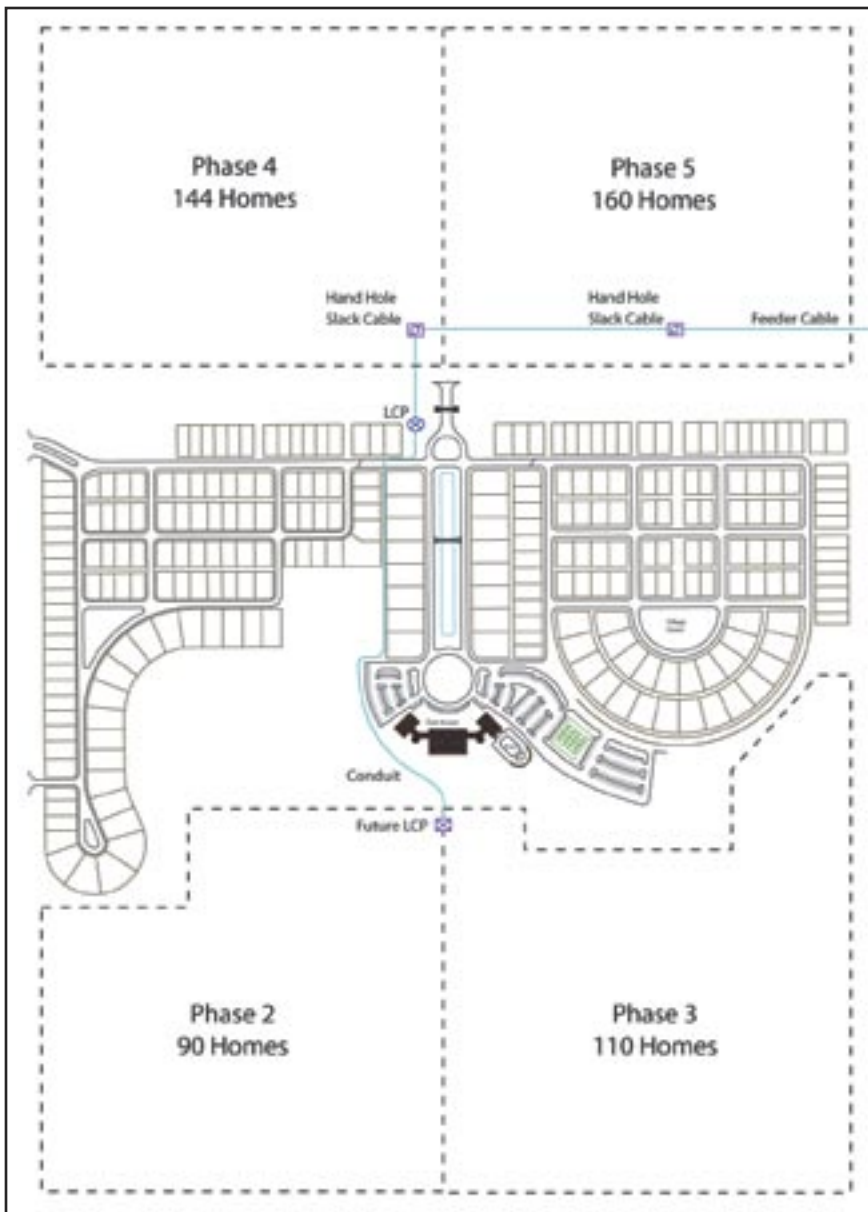


Figure 6. Preparing for build-out of future development phases.

FTTH cables and conduits in conjunction with the other utility infrastructures.

Well-integrated neighborhood and FTTH network designs exhibit a high degree of compatibility between lot layout and terminal sizing. The result is a straightforward construction and splicing plan that provides the desired services for the lowest cost. When lot layout and NAP sizing can be coordinated, it offers these benefits:

- Simplified splice plans/minimized error from cross splicing
- Reduced labor cost
- Efficiently used LCP and NAP ports

- Minimized street crossings of drop cables
- Easier documentation and maintenance

Figures 4 and 5 illustrate a non-optimized and an optimized lot layout for a given land area.

Phase FTTH Deployment with Land Development

FTTH network construction, just like real estate development, can be phased to accommodate financial targets and to scale product or service demand over time. Even if the exact lot plan for future phases is not yet clear, the FTTH

design can anticipate the number of lots in future phases. Based upon the number of lots, density of the neighborhood, and layout of the phases, the designer can appropriately size LCPs and strategically place them to service current lots, as well as to offer hardware capacity for future lots.

The designer can also pre-determine feeder routes and fiber counts to ensure sufficient capacity for the future. System installers can place hand holes with slack cable along the feeder route for easy splicing to future LCPs. When growth requires, installers can splice in factory-loaded LCPs with stub cables. The incremental cost of including the additional fiber in the cable is small compared to the future costs of pulling in additional cables. The extra fibers remain dark until the designer needs to provide service to future phases. Figure 6 illustrates placement of feeder cable, hand holes, slack coils and conduit to facilitate build-out of future phases.

Appreciate the Business Opportunity of FTTH

Effectively market your network along with your community to maximize value and awareness. Leverage the brand recognition and technical leadership of a vendor connectivity program. The tip-to-tip solutions, technical expertise and training available in such programs can accelerate design and deployment while avoiding common pitfalls.

Bandwidth alone is not the end game. Instead, the high-quality, life-enhancing experiences that are possible because of the high bandwidth that a FTTH network provides are the objective. As homebuyers choose a neighborhood for its sense of community, they also expect an increasing level of connectivity.

Market research shows that buyers put a real value on the benefits that fiber connectivity offers. We can expect to see continued pull-through by the home-buying public for these services. Developers that integrate fiber into the design of neighborhoods can expect improved return on their investments. Continued product innovations, such as pre-fabricated network assemblies and components, will revolutionize how fiber is

placed in a neighborhood. These pre-engineered, factory-built sub-systems are already reducing construction costs and speeding deployments in FTTH networks today.

Real estate developers and network designers share an important common goal: Design the neighborhood and the network for the most efficient use of capital to offer the greatest value and highest quality living experience possible at a given price point. By integrating neighborhood and network design into a parallel, rather than serial, process, developers can maximize property values, profit margins, and quality of life.

Realize the opportunity-cost if FTTH is *not* part of the overall project plans. Not only does FTTH create demand and higher selling prices, over time, it is a clear differentiator that moves innovative developers to the front of the pack. ❖

About the Authors

Mark Conner is a project manager providing support to Verizon FTTH deploy-

ments, as well as an FTTH design instructor. Patricia Hanlon is a project services business analyst, as well as a fiber installation instructor.

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