

# Avoiding the Common Hurdles Associated with Fiber Optic Network Deployment

By Troy Toensing ■ *Americable*

The catalyst for the newly emerging fiber to the "x" (FTTx) market is the ever-increasing demand for bandwidth. Clearly, the demand for high-speed data access and the associated enhancements to broadband video and voice traffic cannot be supported long term over the existing copper cabling infrastructure. Fiber optic cable offers virtually limitless bandwidth carrying capacity that will support data, video and voice now and well into the future.

Significant enhancements are being made by optical networking suppliers that are increasing the capability and reducing the cost of FTTx. But while these hardware companies must focus on improving their core technologies, service providers are challenged with issues related to deployment. These service providers require cost effective and reliable physical layer products, design services and support to ensure that their FTTx deployments are reliable, competitive, scalable and profitable.

The following guidelines are meant to serve as guideposts for the novice and reminders for the more experienced engineering manager embarking on an FTTx deployment project.

## Common issues Associated with Head-end or Central Office Development

### Location

Proper placement of the head-end or central office is critical. In the short-term, poor placement can impact your

initial budget by creating the deployment of excessive fiber lengths. For example, consider a central location with easy access and positioned close to the main streets of the development. This will help create a main backbone for all fiber in the development instead of a chaotic scene of multi-fiber cable going out in all different directions. In the long-term, environmental conditions may become less than ideal, driving up maintenance costs. In addition, while aesthetics are difficult to measure, determining proper placement during the planning stages could prevent a potential eyesore for years to come.

### Size

Planning for adequate space will become more important in the years to come as the network grows. Be sure to consider not only today's requirements, but also the long-term needs of the network. One simple example is to look at the foundation size of the central office. The foundation is the fundamental building block from which the building process begins. It must be able to support the weight of a pre-cast concrete structure, which can weigh in excess of 80,000 pounds, as well as be flexible enough to allow for entrance duct placement and routing.

### Rack Configuration

Another issue to be mindful of is proper communications racking design and configuration. In order to provide a sound support structure for the fiber optic splices, terminations, and an endless variety of equipment, it is important to configure the communications racks correctly. Part of this consideration should include the assumed evolution of the network. Typically, the best



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configuration is to start your lineup on one end of the shelter, continuing along a horizontal plane. You must also allow room for electrical separation, as dictated by your state and local regulations. Items that may impact this configuration include door placement and sizing, structure isolation, and internal power generation and rectification - not to mention facilitating the ease of fiber optic cable, jumper and copper cable, and jumper routing.

**Fiber optic termination and splice equipment**

Space demands on an FTTx network are extreme. That's why it's critical to

select fiber optic termination equipment that packs a lot of ports in a small amount of space. However, port density must not come at the cost of scalability, ease of access, or cable protection - all attributes that are critical to maintaining a cost-effective network.

**Scalability**- Scalability is important as growth occurs in the network. By using a product that allows you to implement terminations and splice panels as they are required, the cost of service for initial installation can be spread out over the growth of the network, saving initial startup costs.

**Ease of Access** - Look for termina-

tion panels and splicing trays that facilitate human access to the connector. You don't want to have to use pliers or tweezers to reach a

particular adapter on the panel. And the more accessible the equipment, the easier and cheaper it will be to maintain.

**Cable Management** - Cable management is the one issue that is overlooked most often during the initial setup, and yet it has the potential to create the most problems in the long-run. For example, poor cable management can lead to an inability to trace jumpers while performing system maintenance and moves, adds, and changes. Or, if not designed properly, it can cause an excess strain on fiber jumpers, causing micro-bends and cracking of the fiber,

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which in turn can cause severe signal degradation. Finally, poor management often leads to excessive jumper piling, which can cause increased attenuation due to the shear weight of the fibers on top of each other - over time they can become entangled, causing excessive fiber bending. One suggestion is to review fiber termination equipment that has considered the bend radius required to ensure the protection of the fiber. One should also consider routing ease and a system that accommodates adequate levels of slack storage.

### AC-DC Power

The AC to DC power rectification and battery backup system needs to be sized correctly to power all of the equipment consuming DC power. These systems are typically designed to allow for peaks in power consumption and should never be allowed to run at peak capacity for extended periods of time. Designers must balance the cost of initial implementation with the needs of implementing electronic platforms as customers are brought on line. Three other areas of concern may be the integration of the DC plant into the existing rack configuration, complete grounding infrastructure isolation, and cable routing of the DC distribution.

### Backup Power

Back up power generators are required to feed the network in a black-out or emergency situation. These systems are generally fueled by natural gas routed underground in a true redundant configuration from the local supplier to the central office or headend building. This redundant pathway needs to be considered when designing the entrance duct system and vault placement. Aesthetics must also be considered - how will this large generator look sitting next to the meticulously designed communication shelter? If appropriate, consider installing the generator inside the shelter.

### HVAC systems

HVAC and humidity systems are typically sized to meet the geographic zone in which the communications shelter is placed. However, you should also consider the heat dissipation of all of the electronics, the DC plant, and the back up AC power generator during the initial design assessment.

### Security systems

There are countless security systems worthy of consideration for inclusion in the design of the building. One of the more important options, aside from access limitation and control, may be tracking capabilities. With this tool, you can record who entered the shelter, as well as when and how long they were inside. This function may be useful for historical data, such as event timing and logging administration time. Also consider outcalling devices, which can be configured to call a predetermined telephone number and deliver a sequence of DTMF tones to a paging device or telephone to indicate a predetermined event, such as temperature extremes, the presence of water, or a power interruption.

### Common issues associated with the outside plant (OSP) design and installation

Without proper planning, the outside plant design and implementation costs can increase exponentially very quickly and greatly impact your budget. Indeed, equipment costs usually eclipse network build-out costs by one or more orders of magnitude. Because there are so many options, from APON to EPON to active electronics in the field, oftentimes mistakes are made in selecting an efficient routing design. When the incorrect routing of products is specified, or there are inaccurate splitter ratios and duct and drop cable lengths, the costs increase exponentially - adding both unnecessary labor and hardware costs. It is for this reason that a standards-based approach is essential

to an effective installation. For examples of standards, consider resources from industry associations, such as TIA, BICSI, IEEE, NEC, etc.

### Loss Budget

Prior to implementing or designing a fiber optic network, a loss budget analysis is recommended to ensure the electronics platform will function as intended. Both the passive and active components of the circuit should be included in the budget loss calculation. In addition, the calculation should include an estimate for future splice loss due to maintenance activities, such as fiber repairs. Passive loss is made up of fiber loss, connector loss, and splice loss. One should also include the couplers/splitters as well. Prior to the system turn up, test all strands with a light source and fiber optic power meter to ensure that it is within the loss budget.

### Vault / Closure Placement

Before determining the fiber optic strand count, you must determine the placement of the splice closures. The closures will house and protect the optical coupler/splitters and will be buried underground. At some point in the future, access to the splices, fiber optic cable, and grounding infrastructure for cable locating may be required. Therefore, these systems should be placed where they can be accessed without undo environmental damage and home owner/tenant disruption. However, all parties need to have realistic expectations regarding placement - some inconvenience is to be expected. With the invention of subterranean vault placement and exterior small-form grounding caps, the options for underground placement have become much greater.

### Strand Count

One of the most expensive components of an FTTx network implementation is the outside plant fiber itself. By performing complete and thorough research into the full intent of the pro-

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ject during the design stage of the development, you can ensure proper strand count and sizing. This will help avoid considerable costs of over engineering as well as maintaining adequate fiber strands for future and redundant routing. Some of the fundamental issues to contend with when determining the proper fiber strand count include:

- APON, EPON, or Active architecture
- IP Video vs. RF video design
- Point to point or point to multi-point
- Future development progression
- Overbuilding of nearby neighborhoods
- Future service offering
- Municipal and community buildings

### **Splice Chart**

One of the best ways to ensure proper design and maintenance of a network is by developing a splice chart. A splice chart is a document developed by the designer to facilitate the tracking and administration of the fiber optic strands that travel from the communications shelter, through the network, (including splices and couplers/splitters) and finally to the home or business. This document, if administered and maintained properly throughout the entire installation process, will allow the timely and cost sensitive cross-connection (patching) of all revenue generating circuits. Without a properly maintained splice chart, it may be necessary to trace each fiber optic strand after installation. This is a very costly and time-consuming process.

### **Proper Documentation**

Proper documentation of the network design saves time and increases the reliability of the installed network. But, documentation goes beyond pretty pictures, accurate work instructions, and product specifications. By providing written, verbal and detailed graphic instructions to your installation personnel and by ensuring that the contractor is trained to your specification, you increase the likelihood of achieving a reliable, standards-based network that is designed and installed exactly as intended.

### **Common issues associated with residential design and installation**

To fully utilize the fiber optic infrastructure installed in the network, the home, MDU, or business must be wired correctly for network optimization. Just as we wouldn't expect a resident to have the knowledge necessary to install natural-gas distribution lines within his or her unit, we shouldn't expect the resident to design and install the structured wiring plan. Creating a document that outlines the minimum wiring requirements as defined by the EIA/TIA 570A Residential Telecommunications Cabling Standard is in the best interest of everyone. This document should be reviewed by the builders and developers as an aid in understanding the fundamental wiring requirements for modern, technology-driven living spaces.

### **Distribution Device**

Much like the main electrical distribution box in which all of the circuit breakers are located and the electrical

wiring terminates, the dwelling needs a central point for all of the internal cabling. At this central point, the cabling is terminated, administered and can aid in troubleshooting problems. The use of a 570A device is recommended for the distribution point. This device should be chosen based on several factors, such as the size of the building, the scope of wiring (such as security systems), and available options for future applications. There are many types of distribution devices on the market, but make no mistake, a building without a central point of administration such as 570A devices will not be compared fa-

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vorably to buildings with 570A devices.

### **Structured Media**

The days of the four-wire cable, daisy-chained throughout the building, are long gone. Today, the minimum recommended wiring media for each outlet is one category 3 cable for telephone or network connectivity and one series 6 coaxial cable for television or satellite distribution. Unfortunately, this minimum requirement does not support the most common network speeds available in most commercial offices and broadband properties. In addition, these minimums will not support the typical residents requirements for device connectivity, such as a telephone located next to the home office network computer, or in-home video signal distribution. Other media options include s-video connectivity, audio distribution, home automation wiring, and even wireless remote control distribution wiring. With these options in mind, it is best to provide a structured wiring recommendation that covers the most common wiring scenarios and provides an open line of communication for some of the more complicated wiring options.

### **Installation and Administration**

In choosing a wiring installation contractor and implementing an administration program, you need to consider the complexity of the wiring. More stringent wiring installation practices are becoming more commonplace as residential units are being wired much

like commercial buildings. And, with home automation and other wiring options, unit wiring can quickly become complicated. Some ways to alleviate confusion include using clear and easy-to-read electronic type labeling equipment and talking about the labeling system with the general contractor in advance. Consider requesting a complete hardcopy of all test results after completion of the project. When selecting a contractor, be sure to ask for references and information on completed past projects and scope, industry certifications and training programs.

### **Role of the Project Designer/Manager**

The one thing that can be counted on in every installation is change. By being prepared for change and addressing it at the beginning of the project, you can alleviate fear and concern about how to communicate change, and provide a well-established line of communication between the customer, installer, designer and any other personnel involved in the project. This ensures a more accurate budget and establishes a means by which to dynamically handle issues as they arise.

By being active in the project, and establishing an on-going dialog with installation personnel, you have the opportunity to view daily activities and obtain an inside view of any challenges as they arise. This is helpful not only in insuring adherence to the agreed upon

specification, but should also be incorporated into future designs, ensuring a continual quality improvement process.

### **Summary**

The versatility and unlimited bandwidth of optical fiber brings not only crystal-clear communications and entertainment to communities, but also life-changing applications, such as telecommuting, tele-medicine and distance learning. Industry leaders note that FTTx deployments are growing rapidly due to two factors - reduced costs for FTTx systems that place fiber on par with copper or coaxial cable, and increased demand.

However, a fiber to the subscriber network implementation can be a very detailed and difficult implementation. Project managers and network engineers must strive to blend the different styles and standards from the traditional cable television providers to the traditional telco providers to the structured wiring of the premise market. An accurate and cost effective design with an eye to the future will provide a strong foundation upon which to build. ■

### **About the Author**

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The old carpenter's adage of "Measure Twice, Cut Once" certainly holds true for fiber optic network deployment. After years of designing fiber optic networks, I've found that investing a little bit of time in up-front planning can save hundreds of hours of installation time and thousands of dollars in wasted equipment.