

**Extract from FTTH
Prism Magazine
January 2007
(Updated 4/12/2007)**



**FIBER-CONNECT
YOUR
COMMUNITY™**

Increase Return on Investment for Fiber-to-the-Home, Business, and Multiple Dwelling Unit (MDU) Deployments.

- ▶ Access ADVANTAGE™ System
- ▶ OptiCost™ FTTx Modeling Services
- ▶ NEW Innovative Products: AllWave® FLEX Jumpers and Fanouts, Ruggedized Splitters, and the ORBITAL™ Cabinet 288.



www.ofsoptics.com

John George is a regular contributor to The FTTH Prism and a long-time fiber optics industry veteran. His insider comments and understanding are always appreciated in these pages. Both John and David Stallworth work at OFS Optics, a Furukawa company.

Optimizing FTTH Economics through Intelligent Network Design

By John George, Director, FTTx Solutions, and David Stallworth, Manager of Fiber Network Design, OFS

Successful FTTH deployments can deliver an attractive return on investment if the first cost and life-cycle cost of the network is minimized, while preserving the ultra-high-bandwidth video and Internet capability of the network. While much attention is focused on the electronics and active optical elements of the network, the installed cost of the passive fiber network itself also deserves close scrutiny. The fiber distribution and drop part of the outside plant (OSP) network are economically sensitive to the choice of network

design and the method to connect the optical fiber elements. A cost model developed by OFS was used to analyze the cost of this critical portion of the network, and compare the total installed cost of various options. A key finding of this analysis is that a savings of over \$100 per subscriber is possible using an optimized network design and optimized methods to join fibers within the network

The fiber distribution and drop portions of the network are shown in Figure 1. In most FTTH designs, a single optical fiber supports up to 32 homes from the central office or head end. The fiber will reach a fiber distribution point (FDP) close to a neighborhood containing an optical splitter, or in some cases an Ethernet switch. From this splitter or switch will be a single fiber dedicated to each residence.

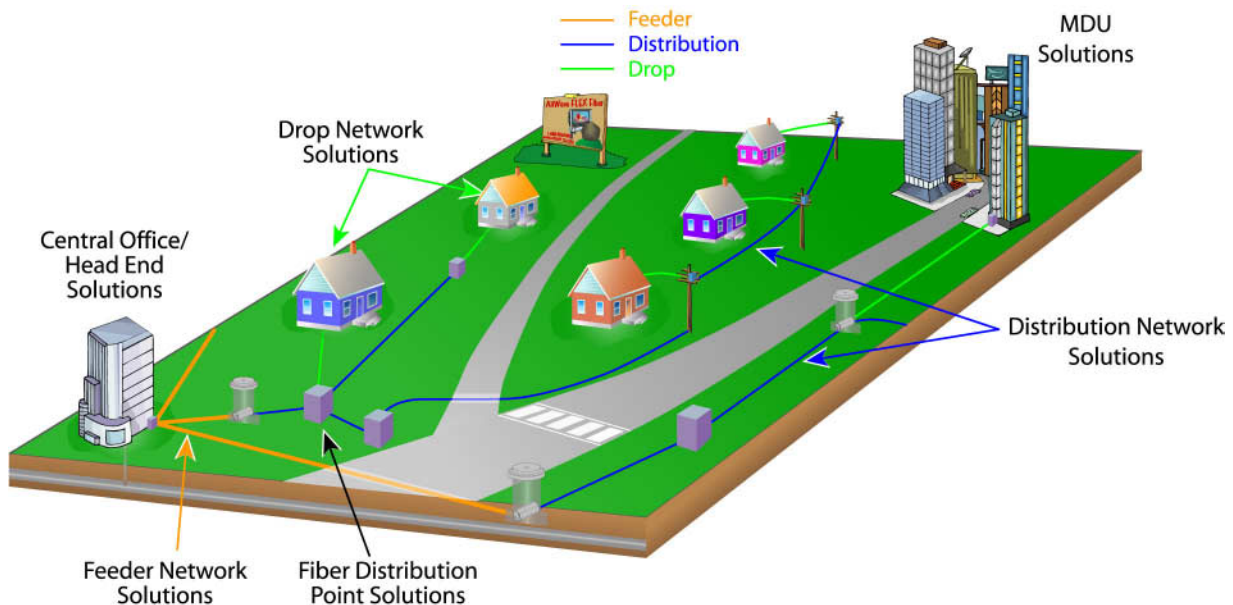


Figure 1 – FTTH Network showing Distribution and Drop

Optimizing the economics of an FTTH network requires three elements: intelligence about network elements, intelligence about how to place these elements in the field for maximum economy, and understanding the relationship between network element costs and customer dynamics such as take rate, geography, and labor rate. Gaining intelligence about these three elements can only be accomplished with a cost model that can reflect the cost accurately and has the capability of analyzing the effects of take rate, geography and labor rate.

A cost model developed by OFS can analyze customer specific dynamics and the cost of network elements simultaneously. The model can quickly provide customers with the cost of various design options. This model is divided into three sections: the top section identifies the network elements (cable, closures, splitter location, etc.); the middle section containing the variables such as material costs, geography, labor rate, take rate and contract placing costs; and the bottom section summarizes the cost on a dollars per subscriber basis and bar charts the costs of various network design options as shown below in figure 2.

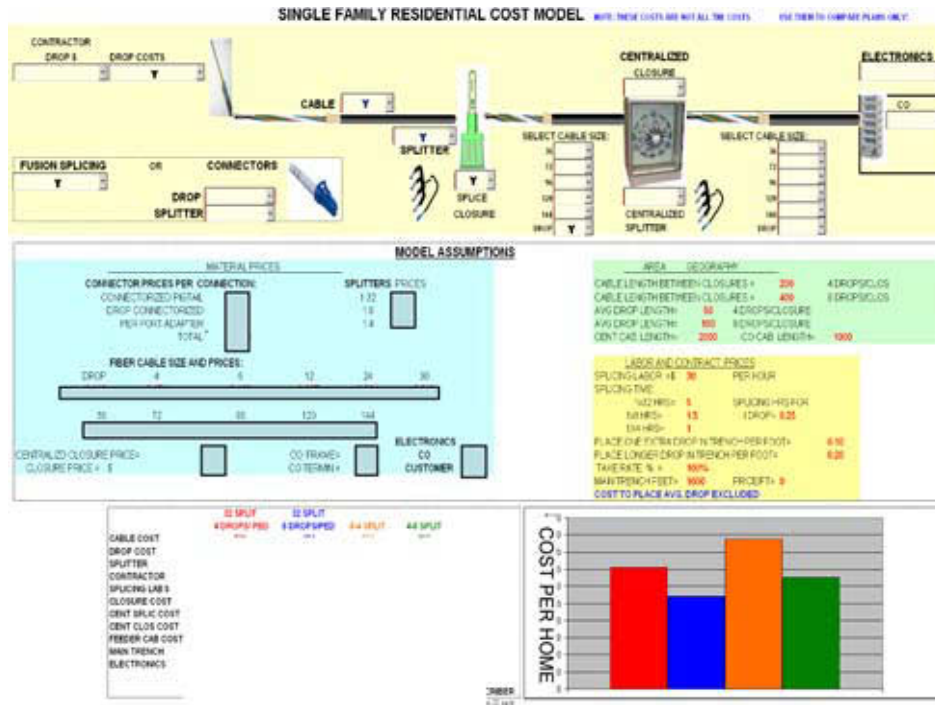


Figure 2 – Example output of OFS FTTH Cost Model

We will next analyze the installed cost of various options for the OSP plant distribution and drop networks. The drawing in Figure 3 shows one proposed design option for an ideal area of 40 homes that have lot widths of 100 feet. This solution calls for placing a cable along the south side of the street with a drop closure serving every four homes. The cable and drops are placed underground generally by a contractor. Ten drop closures are required for this design placed on every other lot line.

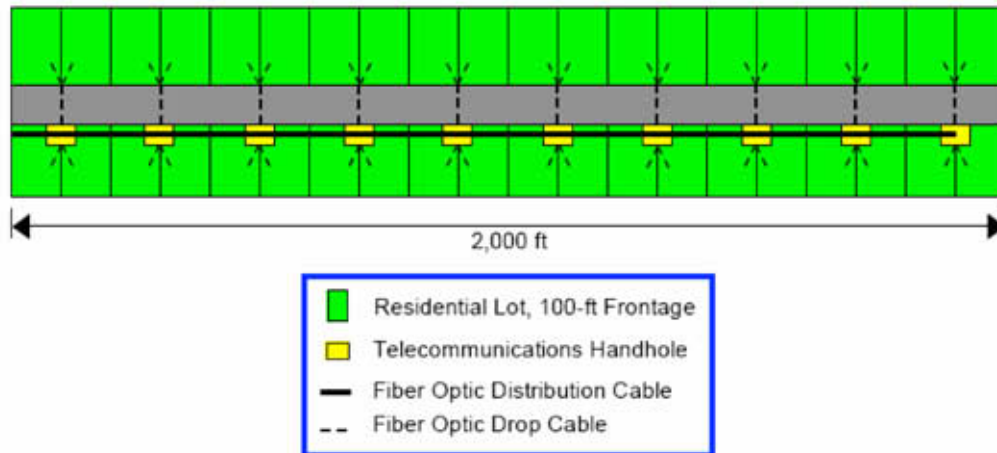


Figure 3 – Four Home per Fiber Access Point Design

The OFS recommended architecture for this same area is shown in Figure 4.

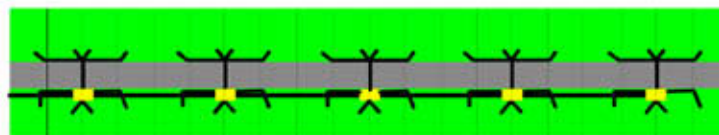


Figure 4 – Eight Home per Fiber Access Point Design

Notice that this design is quite different in that it has fewer network elements. Five drop closures are required in this scenario, half as many as in the previously described design. The model examined the cost of drop closures versus the cost of placing longer drops and fewer drop closures. Since the area is moderately dense (five-six homes per acre equivalent) the model recommended utilizing less closures and more fiber drop. After analyzing the model results, this recommendation is valid for lot widths up to several hundred feet. The reason is that the cost of the longer drops is more than offset by the cost of a drop closure and the associated contract placing cost as well as splicing costs. This design provides the most economical design because the number of network elements is reduced, especially for the more costly elements. More fiber drop is proposed but this is a relatively inexpensive part of the overall costs, especially compared to the drop closure. Reducing the number of closures in half has other advantages as well. It has been our experience that the fewer the sheath openings, whether in the field or in the factory, the lower the overall maintenance

will be over the years. Also, after all the drops are placed, the fusion splicing used in this network will maximize network reliability. Maximum network reliability reduces life cycle cost by preventing costly truck rolls, and increases customer retention by avoiding service disruptions. The fusion-spliced system provides additional benefits

- Easy network testing and fault location using conventional test equipment;
- Lower optical loss and lower optical reflections, to support longer reaches and improve video quality, compared to connectors;
- A continuous optical path with no risk of dirty connections degrading service support to customers;
- Faster installation, easier supply chain logistics, and fewer truck rolls for common distribution cable usable throughout the network.

An alternative design to the fully fusion spliced network is the terminal distribution system.

This approach utilizes factory-terminated distribution cables, factory-terminated drop terminals, and factory-terminated drop cables. The factory terminated distribution cables are custom built for each street based on a precise survey of the distance between poles or hand holes on the street, enabling the factory splice points and terminals to align with the poles or hand holes.

Tables 1 and 2 show a cost analysis of the OFS proposed conventional fusion spliced design and the terminal distribution system, for the 40 home models described above.

Notice that the conventional fusion spliced design provides the lowest total cost – saving \$49 to \$87 per home passed and \$47 to \$70 per home connected, for a total savings of \$96 to \$157 per home in this analysis. However, one should not just look at the initial costs but also the long term ramifications of the design choices discussed previously. The OFS OptiCost model proposed fusion splicing in lieu of outside connectors for the splicing of the drop to the distribution cable, compared to using connectors for this junction in the competitor's plan. Experience has shown that whenever a fiber is fusion spliced, the likelihood of a failure is decreased compared to fibers mated through a connector.

Taking this fact into account in the above plans, a lower maintenance cost may result with the conventional fusion spliced design. Fusion splices have proven to be extremely reliable, with a 25 year record of reliable service in long haul and metro networks.

Fiber Distribution System Passing Homes

	Terminal Distribution System	Terminal Distribution System	Fully Fusion Spliced System
	4 homes/drop terminal	8 homes/drop terminal	8 homes/splice closure
MATERIAL			
2000 ft dielectric 48 fiber loose tube cable	0	0	\$840
Custom Terminal Distribution Cable with Factory Installed Sealed Access Points and OSP Multifiber Connectors	\$3,590	\$2,559	0
Fusion splice closure (re-enterable, each)	0	0	\$150
Factory connectorized sealed terminal (each)	\$150	\$250	0
Number of Access Points Required	10	5	5
OSP Connectorized Sealed Terminals (NPV. With the TDS the terminal cost is assumed to be deferred an avg of 2 years for the 4 home per terminals case and 1 year for the 8 home case)	\$1,134	\$1,087	0
TOTAL MATERIAL COST	\$4,724	\$3,646	\$1,590
PER HOME PASSED	\$118	\$91	\$40
LABOR			
Precise access point location survey, ordering, logistics management of custom terminal distribution cable	\$500	\$500	0
Distribution Cable Installation	\$8,000	\$8,000	\$7,500
Terminal Installation Time (hrs)	0.2	0.2	3.5
Number of Terminals	10	5	5
Loaded Labor Rate (high labor cost SP)	\$35	\$35	\$65
Loaded Labor Rate (most other FTTH deployers)	\$25	\$25	\$40
TOTAL LABOR COST (high labor cost SP)	\$8,570	\$8,535	\$8,638
TOTAL LABOR COST (typical labor cost)	\$8,550	\$8,525	\$8,200
PER HOME PASSED (high labor cost)	\$214	\$213	\$216
PER HOME PASSED (typical labor cost SP)	\$214	\$213	\$205
TOTAL COST TO PASS Homes (high labor cost)	\$13,294	\$12,181	\$10,228
TOTAL COST TO PASS Homes (typical labor cost)	\$13,274	\$12,171	\$9,790
TOTAL COST Per Home Passed (high labor cost)	\$332	\$305	\$256
TOTAL COST Per Home Passed (typical labor cost)	\$332	\$304	\$245

Table 1

* The analysis and costs in tables 1 and 2 are general estimates and results may vary based on variations in the assumptions for specific deployments. Maintenance and inventory cost premiums are present value for a 10 year period.

Fiber Drop Connection to Home

	Homes per Terminal or Closure	Ruggedized Connector Drop (Terminal End) Fusion Splice (ONT End)	Ruggedized Connector Drop (Both Ends)	Fusion Spliced (Both Ends)
Avg Drop Length (ft)	4	75	75	75
	8	125	125	125
MATERIAL	4	\$ 53	\$ 81	\$ 19
	8	\$ 61	\$ 89	\$ 27
Labor hrs		1	0.4	1.5
Rate/hr (high labor cost SP)		\$65	\$35	\$65
Rate/hr (most other deployers)		\$40	\$25	\$40
LABOR	High Labor Cost	\$65	\$14	\$98
	Typical Labor cost	\$40	\$10	\$60
Maintenance cost premium	High Labor Cost	\$68	\$68	\$0
	Typical Labor cost	\$49	\$49	\$0
Inventory cost premium		\$3	\$5	\$0
TOTAL	High Labor Cost	\$ 186	\$ 163	\$ 117
4 Home Case	Typical Labor cost	\$ 142	\$ 140	\$ 79
TOTAL	High Labor Cost	\$ 194	\$ 171	\$124
8 Home Case	Typical Labor cost	\$ 150	\$ 148	\$87

Table 2

Outside connectors must be cleaned every time they are exposed to air. Therefore, a \$49 to \$68 maintenance cost advantage per home is estimated for a fully fusion spliced distribution plant, based on the present value of the savings for a 10 year period. Fusion splicing keeps technician hands out of the plant and the overall troubles are decreased dramatically. With fusion splicing, a fiber ends are welded together that is dedicated to a home and this generally provides the most reliable network possible. Customer satisfaction is also at its highest when troubles are minimized and this can prevent migration from one service provider to another.

One advantage of the Terminal Distribution System and that is speed. Such a system can increase deployment velocity for passing and connecting homes. Service providers desiring to pass many homes quickly with a limited labor force may be willing to pay the premium for the Terminal Distribution system.

In summary, developing an in-depth understanding of the cost relationships between the network elements of FTTH and where to best place them in the network can provide the most economical network both initially and for the long term as well. The intelligent mix of the labor force and material can only be accomplished by examining the customers' dynamics such as labor rate, take rate, housing density along with the proper design choice. In the specific comparison examined for the distribution and drop portions of the FTTH network it was found that a Fusion Spliced design provided the lowest cost both for material and labor as well as total cost - saving \$49 to \$87 per home passed and \$47 to \$70 per home connected, for a total savings of \$96 to \$157 per home. The lower first cost, improved reliability, improved optical performance and video quality make the fusion spliced network the most economical choice for most FTTH deployments.