

# Distributed Splitting For Rural FTTH Deployments

To make rural fiber deployments economical, place splitters in the field and position them in locations that minimize the use of fiber.

By David Stallworth ■ OFS

Even though most of America's geographic area is sparsely populated, very little research has been done on the best ways of deploying fiber to the home in rural areas. Serving scattered customers in rural areas challenges typical methods of deploying FTTH, such as placing splitters in cabinets or "home running" fibers with splitters in the central office (CO). These methods, which may work well elsewhere, are not cost-effective in rural areas, where they result in long lengths of fiber between customers, increased splicing requirements, increased installation time and reduced reliability.

## DISTRIBUTED SPLITTING MINIMIZES FIBER CABLE SIZES

In a sparsely populated area, it makes sense to move the splitter as close to the home as possible to minimize the lengths of the 32 output fibers and maximize the length of the single input fiber. This method, known as distributed splitting, can be accomplished by placing splitters in splice cases with fiber drops to eliminate the need for separate housing.

Distributed splitters are also better for accommodating unplanned growth, because they can be installed in the right spots to handle growth. Cost models illustrating the advantage of distributed splitting over other options are available but beyond the scope of this article.

Distributed splitting has additional economic benefits if the splitter is fusion spliced into the network at the outset. Fusion splicing offers several benefits over connectorization: It reduces opti-



**SUMMIT**  
**2010**  
**BROADBAND PROPERTIES**  
*Preview*

*The Broadband Summit will feature presentations on rural FTTH technology, policy and development – including a full day of sessions sponsored by the Rural Telecommunications Congress.*

cal loss and increases a network's overall reliability by eliminating connectors and jumpers that can cause problems. In addition, fusion splicing the splitter initially reduces installation time because the installer does not have to visit the splitter location. Finally, connectorized drops are often infeasible in rural areas because houses are often far from the road. This method creates no more splicing than placing splitters in cabinets or in the CO, as cabinet inputs and outputs must also be spliced initially.

## USING TWO LEVELS OF SPLITTERS

The graph in Figure 1 compares the cost of a 1 x 32 splitter and cable with the cost of a 1 x 4 splitters feeding four 1 x 8 splitters and cable. Although both options provide 32 outputs, they use different split techniques to reduce cable size. If 32 customers live within about 5,000 feet of one another, the 1 x 32 splitter

is most economical. If, as in rural areas, the 32 customers are spread out over more than 5,000 feet (or 1 mile), the cable cost saving offsets the additional splitter cost and the 1 x 4/1 x 8 option becomes more economical. The farther apart customers are, the more economical the 1 x 4/1 x 8 option becomes.

Another alternative is to use a 1 x 8 splitter to feed eight 1 x 4 splitters. Although this alternative is slightly more expensive (between \$5 and \$10 per customer), it may offer a more attractive alternative by bringing splitters closer to homes, depending on how the population of a rural area is distributed.

Using full-spectrum splitters that allow the passage of all available frequencies in the fiber cable is essential. In addition, because fiber has an inherent water-peak problem at certain frequencies, the fiber deployed in all parts of the feeder and distribution cable should

### About the Author

*David Stallworth is the design and product manager at OFS, a manufacturer of optical fiber and connectivity solutions. You can reach him at 770-798-2423 or by e-mail at [dstallworth@ofsoptics.com](mailto:dstallworth@ofsoptics.com).*

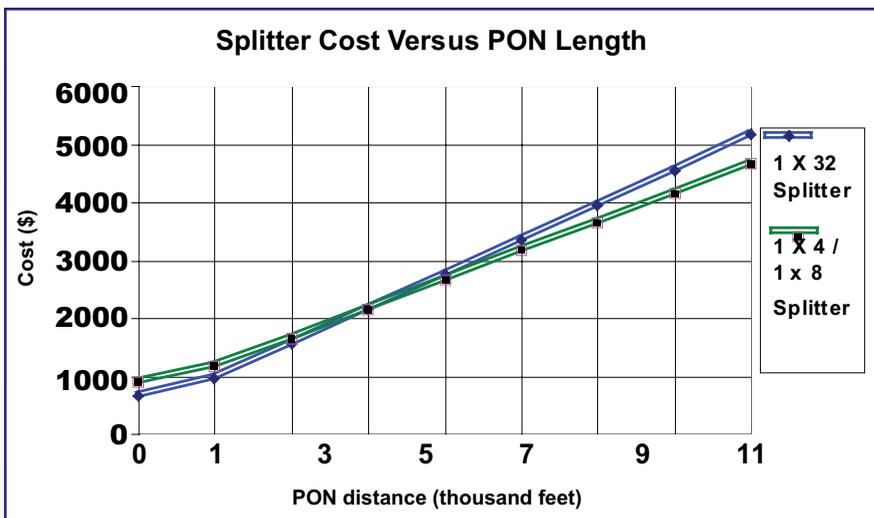


Figure 1: As the distance between customers increases, a two-level splitter arrangement becomes more economical.

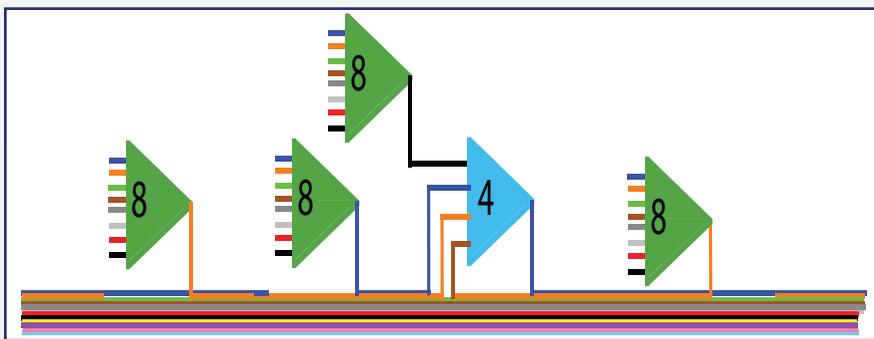


Figure 2: Cutting and reusing fiber minimizes the number of fibers required to serve a given area.

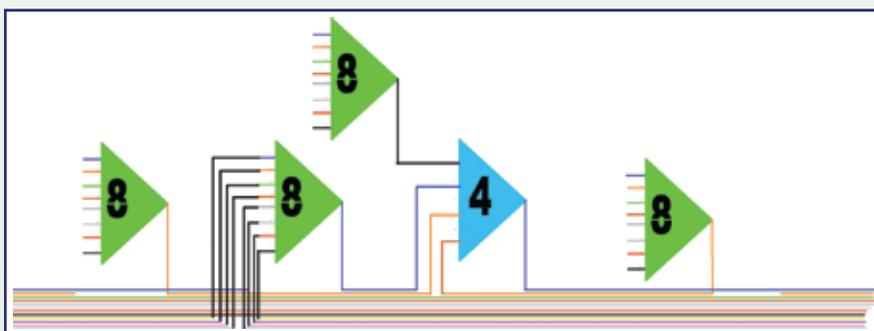


Figure 3: When customers are too far from the splitter to be served with drop cables, distribution cables can be cut to serve them.

equal or exceed zero-water-peak fiber standards. Failure to do this will require cable reinforcement in the future.

## MAXIMIZING THE USE OF FIBER

Modeling the FTTH network yields some interesting discoveries that are unique to this technology. The splitter turns one fiber into as many as 32 ports anywhere in the network. Proper plan-

ning makes accommodating up to 352 living units on a single 12-fiber buffer tube possible. The key is the location of the splitter. (Of course, more than 12 fibers may be needed in a rural area; the 12-fiber case is simply an example.)

In general, the most economical place to put a central office, node, splitter cabinet, distributed splitter or drop closure is in the middle of its serving area because

a central point of origin minimizes the amount of fiber required to reach all the endpoints. Figure 2 shows the splicing of the splitters in a 1 x 4 arrangement. The 1 x 4 splitter is represented by the blue triangle and the 1 x 8 splitters are represented by green triangles.

Notice that once the blue feeder fiber entering from the right is spliced to the 1 x 4 splitter, the rest of the fiber is dead and available for reuse. The dead blue fiber is reactivated (shown emerging from the left of the 1 x 4 splitter) and spliced to one of the 1 x 8 splitters down the route. Once it is cut at the 1 x 8, it is reused again for distribution out of the 1 x 8. Conserving fiber in this way helps drive down the cost of rural deployments. With this arrangement, it is now possible to serve up to 352 customers if none of the 12 feeder fibers is used for distribution other than dead fibers previously used for feeding a 1 x 4.

If additional distribution fiber is needed to reach more of the 1 x 8 splitters, another fiber can be cut in two, attached to two different ports of the 1 x 4 splitter and used to serve two 1 x 8 splitters. (See the orange fiber in Figure 2.) Doing that avoids having to use two separate fibers to serve the two 1 x 8 splitters. OFS studies indicate that using these methods allows fiber deployers to approach the cost of using copper or coax in rural areas – making FTTH technology a viable rural candidate.

Although the 1 x 8 splitters deployed at the second level may be suitable for clusters of homes, they will be challenging to use in sporadically or sparsely populated areas. In such areas, some of the 12 feeder fibers must be used for distribution from the 1 x 8 splitters, further reducing the maximum number of customers served. Smart placement of the 1 x 8 splitters can minimize this impact. If the eight customers are spread out, fibers can be cut at the 1 x 8 splitter and the outputs fed to the customers via the cut fiber.

In Figure 3, four fibers were cut at a 1 x 8 splitter, and both sides of the cut fibers were used for distribution. This is the extreme case and is not normally necessary, as the splitter should

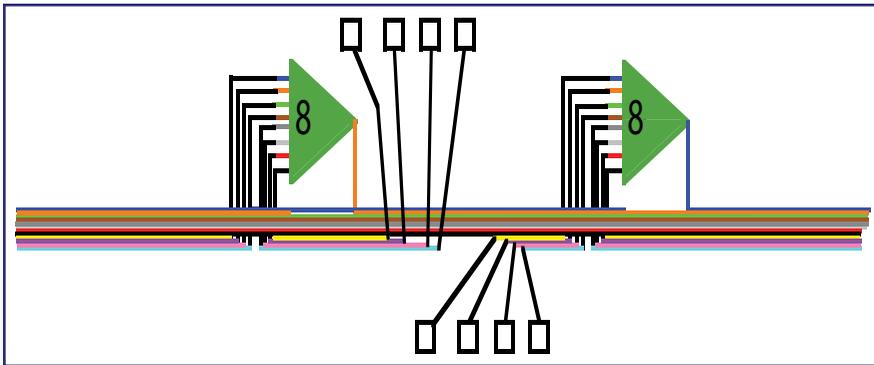


Figure 4: Once distribution cables have been cut and spliced to drop cables, they can be reactivated and used for further distribution.

be within reach of at least one customer who could be served with a drop directly out of the splitter.

These same fibers can be used for distribution from the next 1 x 8 splitter, as they are dead once they have been spliced to a drop to serve a customer. Remember that the dead blue fiber can also be reused for distribution downstream from the splitter.

Figure 4 shows the distribution deployment using fibers in the cable to illustrate this concept. The houses served are on different sides of the street for illustrative purposes and can be randomly distributed between the two splitters.

Figure 5 shows the alternative arrangement – a 1 x 8 splitter feeding eight 1 x 4 splitters, with the 1 x 8 splitter positioned in the middle so fibers can be cut to feed the 1 x 4 splitters in both directions.

This configuration allows service of up to 288 customers with a single 12-fiber buffer tube. However, the 288 maximum does not allow for distribution fibers from the 1 x 4 splitters, which can be a problem in rural areas. Providing for distribution fibers in the buffer tube reduces the number of customers who can be served. However, only one fiber

at a 1 x 4 splitter needs to be cut to provide distribution for two of the four 1 x 4 output ports. Down the cable, dead fibers should be available to distribute from the third port of the splitter. The fourth port could serve a customer directly out of the splitter and would not need to be in the cable. This would drop

***Strategic location of splitters and reactivation of feeder and distribution cable for use downstream from the splitters helps reach a maximum number of customers with a minimum amount of fiber optic cable. These techniques make fiber deployment in rural areas economically viable.***

the capacity from 288 to 256 customers, still a good amount but less than the 1 x 4 option discussed previously. Another option is to serve two 1 x 4 splitters directly out of the 1 x 8 in the same closure and save a fiber for an additional PON downstream.

These options provide ways to serve

rural areas using either 1 x 4, 1 x 8 or a combination of both. There is nothing wrong in mixing these two along a route if necessary. Using two different strategies in the same route does tend to complicate things but not terribly much. This option may seem difficult, but it is only different.

## FREQUENTLY ASKED QUESTIONS

### What about record keeping?

The technique described makes record keeping important but not impossible. Using the 911 addressing process, a deployer can assign a name to each splitter location. (A similar technique is often used in the copper world for tandem crossboxes.) In rural areas, maintaining accurate records is paramount because the facilities are scattered over a large area and technicians must know where everything is located to reduce wind-shield time.

### Will growing bandwidth be more difficult if the splitters are in the field, rather than in a cabinet or a CO?

No. The new 10GPON standards indicate that bandwidth will be increased by using more frequencies. This trend will continue in the future. Bandwidth growth will involve changing the

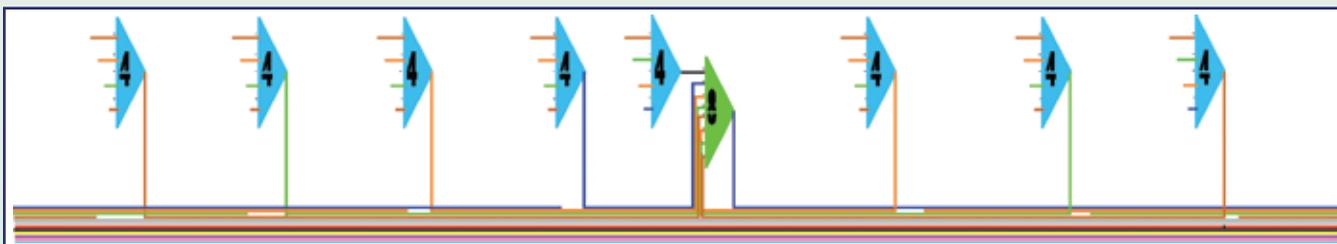


Figure 5: Fibers can also be cut and reused when the eight-way splitter is at the first level.

electronics on both ends of the fiber, rather than reducing split ratios. This makes it possible to button up the outside plant and leave it alone.

Each available frequency has a 129-terabit capacity, so what need is there for manipulating the outside network? Designing the network appropriately at the outset offers the capability to extend the life of the plant, significantly reduce outages and maintenance, increase revenue because of high reliability, minimize the number of maintenance technicians, better utilize investment by activating dead fibers and minimize optical loss.

### Is a cabinet needed for testing?

No, and here is why: Most of the troubles encountered will be confined to a single customer. There are 32 customers beyond the splitter. If one customer calls in with a problem, the location can be quickly determined by observing the other 31 customers' signals. If they are working, the trouble is probably unique to the caller

*Because rural FTTH deployers have few competitors, take rates tend to be high and splitters are more fully populated. This is another reason distributed splitting is more attractive than centralized splitting in rural areas.*

(a cut drop cable or an ONT failure). A technician can go to the customer's location and perform tests from the ONT if necessary. A cabinet is not needed; in fact, it can add to the potential for trouble because it contains failure-prone connectors and jumpers.

Electronics vendors have excellent management systems that monitor the health of every ONT in a network. That information can be used to determine trouble resolution. In addition, test equipment vendors have excellent test gear on the market today that can test through a splitter if necessary.

### CONCLUSION

In summary, moving the splitters close to homes in rural areas makes sense economically and operationally, although it requires some adjustment in thinking. Rural areas generally have few competitors and generate high take rates – another reason distributed splitting is more attractive than using cabinets or home-running fibers. Bringing broadband to rural areas is expensive, but this method helps reduce the cost impact compared with other alternatives and provides a unique way to handle growth that was unplanned. **BBP**



**Downspout Raceway**  
*Hide your cabling in plain sight*

**Crown & Cove Molding Systems**  
*When ordinary raceway won't do*

[www.GoMultilink.com](http://www.GoMultilink.com)  
[Sales@GoMultilink.com](mailto:Sales@GoMultilink.com)  
440.366.6966

**Multilink**  
Innovation At Work