Say Goodbye to the Splitter Cabinet

Fiber optic network designers traditionally designed outside-plant networks to look like the copper networks they replaced. Changing cost structures are making this design obsolete.

By David Stallworth

or the last eight years, I have closely followed the costs of deploying fiber to the home and tracked how those costs affect operators' overall cost structures. To configure the most economical outside-plant (OSP) FTTH network, one must take all these costs into account, together with take rate, labor rate and density - three factors that, I have found, affect FTTH economics more than any other outside factors. I am still surprised

how little is heard about these factors from the vendor community, consultants or engineering companies. In many cases, vendors or consultants commit to a single design strategy and stick with it even if the take rate, labor rate or changes in cost relationships suggest a switch to a different strategy.

THE ECONOMICS OF OSP

As I've discussed in earlier articles in this magazine, there are three major approaches

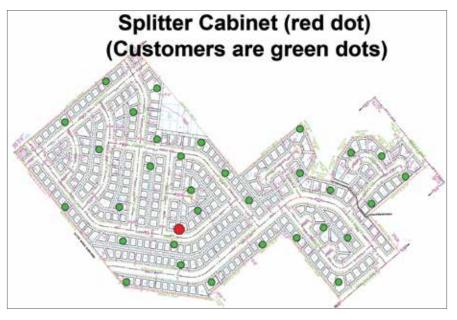


Figure 1: A centralized splitter cabinet can serve several hundred customers over a large area.

to designing outside plant for PON systems: locating all optical splitters in the central office or node; placing large, centralized splitter cabinets in the field; and distributing splitters in drop enclosures, one per PON. Until recently, each approach offered advantages for certain types of deployments.

Today, however, there is no longer any economic reason for placing optical splitters in a cabinet (also called a fiber distribution hub, or FDH).

You heard it right. There is no justification from an economic standpoint to place splitters in a cabinet in the field. Typically, such a cabinet

Placing splitters in a centralized field cabinet helps reduce electronics costs – but FTTH electronics are so inexpensive today that this advantage no longer matters much.

serves several hundred units, and multiple splitters can be placed in each one to serve the customers in a large area. This is why they have become obsolete:

A splitter cabinet can efficiently utilize the ports on an optical line

How Take Rate Affects OLT Cost per Subscriber \$2,500 \$2,000 \$1,500 Incremental OIT electronics cost per \$1,000 subscriber \$500 \$0 90 50 40 30 10 100 20 Take rate (percent)

Figure 2: Incremental OLT port cost per subscriber as a function of take rate Source: David Stallworth

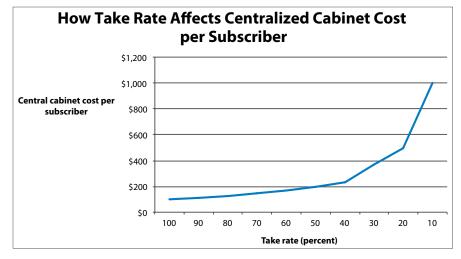


Figure 3: Centralized cabinet cost per subscriber as a function of take rate Source: David Stallworth

terminal (OLT) in the central office or node. OLT port cost should be considered part of OSP cost, as OSP design affects the number of OLT ports in a network.

Consider Figure 1, which shows a centralized splitter cabinet that serves a large area.

As customers are added in this area, splitters and OLT ports can be added as needed. For example, the first splitter can serve the first 32 customers, and a second splitter and OLT port will not be needed until the 33rd customer is acquired. By contrast, if splitters are distributed in small enclosures throughout the field, each will require a separate OLT port from the outset even if the splitters are not used to capacity.

It is easy to see that a splitter cabinet can postpone investment in OLT ports, but how much should an operator spend for a splitter cabinet in the field to save OLT port cost? This is an important question to ask because the *total* cost of the network must be considered.

The OLT is a required part of the network because it provides the light for the system to work. It is not optional. OLT cost per subscriber depends on the number of subscribers using each OLT port. That cost is minimized when each port serves a full 32 customers. The incremental cost is the difference between the cost at 100 percent take rate (that is, with each OLT port serving 32 customers) and any actual lower take rate. Figure 2 depicts this relationship, and you can develop a similar cost chart based on the cost of your OLT.

Note that at 100 percent take rate, the incremental cost is 0 – that is, OLT port cost per subscriber is minimized –

TECHNOLOGY

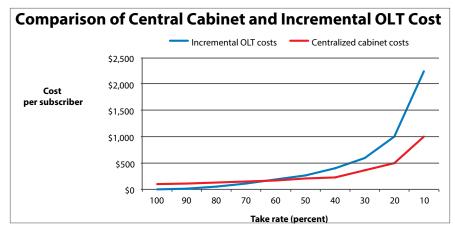


Figure 4: Additional OLT costs incurred with distributed split architecture versus cabinet costs incurred with centralized cabinet architecture

Source: David Stallworth

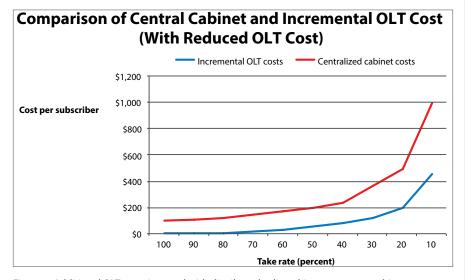


Figure 5: Additional OLT costs incurred with distributed split architecture versus cabinet costs incurred with centralized cabinet architecture, assuming reduced OLT costs Source: David Stallworth

and the incremental cost per subscriber increases as the take rate declines. To chart this cost for your own network, first calculate the OLT port cost for a single, 1 x 32 splitter when the port is connected to 32 subscribers, then reduce the number of subscribers while keeping the OLT cost constant. (Items such as the chassis that holds the OLT are a common cost and can be ignored – the OLT card itself is the item under discussion.)

Now consider the cost of a splitter cabinet, including all its components –

the cabinet itself, the concrete pad, the handholes, the conduit, the right-of-way, the landscaping and so forth. Add in the cost of the larger distribution cables needed to support a large cabinet, as compared with, say, the cables needed to support a distributed split design that can handle the same number of customers. For example, a distributed split design can support 256 customers on a single 24-fiber cable, but supporting those same customers from a centralized splitter cabinet requires about 288 distribution fibers.

The extra cost of the distribution cables – typically between \$50 to \$150 per home passed – must be added to the cabinet cost to arrive at a total cabinet cost for comparison. Figure 3 shows this cost as a factor of take rate.

Note that as the take rate decreases, fewer customers are available to share the fixed cost, so the cost per subscriber must increase.

Now the two charts can be combined as shown in Figure 4. At low take rates, operators can realize enough OLT port savings to justify the total cost of a cabinet, but at higher take rates, not enough efficiency in OLT port cost is gained to justify the cabinet cost. In this case, a distributed split design provides a more economical choice for the network.

As OLT port costs decline, the crossover point at which cabinets become economical also drops. A typical business case for FTTH requires a take rate of 30 percent to 50 percent to yield enough revenue to justify the expenditure. If the OLT port cost is low enough, the crossover point may be even lower than this range. This would eliminate the economic justification for cabinets.

Over the last few years, OLT port costs have dropped below \$50 per subscriber – sometimes significantly lower. Recently I have seen prices as low as \$25 to \$35, and I expect this trend to continue. Why? First, the number of ports on each card has dramatically increased. Years ago, there were two-port cards; then four-port cards became available. Today, 16-port cards allow the common costs of each card to be shared by more subscribers.

In addition, as more cards are developed and more vendors produce them, competition has brought prices down. Finally, improvements in technology have also driven prices down.

When OLT port costs drop to \$50 per subscriber, Figure 4 is replaced by Figure 5. The two lines no longer cross over, and there is no take rate that can support placing splitters in a cabinet.

Of course, if cabinet prices were also to drop, cabinet placement might

become economical again. However, this is not a likely outcome. The cost of the cabinet is not the only factor to consider; there are others, such as rightof-way cost, concrete pad cost, labor cost, and so forth, that are unlikely to fall. In addition, there is no way to reduce the extra splicing costs for a cabinet design compared with the distributed split design option.

CONSIDERATIONS OTHER THAN COST

That leaves only operational reasons to deploy a cabinet. Some network operators and cabinet vendors say cabinets are needed for maintenance testing, but testing a network from an endpoint at a subscriber's home is just as easy. Most troubles prove to be singles related to the end of the fiber or to connectors or jumpers.

Cabinets, because they contain connectors and jumpers, may be a place for troubles in the future. The two weak spots in a fiber network are connectors and jumpers, so why add more of them when they may not be needed? As well, a cabinet will inject optical loss in the network; connectors contribute at least about 0.25db per connector, equivalent to about 1 kilometer of fiber.

Nor do cabinets offer any clear advantage when an operator upgrades a network. Although the time to handle the splitter itself is minimized because of its accessibility in a cabinet, the windshield time involved in accessing customer locations may offset any gains. This trade-off was discussed in detail in an article in the October 2011 issue of this magazine.

The real problem is that network designers are used to having an interface between feeder and distribution cables, and sometimes changing thinking patterns is hard. Copper and coax networks have similar interfaces - in a copper network, a crossbox is placed between feeder and distribution, and in a hybrid fiber-coax network, an interface exists between fiber and coax.

Does that mean an interface is needed for fiber technology? The answer is no. There really is no

Operational advantages are often cited for placing splitters in a field cabinet, but these advantages don't hold up under close scrutiny.

compelling operational reason to place splitters in a cabinet. To provide new service through a splitter cabinet, a technician will always have to visit the cabinet, place a jumper from the splitter to the distribution fiber and test everything. This requires spending extra time with splitter cabinets in comparison with distributed splitting, in which a splitter can be spliced into the network initially and does not have to be visited for every installation.

THE DISTRIBUTED **ALTERNATIVE**

More and more companies are deploying distributed splitting, and they have developed innovative, highly economical ways to configure distributed splits that result in reliable, operationally sound networks. There are easy methods to provide 1 x 32 PON service to more than 256 customers with a single, 24-fiber cable in a residential area. Another method allows a designer to serve more than 352 customers with only 12 fibers.

Compared with the cabinet strategy, this method can reduce splicing by anywhere from 20 percent to almost 50 percent. Imagine the materials reduction achieved by decreasing the number of fibers from 288 or 352 to 12 or 24. This design method can be applied equally to high-rise buildings, campus-style MDUs, single-family areas or rural areas.

You can expect to see more companies deploy this architecture in the future, especially if WDM-PON becomes common. The electronics cost of WDM-PON will be extremely small compared with today's cost because WDM-PON splits wavelengths rather than power, so the electronics-versuscabinet trade-off will look more like Figure 5 – a "cabinetless" network.

Finally, there is a growing distaste for big, ugly boxes that the public can see. This problem will continue to grow, and some companies have had to switch strategies because of it.

It is still possible, of course, to place splitters in a central office or node. This was once an economically viable option for deployments with low take rates, compared with placing a cabinet within a few thousand feet of the central office or node. However, the same change in OLT prices that rules out cabinets as an economical option also rules out the central office or node option. Placing distributed splitters close to the central office or node may be economically justified, but good engineering judgment is needed.

In conclusion, I am not trying to push a specific design option, but I do think customers need to know the truth, even when it may hurt a little. I have no real preference, but I offer this information about distributed splitting because many people have not had the opportunity to study distributed splitting intensively. You may not hear much about it from the vendor community or even from engineering firms. Operators can certainly continue to deploy cabinets, but they need to understand that this decision may add hundreds of dollars per subscriber to the total cost. If funding is an issue, distributed splitting may be a solution to investigate further – as long as you can forget what you did in the past and embrace the natural advantages this technology offers. �

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