Preconnectorized Solutions: The Answer to Time Consuming Network Upgrades

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Fiber deployments are accelerating across the country, forcing operators to invest in a slew of expensive and time-consuming plant upgrades. In recent years, preconnectorized fiber solutions have gained traction across the telecom industry, and this paper explores the value and best practices of a preconnectorized deployment

The Alternative to Traditional Deployment Methods

FTTx deployments are increasing in pace across the country, as operators seek to connect more and more homes each year. Traditional methods of deployment (e.g., fusion splicing in the field) are either too slow, or too expensive, to keep up with demand. As a result, preconnectorized fiber solutions have become increasingly popular. By planning and designing in advance, time-consuming labor can be replaced by precision-manufactured solutions, which enable quick and cost-effective deployments to any number of subscribers. In this paper, we'll cover the necessary components of a preconnectorized FTTx deployment, and how it can unlock opportunity for operators and subscribers alike.

Stakeholder Commitment

Time and time again, preconnectorized fiber distribution solutions such as Corning's FlexNAP™ distribution system prove to be a lower total installed cost as compared to traditional, spliced networks. One example can be seen in Charts 1 and 2 (next page), which is the calculation of three different architectures on the same design area. This example validates the potential savings in your network. The time comparison for this example shows 34% to 45% savings in installation time over the two alternative architectures due to the manufactured, prespliced FlexNAP distribution cables, preterminated MultiPort terminals and hardened OptiTap® drops. The savings are also a result of a coordinated, company-wide system that complements the optical products.

The FlexNAP system requires a holistic approach to building a fiber-to-the-home/business network. Starting with planning and design, extra care should be given to these early phases as the premanufacturing of distribution cables requires precision that would normally be adjusted in the field during installation. While bulk cable allows for flexibility and on-the-fly changes in the field, it requires more time, labor, and splicing. This ultimately drives the total cost up, introduces risk in human error, and takes more time to serve the same number of potential customers. Therefore, organization-wide stakeholder buy-in ensures a successful FlexNAP fiber deployment – reaping several potential benefits by "measuring twice, cutting once."

Chart 1: Total Deployment Cost ($/HP)

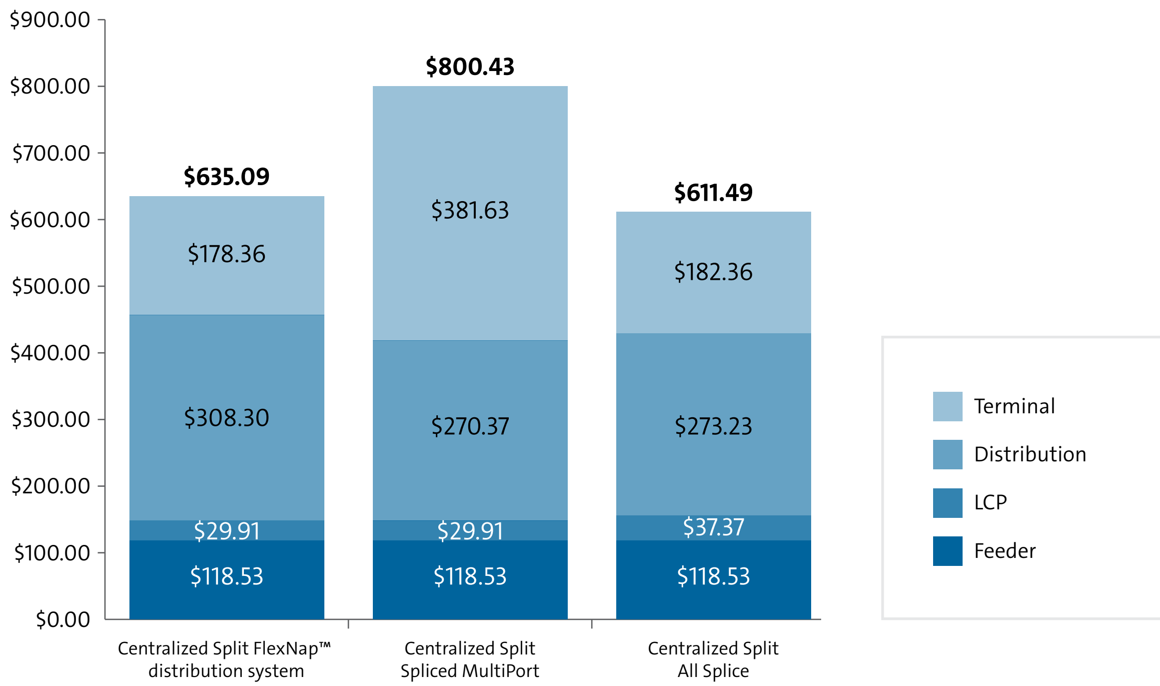

Chart 1 combines material and labor costs across each segment of the three architectures and displays the total cost per home. The displayed results facilitate a comparison of total costs (labor and material) for the three selected architectures.

Chart 2: Time to Pass All Homes

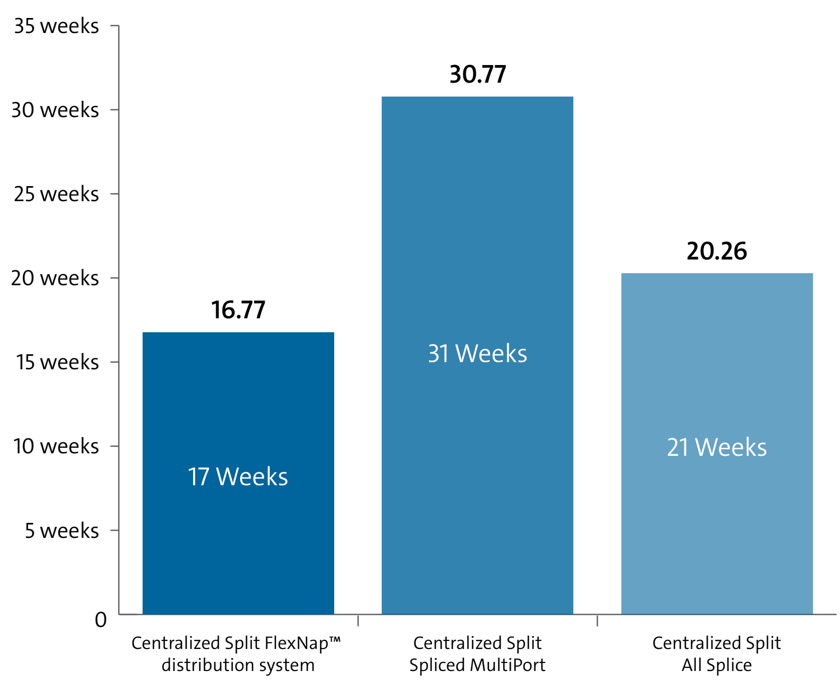

Chart 2 displays the number of weeks needed to deploy each of the three architectures and allows a side-by-side comparison of the time to pass the target number of homes.

As illustrated in Charts 3 and 4, the importance of detailed survey and design work comes before material orders are placed. This requires broad support and agreement upfront, which ensures the construction, and operations phases of a fiber build go smoothly. Stakeholder agreement includes leadership and many operational and administrative departments such as finance planning, engineering and logistics, as well as material, construction, and operations. Before the first customer can be connected quickly and smoothly, stakeholders need to agree to a holistic approach with modified processes and standards that maximize the savings of a FlexNAP™ system fiber solution.

Chart 3: Traditional Process

Chart 4: FlexNAP Process

Planning/Design Process

Once an organization has decided that a FlexNAP system is most advantageous, roles and responsibilities should be assigned and processes established. This starts with identifying an overall program or project manager. A program/project manager ensures each department or group is delivering on the agreed-upon timeline, in addition to solving issues and problems that prevent the smooth deployment of the fiber network. Additionally, people need to be assigned for planning, survey and engineering, construction, and operations. The overall direction and pace of the fiber build can be accomplished by breaking a large area down into segments or design areas, which enables workstreams to focus on manageable chunks. A planning process can also outline who collects existing information, identifies missing information that is collected during a field survey, and transmits that information to the design group. Before FlexNAP cables are ordered, installation crews are scheduled, or permits are acquired, early planning is needed to ensure the installation of a FlexNAP system happens as those materials are delivered. Without this first important step, a FlexNAP build can become stalled and disorganized, leading to a great deal of frustration.

Network designers and on-site survey crews can be in-house employees or can be contracted to third-party vendors. In either case, information from planning should be complete and consistent. This eliminates back-and-forth information requests and subsequent answers that prevent survey and design from beginning.

Design Rules and Criteria

Along with planning roles, responsibilities, and processes; design rules and criteria further enable designers and installers to execute within agreed upon parameters. Design rules include specific details about how materials should be designed to meet stakeholder expectations. Common design rules include limiting the number of cables that run parallel with each other, standardizing the capacity of terminals, the maximum length of drop cables, and/or the number of splitters to include in newly placed fiber distribution hubs. Design rules are important to avoid common pitfalls. For example, too many cables on the same path can create a headache for construction and extended drop lengths can slow down customer-install technicians.

Each broadband provider handles unique circumstances concerning pathway, labor, and customer demand. Design rules and criteria enable a fiber build to move forward smoothly so customers are passed and served, increasing revenue.

Preengineering and Design Process

With the organization in agreement on the overarching direction, as well as establishing the design rules and criteria, more focused engineering and design work can begin. This starts with gathering a complete set of existing infrastructure drawings to start the project. This allows you to create a realistic schedule, scope of work, and accurate bill of materials (BOM). Some of the basic existing system information may include the total plant mileage, total number of homes/businesses and the assumed take rate, reliable maps, and the design/drafting software platform available.

Understanding the geographic layout of the project is essential to determine the locations of key optical components, especially in larger projects. This understanding also informs likely expansion areas in the future, so that extra fiber capacity can be built in that direction today. Total homes passed and subscriber take rate determines how much capacity and cost to build into the plant today, as well as how much fiber to build in for future use. Reliable maps with current information are critical and enable a full predesign walkout in order to gather accurate plant and homes-passed data. Operators that have a high level of confidence that their maps are accurate may be able to forego this step, but FTTx design is very sensitive to using proper source data. Map inaccuracies, like additional homes, which may not be discovered until the construction phase, can impact the design and material order. You may need to install a custom fiber drop a long distance to find the nearest open optical port. If this problem is extensive, it can delay construction and add cost. Finally, it is a good idea to determine your choice of design and drafting software. Considerations include the cost of the software, as well as if you want to do the map maintenance yourself or have it contracted out. Today's standard is to have your plant drafted into a GIS platform, giving you the ability to quickly pinpoint outages, trace fiber connectivity, extract billing data, identify dark fibers, and create a list of homes within a service area.

With preengineering underway, it is important to determine the specific architecture and equipment before walkout and/or design begins. This helps to properly set the job up and gives instruction to walkout and design, avoiding potential rework and delays in construction. Customer density, proximity to the central office or hub, and customer familiarity and preference of equipment may all be factors. Is this a greenfield or brownfield build? In the case of a brownfield build, some existing fiber may be utilized for transport, lowering the cost of the build. In this case, it is necessary to have very accurate fiber documentation to make sure you aren't turning something off when you reallocate fibers to the new build. Like with the system prints, it is important to have accurate fiber documentation, as many organizations find that a fiber audit is also necessary. In a greenfield build, fiber can be laid out in the most efficient path — but it is also important to allocate extra fiber to likely areas of future expansion. Optical electronics is an important piece in determining the overall architecture, equipment placement, and construction phasing. Although the passive components of the network, including FlexNAP™, are not impacted, determining the manufacturer and model numbers of the passive optical devices and optical fiber you intend to use is also necessary for an accurate BOM.

Project scheduling is important and needs to be created and distributed. Detailed and attainable schedules issued beforehand allow buy-in from all stakeholders, giving them a clear understanding of schedule bottlenecks and milestones. It also establishes responsibilities to ensure the schedules are met. Some important things affecting the schedule are walkout, fiber audit, permitting, make-ready, and material ordering.

If it's determined that a system walkout is required, the scope of the field work, as well as the prioritization of the areas, needs to be carefully planned out. If the plan is to reuse existing fiber, a detailed audit of the existing fiber plant may also be required to make sure the fiber documentation is reliable. If there are any permits required, a plan must be put together to submit permit requests as soon as possible. Permit approvals may be a source of delay in placing aerial or underground cable, as well as optical equipment. For aerial placement, a discussion will be needed early on with the pole owners on the timing and cost for any potential make-ready needed. Extensive make-ready can heavily impact scheduling and costs. If lag times for equipment are excessive, a partial BOM can be estimated early in the process and an order placed, with the remainder being ordered upon completion of a final BOM. This should eliminate equipment lag times as a source of delay.

Transport and Distribution Design

The fiber between the central office/hub and the local convergence point (LCP) can be either newly installed or can utilize dark fibers inside of an existing fiber sheath. Either way, the design and fiber path must be documented. The LCP, also referred to as a PON cabinet or fiber distribution hub (FDH), drives the sizing of serving areas. When determining LCP size and location, decisions may be based on density and geography. LCPs should be in places that are fairly protected from road hazards, but also provide multiple paths to run fiber in several different directions. LCP size affects fiber counts and the amount of passive, and possibly active, devices in one location. Another contributing factor in transport and distribution design is the placement of active equipment in the field vs. in a central location like a central office. If the area to be served is close enough to the central office or hub, it can be designed and built with purely passive gear. However, this may require the usage of more fibers on the transport link. Areas farther out will require some optical amplification and will thus also need an AC power supply located nearby. This may require additional permits. This approach generally uses less transport fiber because the signals are amplified, then split, in the LCP.

Designing the fiber from the LCP to the subscriber's home is the most involved and time-consuming part of the engineering and documentation process. Standardized fiber counts for easy ordering, construction stocking, and warehousing can ease the overall logistical burden of a project. Serving special locations like multidwelling units (MDU) or businesses may require dedicated distribution fiber and specialized MDU active equipment. One network design can serve all these potential customers, but needs to be planned and designed from the onset of the project. Most customers prefer keeping the transport and distribution fiber in different sheaths, but they can be designed inside of a single sheath to save on over-lash or dual trench.

Fiber Drop Design

In an FTTx plant, we generally try to use design efficiencies. One of the ways we accomplish this is by aggregating the fiber drops to fewer terminal locations. There are several options, and the final choice is usually determined by customer preference along with a cost/benefit analysis of a few different factors. When no aggregation of drops is implemented, fiber drops are designed to run to the nearest pole or ped. This results in many more optical tap locations and can be much more expensive. Without drop aggregation, the drop portion is easier to construct, maintain, and troubleshoot. Another option is to aggregate drops one span in either direction. Fiber drops are run to the pole or pedestal, and then parallel to the distribution fiber up to one span in either direction to an optical tap. This is much more cost effective than it would be without using aggregation. In very dense areas, you may want to limit the number of parallel drops. Aggregating two spans may save more on optical taps in rural areas, but it may also make it harder to construct and maintain by having parallel fiber drops for this distance. This option does make it more likely to utilize all available fiber tap ports. When running underground drops under an aggregation plan, operators may choose to initially install 100% of the underground drops in drop conduit, so they are not forced to trench through someone's lot when a neighbor becomes a new subscriber later.

There are three different connectorization options for the drop portion of your plant—no preconnectorization of the drop fiber, connectorized on both ends, or connectorized on only one end. This decision is usually made by the operators based on their preference. Below are the pros and cons of each approach:

No connectorization: Fiber drop cable can be ordered in bulk reels and cut to length as needed, resulting in less drop cable stocking requirements. Each drop can be custom cut to length, resulting in very little waste and surplus. However, a fusion splicer may be needed for construction. If you also opt to do it this way for ongoing installation and maintenance, then a fusion splicing tech may be needed for these tasks. Higher loss field-installed mechanical connectors may also be an option.

Connectorized on both ends: Walkout needs to accurately gather fiber drop lengths, in order to come out with a detailed drop BOM. This may require a more expensive and time-consuming walkout. Typically drop lengths that are preconnectorized on both ends are available in 25-ft increments, resulting in complicated and extensive warehousing requirements. During installation and construction, each end just snaps in, meaning that no fusion splicer is required. This allows for faster installation using installers instead of fusion splicing techs.

Connectorized on one end: Like the option above, the walkout still needs to accurately gather fiber drop lengths, in order to come out with a detailed drop BOM with individual fiber lengths. Fibers are cut to length to come up with an efficient installation and spliced on only one end. A fusion splicer will be required for installations.

Run drops to subscribers only or to all homes passed: Running fiber drops to all homes passed is more expensive initially, but allows for less expensive, quick connections in the future. This is usually done only when the operator is confident of a subscriber take rate of nearly 100%. A fusion splicer may be needed.

Drop design rules are necessary for you to get the design you expect. In the case of maximum fiber drop length, signal loss is not a consideration. Rather, the difficulty of running a drop fiber over a long aerial or underground distance is a more likely determining factor. The maximum fiber drop length is usually determined by customer preference but may vary from aerial to underground drops. These will usually have to be custom cut to length but will save on running extra distribution fiber.

Material/Construction Management

As important as the planning, survey, and design phases are in the early stages; material and construction management are equally important to a successful network build. FlexNAP™ distribution cables are designed and manufactured for specific cable runs. Construction managers need to have the right cables for the right build areas, and this makes the management of material especially important. Likewise, installers need to have the appropriate construction prints to determine the correct path for each FlexNAP cable.

Conclusion

With the pace and complexity of FTTx deployments increasing, operators need to explore all avenues to save time and money when deploying a fiber network. Preconnectorized fiber distribution systems, like FlexNAP, offer the advantage of both time and cost savings. These savings are realized by reducing field splicing and traditional field cable access work. To maximize savings from a preconnectorized solution, specific consideration should be paid to planning and designing a fiber network. With organizational alignment around the preconnectorized methodology, we can ensure America gets fiber quicker, more easily, and with the capacity to serve future needs.

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