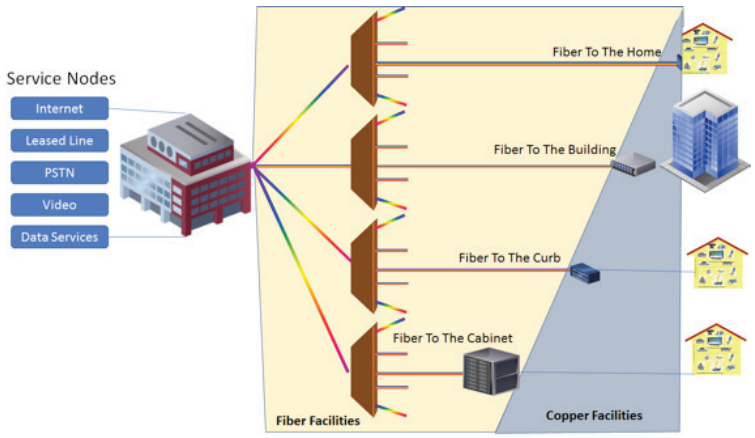
Automated fiber switching enables dynamic physical connectivity in network architecture and simplifies fiber based services provisioning. In large scale world-wide FTTx deployments, operators will benefit from significant savings in both capital and operating expenditures.

FTTx Coming Of Age

Fiber-to-the-X (FTTX) comprises the many deployment scenarios of the optical access network infrastructure. These include fiber to the home (FTTH), fiber to the premise (FTTP), fiber to the building (FTTB), fiber to the node (FTTN), and fiber to the curb or cabinet (FTTC).



The dynamics of these new networks are constantly evolving, making it difficult to identify the right network architecture. Additional flexibility, built into the central office, will enable the carrier to get the most out of the fiber, including the ability to use the same fiber to take advantage of any service opportunities that may arise in the future, such as servicing next generation wireless carrier fronthaul networks.

Staying competitive and guarding long-term profitability are two crucial drivers for carriers. To assure profitability, carriers must optimize their networks, and carefully control both capital and operational expenses (CAPEX and OPEX). While choosing products for deployment, they must keep in mind the products' total cost of ownership by considering not only the products' initial cost, but also future functionality.

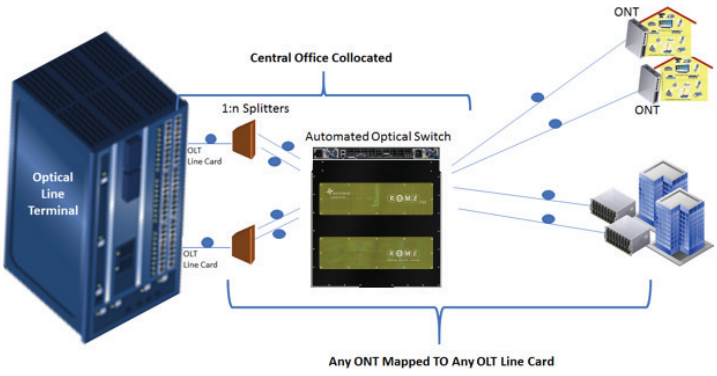
For example, at some operators today, if a craft-person intervention activity will take more than 30 minutes, management allows the installer to simply disable the current link and replace it with another. This can lead to a cabling facility nightmare, containing both used and unused fiber links, and after some years of service, an unmanageable network element. Today, an average of 9 connection points per subscriber are found inside a large CO (i.e. an office serving more than 50,000 customers). This large number is largely due to poor migration planning and poor documentation of existing fiber links. Not only is space wasted by excess fiber cables, but the total cost of owning and operating the equipment also increase.

Capex Savings Of Efficient FTTx Provisioning

The capital expense of active equipment accounts for about 33% of FTTx deployment costs. In fact, the primary benefit of a Passive Optical Network (PON) shared network architecture is that it enables carriers to spread expensive Central Office (CO) Optical Line Terminal (OLT) equipment costs across a larger pool of subscribers. In addition, the absolute value of CAPEX per remote Optical Network Terminal (ONT) is still high and obviously not feasible to be fully covered at fiber installation time.

Usually, the price offered for subscribers is much lower than carrier investment cost (CAPEX) per subscriber. In order to attract more subscribers, carriers typically apply pricing policies allowing for gradual payback of the investment from revenues during the whole lifetime of the network. Coupled with the fiber Outside Plant 20-year depreciation cycle, some carriers have responded to inefficient PON utilization CO OLT equipment by placing and collocating splitters in the CO. In this architecture, end users are connected to one of any PON splitters that is collocated in the CO. In this manner, splitters can be populated fully before additional OLT equipment must be purchased. Integrating the collocated splitter architecture with an automated fiber switch system enables a 100% utilization and controlled "pay-as-you-go" growth strategy to carriers.

After the carrier deploys the network and signs the first subscriber, it provisions an expensive OLT line card that is connected to the automated fiber switch system. The network manager connects the new customer's distribution fiber to the appropriate splitter via the automated fiber switch, automatically and remotely. A second subscriber signing up from any of the homes connected to the automated fiber switch system can be provisioned on the same OLT line card, via the automated fiber switch connecting the Distribution fiber to the appropriate splitter. That way, the first 32 new subscribers connected to the automated fiber switch system can all be connected to the first OLT line card that is connected to a CO collocated 1:32 splitter.



Therefore, the carrier can fully populate each PON Splitter **before** investing in an additional OLT Line Card.

In addition, subscriber Churn can be managed with this same architecture, with cancelled subscribers moved remotely from the lit fibers and new subscribers moved onto them. Load balancing operations can also be performed to spread high use subscribers efficiently across PONs, thereby delaying the need to upgrade to a higher-bandwidth technology. And when the time comes to upgrade to a higher-bandwidth technology, automated fiber switching can assist in grooming like users on PONs according to their bandwidth requirements, to make the transition easier.

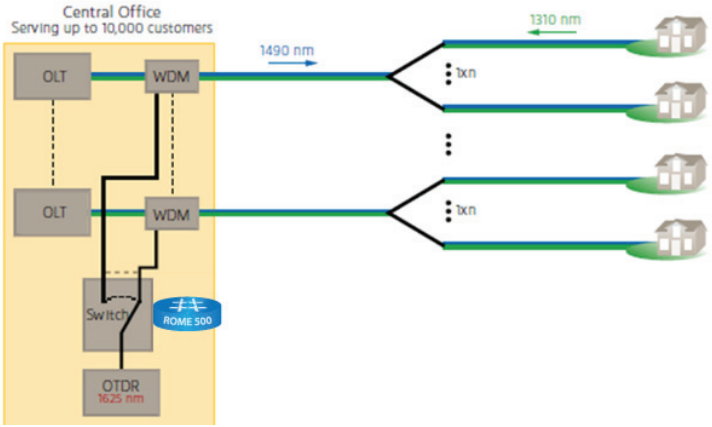
It is important to note that automated fiber switching products (e.g. the ROME product) ecosystem based architectures allows carriers to defer OLT equipment costs, and simultaneously dramatically decrease capex as well. The incoming Outside Plant (OSP) cables used for the FTTx network will have large fiber counts for accessing as many homes as possible. Since a major expense of any network is burying the OSP cable, OSP cable is typically sized to meet future service needs. For instance, reaching a neighborhood of 3200 homes, an OSP cable would minimally require 100 fibers (1 per 32 homes) based on full utilization of 1x32 optical splitters.

However, considering take rates, spare fibers, splitter usage, future service offerings, distance from the CO and other unknowns, the number of fibers in the OSP cable would more likely end up being closer to 1 per 8 homes, or 400 fibers. Also, these OSP cables will likely pass several other areas, including businesses and cell towers, providing even more opportunities over the same cable plant. Therefore, each fiber needs to be easily accessible from all areas of the network – not just the FTTx-designated equipment, which is an additional benefit of automated fiber switching.

Zero-Touch Provisioning

Carriers can also use automated fiber switching products to enable zero-touch provisioning, where they provision new subscribers without sending a technician into the field. In this scenario, carriers pre-connect Distribution cables to the customer location during fiber installation. When a new subscriber is ready to be provisioned, CO or Provisioning Center based personnel remotely cross-connect the appropriate splitter to the appropriate Distribution cable. The operator ships the ONT to the subscriber for self-installation, and the network auto-discovers the ONT as soon as it is connected to the network. Zero-touch Provisioning may save substantial costs in high-density scenarios such as Multi-Dwelling Units (MDUs), where entry rights are often difficult to obtain from landlords.

There are more than 30,000 central offices in North America, and the PSTN remains a $100 billion annual revenue business in the US alone. Increasing automation is a goal for traditional network service providers (e.g. Telcos) to lead them into the next evolution of value-added services. Provisioning OPEX savings can also result from testing multiple PONs with the same Optical Time Domain Reflectometer (OTDR) using an automated fiber switch to select the PON to be tested at the CO. This approach enables a single OTDR to handle testing for an entire CO.



Conclusion

Automated fiber switching systems can enable FTTx carriers to minimize time-to-revenue and labor requirements during provisioning, eliminate database mismatches resulting from human error, optimize capex and facilitate service turn-up testing and maintenance. Automated fiber switching products also significantly offsets other capital expenses such as OLT Line Cards, while simultaneously reducing operating expenses. This can deliver a return on investment (ROI) in less than two years, and improve the FTTx business case.

