WHITE PAPER

Adding New Video Services Warrants New Central Office Considerations

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Although it's fair to say the distribution and access elements within the outside plant (OSP) portion of the fiber-to-the-premise (FTTP) network demand the majority of attention during deployment, it's still important not to overlook implications to the central office (CO). Any FTTP network requires the same flexibility as the transport network—and it all begins in the CO.

ADC recently published an important white paper to address these issues entitled, Central Office Implications for Deploying FTTP. The paper can be found on ADC's website at www.adc.com/Library/Literature/1291110.pdf. Although these implications for the CO are no less important today, the addition of video services to FTTP network presents some additional challenges to the CO not previously addressed.

First, a review

Before discussing the unique challenges of video, it's important to briefly review the overall implications that FTTP has on the CO architecture—and the importance of making informed decisions in the early stages. The goal of network planners is always to minimize capital expenses and long-term operational expenses, while achieving the highest possible level of flexibility in the network.

Architectural decisions involve connection strategies between optical line terminal (OLT) equipment and OSP fibers, flexibility in terms of test access points, and WDM positioning. As discussed in the previous paper, a key requirement for providing flexibility evolves from ensuring full crossconnect capability. With all OLTs, as well as OSP fibers, connected at the fiber distribution frame (FDF), easy access and significant long-term network flexibility is achieved, enabling easy adds, moves, and changes to the FDF. Since the one constant in telecommunications has always been change, any assumption that the network will remain static can result in significant long-term capital expense and flexibility issues.

The second critical architectural decision involves placement of the video WDM within the CO environment. The video WDM combines the voice and data signals with video signals onto a single fiber—a key element of FTTP deployment. Again, with expense and flexibility in mind, ADC concludes that placing the video WDM in the crossconnect FDF line-up is the best option.

This is done by using patch cords to connect the OLT equipment to the inputs of the video WDM. A crossconnect patch cord connects the video WDM common port to the designated OSP port, providing an immediate advantage of requiring just three connector pairs while still maintaining maximum flexibility. With the video WDM located at the FDF and all OLT patch cords routed directly to the FDF, even greater flexibility is provided regarding how the OLTs are combined and configured. Any OLT is easily combined with any other OLT, regardless of CO location.

Factoring in the video

The addition of video signals now presents new challenges to the configuration of the CO in order to maintain the same flexibility and price points desired in deploying FTTP. The video overlay onto the FTTP network adds additional fiber cable management requirements. Also, in order to split the video feed to multiple PONs, additional optical splitting is necessary. Optical path protection switches are also incorporated where the video signal enters the service office from the video serving office.

From the video OLT, video signals will pass through several erbium-doped fiber amplifiers (EDFAs) used to amplify and split the signal. Each EDFA output will be further split by additional optical splitters to maximize the video output, allowing the most PONs to be served using the fewest number of EDFAs. Each EDFA can have up to four outputs, each with its own optical splitter, depending on signal strength.

The use of optical splitters is critical, but there are several placement options. For instance, the splitters could reside in either the OLT equipment frame or the fiber frame. Placing the optical splitter in the fiber frame enables even more flexibility. For instance, if a particular PON is located a considerable distance away, a stronger video signal would be required and the signal should not be split. By having the optical splitter in the fiber frame, a patch cord can be run from the EDFA to the fiber frame, thus bypassing the optical splitter and allowing a stronger video signal to go to that PON. This flexibility allows video signals of various power levels to reach PONs at various distances. These optical splitters would reside in the fiber frame in a chassis very close to the WDM chassis on the 1550-nm input side.

Assuming the office providing the video service is not the same office where the video signal originates, optical protection switching is also a consideration. Through diverse path routing, both a primary and protect video feed enters the optical protection switch in the video OLT equipment frame. The primary video feed throughputs to the video OLT, but should that signal drop below a preset power threshold, the system automatically switches to the redundant path, or protect video feed. The diverse path routing takes place at the transmission side where a 1x2 splitter creates two diverse signals. This basically provides SONET-like protection without all the electronics by using a splitter and an optical switch—much more cost effective.

Several important cable management considerations that apply in general to the FTTP network architecture will apply "in spades" when it comes to video signals. Since video signals are usually high-power analog, they require considerations for the use of angle polished connectors, connector cleaning techniques, and other cable management practices that contribute to signal quality.

Every network designer wants to get the most out of the existing electronics. In FTTP, that equates to getting the most PONs served and achieving the highest network flexibility for the least amount of expense. But the constantly-changing network still requires everyone to not only peer into the future, but design today's FTTP networks with the ability to adapt to the future.

Test access for the future

Testing the FTTP network is a serious challenge for service providers. Advanced FDF solutions are being adopted that enable remote test and monitoring functionality. With traditional FDF functionality, performing tests or troubleshooting problems requires breaking into a patch and basically taking the network out of service. But monitoring and testing capabilities can be incorporated into advanced FDF solutions that will enable remote monitoring and traffic identification, as well as reduce troubleshooting and fault isolation time. The net result is more efficiency, reliability, and cost savings.

By placing an optical NxN switch between the test equipment and the access port on the fibers, any fiber can be tested with any test equipment from the network operations center (NOC). For example, if contact is lost with several optical network terminals (ONTs), an optical time domain reflectometer (OTDR) trace can be performed over the particular fiber to isolate the fault. Performance monitoring tests can also be accomplished without having to dispatch a technician to the frame to manually perform testing.

Built-in diagnostics can identify problems within the electronic equipment, but to see what's happening within the fiber requires specific test equipment and non-intrusive access points. In any FTTP network, it's a point-to-point connection from the OLT to the customer. If there is a failure in that network, the customer is out of service—there is no redundant path available. Therefore, the ability to restore the network quickly and easily is absolutely critical. The addition of this single switch provides technicians with quick, easy, reliable access to the network—all of which greatly reduces network outage time and saves money.

Designing the CO to accommodate FTTP requires similar, if not more stringent, cable management and architectural attributes as any transport network. The video overlay makes even more demands on the CO in terms of efficiency, flexibility, and accessibility. Decisions made by service providers today will significantly impact the future reliability—and profitability—of their FTTP network. But with careful planning, future-proofing the CO is a good way to begin.

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