

DiamondWave® FiberConnect Revolutionizes Central Office Fiber Management

Introduction

Today's telecommunications central offices typically have hundreds or even thousands of optical fiber connections between the various pieces of equipment used to provide telecommunications service (intra-office fiber), and between this equipment and the fibers connected to adjacent central offices (inter-office fiber). These connections are made on manual, unmanaged fiber distribution frames and patch panels. The manual maintenance of these connections is labor-intensive and represents a significant operational expense. In addition, connection and disconnection errors made by technicians – due to the sheer density of the fiber patch panels – are a major cause of service outages. Calient Networks' recent revolution in the price of software-controlled Fiber-Optic Cross-Connect Systems (FOCS) presents the opportunity to reduce central office staffing levels, reduce the number of service-affecting outages and speed problem resolution. This paper discusses the value of Calient's FiberConnect FOCS in central office fiber management.

Central Office Fiber Management Today

In a staffed central office today, the fiber management roles of the staff include:

- Manual rearrangement of fiber connections for maintenance and changes
- Manual maintenance of the database of fiber connections
- Troubleshooting and isolation of equipment and inter-office fiber faults

Rearrangement of a fiber connection requires:

- Identifying the fiber to be moved
 - o Labeling of the fibers may not be accurate
 - o The database of existing fiber connections may not be up to date
- Disconnecting it, without disrupting connections on adjacent patch panel ports
- Identifying the new port to which the fiber will be connected
- Cleaning all the fibers involved in the rearrangement
- Reconnecting the fiber to the required new port without disrupting connections on adjacent patch panel ports
- Re-labeling the fiber
- Updating the database of fiber connections

Fiber trouble-shooting and fault isolation requires:

- Identifying the fibers which may be the source or location of the trouble
 - o Labeling of the fibers may not be accurate
 - o The database of existing fiber connections may not be up to date
- Disconnecting each fiber in turn, without disrupting connections on adjacent patch panel ports
- Cleaning the fiber
- Connecting the fiber to a piece of diagnostic test equipment, for example an optical time-domain reflectometer (OTDR)

- Operation of most types of diagnostic test equipment requires specialized training
- Interpretation of result also requires specialized training
- In some offices, this is a “two-handed” operation, with one staff member at the CO and one in the field
- Reporting the diagnosis and fault location to the Network Operations Center, so that a crew is dispatched to the required location to fix the fault
- Re-cleaning and reconnecting the fiber to the required port without disrupting connections on adjacent patch panel ports
- Re-labeling the fiber and updating the database of fiber connections, if a change was made

If the central office is unstaffed, then technicians are dispatched to the office from another location in order to perform each of these tasks. In either case, these processes are time-consuming and error-prone. In addition, due to the manual nature of the fiber connection and updating the database records, it is inevitable that some of the fibers are left “connected to nothing.” The fibers and equipment left in this state are “stranded” or lost.

The Way Forward: Central Office Fiber Management Using a FOCS

A Fiber-Optic Cross-Connect System (FOCS) is the dynamic, software-controlled equivalent of a manual fiber distribution frame or fiber patch panel. The Calient Networks DiamondWave® FiberConnect FOCS streamlines fiber management and enables remote connection management and troubleshooting. Calient’s recent technological and manufacturing breakthroughs now make dynamic fiber management with the FiberConnect inexpensive and reliable.

Central office fiber management with the FiberConnect is performed from the Network Operations Center. Once the FiberConnect is installed at the CO, and fibers connected to it, connection and database management and troubleshooting are performed remotely. At installation, the user uses the FiberConnect GUI to label, in software, each fiber by associating a name and other critical information with the fiber.. Connections are rearranged without physically disconnecting fibers, so re-cleaning of the fibers is eliminated. The FiberConnect is strictly non-blocking, so changing one connection does not disrupt existing connections. Any connection change is recorded by the FiberConnect, so that the database of connections is always accurate and up to date.

Trouble-shooting and fault isolation are also simplified with the FiberConnect. The FiberConnect allows the NOC personnel to remotely monitor the optical power levels on all fibers. Changes in optical power below programmable thresholds will automatically generate alarms. The NOC personnel can quickly identify the failed fibers, remotely loop back interfaces and remotely connect test equipment to the failed fibers to isolate the problem quickly and effectively. In some cases, the problem can be remotely corrected by routing the fiber connection to a standby piece of equipment. In other cases, the

expert staff at the NOC interpret the test results, locate the fault, and dispatch the right crew with the right tools to fix the fault.

As a result of this increased efficiency provided by the FiberConnect:

- Many central offices that are currently staffed around the clock could be partially staffed (e.g. one shift).
- Offices that are currently partially-staffed could be run as completely “lights out” (unstaffed).
- Offices that are currently unstaffed would require many fewer dispatches

The result in all cases is significant saving in operational expense. In addition, the centralized, automatic control and verification of connections and maintenance of the connection database provided by the FiberConnect means that fibers and equipment no longer become “stranded” or lost.

The Numbers: Fiber Management Savings with FiberConnect

Here we consider the fiber management savings resulting from the installation of FiberConnect in a typical North American central office. We focus on the savings that are common to many service providers. Many other savings that depend more on the specific details of an individual service provider’s operations are listed below, but not included in the calculations.

Capital Costs

In today’s typical manual fiber management, each connection requires two patch panel ports (\$2 each) and a long fiber patch cord (\$30 to \$35 each). Because of database errors, redundant and unused ports, there are typically between 1 and 2 such patch cords used for each fiber connection. So in practice, the capital cost of each fiber connection in use is approximately \$50. Now each fiber connection on a FiberConnect (fully loaded) is priced at \$125. For a typical central office, with 1000 fiber connections in use, the net capital cost of a FiberConnect is $1000 \times (\$125 - \$50) = \$75,000$.

Savings at Staffed Offices

As stated above, the efficiency that the FiberConnect provides allows fully-staffed central offices to become partially staffed, and partially-staffed central offices to be unstaffed. At a typical burdened labor cost of \$90 per hour, one person, on one shift, seven days per week costs approximately \$263,000 per year. So, if the FiberConnect reduces staffing at a central office by one person-shift, the FiberConnect pays for itself in 3 ½ months and provides an ongoing annual savings thereafter.

Savings at Unstaffed Offices

As stated above, if the Central Office is unstaffed, technicians are dispatched to the office from a central location to deal with problems and changes. Typically each dispatch takes

four person-hours, including travel time. If 8% of fiber connections require dispatches each year to resolve problems, and 15% of the changes described above require dispatches, then 230 dispatches will be required to the central office per year. At the same \$90 per hour burdened labor rate, the annual labor cost of the dispatches is almost \$83,000. In this case, the FiberConnect pays for itself in ten months and savings continue to accrue there after.

Savings for Stranded Fiber and Equipment

As stated above, the FiberConnect also delivers savings by eliminating “stranded” fibers. In a typical 1000-fiber CO, 15% of existing fiber connections (or 150 fiber connections) are changed per year. Due to manual errors approximately 10% of these changes result in stranded or lost fibers or equipment. If each stranded fiber or equipment port is valued at \$5,000, then the FiberConnect enables an additional savings of 15 x \$5,000 or \$75,000 per year.

In our staffed and unstaffed office cases above, the stranded fiber and equipment savings together with the ability to eliminate a shift or reduce dispatches leads to an annual savings of \$338,000 and \$158,000, respectively.

Other Savings

This analysis does not consider the following additional cost savings from FiberConnect:

- Reduction in field labor costs from centralized trouble-shooting and fault isolation
- Earlier start of revenue from rapid, remote turn-up of new services
- Competitive advantage and increased revenue from:
 - o Fewer connection errors
 - o Less service down-time
 - o Premium protected services (e.g. 1:N equipment port protection, 1+1 fiber protection)
- Reduction in capital expense due to centralized test equipment
- Reduction in service penalties due to rapid fault recovery
- Space savings in central office

Conclusion

Just as the Digital Access Cross-Connect System (DACCS) revolutionized maintenance and management of copper lines, the Fiber Optic Cross-Connect System (FOCS) is revolutionizing the way optical fiber is maintained and managed. Calient’s DiamondWave FiberConnect FOCS delivers significant operational savings by enabling rapid, remote fiber connection management and trouble-shooting, and reduces the manual errors that lead to outages and stranded fiber and equipment.