THE BENEFITS OF PHYSICAL FIBER LAYER AUTOMATION

INTRODUCTION

The emergence of video sharing, gaming, remote storage, 3-D video and other data-intensive consumer applications is placing increasing bandwidth demands on the Internet infrastructure. Powering these new applications is a vast network of data centers, central offices, telecom rooms, cabinets and other network flexibility points which are connected by high bandwidth fiber optic links. These networks process and exchange digital data between transmission equipment, computers, storage devices, corporate offices and residences through a vast number of network elements.

At the foundation of these networks, tens of thousands or even millions of fiber optic cables transport data between high-speed switches, routers, servers and storage devices. This part of the network is traditionally referred to as "Layer-0" or "The Physical Layer". While the complexity of Layer-0 is unimaginable to most users of the Internet, the challenges for network administrators and technicians operating these networks can be daunting. To manage complexity, networks are built according to a 7-layer hierarchy. Each of these layers serve a specific function, from Layer-7, where familiar software applications reside (i.e., the Google search applet), to Layers-2 and 3, where data packets are electronically routed and switched, down to Layer-0, the physical network of fiber optic interconnections linking network elements and end-users.

Today's network management software systems effectively monitor and automate electronic network elements within Layers 1 through 7 of the network. In contrast, optical interconnect elements within Layer-0, being purely optical and electrically passive, form a "phantom" network whose status and management are relegated to manual records, massive numbers of truck rolls, visual inspection and disparate database records. The development of automated physical layer management solutions is growing in importance to ensure reliable and efficient operations. Corporations spend two to three times the amount spent on hardware to staff their central offices, data centers and manage these networks. A technology that reduces administration and maintenance costs by even 1% can translate into a saving of millions of dollars.

THE SEMI-AUTOMATED OPTICAL DISTRIBUTION FRAME

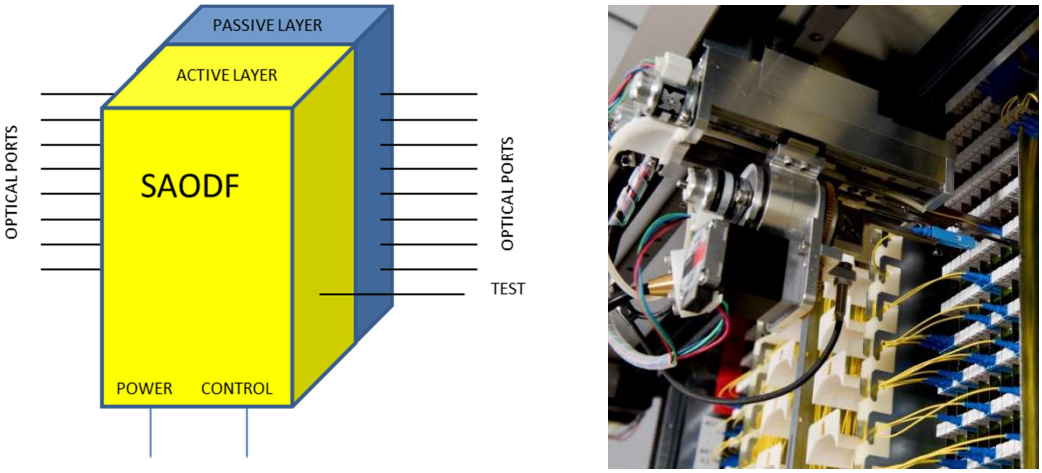
The lack of reliable and cost-effective fiber optic switching is a primary hurdle impeding Layer-0 automation today. To address this shortcoming, Gigacom has developed a Semi-Automated Optical Distribution frame (SAODF).

The SAODF has the following 3 functions:

A **Passive Optical Distribution Frame**: Incoming cables can be spliced and terminated to a connector, just like a traditional ODF does. A smart patchcord slack management system eliminates entangling of the cords, and creates a neat flexibility point over the entire lifetime of the products.

An optional **Active Layer** allows for (re)configuration of the network without a manual intervention or truck roll.

Last but not least, an integrated probe provides intrusive or non-intrusive **Test Access** to every port on the system.



Block diagram of the SAODF and picture of the Active layer (robotics)

The SAODF is the essential building block for a fully integrated solution, when combined with OTDRs, Visual Fault Locators, Optical Power meters, servers, alarm management, Northbound interfacing to existing Operating & Support systems, and so on.

The following benefits for network operators (telecom operator, Cable MSO, data center, ISP,…) have been identified :

1 : AUTOMATION REDUCES OPEX

With a semi-automated fiber management and test system in place, operating expenditures (OPEX) will go down dramatically during the entire lifecycle of the network.

During the 'Network Creation' (build) phase of the network, the fiber certification and characterization can happen automatically. Instead of sending technicians out in the field to create OTDR test reports, a simple script will start automatic measurements overnight. OTDR Post processing software will create these test reports (including pass/fail indication) before the technicians enter their office.

Service Activation is a simple point-and-click operation, eliminating truck rolls (and CO_2 emissions) to a remote central office to make a patch.

Network upgrades (for example, migration to newer transmission equipment) can happen in a controlled and simultaneous way.

Transmission equipment can be made redundant in a very cost-effective manner. Also 1:N redundancy (e.g. 1 spare for many router ports) becomes easy, eliminating costly emergency interventions.

Furthermore, troubleshooting from remote (see #3) and cleaner fiber management (see #6) will contribute to a lower OPEX.

2 : REAL TIME SERVICE PROVISIONING CREATES NEW OPPORTUNITIES AND POTENTIAL REVENUE STREAMS

Until now, service provisioning was a time-consuming exercise when physical patching was required: a job has to be planned and an available technician has to be assigned. He or she has to get the correct material, get permission to go to the site, find the correct keys, waste some time in traffic, and report back when the link was established. Therefore, the time-to-service is rather long.

With an automated system, provisioning can happen in minutes instead of days. This will open a world of new opportunities, and can best be clarified with practical examples:

Links can be temporary provisioned during the time of a big sports event or concert. Transmission equipment and fibers are available to users minutes after the event has finished. Leasing dark-fiber on an hourly basis (through a web-based service) becomes possible.

Bandwidth calendaring allows a more efficient use of the transmission gear based on the time of the day or week. Back-ups and data mirroring can be done during the night when equipment is under-utilized.

In modern networks, different parties (or even companies) are involved. For example in an open-access network, there is typically the infrastructure provider who owns the network, and service providers that offer their services over that infrastructure. When a customer desires to move to another service provider, several truck rolls might be necessary. Technicians dispatch to disconnect the customer from the first operator, then a second truck roll is required to connect to the new service provider. Organizing these tasks is labor-intensive and requires careful planning of resources. With an automated system, this can happen in minutes.

3 : SHORTER DOWN-TIMES (TROUBLESHOOT FROM REMOTE) IMPROVE END-CUSTOMER EXPERIENCE

Troubleshooting fiber-optic networks is more complex than copper networks. In case of a problem in the physical fiber layer, technicians will be sent to the field with little information on what is going wrong. All troubleshooting, fault-finding and analysis has to happen in the field. Once the technicians have identified the problem, they may have to contact another crew to come and fix the problem (e.g. climb a pole, find a buried closure, or dig the street).

With an automated system, the fault-finding and analysis move from the field to the office. A new OTDR trace can be taken and compared with the reference trace that is in the database. The right person, with the right skills and equipment, can be sent to the right place immediately.

In case of shared responsibilities (such as an open-access network), it is important to determine as fast as possible who needs to fix the problem. An automated system will address this issue in minutes, because it offers full visibility on the physical fiber layer.

As a result of all this, the end-customer will experience an improved service from his provider. Problems are identified and resolved in minutes instead of hours. Unnecessary, annoying and expensive visits from technicians are eliminated.

Furthermore, different (and higher) tariff plans can be applied when the MTTR (mean-time-to-repair) is reduced.

4 : FEWER OPERATORS & TECHNICIANS NEEDED

A major Western-European telecom operator estimates that his field personnel can be reduced by 30% if the physical fiber layer would have been automated. Due to the large installed base of traditional ODFs in Western Europe, it is difficult to get to the exact and global numbers. However, for greenfield applications, where automation is applied from day one, these percentages are being confirmed.

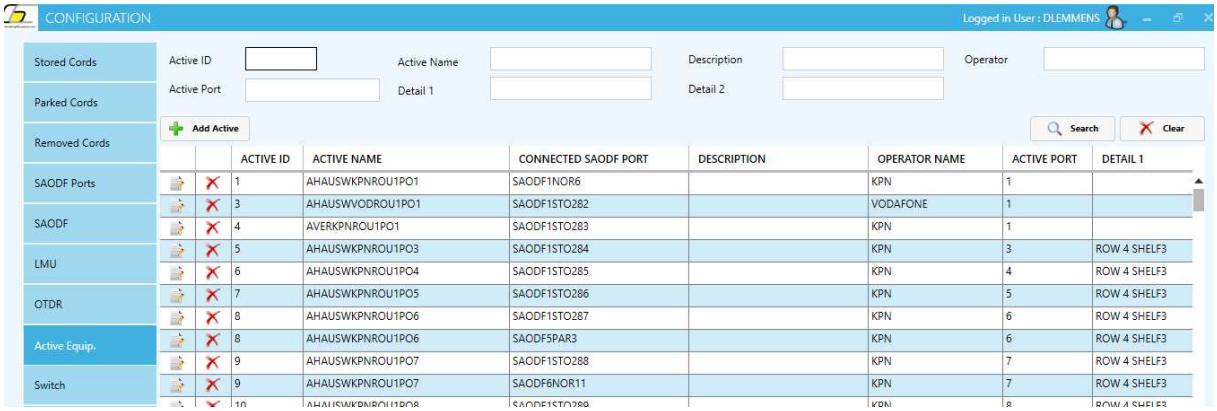
Furthermore, the handling of fiber optic patchcords, connector cleaning, and patching has become a simple point-and-click operation on a computer screen. The job requirements for provisioning are less stringent; a person is able to have full control over the network in days instead of weeks, which is typical for dedicated fiber-optic training.

For higher level, complex troubleshooting and fault-finding, the field technician may get help from 'virtual colleagues' with 24/365 availability. From their smartphone, a technician can check the active alarms, consult port information, take new OTDR measurements, perform an optical loss test, or instruct the SAODF to put red light on a specific port for easy identification of the affected fiber in a splice closure. One technician can work with an unprecedented efficiency instead of using two-people crews.

Screenshots of the Test capabilities

5 : ALWAYS ACCURATE AND UP-TO-DATE DOCUMENTATION

Every manipulation on the network (provisioning, disconnection, test) is automatically logged in the management software with a date/time stamp and user ID. This means that the management software will always be accurate, avoiding surprises.



Screenshot of a Configuration tab

The management software provides the following real-time information : Existing Alarms, Configuration Management of all components in the physical layer, User Administration (technicians, operators, …)

6 : CLEANER FIBER MANAGEMENT AND NO MANUAL ERRORS

In a manual system, the fiber management looks great when the rack is in use for a limited time. But after a few years in operation, the look and feel can be very disappointing. Even the most sophisticated manual ODF turns into a device that cannot be manipulated when proper techniques are not followed.

An automated system will exceed the most disciplined field technicians. Patchcords will always be robotically routed in the correct way and cable entanglement will not happen. Cables will always be patched with the same consistent push and pull force. Drawers will never be left open. Dust caps will always be placed. The unavailability of a port (in use, no spare patchcords available) will directly be reported.

Important: The correct port will always be patched (not the one just next to it, in a different shelf or in a different rack); a hands-off network eliminates the risk of manual errors.

A traditional ODF (left) versus the clean management on an automated panel (right)

7 : A WORLD OF FUTURE PROSPECTS (SDN READINESS)

Software Defined Networking (or, SDN) has demonstrated the ability to bring 'web scale' to networking equipment. As network operators seek to achieve similar efficiencies in networking equipment that the larger datacenters achieved with servers, this network equipment will undergo a transformation where the data plane will be separated from the control plane. In order to fully capture the huge economic benefits of SDN, this will require a shift away from proprietary equipment to more generic equipment. The 'smarts' of network management will then be controlled as a centralized function.

In a world of SDN-enabled network equipment, automatic routing of new services, better utilization of deployed resources, and significant cost savings can be realized. In addition, network operators will be able to more quickly implement both changes and new features to customers in time frames, which are several magnitudes less than current capabilities. This software-controlled network will focus on layers-2 through 7 as a means to effectively route data streams.

All of this will work wonderfully as long as the underlying physical network and optical switching is positioned in the correct place.

With the introduction of the SAODF, it will now be possible to include layer-0 in key flexibility points that can be controlled with the same software that is managing other layers. As new equipment is configured, it would make sense to deploy an optical distribution frame that also has the possibility to be SDN-enabled. In this way, a route that does not qualify for automatic routing can actually be debugged on the fly and now both packet pathways and physical pathways can be manipulated for the best-case connectivity. Express paths could now be defined to remove loads off of the critical optical switches, freeing them up to provide the fast switching needed to manage the network. All the benefits listed above can be utilized while exercising software control over all layers of the network.

ABOUT GIGACOM BENELUX

Gigacom Benelux BVBA concentrates on the automation of next-generation fiber networks for the telecom and datacom industry. We provide high-end and innovative solutions that dramatically lower cost of ownership, maximize network assets and delight end-user customers. Our flagship, the 'Semi-Automated Fiber Management and Test System' allows for (re)configuration and testing the physical layer of fiber-optic networks without a manual intervention or truck roll. This system includes robotic optical distribution frames, test & measurement gear and management software. From our headquarters in Belgium, and in close collaboration with our local partners, we serve more than 20 countries around the globe.

Visit our company at www.automatingfiberspace.com.