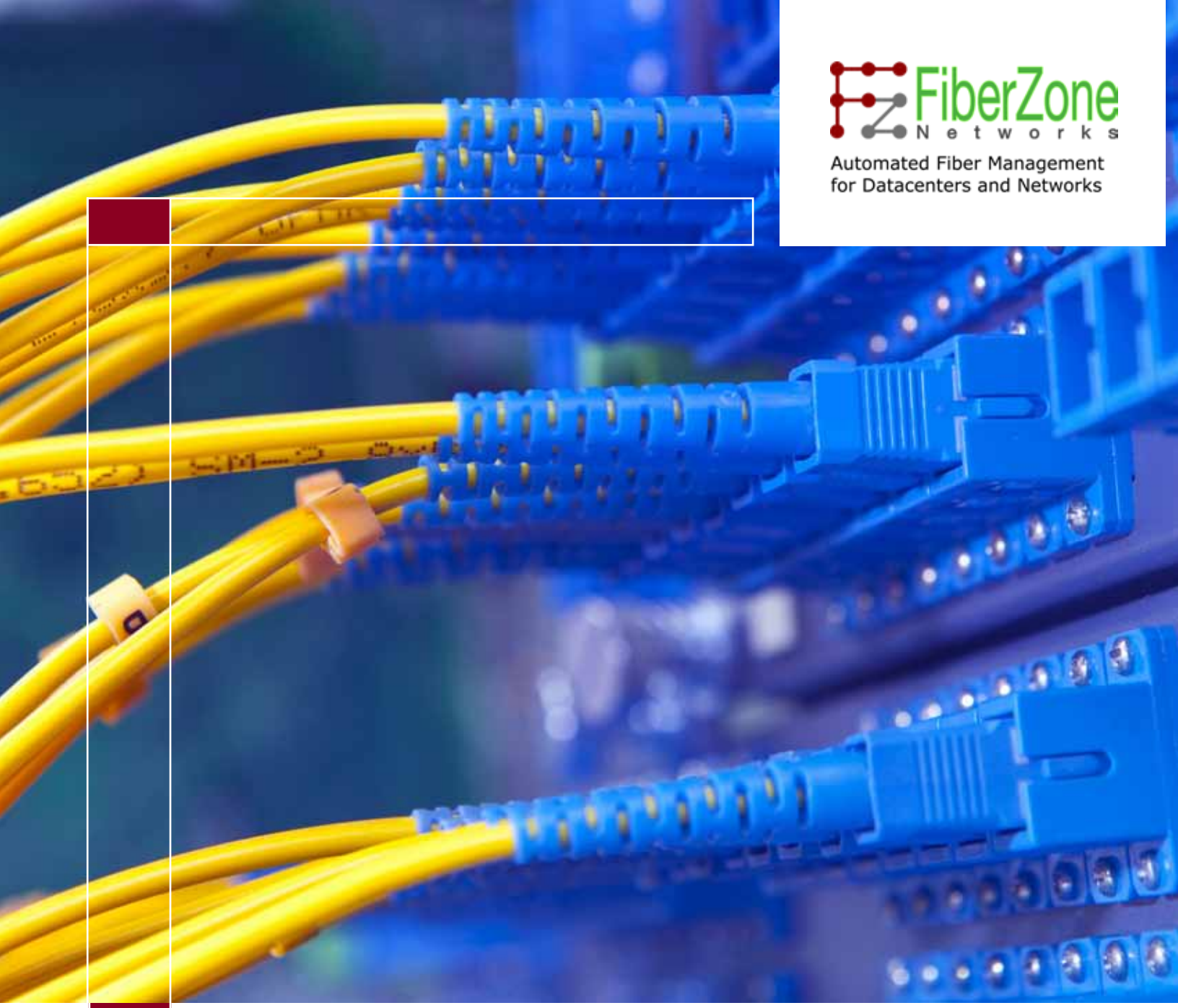

FiberZone Networks

Automated Fiber Management for Datacenters and Networks

Automated Fiber Recovery (AFR)

Application Note

Case Study

June 2010

[www.fiberzone-networks.com]

Challenges for Service Availability over Fiber Infrastructure

Fiber infrastructure for high capacity data and advanced services is rapidly deployed in both developed and developing markets. As network capacity and customers' dependence on advanced services availability grow, ensuring high service availability becomes critical.

Faults in the physical fiber infrastructure cause severe adverse impact on network operators; They damage customer satisfaction, result in significant disruption in network operations, and reduce profits through loss of revenue and payment of service level agreement (SLA) penalties.

Existing transport-layer protection and restoration mechanisms were designed to handle rare and short fault events. Frequent faults, or faults that take longer time to repair, pose new challenges on network operators tasked to ensure high service availability. Traditional transport-layer protection mechanisms simply can't handle multiple concurrent faults, and high network fault-rate in combination with long-time-to-repair significantly increase the chance of concurrent faults on the same fiber facility. Automatic optical mesh protection that rely on intelligent and dynamic control plane have been proposed in the past but never got wide market adoption.

Introducing Automated Fiber Management (AFM)

FiberZone's Automated Fiber Management (AFM) product line is designed from the grounds up to automate, switch and manage fiber infrastructure to dramatically reduce its total cost of ownership, and remove the main barrier for networks to scale. FiberZone's product line consists of best-in-class physical layer switch hardware, carrier-grade software and management modules, and a set of open interfaces for integration with 3rd party equipment, applications and management systems.

The AFM product line utilizes FiberZone's Latched Optical Coupling (LOC™) technology that was developed specifically to address fiber management applications. The principle of LOC™ is to physically couple two optical fibers together without mirrors, lenses, or collimators. Once physical connection is made, it does not require continuous power to maintain, and guarantees optical performance similar or better than those of traditional patch panels under all circumstances.

FiberZone's AFM allows an operator to remotely switch fiber links in minutes, provides remote connectivity management capabilities, maintains accurate fiber records, and provides test access capability for troubleshooting. Fiber switching, management and troubleshooting can be accomplished from a central location, operated by highly qualified staff, without the need to dispatch an urgent truck roll.

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Automated Fiber Management for Datacenters and Networks

Using AFM for Automated Fiber Recovery (AFR)

When a fault in the fiber infrastructure occurs in a network utilizing manual patch panels, the end-point optical equipment identifies Loss Of Signal (LOS). The operator then must test the link with an Optical Time Domain Reflectometer (OTDR) to locate the fault and dispatch technical staff to the fault location to further troubleshoot and repair the damage.

Automated Fiber Recovery (AFR) is a software module available on FiberZone's AFM product line. The AFR software module consists of specific management and control functions required for effective fault management and recovery in the physical fiber infrastructure.

Figure 1 depicts the high level operation of the AFR capability to protect fiber links between offices using FiberZone's AFM product line. By deploying AFM at both end-points of a fiber link, the two AFMs can be remotely controlled to switch from an identified faulty link to an alternative pre-provisioned backup link.

High priority links may be mapped one-for-one, meaning each active high priority link has one specific and dedicated backup link that can be quickly switched in place, in the event of a fiber cut. Lower priority links may be protected by backup links that are shared among multiple working links in an m:n configuration (i.e. $1 \leq m < n$, where m is the number of backup links and n is the number of working links).

The sequence of AFR operation in these cases is as follows:

- An alert is received from the end-equipment that a LOS has occurred.
- The faulty working link is identified and automatically matched with its pre-provisioned backup.
- The management system automatically communicates with the two AFM systems at both end-sites and commands both AFMs to switch from the faulty path to the predetermined backup path.
- From initiation, traffic on the backup link is up and running within less than 1 minute.
- The connectivity process is automatically documented in the EMS logs.

THE BENEFITS

FiberZone's AFM with AFR solution offers a compelling value proposition to operators faced with the task of guaranteeing high service availability for mission critical traffic. It allows them to:

- Guarantee high service availability
- Avoid Service Level Agreement (SLA) penalties and revenue loss
- Remotely troubleshoot faults by highly qualified technical staff and reduce mis-repairs
- Decouple network outage repair from service delivery

Figure 2 illustrates the operation of AFR on FiberZone's AFM for a group of faulty fiber links.

AFR can also be used in an intra-office application, where there's a need to protect links between unprotected and protected interfaces.

Figure 3 shows an example, where unprotected Passive Optical Network (PON) uplinks are connected to protected Layer-3 switch interfaces.

In this example, AFR is used to switch traffic to/from the unprotected PON uplinks to a standby backup interface on a Layer-3 switch, when the working interface on that switch fails. The same sequence of operation described above is used to protected against faults in this intra-office scenario.

Troubleshooting Faulty Fiber

The AFM supports Remote Fiber Test System (RFTS) access bus so that an external OTDR may be connected and access all fibers terminating on the given AFM, or even on any other linked AFM (in such cases the first AFM performs a test bus pass-through to the second AFM). This allows a centrally located OTDR to support testing within a given radius, limited only by the OTDR specified test range, in the following manner (***Figure 4***):

- AFM systems are used to switch the OTDR signal to the measured fiber
- The OTDR is used to determine the correct location of the fault
- A technician is then sent to the problem location in the field to perform repairs, while AFR is used to switch traffic to backup fiber

Repairs are now decoupled from service delivery using FiberZone's AFR and AFM product line

Since an OTDR cannot test for fiber cuts through a repeater/amplifier, if such devices exist between end-points, then an AFM is required at the amplified node to enable testing beyond the repeater/amplifier.

The Business Case

The business case for AFR operating using AFM switches is driven by the following parameters:

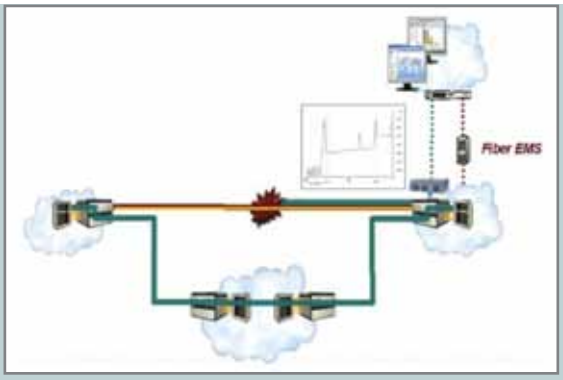

Figure 1: AFR between operator's offices

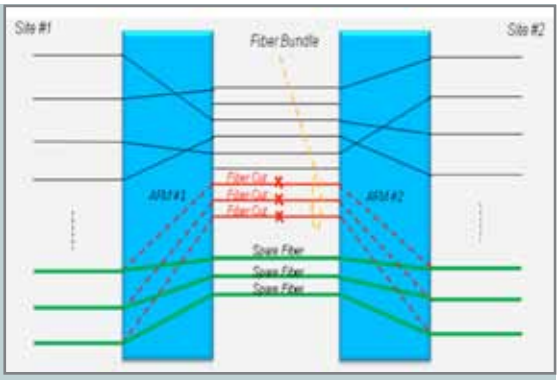

Figure 2: AFR for a bundle of fiber links

- The frequency of service-affecting faults
- The mean time to repair (MTTR) a fault, and the occurrence of mis-repairs
- The direct cost to repair a service-affecting fault vs. the cost to repair a non-service-affecting fault and the corresponding mis-repairs
- The indirect cost of a fault during the MTTR – revenue loss and SLA penalties
- The affect of remote monitoring and preventive maintenance on fault frequency
- The number of working fiber links in a typical interconnected office
- The affect of faults on customer churn

Clearly, the higher the frequency of faults, the longer the MTTR is, and the higher the revenue loss and penalties are, the faster the return on investment in AFR/AFM is.

FiberZone performed a detailed business case analysis with a tier-1 operator in a developing market, and was able to show return on investment in less than 9 months using AFM switches with the AFR software module to provide high service availability for an inter-office
fiber-based network.

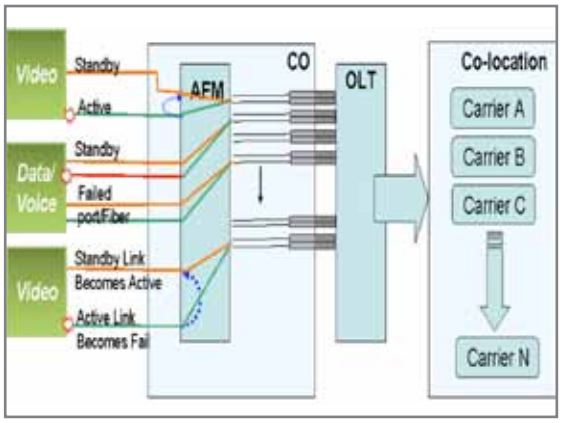

Figure 3: AFR in an intra-office application

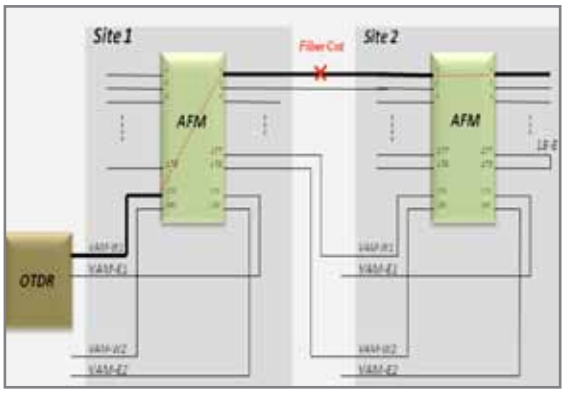

Figure 4: Using OTDR for troubleshooting through FiberZone's AFM

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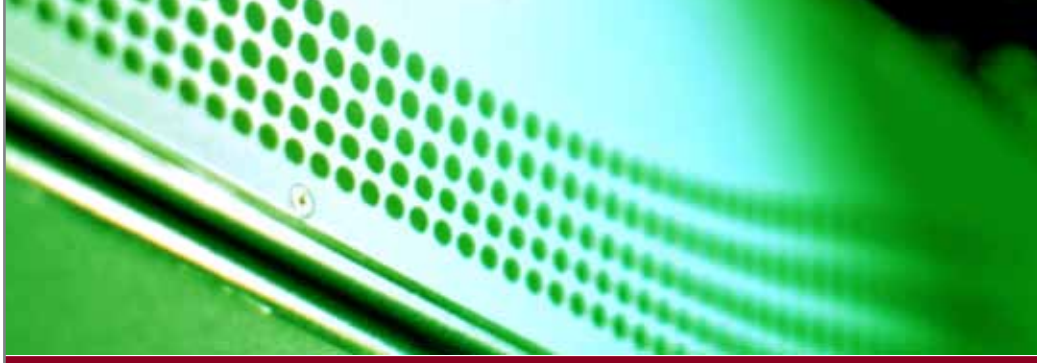

About FiberZone Networks

FiberZone Networks delivers remote fiber connectivity solutions to datacenters and networks with its Automatic Fiber Management (AFM) product line, delivering reliability, flexibility, fault tolerance and management to the fiber infrastructure. FiberZone's AFM significantly increases network reliability and availability, reduces operating costs, minimizes network faults and human errors, and prevents revenue losses & SLA (Service Level Agreement) penalties. FiberZone's AFM product line utilizes patent-pending Latched Optical Coupling (LOC™) technology that delivers reliable passive connectivity in a remotely-managed automated fiber management system. FiberZone's AFM product line has been deployed by leading datacenter and network operators in the U.S., Asia, and Europe.

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