Adtran

Improving network availability and reducing opex

In recent years, the telecom industry has experienced rapid growth, with communication providers across the globe ramping up their investment in fiber buildouts. The surge has been fueled by social and economic factors, creating a significant uptick in demand for broadband access. At the same time, government funding of fiber buildouts in various countries has boosted fiber reach to both suburban and rural areas. As these fiber networks proliferated, communication providers have begun to seek reliable and cost-effective monitoring solutions, aiming for enhanced asset protection, optimized network uptime and more effective resource allocation to streamline operational costs.

Historically, fiber optics has been the established choice for connecting core sites. Now, it's also becoming the dominant medium for access to residences, enterprises, public buildings and cell sites. The communication and data services transported over these fiber networks are crucial for our working environments and our social lives. Any disruption due to damaged fibers can pose significant challenges, even jeopardizing the operation of critical infrastructures. Swift and decisive action is essential to maintain seamless network operations.

Moreover, for a network to run smoothly, personnel in network operations centers and field staff need to be able to distinguish between issues caused by active devices and those caused by passive cables. Identifying these root causes is vital for rapid, effective resolution to service disruptions.

Service providers need an in-service, pro-active fiber monitoring solution that provides end-to-end network visibility from a centralized network operating center. A solution that can quickly identify and locate a fiber fault, enabling immediate action and minimizing downtime

Proactive, in-service fiber monitoring is key

Adtran's proactive ALM fiber monitoring solution addresses the challenges of improving network availability for fiber optic-based networks while reducing operational costs through its innovative and advanced technology.

Previous fiber monitoring solutions were optimized for reactive fiber measurement after a failure rather than proactive in-service monitoring. Traditional test equipment, designed more for portability than centralized operation, cannot be utilized if the network is up and running. As a result, these methods frequently fail to meet the cost and availability requirements of today's quickly evolving network infrastructures.

Proactive, in-service fiber link monitoring solves those problems. It simplifies failure isolation, enabling fiber network providers to take immediate, targeted action, while also preventing false alarms and unnecessary truck rolls. This shortens the repair cycle, reduces the unavailability of a fiber link and accelerates the installation and commissioning of fiber services.

The introduction of Adtran's ALM fiber monitoring solution is an innovative approach that merges optical components with digital signal processing, paving the way for a cost-effective, centralized system dedicated to in-service fiber monitoring.

Multiple devices or a single assurance solution for all services? – It's your choice

Today's communication networks are built on a connectivity infrastructure that leverages a range of interfaces, such as OTN for high-capacity, fixed bandwidth connectivity, Ethernet for packet connections, CPRI in the mobile fronthaul networks or 5G-SDI for 4K native video signals. Each interface comes with different service assurance capabilities and different management tools.

To monitor these installations, service providers often resort to myriad of demarcation devices, each tailored to the needs and capabilities of different services. Fiber link monitoring minimizes the range of network demarcation devices needed to identify each section and responsibility for the network. Fiber monitoring is agnostic to the communication service, meaning a single assurance technology can be applied with any technology independent of speed and protocols deployed. Furthermore, fiber monitoring solutions are completely independent of end system equipment, ensuring compatibility regardless of the vendor.

Monitoring each phase of network deployment

Fiber monitoring solutions aid in every phase of network operation. They can be used to certify and validate installations, proactively monitor operational networks, and serve as primary tools for troubleshooting – pinpointing the root cause and location of an outage and confirming its repair and resolution.

Monitoring network layers independently

There are various problems that can disturb a network connection. There might be a failed interface card, a dirty fiber connector, a misconfigured router or a broken fiber. If the problem is analyzed by a network management system optimized to control an active network element,

all problems look very similar. Consequently, the operator might struggle to differentiate between them and identify the root cause, let alone the location of the problem. This is where monitoring of the physical transmission media comes in. Results from fiber link monitoring enable a service provider to immediately understand the root cause of a problem.

Improving service quality and data security

Service providers want to maximize the value of their fiber assets. By providing real-time information on fiber integrity, latency and attenuation, they can offer high-value advanced services.

Customers benefit from this information in various ways. Network failures are remotely detected and isolated based on a comprehensive set of real-time information, without additional onsite visits. This avoids time-consuming fault isolation and shortens repair cycles as countermeasures can be initiated immediately.

Proactive fiber monitoring also detects malicious attacks on a network, as coupling devices for eavesdropping cause additional attenuation that can be detected on the loss profile of the fiber link.

Competitive differentiation and revenue growth with improved SLA support

By delivering exceptional network quality with minimal downtime and enhanced SLAs, providers can distinguish themselves from the competition. This competitive edge, coupled with the offer of guaranteed uptime services, enables them to drive potential revenue growth.

Who benefits from fiber monitoring?

1. **Communication service providers**
   Fiber failures can be identified without the need for additional truck rolls. This means immediate and targeted responses to address issues, resulting in cost savings and faster resolution times.

2. **Dark fiber providers**
   By leveraging real-time information on fiber integrity, providers can deliver higher network uptime. This not only enhances their service offering but also bolsters customer trust and satisfaction. New customer turnup time is also reduced when fiber connectivity is validated quickly.

3. **Dark fiber customers**
   With continuous fiber monitoring, identifying the root cause of failures becomes swift, drastically reducing repair time and ensuring quick service restoration. Fiber monitoring also acts as a safeguard against malicious activities, including fiber tapping, ensuring data integrity and security.

4. **Mobile network operators**
   Transparent, non-intrusive monitoring of fiber links allows operators to clearly define demarcation points and responsible parties in the front-haul and backhaul network elements.

Adtran ALM advanced fiber monitoring

There are good reasons for communication service and dark fiber providers to monitor their fiber assets with our ALM. The system is simple to install and operate. It assures service quality with real-time information on fiber integrity. Field forces can locate fiber incidents and initiate immediate counteraction. There's no need for additional truck rolls for fault analysis. What's more, dark fiber customers have a way to differentiate between problems on their premises and fiber failures.

Low footprint and operational cost

Unlike traditional OTDR devices, our ALM is a self-calibrating device and does not need to be removed from service for regular maintenance. Its compact design also utilizes solid-state storage and convection cooling, meaning there are no fans to fail or be replaced on a regular basis. Furthermore, its compact form factor leads to significant reductions in both power consumption and carbon footprint.

For any type of application

With its innovative design, our ALM provides a versatile solution for every fiber monitoring application. Procedures for continuous in-service monitoring, fast fault localization and accurate detection of small changes in fiber infrastructure can be set up quickly, involving only a few mouse clicks.

The ALM can also be configured per port to monitor any mix of point-to-point, PON and sensor networking applications. This approach provides a common tool across the entire network and helps reduce workload for support personnel.

Multifunctional test capabilities enable our ALM to accurately locate faults on access, core or backhaul links up to 320 km. It can test up to 64 fiber services with a very short scanning cycle of only 2 to 5 seconds per active link. Expanded solutions up to 800 ports are also included in the solution portfolio. What's more, our ALM supports the industry's first PON monitoring solution, which tracks all the way to the individual ONT without the need for passive reflectors.

Proactive, in-service monitoring minimizes operational costs and drives revenue growth

How does ALM work?

Our ALM is a unique plug-and-play fiber assurance device for proactive fiber monitoring. It enables operators to supervise their critical fiber infrastructure with minimal and simple additions to their existing network. The optical measurement signal generated by our advanced link monitoring solution is coupled into a single-mode fiber and reflected back at the demarcation point. The 1650nm test signal operates outside the C and L DWDM bands as well as outside any passive optical network (PON) generations such as GPON and XGS-PON. The test signal does not interfere with user traffic on the fiber, enabling fully non-intrusive monitoring of the fiber plant while the network is operational. This provides proactive monitoring so that potential issues, from fiber cuts to gradual attenuation, can be flagged and dealt with preemptively, minimizing the risk of them escalating into major service disruptions

ALM in point-to-point networks

The foundation of the ALM solution is based on the use of a "fingerprint," which is a unique reference measurement of the link, along with the use of passive demarcation reflectors. These reflectors are tuned to reflect the ALM's 1650nm test signal. The use of reflectors not only accelerates the scanning process on point-to-point links for both active and dormant fibers but also heightens the precision of attenuation detection throughout the link. This is key when the loss near the far end of the link becomes "noisy" and more difficult to read. In this scenario, the reflector greatly increases the accuracy of information.

Reference measurement
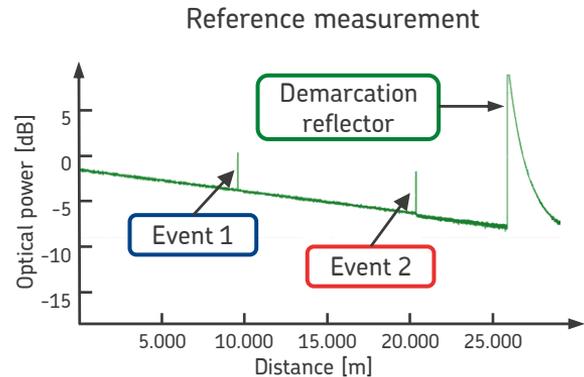
Implementing ALM into your network is simple and easy for dark fiber and active networks. Installation for dark fiber networks simply requires the optional demarcation reflector, if desired, to be added during the fiber installation. The demarcation reflector can be added to existing dark fiber networks by simply installing it at the end of the link. Adding ALM to monitor active networks for greenfield installations requires the addition of the passive coupler to insert the test signal and the optional demarcation reflector at the end of the link. For brownfield installation, a one-time maintenance window is required to install the coupler and optional reflector if desired. The coupler and demarcation reflectors are passive devices, similar to cables, are completely passive and use no electronics or power making installation simple and efficient.

Point-to-point network monitoring

ALM

Demarcation reflector

Dark fiber monitoring

Core network access

Coupler

In-service monitoring

Demarcation reflector
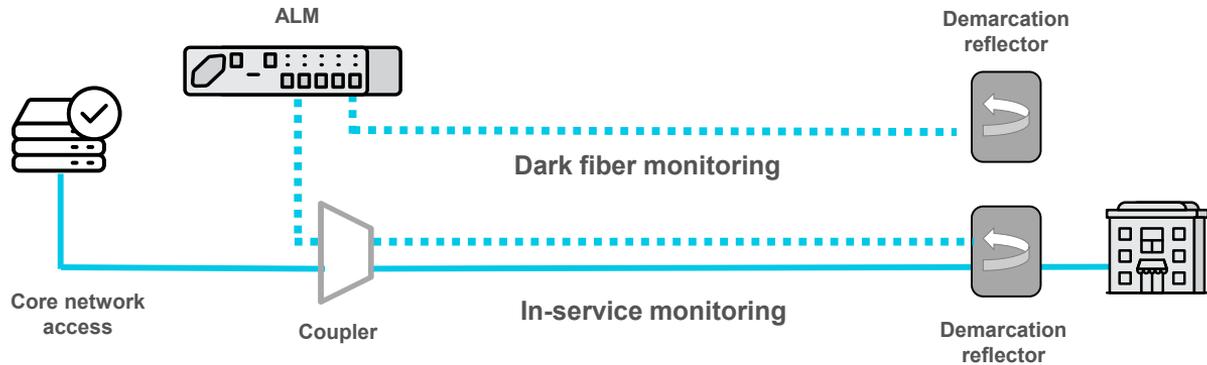
Implementing ALM into your network is simple and easy for dark fiber and active networks with the addition of the completely passive coupler and demarcation reflector.
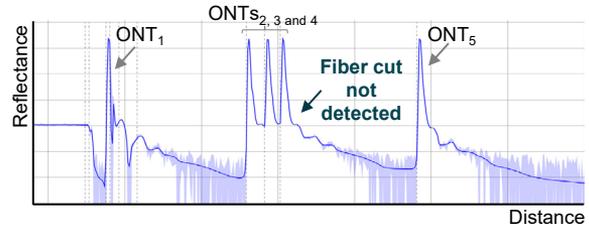
Innovative solution for PON network monitoring

Monitoring of PON networks is available today via OLT and ONT interaction. While this method provides visibility into the operation of the network, the monitoring is based on the electronics in the OLT and ONT being operational. When there is a fiber problem such as a cut, traditional PON monitoring tools are unable to troubleshoot physical fiber plant issues and identify the true root cause and location of the fault. This limitation stems from their reliance on the network being active and operational to function effectively.

Managing PON networks has historically been challenging for any OTDR vendor due to the nature of it being a shared medium as well as the very limited optical dynamic range of the links. Historically any PON monitoring required the use of a passive reflector device that added loss, required additional stocking of components and significantly increased installation cost. With our innovative ALM DPA technology, this can now be done without the need for reflectors.
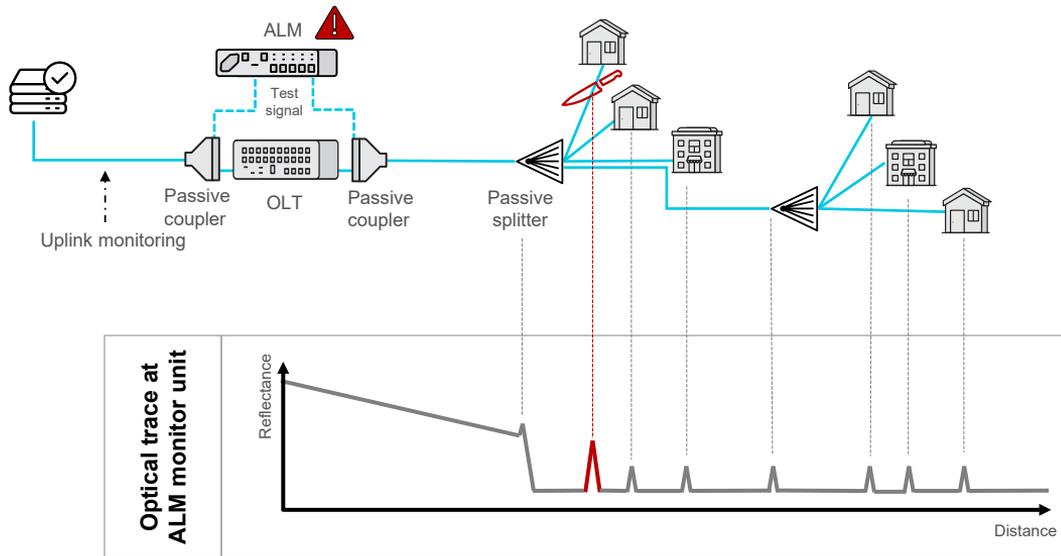
Adtran's Deep PON Assurance (DPA) approach provides visibility in PON networks without the need for reflectors. This new technology takes advantage of intelligent software algorithms and extensive digital signal processing to better detect events in PON networks, paving the way for affordable fiber monitoring possibilities right down to an individual home or ONT.

PON monitoring with standard OTDR (with reflectors)

PON monitoring with ALM DPA (without reflectors)

ALM

Test signal

Passive coupler

OLT

Passive coupler

Passive splitter

Uplink monitoring

Optical trace at ALM monitor unit

Reflectance

Distance
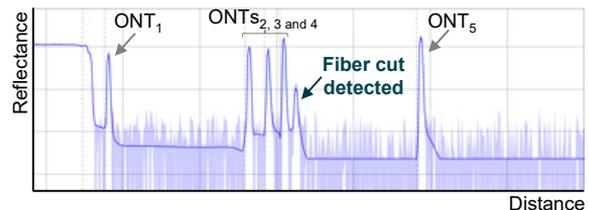
Fiber monitoring provides visibility to each ONT at the physical fiber level to identify fiber vs. electronics as the root cause of events.

Network management, control and monitoring

Fiber monitoring provides precise fault type and location information, whether it's attenuation events like bends and patch panels or actual fiber cuts. The ALM provides the information at an optical level but communicating that information to the NOC and operations teams is critical. The ALM has many methods to accomplish this including support of SNMP, email and NETCONF. Adtran's Ensemble Fiber Director (EFD) provides a geographical view of the network as well as detailed OTDR fault and traditional trace information. By supporting standard SNMP and NETCONF, the ALM can be monitored by a wide variety of third-party network management platforms, trouble ticket and workflow systems.

Precise geographic event identification and GIS support

Service providers and their customers require full visibility of network integrity. They need to be able to direct field forces precisely to the location of a fiber failure. Geographic information systems combine fiber monitoring data with geographic details of cable routes. A graphical user interface shows a fiber map and clearly indicates the locations of any faults or anomalies. There is no easier and faster way for repair teams to identify the position of a fiber break. Our Ensemble Fiber Director builds on the real-time data generated by our ALM fiber monitoring solution.

It further enhances the spatial resolution by correlating the measurement data with the location of connectors and splices in the network.

The ALM also provides the ability to send event information northbound to existing third-party GIS systems to allow the ALM to easily fit into an existing back office system.
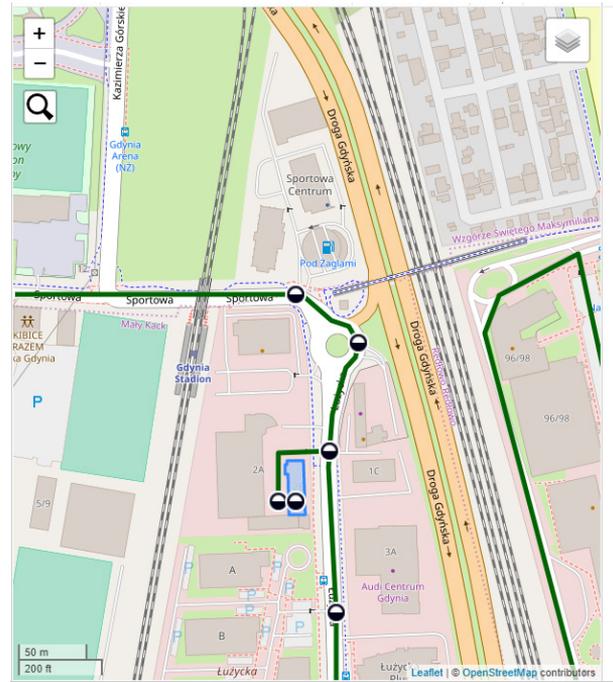
Detailed fiber plant documentation eases troubleshooting to specific locations of access points and ducts. .

Hierarchical event information provides detailed event notification and navigation to the location of the event as well severity and fault information.

Security

Securing a connection with our ALM

Fiber optical transmission systems are potentially at risk of being intercepted. An attacker might introduce a bending coupler or a splitter into a fiber link in order to gain access to the optical signal and to the user data being transmitted. The insertion of these coupling devices adds attenuation at a discrete point on the link, and these suspect signatures can be used to detect malicious attacks.

When an attacker introduces a coupler into a fiber link, the additional loss can be detected by a link monitoring system. This improves the integrity of fiber links and secures communication against eavesdropping.
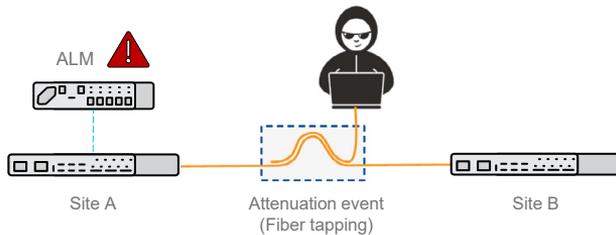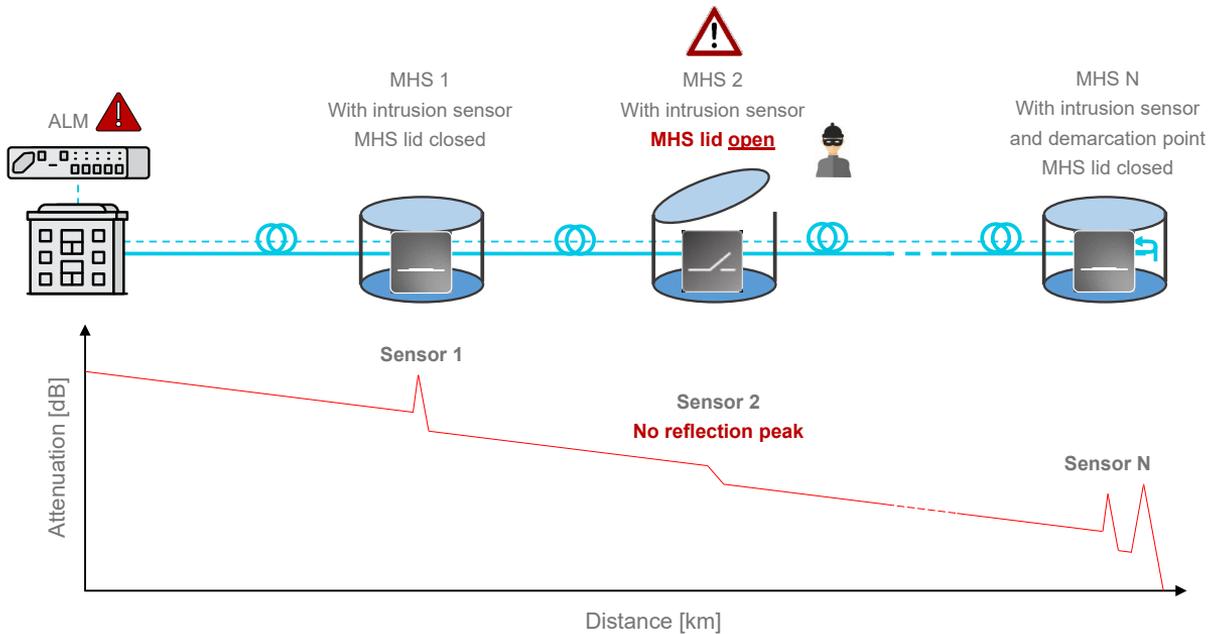

Unmasking an attacker with real-time monitoring of fiber loss

Securing a site with our ALM and passive sensors

Some sites along a fiber link need to be monitored but have no available power. In cases like this, such as maintenance holes that need to be managed and controlled, active devices can't gather local information and transmit it to a central control site. Vandalism is often reported, ranging from removing a cover to cutting through cables. To minimize negative impact, immediate action needs to be taken.

If a service provider wants to monitor such sites, there's a simple solution: applying fiber sensors supported by the ALM fiber monitor solution. These sensors operate in a similar manner to "open and closed" contacts and use a dark fiber cable to connect into the ALM monitored network. Example of sensors available include moisture, maintenance hole covers, and door closures provide physical and environmental information in a complete pass and unpowered solution which do not require battery replacement or wireless connectivity.

Service-agnostic fiber monitoring and proactive service assurance with our ALM solution

ALM

MHS 1
With intrusion sensor
MHS lid closed

MHS 2
With intrusion sensor
MHS lid open

MHS N
With intrusion sensor
and demarcation point
MHS lid closed

Attenuation [dB]

Sensor 1

Sensor 2
No reflection peak

Sensor N

Distance [km]

Passive sensors which do not require power or electronics and are optimized to work with maintenance hole covers provide status change information via a simple dark fiber connection notifying when the cover is removed and replaced. Multiple locations can be monitored on a single fiber.

Summary

With our innovative technology, our ALM enables communication service providers (CSPs) to monitor their entire fiber network infrastructure for any faults or degradation. It provides a simple and cost-efficient way to leverage real-time insight enabling maintenance teams to quickly locate and resolve issues before they affect customers regardless of transport speed and/or end system vendor equipment.

Our ALM enables CSPs to dramatically shorten repair cycles, avoid unnecessary truck rolls, and provide a better customer experience while reducing operational expenses.

If you want to learn more, please, visit
www.adtran.com/alm

ALM highlights

- In-service, proactive end-to-end fiber monitoring
- Detect, identify and localize any fiber break or degradation almost immediately
- For any type of fiber infrastructure
- Innovative DPA technology for PON monitoring without reflectors
- Reduces downtime and prevents unnecessary truck rolls
- Detects fiber tapping devices increasing data security
- Low maintenance, power and footprint

Adtran

ADTRAN
Certified
Supplier

ISO 9001
ISO 14001
TL 9000

nsai

TL 9000
TELECOMMUNICATIONS
ISO 9000
QUALITY
ISO 14001
ENVIRONMENT

TL9000
TL19.1270