

Case Study

Monitoring Critical Infrastructure with Optical Fiber Sensors and the ONMSi

Accurately detecting intrusion, open access points, and thefts

Fiber networks are best known for enabling high-speed data communications. However, since optical fibers are bend-sensitive, especially at certain wavelengths, they are also effective solutions for sensor applications. This case study highlights an application where fiber was used with an optical sensor to monitor intrusion in critical infrastructure operated by a public services utility.

A water company in Europe had optical cable installed along their pipeline network in order to provide internal data services to their various remote sites such as technical communications to operate the company's drinking water infrastructure and services. The utility also found it was able to address needs for infrastructure monitoring, such as maintaining manhole security, throughout their service area.

The Challenge

Utility providers are constantly challenged with ensuring security at infrastructure access points and, in this case, providing safe water for the communities they serve. Threats to municipal or regional water systems, that often include pipelines and distribution sites in remote areas, commonly fall into three categories:

- Illegal access to manholes for purposes of water contamination
- Manholes accidentally left open after service
- Theft of manhole covers and infrastructure components housed in manholes

The challenge was to develop a solution to monitor the status of each manhole to ensure they were not being accessed except for authorized onsite service. In some locations, a manhole flooding alarm had to be included in the monitoring.

Company officials had heard about the use of optical transmission fiber in sensor applications, and they were interested in finding a sensor solution that leveraged existing dark fiber. They also needed a solution that was passive and without additional power requirements.

The Solution

For this application, VIAVI Solutions™ partnered with Grid-Cop®, the developer of a patented, passive, fiber-based sensor solution designed specifically for critical infrastructure monitoring in civil and military areas. This solution was ideal to monitor the status of manholes.

As shown in Figure 1, multiple sensors are daisy-chained on a single, non-dedicated optical fiber. At each local sensing site, an optical coupler sends a small tapped amount of signal via a bending device within the sensor onto a reflector. If the manhole is opened, or if water depth exceeds a maximum level, the sensor creates a localized bend in the fiber within the sensor. The strong reflection initially generated by the reflector disappears.



To monitor these sensors, VIAVI deployed its ONMSi optical network monitoring solution, which consists of optical test units (OTUs) that are each equipped with an optical time domain reflectometer (OTDR) and a multiport optical switch. The OTDR monitors the return signal from the reflectors in sensors mounted in each manhole. When compared to a reference trace taken when all manholes are not in alarm status, any change in the reflector return signal trace triggers an alarm. SMS or e-mail messages notify technicians and managers on call for immediate responses, providing alarm and GIS maps-based alarm/sensor/manhole location information.

The solution designed by GridCop and VIAVI monitors 80+ sensors distributed over a distance of 100+ km on a single, non-dedicated fiber that can simultaneously carry normal traffic.

Results

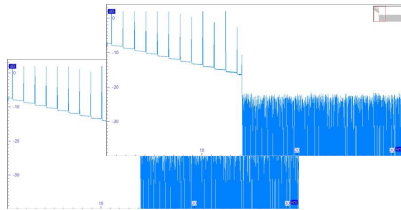
The water company achieved multiple objectives by implementing the joint GridCop/VIAVI solution:

- A strong and reliable security system without additional power requirements
- Accurate detection within less than a minute from the time of intrusion
- Virtually infinite scalability — each sensor daisy chain connects to one optical switch port at the OTU
- Improved service delivery to customers and improved SLA performance
- Lower infrastructure management and risk-insurance costs

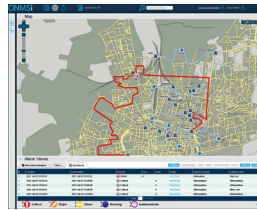
“In 18 months of operation in our pipeline infrastructure, the system has extensively demonstrated its faultless operation and high-grade reliability in a harsh environment of low temperatures and moisture. GridCop and the VIAVI ONMSi platform are the cornerstones of a proactive infrastructure management and surveillance system which puts us at the top of our sector and which we are quite proud of,” concludes a senior executive of the water company.

The VIAVI ONMSi Solution

ONMSi can scale to different network sizes, applications, and complexities. The base system consists of an OTU equipped with an OTDR test module, optical switch, and basic software that runs on a PC or laptop. Up to 24 fiber routes, totaling more than 2,000 possible GridCop optical sensors or sensing points, can be monitored with a single OTU equipped with a 1x24 optical switch. GIS mapping software can be integrated to translate alarms to physical locations. Technicians and managers can access the system using web-enabled smart devices with automated alarm notifications provided via text or e-mail.



OTDR reference
alarm trace compare



Web-based map
to alarm location

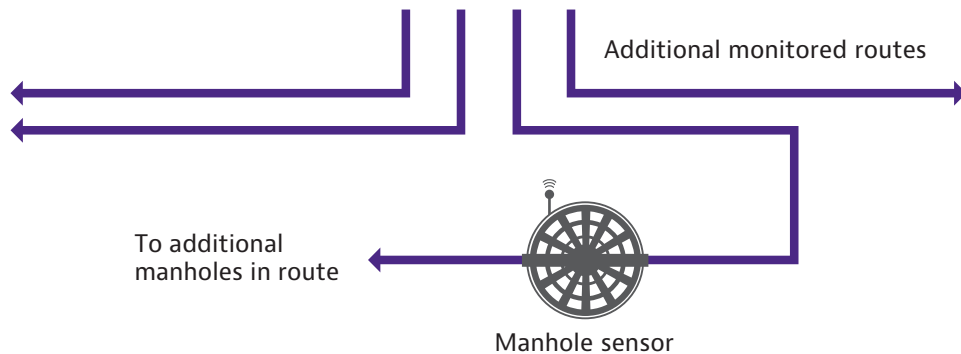


Dispatch notification

OTU
Optical test unit



Optical fiber link monitoring



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