

A scalable solution for protecting critical infrastructure using TamperFighter SoP monitoring

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Critical infrastructure, such as submarine and terrestrial fibre optic networks, faces increasing threats from both human activities and natural events. Traditional monitoring methods are often reactive, leading to costly outages and repairs. The TamperFighter State of Polarization (SoP) monitoring system offers a scalable, proactive solution for real-time detection of physical disturbances along fibre cables. By using SoP sensing, operators can ensure infrastructure availability, enhance security, and enable predictive maintenance. This white paper explains the principles and benefits of SoP-based monitoring with an example from real-world deployment.



Why deploy fibre sensing?

Fibre optic cables are the backbone of global communications, supporting everything from internet connectivity to critical industrial operations. However, these cables are vulnerable to a range of threats, including anchor drags, fishing activities, subsea attacks, and natural disasters such as earthquakes and landslides. According to industry data, the majority of cable failures are caused by human activity, highlighting the need for robust, real-time monitoring solutions.

Traditional monitoring approaches, such as periodic inspections or standalone sensors, are often insufficient. They can be costly, time-consuming, and reactive—identifying issues only after significant damage has occurred. The emergence of fibre sensing technologies, like State of Polarization (SoP) monitoring, is transforming the landscape by enabling continuous, integrated, and cost-effective surveillance of fibre infrastructure.



What is SoP sensing?

State of Polarization (SoP) sensing is based on monitoring the polarization properties of light travelling through optical fibres. When a fibre is disturbed - by movement, strain, or impact - the polarization state of the transmitted light changes. By monitoring these variations, SoP systems can detect both subtle and significant physical events along the cable. Unlike Distributed Acoustic Sensing (DAS), SoP detects and characterizes the power of impacts like e.g. if a cable is physically impacted by a trawl crossing the cable. Furthermore, while DAS requires a dark fibre or separate wavelength bands and normally does not work through optical amplifiers, SoP can be fully integrated into existing transmission systems, operating over long distances and through amplifiers, even using the data-channels.

The figure illustrates how SoP sensing can create reliable alarms when a hit on the cable causing abnormal SoP variations is detected. Also, a permanent shift in the SoP is detected, indicating a displacement of the cable resulting from the hit.



Detecting cable movement



Real-time detection

SoP systems provide immediate alarms for abnormal cable activity, such as hits, displacement, or environmental events (e.g., storms, earthquakes).



Scalability

The technology supports monitoring across multiple cables and network sections, with distributed data processing reducing data volume and enabling rapid response.



Event characterization

SoP detects

- Weak and strong movements
- Displacements
- Environmental influences



Integration

SoP can use a dark fibre, a separate wavelength, or even the data channels.

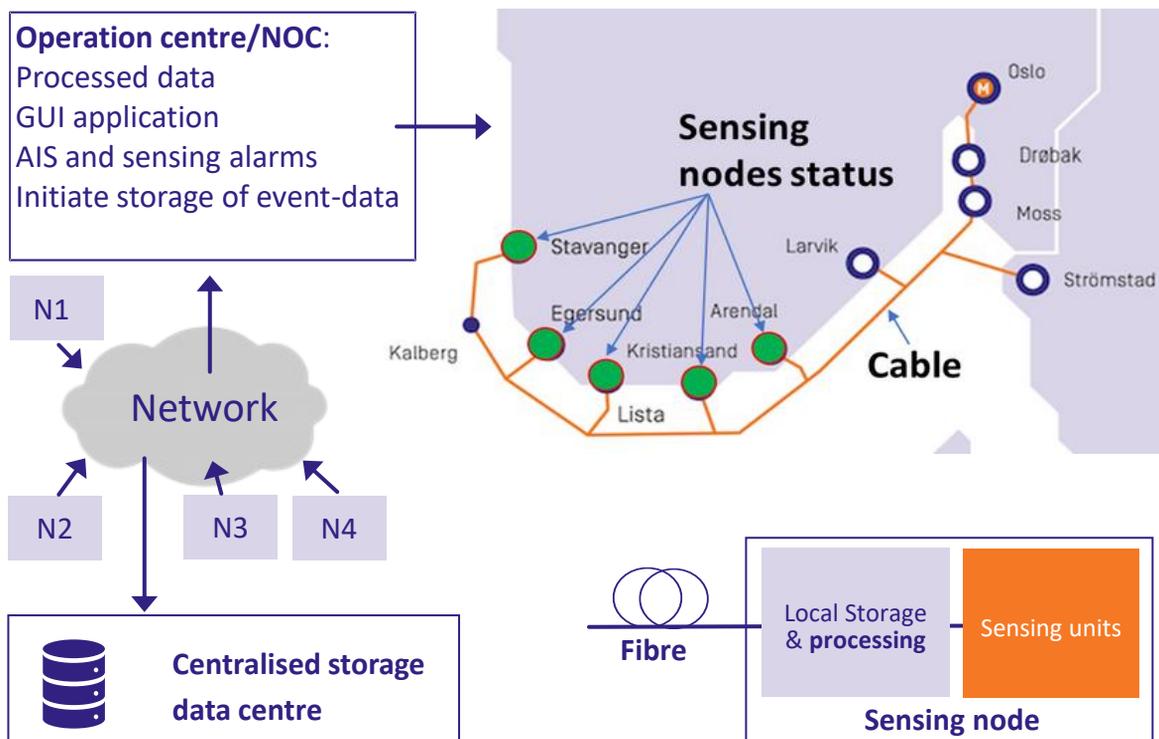
TamperFighter SoP monitoring system

Sensing architecture

The TamperFighter solution consists of dedicated hardware installed in network node rooms with embedded edge-processing software and connectivity to central servers and to Network Operations Centers (NOCs). The system streams processed SoP data in real time, enabling immediate detection and alarm handling. Integration with other data sources—such as DAS, Automatic Identification System (AIS), and weather data— may enhance situational awareness, supporting proactive decision-making.

Real-World deployment: the NORFEST example

The NORFEST subsea cable system is a pioneering deployment of end-to-end SoP fibre sensing. Each cable section is continuously monitored, with the system distinguishing between different types of mechanical interference (e.g., trawling, anchoring, seismic events). When abnormal activity is detected, the NOC can take immediate action—alerting vessels, securing exposed cables, or arranging inspections before a critical issue arises. This proactive approach minimizes downtime and protects both the network and the environment.



Operational benefits



Proactive maintenance

By observing patterns of stress and movement, operators can predict which cable sections may require attention, reducing the risk of unexpected outages.



Enhanced security

SoP monitoring detects activities, such as subsea trawling or anchor drags across cables, attacks or tampering, and supports rapid incident response.



Environmental monitoring

The system can also detect natural events (e.g., earthquakes, landslides), providing valuable data for broader scientific and safety applications.

Integration and scalability

SoP monitoring is designed for scalability, supporting both distributed (edge) and centralized processing. Data from multiple cables and sensing nodes can be aggregated, filtered, and correlated with other sources to provide a comprehensive view of network health. The system architecture allows for section-by-section monitoring and edge computing to reduce data volume. This flexibility makes SoP monitoring suitable for large-scale, mission-critical infrastructure.

Conclusion

The TamperFighter SoP monitoring system represents a significant advancement in the protection of critical fibre infrastructure. By enabling real-time, integrated, and scalable detection of physical disturbances, SoP sensing empowers operators to move from reactive to proactive maintenance and security strategies. The technology's compatibility with existing networks, combined with its ability to support environmental monitoring, positions it as a cornerstone for resilient, future-proof communications infrastructure. As threats to critical infrastructure continue to evolve, scalable solutions like TamperFighter SoP monitoring will be essential for ensuring availability, security, and operational excellence.

