Fiber Optic Pipeline Monitoring System

Preventing and detecting leaks in real time

Detecting pipeline leaks is a high priority

but can be difficult to achieve
without the right systems in place.

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Common System Limitations

- Longer detection times for small leaks
- Limited leak localization ability
- Limited preventative monitoring
- Poor leak sensitivity and reliability
- Single phase leak detection only
- Computational errors
- Numerous false alarms
- Requires dedicated pressure sensors and high sampling rates
- Higher maintenance and costs for additional sensors and infrastructure

You go to great lengths to safely and reliably transport oil and gas to the market. And, although there have been several developments in pipeline monitoring technology, many systems have limitations that leave pipelines vulnerable to leakage, damage and theft.

Overcoming these limitations often results in the installation of multiple, cost-prohibitive systems to effectively monitor various leak scenarios. But it doesn't have to.

OptaSense® raises the bar by delivering a single system that detects smaller leaks faster and more reliably, while simultaneously monitoring for third-party interference and other external pipeline threats in order to prevent leaks altogether.

Get **more** from a single system

Detect, locate and classify multiple threats in real time, along the full extent of your pipeline, with the OptaSense pipeline monitoring system.

Instead of relying on computational assumptions, this system uses distributed acoustic sensing (DAS) technology to transform a standard telecommunication fiber optic cable into a fully distributed sensor capable of detecting the physical characteristics of a leak, including changes in noise, temperature, pressure and ground strain—simultaneously and in real time. The integration of these four modes into a single leak detection system not only provides improved sensitivity, it delivers the reliability required to identify and validate leaks faster and with more confidence.

Once connected to OptaSense equipment (installed every 80km), this pipeline monitoring system monitors the entire pipeline and surrounding facilities, providing uninterrupted and secure data updates continuously, across each 10m of fiber. This means you can detect the presence and location of very small leaks in a matter of minutes, while protecting critical infrastructure from external threats that can lead to substantial damage and loss.

With the OptaSense pipeline monitoring system, you can rely on a single solution that fortifies your overall integrity management program by ensuring threats to your pipeline are predicted and averted.

One system, multi-threat detection
The OptaSense pipeline monitoring system offers a variety of detector applications to monitor leaks, right of way and third-party interference, goehazards, theft, critical infrastructure and inline pigging devices in real time, from a single operating system.

One system, lower installation costs
With a single operating system, you eliminate unnecessary spend on redundant hardware, so you can invest in acquiring what matters most—the real-time information required for optimal pipeline management.

One system, flexible design
Pipelines stretching long distances require a system that can easily adapt to regional requirements and regulations. The OptaSense pipeline monitoring system offers you the flexibility to customize a monitoring solution with detector applications that satisfy the specific demands of your pipeline environment.

Fiber Optic System Advantages

Multi-threat detection
- Leaks
- Third-party and right of way interference
- Ground movement
- Condition monitoring
- Inline inspection tool tracking

Optimal performance
- Faster, more sensitive threat detection and classification
- Rapid, more accurate threat location
- Smarter, more reliable alarms
- Consistent, more robust system performance
- High quality data and reliable communications

Advanced sensing
- Measures acoustics temperature, pressure, strain and orifice noise
- Eliminates conversion and computational errors
- Performs in transient, slack-line and multi-phase flow
- Monitors longer distances using thousands of distributed sensors
- Provides localization accuracy of ±10m

Flexibility
- Customize a system for your specific pipeline environment

Reduced installation costs
- Eliminates the need for redundant systems and hardware

0.5 - 1.5m
(typical installation)

0.2 - 0.5m
(typical installation)

Benefit from a system that offers
- Real-time monitoring, greater reliability and improved operational safety
- Compatibility with standard telecommunication installation methods
- Reduced OPEX by minimizing annual data costs and maintenance fees
- A high data rate environment for pipeline automation and enterprise communications
- A private network that mitigates cyber security risks

Detect leaks faster and with confidence

Detecting a leak quickly and effectively can be limited by a systems level of sensitivity, accuracy, reliability and robustness.

The OptaSense pipeline monitoring system eliminates the guesswork that compromises safe and reliable pipeline management by detecting and locating leaks accurately and in real time, regardless of fluctuating pipeline conditions and flow regimes.

Detect smaller leaks faster with superior sensitivity

Internal leak detection systems are one of the most commonly used methods to detect a leak. These systems use point sensors to track flow rates, as well as provide mathematical and statistical computations of pressure, temperature and product characteristics. Although these systems are useful in identifying leaks, it takes longer to detect them, while small leaks may go completely undetected.

Where point sensors lack in sensitivity, the OptaSense pipeline monitoring system offers a leak detection application that identifies smaller leaks faster—allowing you to eradicate minor issues before they become major incidents. In fact, our fiber-based system can detect small leaks 10 times faster than internal systems—allowing you to detect a 0.1% leak size within a matter of minutes.

Locate leaks with increased accuracy

Another issue with many internal systems and sensors is their inability to identify the location of a leak. With internal systems, leaks are determined by analyzing discrepancies between predicted and measured values. For accurate computational modeling these systems require a large number of point sensors to monitor the extended range of a pipeline. Due to cost, sensors are only installed in increments along key areas of the pipeline, which limits their coverage and reliability.

With DAS technology, the fiber cable acts a physical sensor that offers thousands of detection points along the entire pipeline, capable of pinpointing the location of a leak within 10m, in real time.

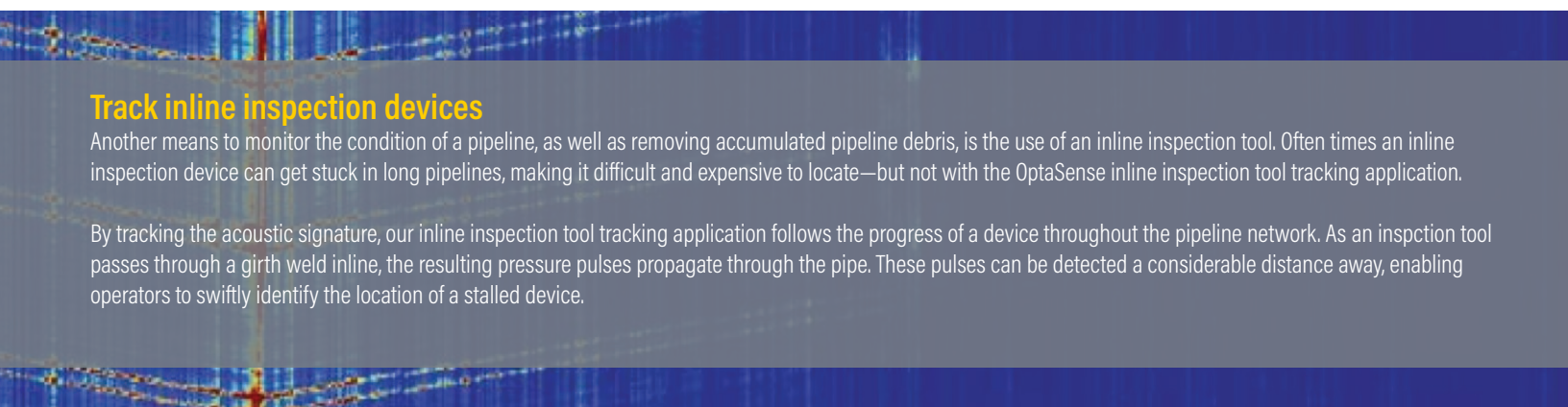## Increase confidence in alarm reliability

Point sensors not only struggle to detect and locate leaks, calibration errors and fluctuating pipeline conditions can impact a system's reliability—resulting in false alarms, missed leaks, or an unnecessary shutdown. Nuisance alarms are also an issue with many external fiber-based systems because they rely on a single detection method, such as temperature.

To minimize the costly impact of an unreliable system, the OptaSense leak detection application validates leaks before sounding an alarm. Using a patented multimode leak detector, our system confirms suspected leaks by measuring changes in noise, temperature, pressure, and ground strain, simultaneously and in real time. Multimode detector settings can be customized across every 10m section, adjusting to the environment and operating states at various locations.

Rely on robust system performance

Today's complex pipeline networks require robust systems that perform under changing fluid compositions, temperatures and pressures, which for many internal systems often result in computational errors and false alarms.

The OptaSense pipeline monitoring solution eliminates these issues by delivering a system that performs under transient, slack-line, and multi-phase flow conditions. Even when critical pipeline infrastructure goes offline, this fiber-based system ensures continuous and reliable real-time event detection, classification and location.

Track inline inspection devices

Another means to monitor the condition of a pipeline, as well as removing accumulated pipeline debris, is the use of an inline inspection tool. Often times an inline inspection device can get stuck in long pipelines, making it difficult and expensive to locate—but not with the OptaSense inline inspection tool tracking application.

By tracking the acoustic signature, our inline inspection tool tracking application follows the progress of a device throughout the pipeline network. As an inspction tool passes through a girth weld inline, the resulting pressure pulses propagate through the pipe. These pulses can be detected a considerable distance away, enabling operators to swiftly identify the location of a stalled device.

Mitigate the risk of external pipeline threats

Pipelines are susceptible to various external threats that can result in significant damage, or worse, a rupture.

However, a majority of these incidents can be prevented.

In addition to leaks, the OptaSense pipeline monitoring system detects the external events that lead to pipeline damage, so you can respond to threats before incidents occur.

Detect external interference

Offering third party interference monitoring and right of way detection, our system alerts pipeline operators of potentially hazardous activity occurring within the pipeline corridor, such as digging, vehicle movement and other large machinery, before contact with the pipe is made.

Utilizing the fiber optic network around remote facilities, the system can also detect threats and unwanted activity near above ground infrastructure, such as block valves, refineries and pumping/compressor stations.

Protect pipeline infrastructure

Sabotage and theft are another threat that can significantly impact pipeline integrity, as well as an operator's bottom line. Protecting pipelines in high-risk areas typically requires a separate leak detection and security monitoring program, but the OptaSense pipeline monitoring solution can do both.

By integrating leak detection, security monitoring and theft prevention into a single system, the OptaSense pipeline monitoring solution provides the sensitivity and reliability required to detect and locate suspicious activity, such as illegal hot taps and vandalism, up to 100km from a single location.

With this knowledge, you not only improve incident reduction, you increase the effectiveness of response mechanisms, such as ground patrol and helicopter reconnaissance, by ensuring manual inspection is focused on areas of real activity.

Monitor seismic disturbances

Sizeable ground shift and rock fall events can also be detected with the ground movement monitoring application. By recording all activity in the vicinity of a pipeline before and after a large scale, widespread disturbance, such as earthquake, engineers can gain an understanding of resulting damages and whether asset integrity has been compromised.

Detecting pipeline leaks faster and reliably is a priority, but leaks only account for a portion of total risk.

WHY DAS?

Using fiber optic acoustic sensing technology, our system identifies the unique acoustic fingerprints of events that pose a threat to your pipeline, such as third party interference, manual or mechanical digging and forces of nature.

Real-time detection

What makes DAS one of the most effective solutions for monitoring external threats is its ability to convert a fiber optic cable into an array of virtual microphones capable of detecting, locating and classifying these threats in real time. Detect a person walking up to 10m away from a buried fiber, and vehicles up to 15m away. Manual digging can be detected as far as 10m, while mechanical digging or other larger machinery can be detected at distances reaching 50m.

Advanced processing and algorithms

Activities or events that occur along a pipeline produce unique sounds and vibrations, which DAS can detect. Using advanced processing, these unique acoustics are analyzed to eliminate background noise and then converted into a high resolution visual. By applying advanced algorithms, these sounds and vibrations are deciphered to create specific alarms for a given event or sequence of events—allowing you to monitor individual or interactive threats, where and how often they occur, whether they are time-dependent and their potential of becoming a major issue.

Reliable alarms

In many external acoustic systems, higher levels of background noise can trigger false alarms—in some cases dozens of alarms each hour—which make it harder to detect external interference. To ensure nuisance alarms are effectively minimized, the OptaSense pipeline monitoring system observes these activities over a short period of time to create an exact picture of normal events prone to that area.

Smart zones

For more dynamic thresholds, this system offers smart zones that provide the flexibility to customize alert settings for specific regional needs, such as terrains, roadways and rivers, at different times of the day. With this insight, you can distinguish normal pedestrians and roadway traffic from an unexpected vehicle unloading several people.
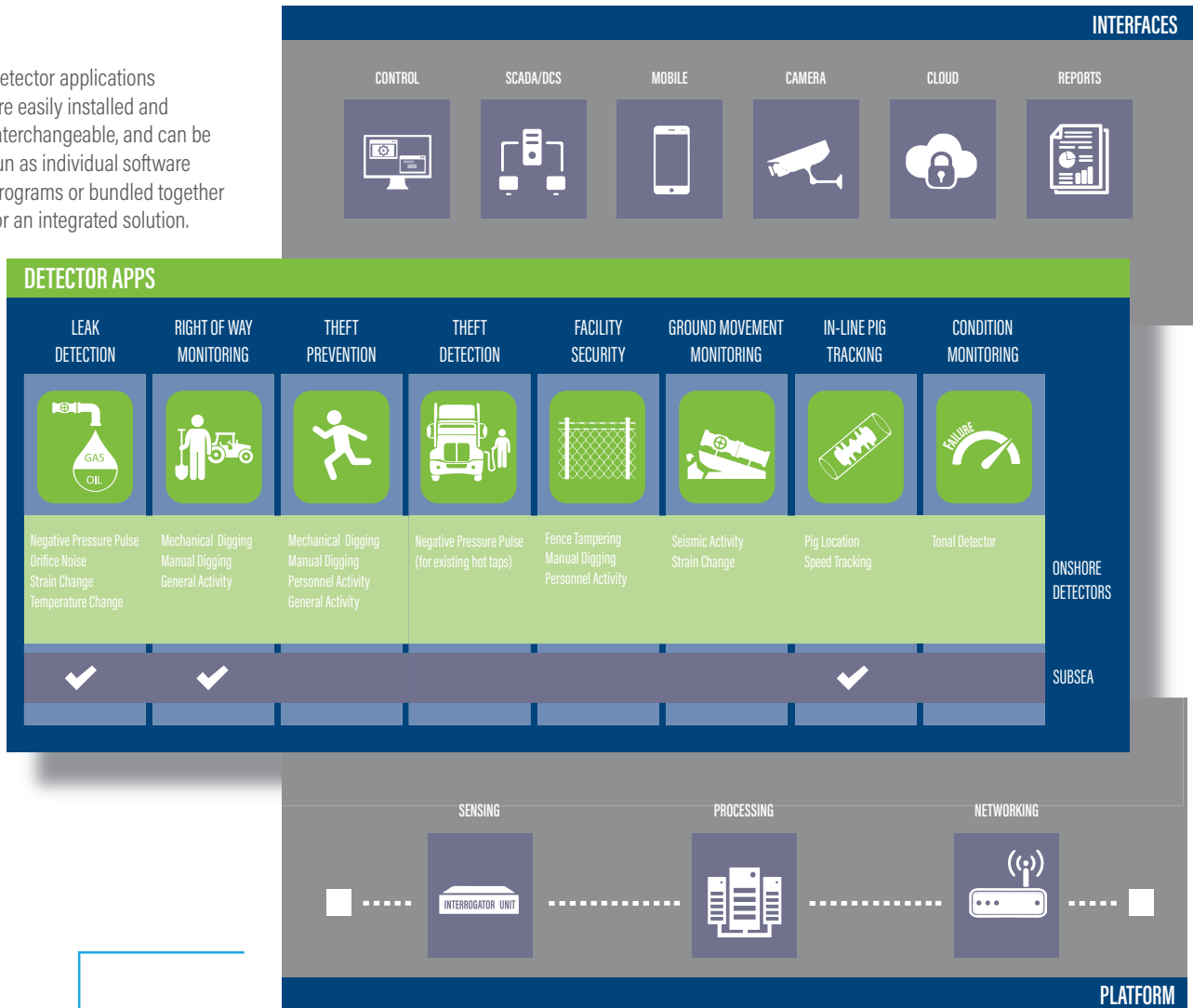
Pipeline expansion is accelerating around the world, as is the pressure to increase the safety and reliability of existing, aging infrastructure.
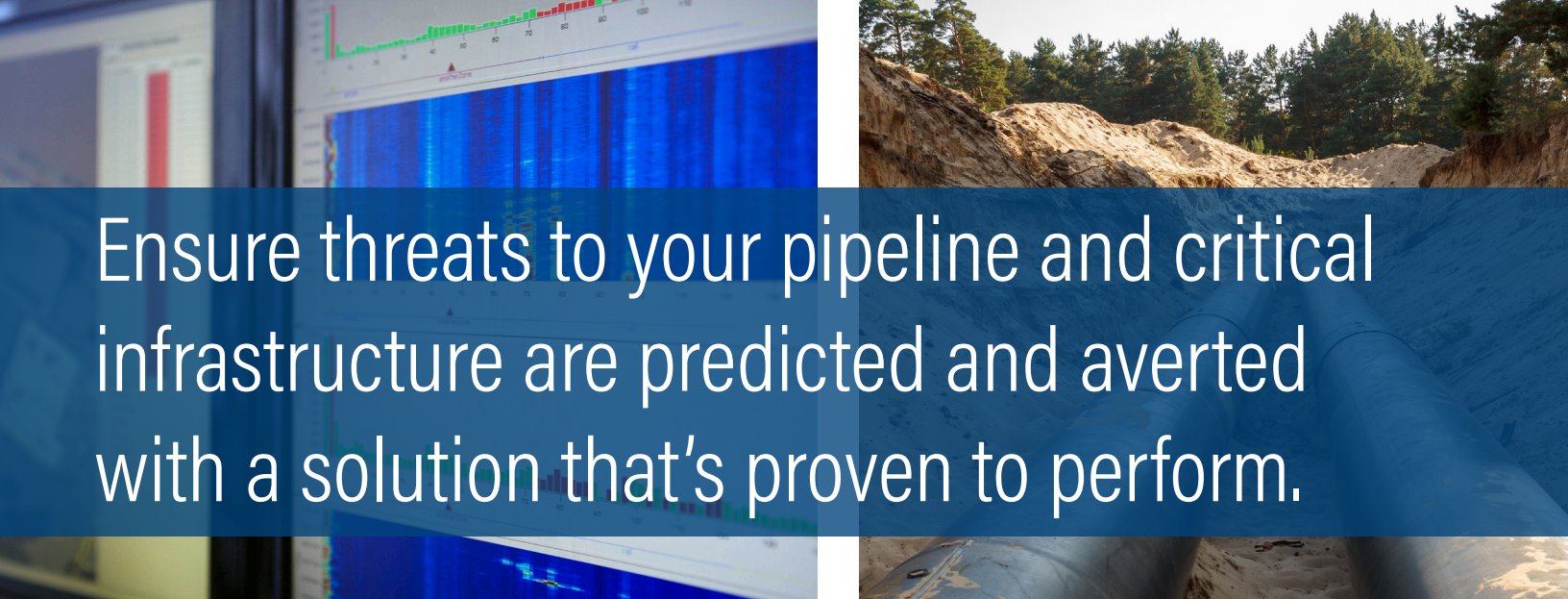
ONE system, MULTIPLE applications

Our pipeline monitoring system provides real-time, actionable data that optimizes business decisions and costs by increasing operational efficiency, maximizing productivity and reducing risk.

Multifunctional interfaces delivers real time operational data to right people, in the right format (trending reports to operations management, security alarms to the security team via mobile devices and leak detection alerts to main control via SCADA).

INTERFACES

CONTROL	SCADA/DCS	MOBILE	CAMERA	CLOUD	REPORTS

Detector applications are easily installed and interchangeable, and can be run as individual software programs or bundled together for an integrated solution.

DETECTOR APPS

LEAK DETECTION	RIGHT OF WAY MONITORING	THEFT PREVENTION	THEFT DETECTION	FACILITY SECURITY	GROUND MOVEMENT MONITORING	IN-LINE PIG TRACKING	CONDITION MONITORING	
Negative Pressure Pulse Orifice Noise Strain Change Temperature Change	Mechanical Digging Manual Digging General Activity	Mechanical Digging Manual Digging Personnel Activity General Activity	Negative Pressure Pulse (for existing hot taps)	Fence Tampering Manual Digging Personnel Activity	Seismic Activity Strain Change	Pig Location Speed Tracking	Tonal Detector	ONSHORE DETECTORS
✔	✔					✔		SUBSEA

PLATFORM

SENSING	PROCESSING	NETWORKING
INTERROGATOR UNIT		

Platform sensing, processing and networking hardware can be easily retrofitted for pipelines with existing fiber optic cables.

Ensure threats to your pipeline and critical infrastructure are predicted and averted with a solution that's proven to perform.

By combining leak detection and security monitoring into a single system, OptaSense helps you keep oil, gas and other products where they belong—in the pipe.

Our pipeline monitoring solution provides decision-ready data that optimizes business decisions and operating costs by increasing operational efficiency, maximizing productivity and reducing risk.

In fact, with more than 15,000km of pipeline under contract in over 40 countries, our fiber optic monitoring solution is protecting some of the world's most valuable assets.

For a **reliable** and **robust** pipeline monitoring solution that **detects**, **classifies** and **locates** **multiple threats** in **real time**, contact your local representative or visit us online to learn more.

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