INFINITE TECHNOLOGIES

T8 SENSOR

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T8 SENSOR | PIPELINE

Multipurpose system of technological monitoring
and critical facilities protection

DAS DUNAY I PIPELINE

Pipeline monitoring is associated with high financial costs for maintaining the functioning of the safety infrastructure.

In the classical solution of the issue, such a line of defense contains many elements, each of which requires periodic maintenance and control of its operation.

Dunay Distributed Acoustic Sensor (DAS Dunay) manufactured by T8 The sensor is based on the distributed acoustic sensor technology. The sensitive element of the system is a fiber optic cable that does not require maintenance.

One fiber of an optical cable, located along the pipeline, can replace a thousand sensors. The sensor connected to the DAS Dunay cable allows monitoring and diagnostics of the pipeline, classifying such impacts as:

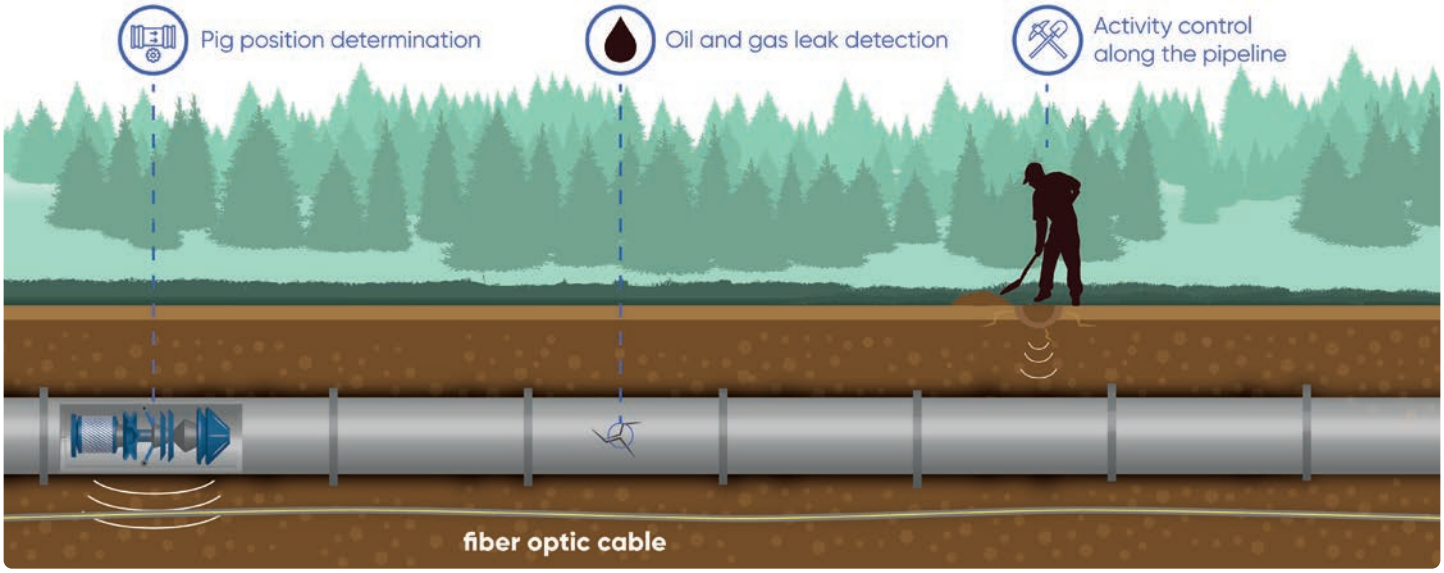
• activity along the pipeline (unauthorized tie-in, work of heavy machinery, work with entrenching tools, etc.)

Dunay in 3U format for a telecommunications rack

• position of the pig

• oil and gas leakage (thermal and mechanical gradient)

DAS Dunay allows the system operator to quickly respond to unauthorized impacts and prevent theft of natural resources, as well as reduce the risks of adverse consequences of an oil or gas leak.



EVENT RECOGNITION

Any mechanical impacts near the pipeline, such as human steps or vehicle movement, have a unique vibroacoustic trace, which is captured by the sensor cable and recorded by DAS Dunay.

Using neural network algorithms, the system can be trained to classify additional types of events, with high accuracy and minimal error probability, necessary for each customer and specific object.

To ensure the operation of the neural network, both the computer built into DAS Dunay and an external server can be used.

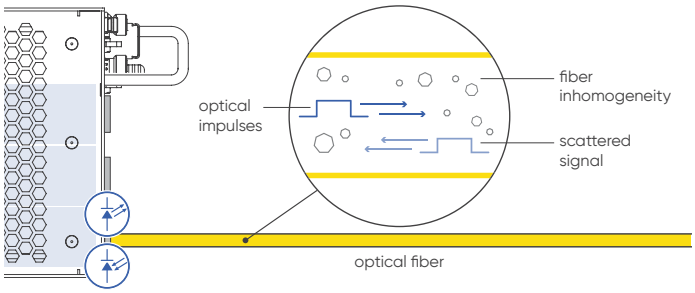
WORK PRINCIPLES

The distributed acoustic sensor makes it possible to detect acoustic vibrations at a distance of up to several tens of kilometers from the location of DAS Dunay along the optical cable.

DAS Dunay consists of a signal emitter and receiver unit, a data processing system and software (SW). The classification of each event (violation class) occurs using neural network algorithms.

The sensing element is a cable-sensor with a standard telecommunication single-mode fiber (G.652, G.655, G.657), the service life of which is more than 25 years. DAS Dunay is connected to one of the fibers of the sensor cable, which continuously monitors vibroacoustic events along the fiber optic cable, which makes it possible to detect incidents in real time.

The operation of the system is based on the principles of coherent reflectometry and Rayleigh scattering. Optical pulses are periodically introduced into the fiber, part of the light is scattered by the inhomogeneities of the fiber and propagates in the opposite direction. With fiber microdeformations caused by vibroacoustic effects and temperature fluctuations, the parameters of the scattered signal change.



The principle of operation of DAS technology

Analyzing changes in the interference pattern of the backscatter signal, DAS Dunay makes possible to determine the location and nature of the impact in the sensitivity zone of the cable sensor.

SYSTEM CAPABILITIES IN OIL AND GAS LEAK DETECTION

- spatial accuracy ± 20 m
- minimum detectable gas leakage: 25 bar, Ø 2 mm
- minimum detectable oil leak: 2 bar, 4 l/min
- detection time < 0.5 minutes

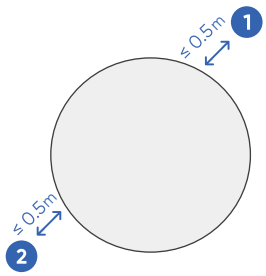
FEATURES OF MOUNTING THE SENSOR CABLE

To detect oil and gas leaks, a fiber optic cable is laid at a distance of up to 0.5 m from the pipeline. For a pipeline with a diameter of more than 0.7 m, two optical sensor cables must be used.

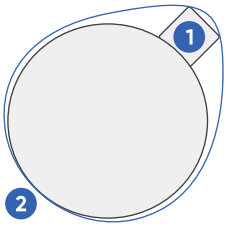
In all cable laying options, the sensitivity to leaks and the detection of activity in the monitoring zone depend on the distance between the pipeline and DAS Dunay within its operation.

Options for laying fiber optic cable:

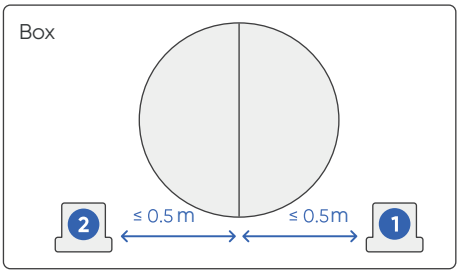
Underground laying



Laying on the pipeline



Packing in a box



1 Fiber optic cable

2 Optional fiber optic cable for pressures < 5-10 atmospheres or pipelines with a diameter > 700 mm

Rubberized clamps

Polymer or metal ties every 0.3 - 0.5 m

Rigid fastening every 0.3 - 0.5 m

BENEFITS AND CAPABILITIES

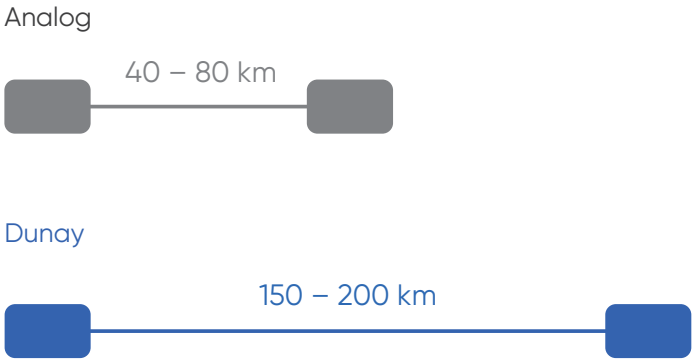
DAS Dunay provides the operator with ample opportunities to detect vibro-acoustic events.

When installing the system, T8 Sensor specialists carry out individual settings of DAS Dunay taking into account the characteristics of each object.

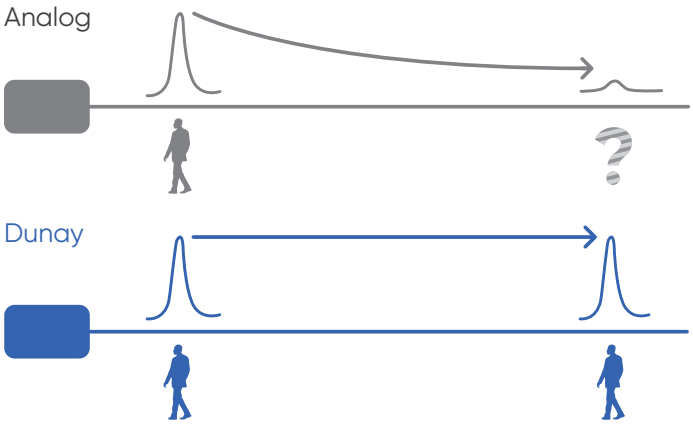
There are a number of advantages that distinguish DAS Dunay from other systems:

Range is 75-100 km length of sensor cable per system (up to 150-200 km between substations)

System response linearity
Stable signal shape for 1 km, 20 km, 50 km and more due to the use of a coherent phase-sensitive reflectometer; no fading zones.



Extended range is up to 75-100 km per system
(up to 150-200 km between substations)



Linearity of the system response over the entire length
of the sensor cable

Using the hidden line part
A passive sensor cable buried in the ground does not allow detecting the boundary either visually or by measuring electromagnetic field fluctuations, since the sensor cable is a passive element of the system that is not a source of electromagnetic radiation. The use of hidden laying of the sensor cable makes it difficult for potential violators to conduct reconnaissance of the area, allows you to preserve the landscape appearance of the monitoring object and use the system in specially protected areas of cultural heritage.

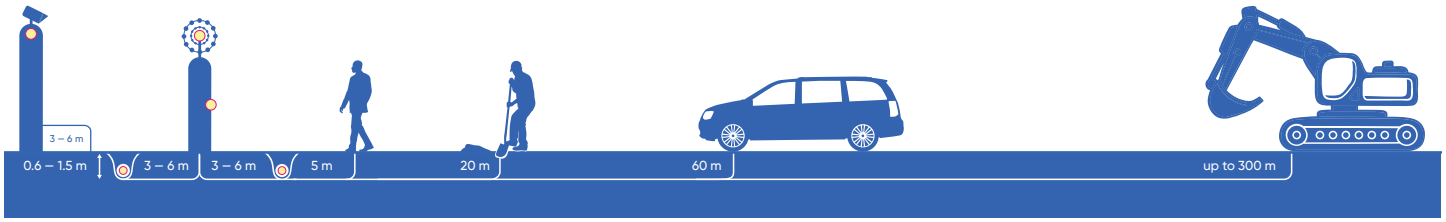
Ease of operation of the linear part:
• no need for power and equipment at the far end of the line (power is supplied at the installation site of the equipment)
• immunity to electromagnetic interference
• insensitivity of the system to external disturbances — industrial disturbances, air, railway and motor transport noise, tree wind and movement of small animals

Integration through open interfaces (APIs)
with other installed monitoring, activity control and video surveillance systems

Early event detection
Classification of the source of exposure before the intersection of the sensing element and the security line:
• human steps: 5-10 m from the cable
• manual digging: 15-30 m from the cable
• movement of a passenger car: 50-60 m from the cable
• movement and digging of heavy machinery: 50-300 m from the cable

Preservation of system operability in the event of a break in the sensor cable with localization of the event site

Deployable on existing fiber infrastructure



Maximum distance from the fiber-optic cable for registration and classification of vibroacoustic effects

Specifications

System settings	
Optical fiber type	G.652, G.655 or G.657 (ITU), single mode
Fiber length (sensing element)	75 km (up to 100 km depending on configuration)**
Spatial resolution	10 m
Optical parameters	
Wavelength	1550 nm
Scanning frequency	0.5–20 kHz
Strain sensitivity from 0.14 nanostrain	from 0.14 nanostrain
Dynamic range	30 dB
Maximum power	10 mW
Connector type	LC/APC
Embedded PC	
Processor	Intel Core i7 *
RAM / HDD	8 GB / 2 TB *
Protocols	TCP / IP, UDP
Interfaces	SFP, RG45, USB 2.0, DVI-D, Display Port
Versions	
Power supply	110–127 V / ~200–240 V, 50–60 Hz
Power consumption (OTDR / server)	300 W (100 / 200 W)
Dimensions	497 mm x 345 mm x 137 mm (3U version)
Weight	17.5 kg

*Dependent on operating conditions, subject to change

** Depending on delivery configuration

SYSTEM FUNCTIONS

Display of detected and recognized events
During commissioning, T8 Sensor specialists perform "mutual binding" of the sensor cable and pipeline (monitored object) to any public mapping platform (Google Maps, Yandex.Maps), or to an individual map format used by the customer.

The company's engineers customize the system interface according to the customer's requirements. The display of information about the detected events is displayed on the operator's screen in graphical form (on the diagram map) and in textual (tabular) form. The operator can filter aggregated events for each category of severity (alarms).

Integration
The maximum efficiency of the monitoring system is achieved when it is used in conjunction with other sets of technical means:
- life support
- power supply
- access control
- emergency protection system
- emergency/security warning system

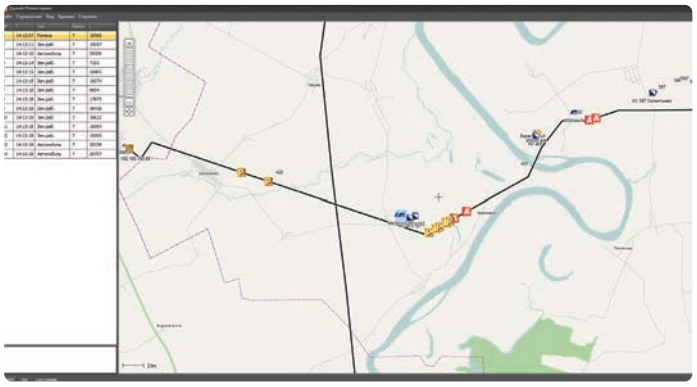
T8 Sensor is working on the integration of the monitoring system and unmanned aerial vehicles (UAVs). API for integration is carried out through xml, json, modbus.

Scaling
The developed architecture of the system makes it possible to automatically combine up to 20 devices into a single complex, which makes it possible to cover more than 1500 km.

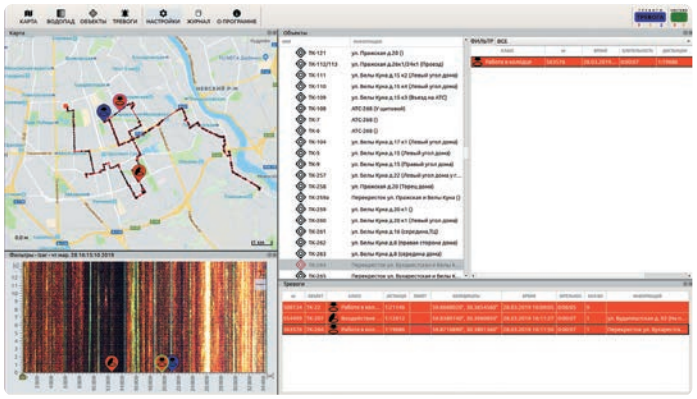
The number of connected devices is limited only by the computing power of dedicated aggregation servers, which allow operators to work with the system remotely.

Each DAS Dunay device can act as a server for five other systems. In addition, the system allows you to divide any monitoring object into an arbitrary number of zones with different customizable monitoring parameters.

JSON or XML / User Interface



System operator window showing a map and a list of events at the turn



User interface with event log

T8 Sensor is a Russian developer and manufacturer of fiber optic sensor systems. Main activities: scientific research in the field of photonics and development of multifunctional systems for technological monitoring and protection.

T8 Sensor conducts research and development activities. All developments are protected by patents valid on the territory of the Russian Federation and on the territory of the Eurasian Patent Convention.

Part of the research is carried out by the company's specialists in the interests of the telecommunications equipment manufacturer T8 LLC.

Distributed acoustic sensor Dunay is the main development of the company with a wide range of applications: monitoring of transport infrastructure facilities (railways, metro, runways, bridges, tunnels, highways), perimeter security, pipeline monitoring, vertical seismic profiling, and monitoring state of the optical infrastructure of telecom operators.

Currently, DAS Dunay is successfully operated at the facilities of the fuel and energy complex, the oil and gas industry, auto and air transport infrastructure, and telecom operators.

GEOGRAPHY OF APPLICATION

COMPLETED PROJECTS

GAZPROM TRANSGAZ | UFA
Number of systems: 2
Total length: 89 km (37 km + 52 km)
Launch year: 2015

KAZTRANSOIL | KAZAKHSTAN
Number of systems: 2
Total length: 86 km
Launch year: 2020

SARATOV REFINERY
Number of systems: 2
Total length: 10 km
Launch year: 2019

GAZPROM TRANSGAZ | Ukhta
Number of systems: 1
Total length: 100 km
Launch year: 2018

KAZTRANSOIL | KAZAKHSTAN
Number of systems: 1
Total length: 40 km
Launch year: 2021

T8 SENSOR I DAS SYSTEMS

T8 Sensor is a Russian company for the development
and production of fiber optic sensor systems

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