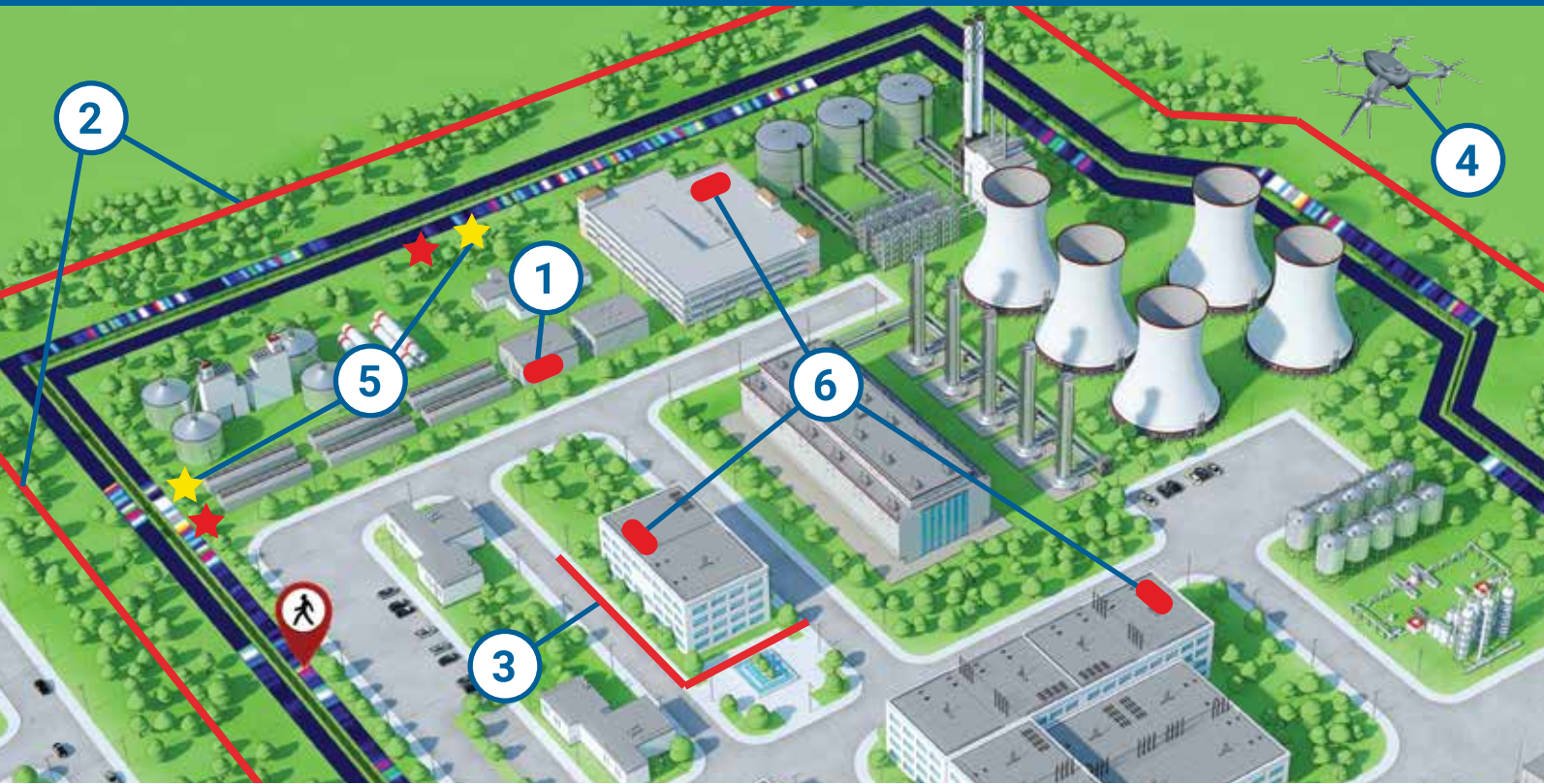# BG·OPTICS

INTEGRATED SECURITY SOLUTIONS

www.bg-optics.com

BG-OPTICS INTEGRATED SECURITY SOLUTIONS

1 Central control unit

2 WOLF perimeter control line

3 WOLF object control line

4 PHOENIX quadrocopter

5 ALBA video surveillance system

6 OVCHARKA multi-beam radar

BG-Optics company was established in 2014 as a unit of technological department founded by Biblio-Globus tour operator. The tight-knit team of BG-Optics composed of the premium level professionals with Candidates and Doctors of technical and physics-mathematics Sciences amongst team members. BG-Optics focused on complex safety and security solutions for areal and linear objects. Integrated security solution of BG-Optics comprised four technical subsystems: WOLF fiber-optics perimeter control system, ALBA stationary video surveillance system,

PHOENIX airborne surveillance system and OVCHARKA multi-beam radar that ensures spotting of low size stealth air objects. All the systems are integrated by common software and single operator's interface that enables docking of all components in any set according to the security complex requirements and displaying to the operator simultaneously information from all systems.

Common software allows to consolidate data of all systems. It also provides data exchange/storage, log records and synchronization of commands to all systems in emergency.

BG-Optics software integrates easily with third-party security equipment such as ACS (Access Control Systems), continuous radioactive control systems and other modules according to the critical site's specific security requirements. BG-Optics software supports web-interface that enables to control the entire complex remotely using any mobile device, such as tablet or smartphone. Rapid response team members can also be equipped with mobile devices in order to get information from the complex.
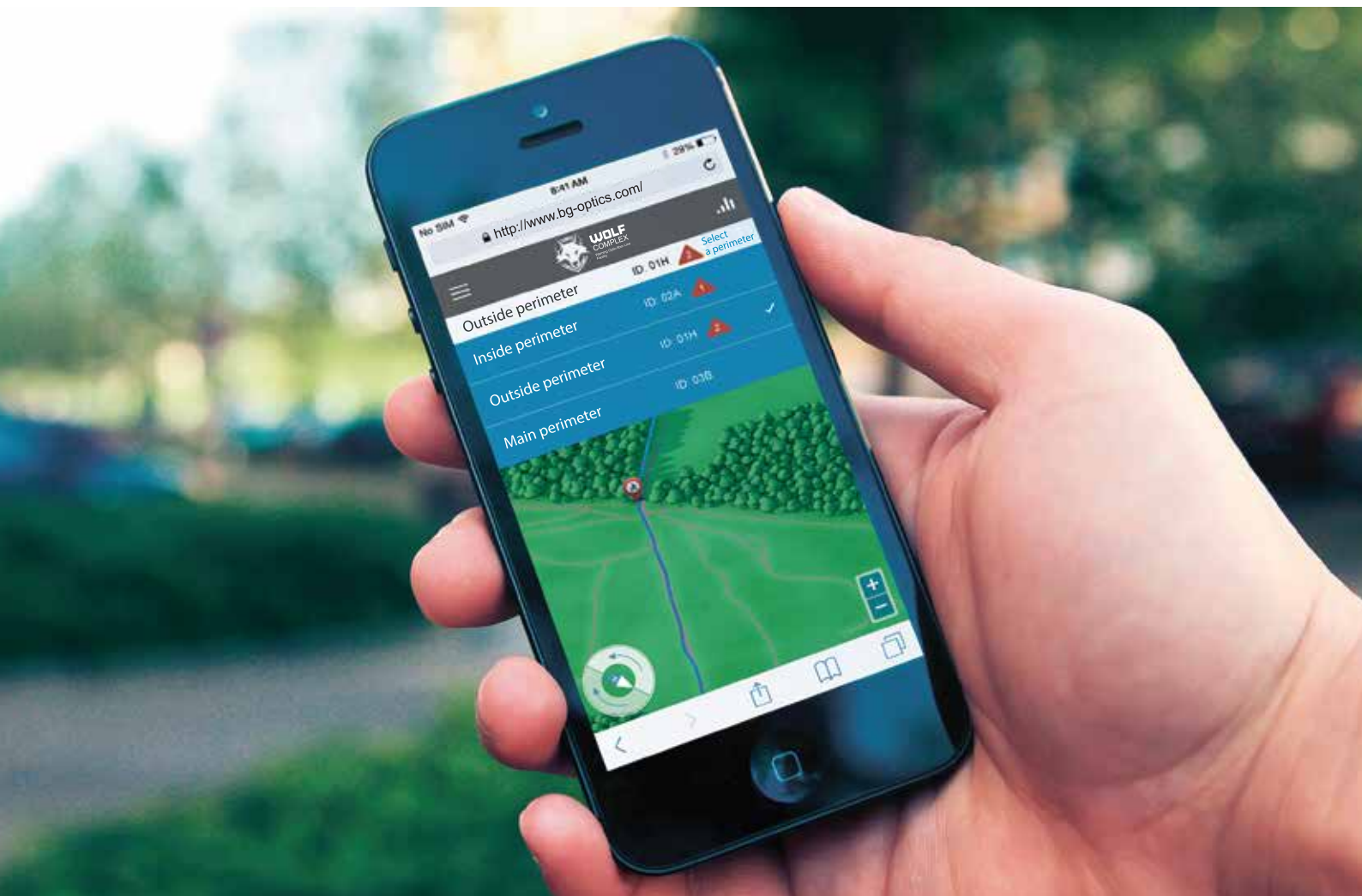
WOLF FIBER OPTICS CONTROL SYSTEM
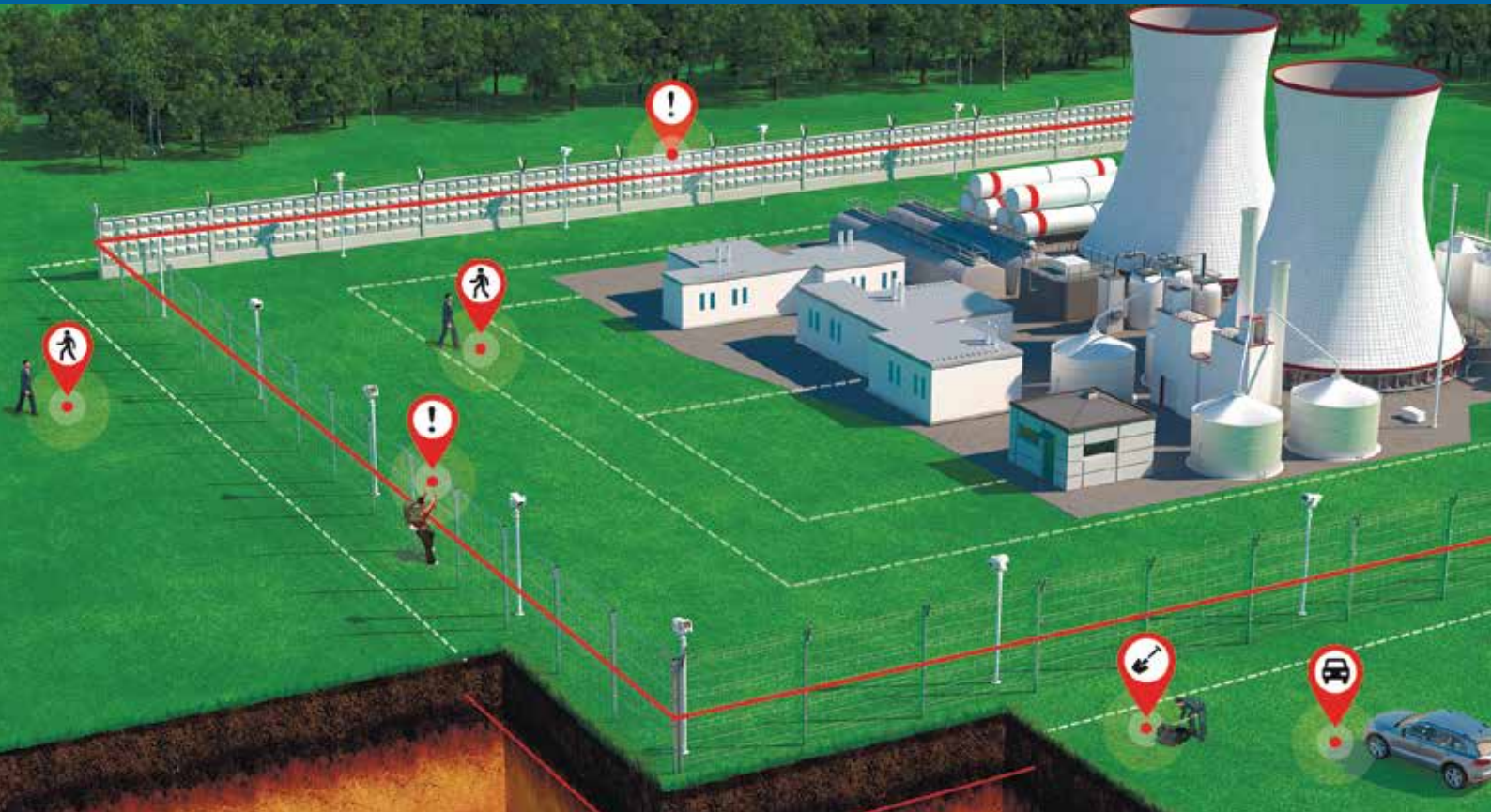
WOLF fiber optics perimeter control system is the most advanced and inconspicuous system for detection of any adverse approach to the protected area and crossing its borders.

WOLF can detect any ground or fence adverse activity that cause the ground or fence vibrations. It can also distinguish the type of activity or intruder.

Key benefits:
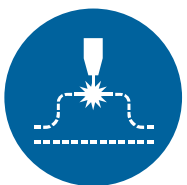
No battery or any other power supply required
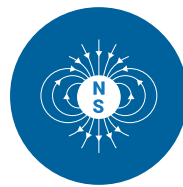
Cannot be disabled by any electromagnetic effect

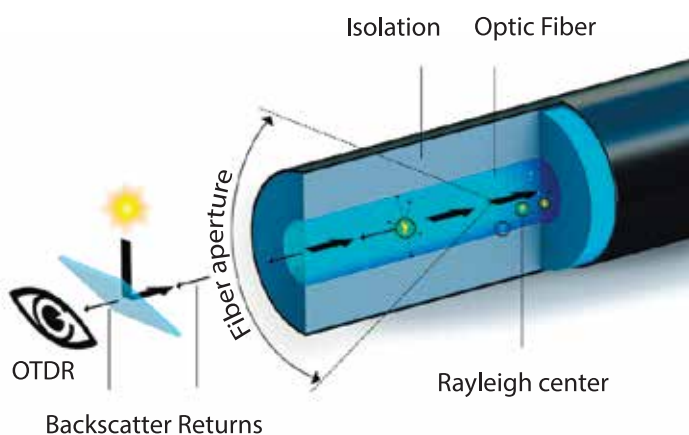Invisibility of the fiber optics sensor

All-weather operation

The fiber optics is easy to repair by welding in case of accidental or intentional damage

No way of radio electronic detection as the fiber optics emits no signal

WOLF system architecture is based on a distributed vibroacoustic sensor. Any standard telecom single-mode optical fiber can be used. Optical fiber does not require power and is not a source of electromagnetic radiation that makes difficult to determine its location in ground. The heart of the system is OTDR (Optical Time Domain Reflectometer). WOLF operation utilizes the effect of light scattering in the optical fiber. The optical module beams laser pulses into the optical fiber. As any optical fiber is not uniform by structure it has inhomogeneity of refractive index, that causes dispersion of laser probe pulses. This effect is known as Rayleigh scattering. Coherent reflectograms are formed on basis of backscattered laser signal. The reflectogram does not change in time in the absence of external effects. When pressure on ground occurs the reflectogram is distorted in the place that corresponds to the place of the impact.

1   Optical Termination Panel

2   Optical Module

3   Secondary Processing Server UPS

4   UPS

Isolation   Optic Fiber

Fiber aperture

OTDR

Backscatter Returns

Rayleigh center

After processing with ADC (analog-digital converter) the system processor determines the useful signal and makes
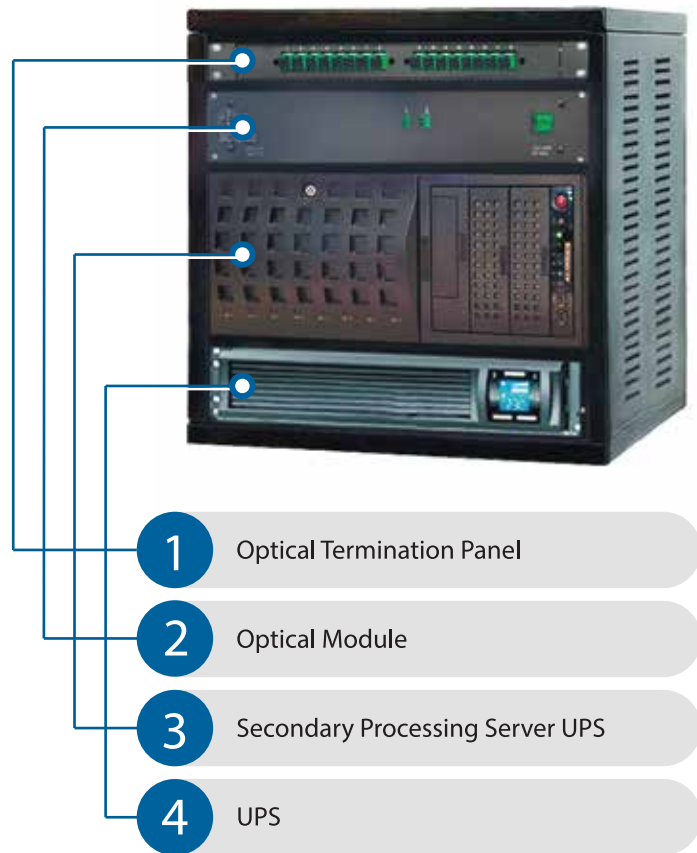
primary channels information an assessment of primary information from channels to focus on preset reference. The user friendly interface will display to the operator information about the exact location of the intruder at the secured perimeter and its type. WOLF system allows to determine and classify activities of any type that cause ground or fence vibrations.

The accuracy of the event location is up to 5 meters through the entire optical fiber length of up to 70 km. Multi-channel modifications of WOLF optical modules designed for connection of several optical fibers to different channels. Along with laying the fibers in the ground or fence towards each other, that enables to extend the controlled perimeter up to 140 km.
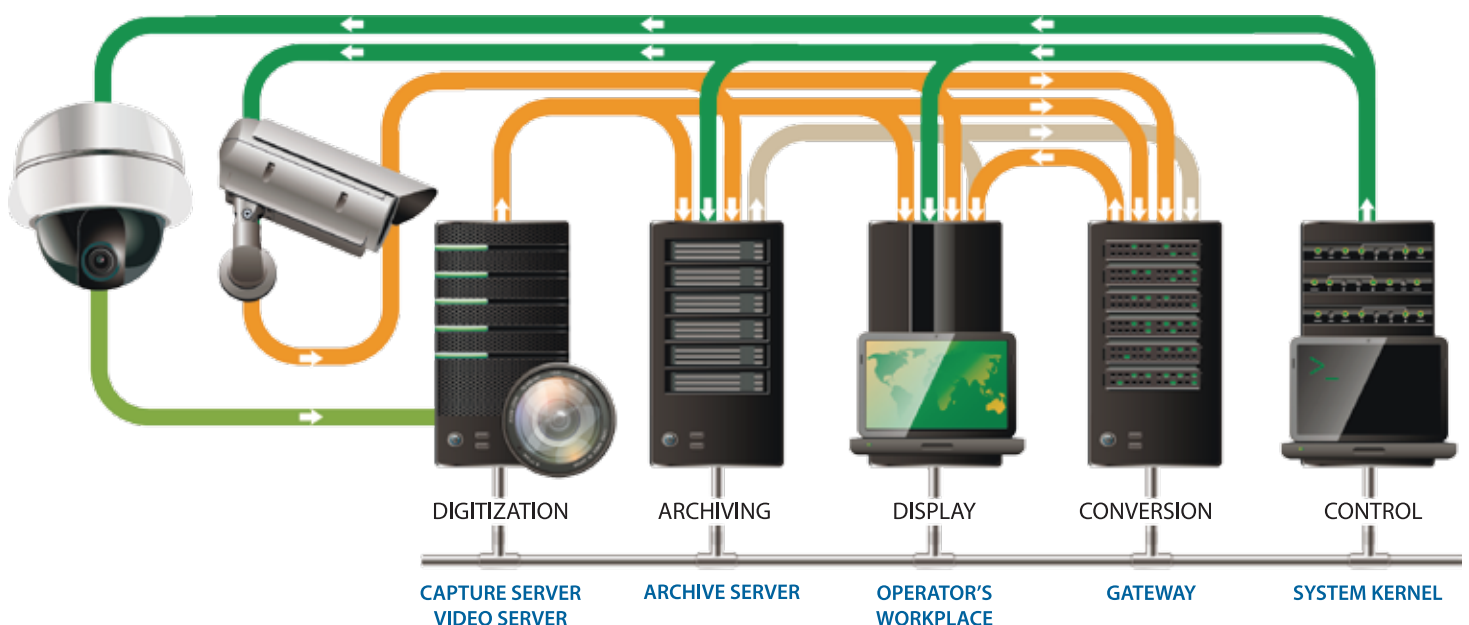
ALBA PERIMETER VIDEO SURVEILLANCE SYSTEM

ALBA perimeter video surveillance system is a component of BG-Optics complex security solution. Professional software enables to control IP- and hybrid surveillance systems of any size. ALBA could be installed on any size objects regardless their territorial distribution, number of cameras, number of users of the system and time of storage. Installation and setup of ALBA software do not require any special knowledge. The software has an intuitive interface, three working windows and a single configurator of settings.

Key benefits:

- Modular architecture allows to build flexible high-performance systems.

- Creation of geographically distributed video surveillance systems with a single control center.

- Multi-monitor configurations and video walls support.

- Support of cameras with resolution up to 5 MP (2592x1936) and a speed of 25 frame/sec per channel.

- High performance of decoding and display of video information.

- Support of IP cameras from various manufacturers via RTP/UDP, RTP/TCP, RTSP, or HTTP protocol.

- Russian, English and Spanish languages support.

- Full support of the IP-equipment integrated situational intelligence software.

DIGITIZATION	ARCHIVING	DISPLAY	CONVERSION	CONTROL
CAPTURE SERVER VIDEO SERVER	ARCHIVE SERVER	OPERATOR'S WORKPLACE	GATEWAY	SYSTEM KERNEL

# ALBA SITUATION INTELLIGENCE SOFTWARE

The basic package of ALBA situational intelligence software includes:

- **Definition of object in the area or crossing the borders of the observed area.** Allows setting arbitrary areas of border crossings' monitoring with relevant notice to the operator. System administrator can create decision rules to generate alarms and/or information messages for the system operator.

- **Object classification.** The relevant categorization log based on display area occupied by objects created during software setup. Supports main object types: human, animal, car, truck.

- **Identification of left or suddenly missed items.**

- **Detection of camera movement.** It is a function of the system sabotage. Requires no additional configuration and just alarms the operator about sharp movement of the camera.

- **Simultaneous tracking of up to 100 objects in the observed area.** Ability to simultaneously track up to 100 objects on the area of interest with displaying of the tracking results and the direction of movements of each object.

- **Camera lens obscuring detection.** It is a function of the system sabotage. Obscure factor can be set up as a percentage of the entire image area.

Interface of License Plates Recognition
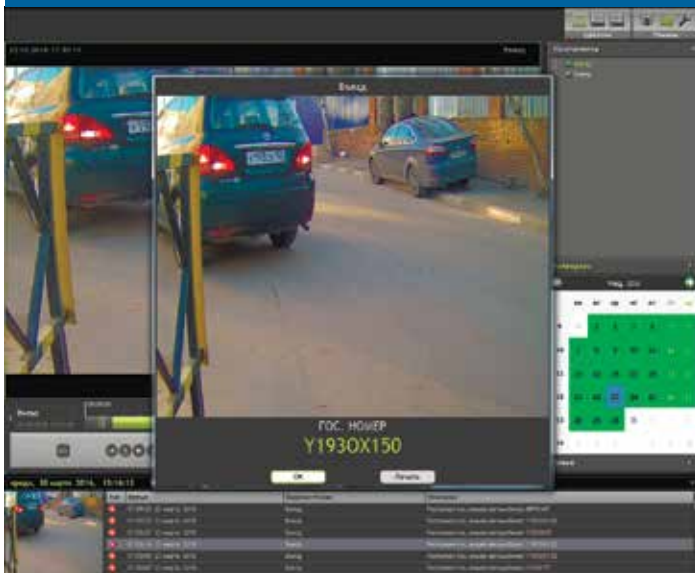
Leaving car
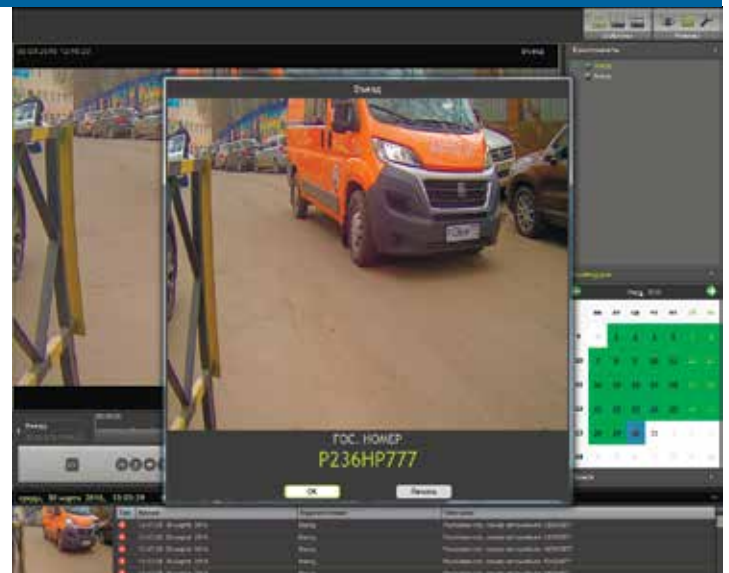
Approaching car

The advanced package in excess of the basic package includes:

- **Identification of human movements against the direction of stream.** Used to detect human movement against the main stream in order to prevent possible emergency.

- **Identification of too slow/high speed of human movements (running man).** Used to determine an individual moving with the slower or higher speed than other objects in the area of interest. Used to detect suddenly stopped or fast moving human.

- **Detection of people congestion, including in unauthorized places.** Used to identify offences and riots in a scene.

- **Counting of objects moving in two directions.** Filter can be set up for counting objects moving in both directions.

- **Identification of increasing activities of people in the monitored area (loitering).** Used to determine the constant chaotic movements of an object in predefined area in order to detect acts of vandalism, pilferage intents, unauthorized photo or video.

- **Self-learning function.** Ability of self-learning in automatic mode based on instant scene study is one of important features of each algorithm.

ALBA Advanced Package Interface

OVCHARKA AIR PERIMETER PROTECTION SYSTEM

OVCHARKA air perimeter protection system is an integral part of BG-Optics security complex. It is intended to detect air-delivered intrusions to the critical sites. Rapid development of production and diverse use of small-sized unmanned aerial vehicles (UAV) for different purposes like reconnaissance or point air strikes gave impetus to OVCHARKA startup. UAVs of small size reach velocities of up to 50 m/s. In terms of radar detection UAVs nearly indistinguishable from birds. Therefore, recognition of them on the approach to the protected object is extremely difficult. Engineers of BG-Optics successfully found the solution in the form factor of a multi-beam radar. Complex calculation work and mathematical modeling approach to the radar software development is completed by now. Mathematical rationale of the software fully described in the "Multi-beam radars in security complexes.

Antiterrorism" book written by the project developers. Suppliers of domestically produced components were chosen at the same time, and assembling of the radar test sample has

started. It is planned to test the radar at the beginning of 2018 and then certification and serial production will start.

Specifications:

- Frame rate: 0,5 Hz

- UAV detection range: 0,2 to 15 km

- Moving human detection range: 0,2 to 5 km

- Min object velocity for detection: 0,5 m/s

- Positional accuracy: 10 m

PHOENIX AIRBORNE VIDEO SURVEILLANCE SYSTEM

PHOENIX airborne video surveillance system designed on base of quadrocopter UAV. BG-Optics assembles the quadrocopters on its own premises as well as produces their main components, including carbon bodies, propeller blades, circuit boards, motors with gearboxes and supplementary equipment, such as carriers with auto-release lock and 2 kg payload capacity and gyro-stabilized gimbals for carrying conventional or infrared camera.

Main locally produced parts

Motor with gearbox

Carbon body and propeller blades

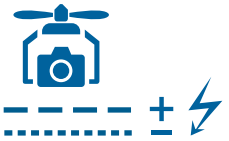*Gyro-stabilized gimbal with a camera*

Key benefits:

Self-sustainment

● **Automatic control system**

It includes inertial navigation system, satellite navigation system and navigation by visual markers.

● **Automatic charging**

It includes onboard battery charging unit and a ground-based control unit, coupled with the meteorological station.

The system works 24/7.
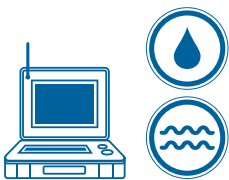
Portability and reliability

Ground-based control system (GBCS) includes a set of spare parts and replacement battery that charged directly in the case of the GBCS. The GBCS case is weatherproof.

Easy maintenance

Serviced by one operator. Battery or payload replacement requires no special tools.

PHOENIX Quinary in Flight

There are several modes of PHOENIX system usage as a part of integral security complex.

1) Manual mode. The operator sets the flight task and manually pilots the copter to the alarm area, and also operates the camera.

2) Semi-automatic mode. When the alert signal is received by WOLF system it automatically builds a route for a copter to the alarm point and sets the task for video capturing, and the operator has just to confirm the flight start.

3) Full-automatic mode. The copter performs independent flight-around by the instructions of the WOLF system and the camera automatically transmits the image to the main WOLF server for recording.

Specifications:

- Flight time: > 60 min
- Line of sight: 1,5 km
- Ferry range: 12 km
- Service ceiling: 2 km
- Wind resistance: 10 m/s
- Ambient temperature range: -20°C to +50°C
- Weight without payload: 6 kg
- Take-off and landing: vertical

INTEGRAL AIRPORT TERRITORY PROTECTION

0,3 – 0,7 m

5 m 5 m

The following deployment scheme of BG-Optics WOLF system is offered for monitoring moving objects along the aerodrome territory and particularly for preventing intruders people or illegal vehicle entrance to the runway. Optical cable-sensor is placed in two lines on both sides of runway. The distance between lines is 5 m and layout depth is 30-70 cm. When alarm signal of intrusion comes to system, it automatically focuses the closest video camera to the alarm zone and displays the picture to the operator. If necessary, the operator can send PHOENIX copter with video camera, or the system makes it automatically.
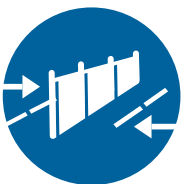
Capabilities:

Attempts of climbing over the fence

Heavy vehicles from up to 50 meters distance

Perimeter crossing can be determined if 2 or more parallel optic lines are used

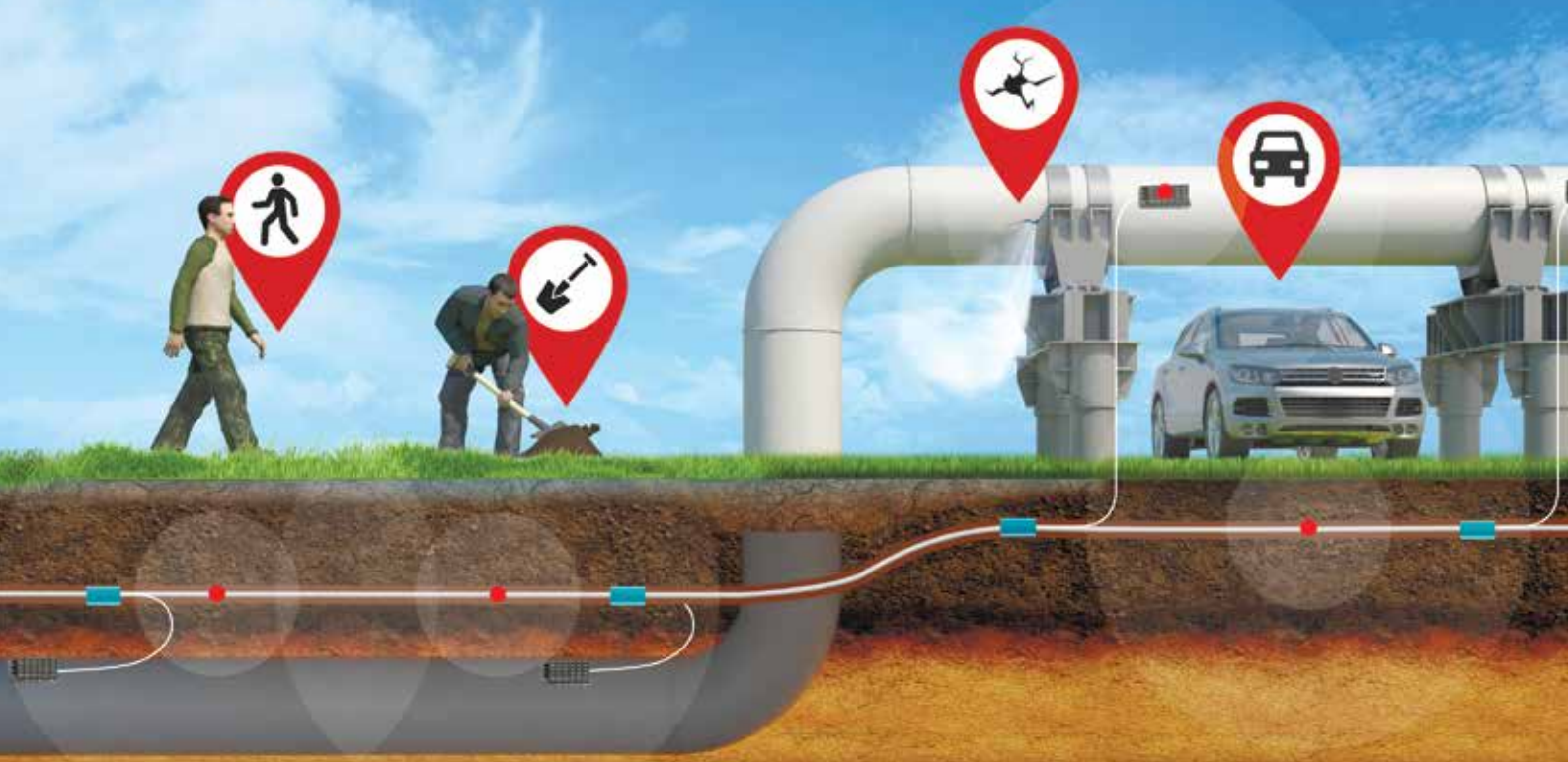Accurate positioning of the moving object when using special cable laying patterns

Human approaching the fence at up to 5 meters distance

Attempts of undermining or digging tunnels under the fence up to 3 m in depth

# CONTINUOUS REMOTE MONITORING OF PIPELINES TECHNICAL CONDITION

Parametric system are currently the main monitoring tool of pipelines condition. However, they have two significant drawbacks: low sensitivity to leakage spot determination that is less than 0.5% of rated flow, and low accuracy of the accident site - up to 500 m. Solution of BG-Optics significantly improves these parameters to provide accurate and rapid diagnosis of the pipeline for leaks, illegal siphoning and other dangerous accidents of natural or man-caused nature.

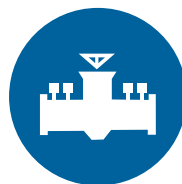## Pipeline applications:

Instant detection of attempted siphoning up to 5 m
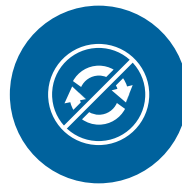
No sensor synchronization required

Can be installed on the objects built on piles

Pipe destruction detection long before an accident

Savings from common fiber-optic cable usage to transfer data from different types of sensors

Sensing element does not require electric power that is critical for gas and oil pipelines

WOLF system with multi-channel module provides total security for oil and gas storage facilities. Fiber optics sensing elements are laid in the ground and also are attached to the fence in order to provide perimeter security and promptly detect unauthorized invasion to the facility. Vibroacoustic sensors that monitor integrity of tanks structure are attached directly to the each tank and are connected to each other through an optical fiber. Method of acoustic emission allows to pinpoint the weakened section of the construction at the initial stage of destruction, that gives enough time to the technical service to take emergency preventive actions. Optical fiber usage as data transmission cable enables to receive signal simultaneously from all vibroacoustic sensors that provides savings during installation and subsequent operation of the complex.
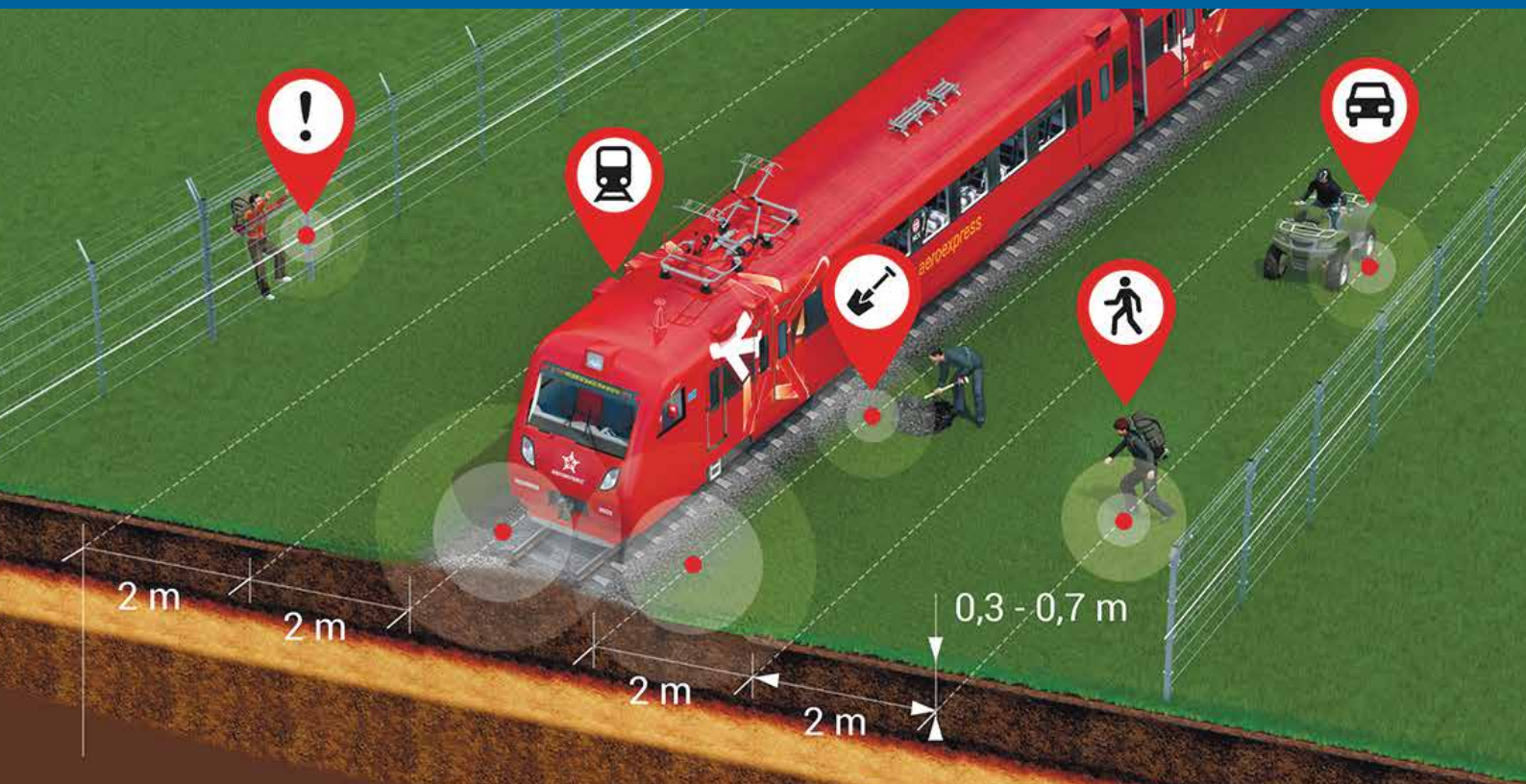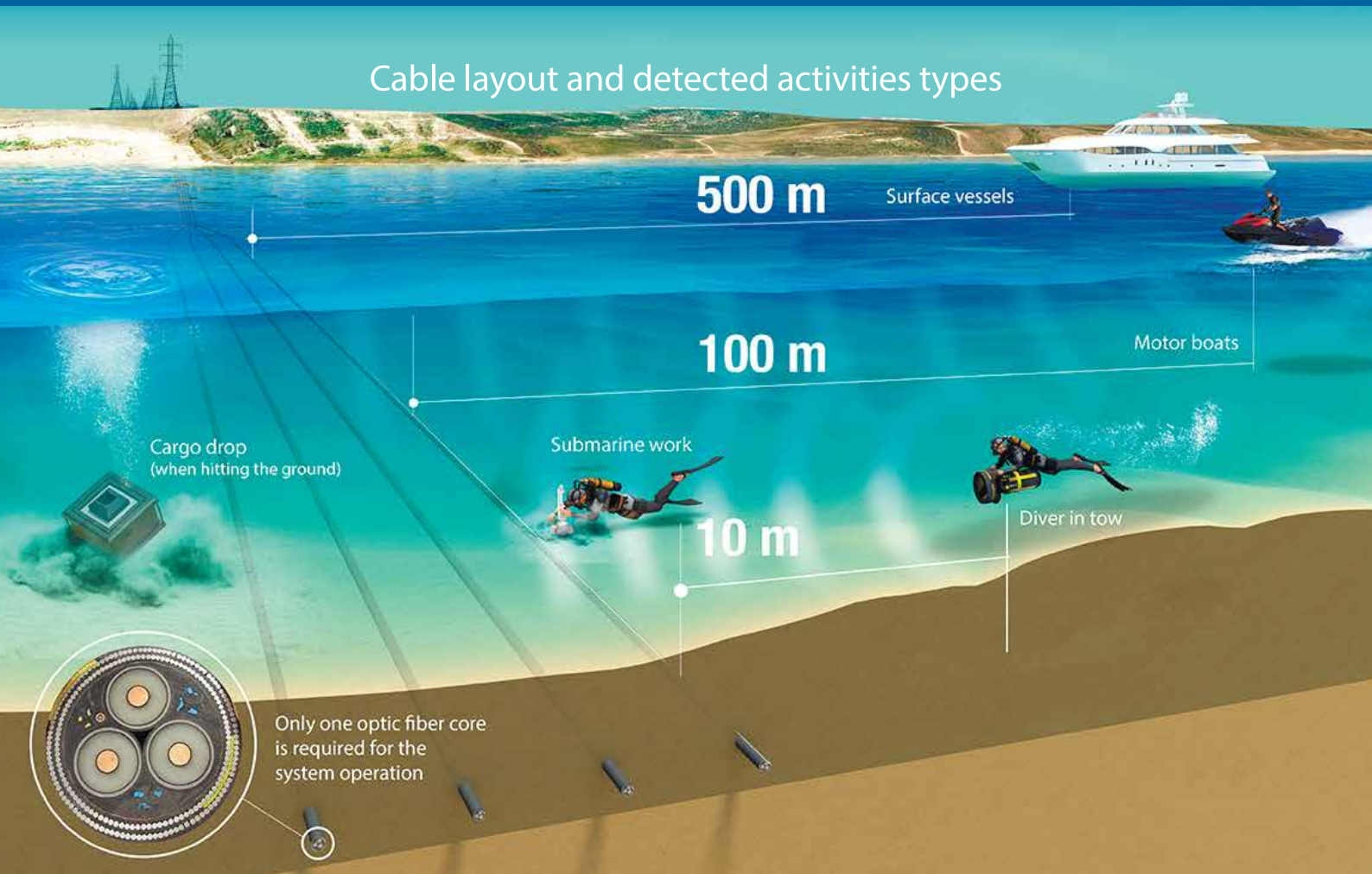
Development of railway network in Russia in the 21st century will focus on the construction of high-speed railways (HSR), the first of which should connect Moscow with Kazan. Train speeds on this HSR would reach up to 360 km/h. This faces safety and security to very high requirements because, for example, at this speed a train covers 100 meters in one second, and a sudden human crossing the railway track will not be able to evaluate the speed of approaching train. Most of the way first VSM will run in forests where possible crossings of railroad by large animals may occur, so fast object detection and early alarm warning would be critical both for dispatchers on duty and train drivers. The highest level of the safety and security systems automation should be incorporated in the project development to eliminate the "human factor". Also the

HSR project assumes localization level of equipment production and operational software development as of 85% or higher. BG-Optics solution fully meets these criteria. Moreover, it will give significant cost savings, because one optical module is sufficient for monitoring of 140 km of linear section of the railroad. Over 150 km of Moscow – Kazan HSR are planned to be laid on artificial structures: bridges, flyovers and overpasses. BG-Optics fiber optics sensing element can serve not only as unauthorized access sensor, but to work as non-destructive testing sensor. It can detect incipient structural failure at the very beginning that gives enough time to take preventive measures. The spare optic fiber of the cable can be used as a data transmission line that eliminates cost of laying of additional communication lines along the entire length of the railway.

LONG WATER BORDERS PROTECTION

Cable layout and detected activities types

500 m — Surface vessels

100 m — Motor boats

Cargo drop (when hitting the ground)

Submarine work

10 m

Diver in tow

Only one optic fiber core is required for the system operation

When the boundary of a large protected area runs along water, use of conventional fiber optic cable does not provide desired results. Low viscosity environment strongly suppresses the transverse vibration, and vibroacoustic signal becomes much weaker. To detect unauthorized activities in the aquatic environment sensitivity of the optical module could be increased, but in this case rejection of background noise becomes almost unreachable task. Engineers of BG-Optics went the other way. Specially designed cable was developed and produced. The cable is able to detect both shear waves and longitudinal waves. The latter ones are mostly propagating in the aquatic environment. By design, the cable resembles a fiber-optic hydrophone of several kilometers length. Due to the reflectometric principle of the optical unit operation the cable can be represented as an antenna array consisting of virtual hydrophones with increments of meters, which allows to solve the problem of determining true target bearing.

Cable laying is made in several rows on the bottom of the waterway. Special coupling muffs on the waterline are used to join the water cable with the conventional one. This provides continuous underground-underwater signal passing through each channel of the optical module of the security complex.

WOLF SYSTEM INTEGRATION INTO F1 SECURITY COMPLEX

Formula 1 main track in Sochi has an adjacent service track around the whole track. During the races it is watched by marshals who provide safety and security. Between races the track is served with video surveillance system of approximately 100 cameras that are watched by only 2 servicemen. To ensure the prompt response of servicemen to potential incidents on the track it is highly desirable that the picture from the closest to the scene camera was displayed immediately on the screen showing large image of the scene. WOLF system was first deployed on F1 Sochi in 2016. It was successfully integrated with current video surveillance system. Two fiber optics cables (indicated by dashed lines in the figure above) were laid by both sides of the service track and connected to the optical module. Processed simultaneous signal from two lines can distinctly specify whether an object is just approaching and moving along the boundary (fence) or crossing it. When the boundary crossing signal alarms the WOLF system automatically displays the image from the camera directed at the area where the alarm came from.

- **Deployment:** Feb - Apr 2016
- **Perimeter length:** 5,84 km
- **Start:** Apr 2016

During two first weeks of the test period there were 5 incidents detected: 4 individuals and 1 cyclist.

Sensing element/cable-sensor of WOLF system can be placed on fences of various types to detect the fact of overcoming them and invasion to the protected area.
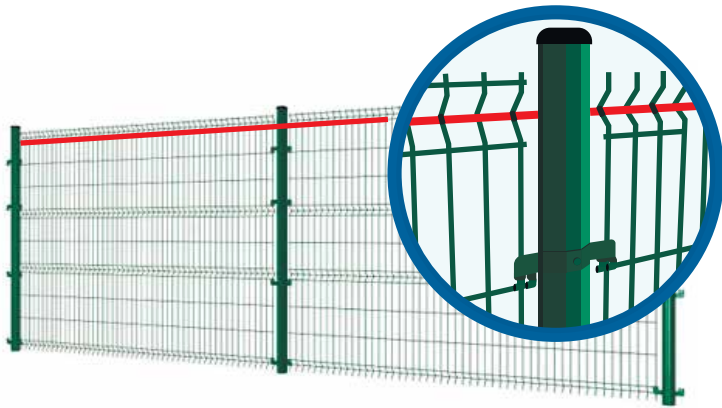

Mesh fencing: cable is attached to the horizontal rail with clamps. To improve protection from interference caused by external effects (heating under sun, wind blasts caused vibrations), the cable sensor is laid in plastic ripple.
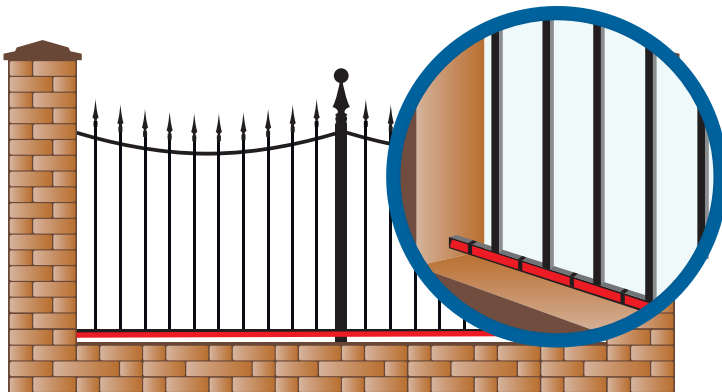

Decorative welded wire fencing: cable is attached to the lower horizontal rail with clamps and laid through holes in columns. To increase fence overcoming detection reliability several cable sensors need to be installed.
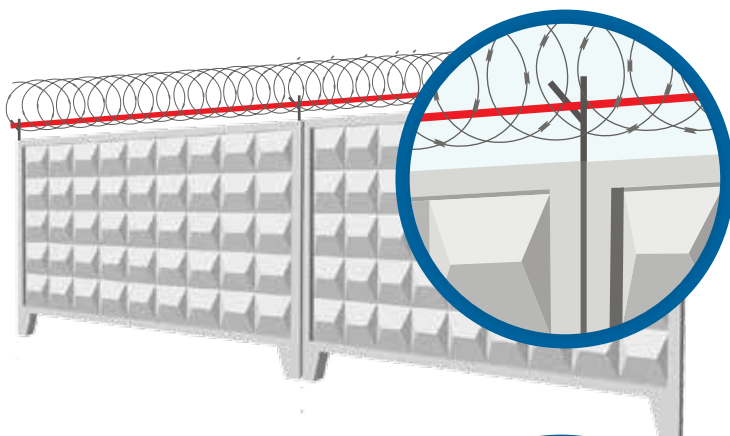
Fences made of concrete slabs/sections: L-shaped or Y-shaped steel angles are mounted on bearing posts/columns. Zinc-coated steel wire is stretched between them to form a horizontal guide. Cable-sensor is attached directly to the guide with clamps.
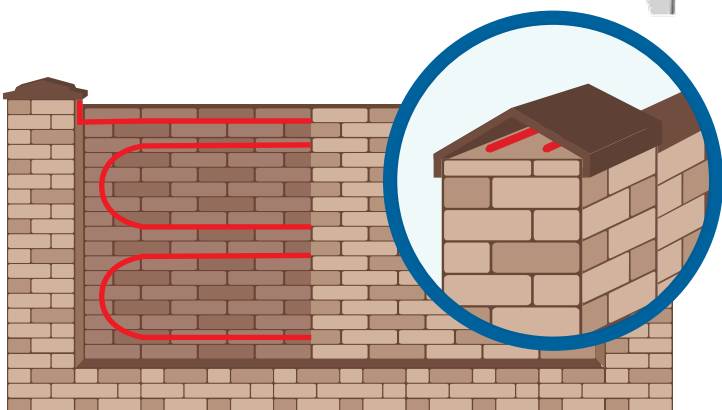
Solid decorative fences: cable sensor is installed under the decorative trim into a horizontal chase or a seam between the tiles. If there is a decorative flexible roof on the top of wall the cable-sensor could be laid underneath.
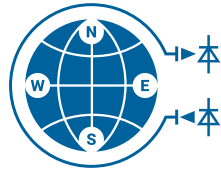
BG·OPTICS

Tel: 8 (499) 677-16-93

Email: info@bg-optics.ru

Address: 127083 Moscow,
            1, bldg. 12,
            8 Marta street

Web: www.bg-optics.com