Theft of copper cables is costing national rail network operators hundreds of millions of pounds annually with service disruption and repair costs.

The damage also causes potential safety issues to both staff and passengers.

The increasing price of refined copper over the last 5 years is a significant factor in the general rise of cable theft incidents.

Even the theft of a small amount of copper cable can have the most serious effect causing railway control centres to crash.

Surveillance security solutions such as CCTV are too expensive to cover anything but the most vulnerable stretches and even when they are deployed, thieves simply shift their attention to un-monitored areas.

Other Rail Network Threats

Theft and vandalism is not the only risks facing Rail Networks:-
- Trespass
- Rail failure, corrosion and fracture
- Points failure
- Landslides
- Movements on un-manned level crossings

Such events account for a large number of incidents worldwide each year, often leading to significant losses and can have disastrous consequences.

Solution

The WG Railways Security Protection System (RSPS) provides a solution for the detection of intruders interfering with rail track cabling that is both passive and undetectable.

A single RSPS standalone unit can protect up to 50km of track, by integrating multiple systems there is virtually no limit to the distance that can be monitored from a single location, 1,000’s km of track can be effectively protected or even the entire network.

RSPS is a Distributed Acoustic Sensing technology that makes it financially viable to monitor an entire network, 24/7 with alarms triggered in time to intercept offenders and prevent or minimise damage.
The RSPS system uses back-scatter analysis of pulsed laser light to turn a standard optical communications fibre cable into a high fidelity sensor that detects sounds and vibrations along its entire length, it will classify suspicious events and locate them down to 1 metre accuracy, delivering precise GPS co-ordinates to the security operator.

The RSPS interrogator can normally be attached to a spare fibre in an existing communications cable, or new fibre can be easily and cost effectively deployed.

Even when the fibre runs in buried ducting, RSPS can typically detect and identify the acoustic signature of people and animals at up to 15 metres and of vehicles at up to 40 metres from either side of the sensor fibre.

The audio waveform of a cable conduit lid being lifted

The intelligent software minimises nuisance alarms, it is configured to ignore background noise or known maintenance works, alerting only to specific profiles caused by suspect activity.

The RSPS provides GPS co-ordinates of suspect events to an intuitive user interface or to any mapping system and can simultaneously locate and identify multiple events separated by as little as 2 metres along the entire sensor fibre.

The sensor fibre itself requires no power or additional equipment along its length and is resistant to electro-magnetic interference from HT power circuits etc.

The sensor cable is un-affected by lightning and does not corrode, so once deployed it is virtually maintenance free.

**Operation**

The RSPS has standard event recognition software, when commissioned the system will be set in a learning mode for period of time to experience all of the local environment conditions, those that are non-threats will then be assigned as non-alerts.

The RSPS acts as a microphonic cable, sound can be ‘heard’ along the entire sensor fibre length.

The RSPS system sensor interrogator generates a special signal in the optical fibre cable, this signal is changed by sound or ground borne vibrations and the interrogator receives and interprets these vibrations as either a threat or non-threat.

Once programmed with the event recognition software, the RSPS interrogator can identify and locate the likely cause of the sound / vibrations and automatically send an alarm of a threat.
The alarm threat information is displayed on a user-friendly graphical interface; the system incorporates a “listen-in” mode to enable the user to actually hear what is going on at a particular location.

**Key System Advantages**

- Accurate location of events down to 1 metre
- Extremely robust
- GPS integration with full mapping capability
- Immune to RF and EMI
- Industry leading sensitivity
- Instantaneous detection of acoustic / vibration event
- Integrates with security management systems
- Intelligent characterisation of detected events
- Intrinsically Safe even in explosive environment
- Multi-platform access for Web
- Remotely configurable via secure connection
- Virtually maintenance free

**Distributed Acoustic Monitoring Specifications**

- Max fibre length: 50 km
- Max spatial resolution @ 15 km: 1 metre
- Max spatial resolution @ 50 km: 5 metres
- Min separation for discrimination of unique events: ± 2 metres
- Max signal bandwidth: 10 kHz

**Typical sensitivity (detection distance from fibre)**

- Digging: 25 metres
- Footsteps: 15 metres
- Vehicle: 40 metres

**System Requirements Theory**

One RSPS interrogator unit will protect up to 50 kms of rail track, power is only required at the interrogator position.

50 kms

Two RSPS interrogators can cover up to 100 kms of rail track.

100 kms

By linking multiple RSPS interrogator units the system can monitor hundreds, even thousands of kilometres from a single location.

100 kms 100 kms
Electrical power is required at each RSPS interrogator position. In reality electrical power may not actually be available at 50 km interval locations along a rail track, therefore the actual positioning of the RSPS interrogators will be where there is electrical power available.

**Other Options**

**Facilities Perimeter Intrusion**

The RSPS can be used to operate as a perimeter intrusion detection system around Railway facilities this can be integrated with local CCTV systems to provide full security coverage of the local area.

**Railway Points Monitoring**

The RSPS can be utilised to provide remote condition monitoring of railway points, detecting changes to the normal vibrations caused by the points operating, indicating wear or faults etc.

**Rail Monitoring**

The RSPS can be utilised to provide remote condition monitoring of railway track, detecting changes to the normal vibrations caused by the trains passing over the rails, indicating broken rails etc.
Level Crossing Monitoring

The RSPS can be utilised to provide remote condition monitoring of railway crossings, changes to the normal vibrations caused by levels crossing barriers, indicating that they are not functioning normally etc. The system can also be utilised to indicate unauthorised persons or vehicles moving on the crossing when it is in the closed position.

Wheel Flat Spot Detection

The RSPS can be utilised to provide detection of a wheel flat spot, a flat spot occurs when a rail vehicle's wheels are dragged along the rail after the wheel or axle has stopped rotating, the wheel will then overheat and it can cause damage to the rails and points, the RSPS is able to detect the particular carriage and axle with the flat spot.