Application Note AN-8
Wave-Guard "RF" IDS for Very Long Perimeters

Introduction

As the global need for security grows, the demand to protect longer perimeters increases. Recent needs to secure large public utilities calls for securing longer perimeters. Further to this, there are more and more instances where electronic detection is being used to strategically protect countries borders. For these long perimeter requirements a sensor must be covert, provide excellent performance and require little maintenance. Wave-Guard "RF" IDS meets all of these requirements.

Requirements for Very Long Perimeter Applications

Wave-Guard "RF" IDS is ideal as a long linear perimeter sensor because it fulfills the following requirements:

100% Covert - Along unprotected perimeters, it is crucial to have a completely hidden sensor. The Wave-Guard "RF" IDS processor and leaky coaxial cables can be entirely buried, decreasing the chance of tampering, sabotage or destruction. The Wave-Guard "RF" IDS leaky coaxial cable is easily buried into a single small groove while maintaining the current soil conditions, hence becoming invisible a few hours after the installation.

Zero maintenance - By having a maintenance free sensor, maintenance personnel are not required to make trips along these perimeters where danger may be present. All diagnostics are carried out using the SureNet control software, from a remote location via the power/alarm control bus.

Zero natural nuisance alarms - A sensor along a lengthy perimeter must be immune to the operating environment. High winds, hot or cold temperatures, rain, fog, sand storms or snow do not affect the Wave-Guard "RF" IDS. The Wave-Guard "RF" IDS also requires a minimum intruder volume of 15 kg (33 lbs) for detection, making it immune to small animals.

System Configuration

The ideal configuration for such large perimeter is "cable to antenna". In a "cable to antenna" configuration, the leaky coaxial cable transmits and the antenna receives a radio frequency signal. Multiple transmitters are buried in series, separated by the leaky coaxial cable that makes up the detection zones. These zones can vary in length from 50m. The antenna normally consists of a directional Yagi type antenna that points in the direction of the transmitters. The higher the antenna is positioned, the longer the perimeter can be. The processor is connected to the antenna. The processor receives and generates the alarm conditions at the antenna receive points, which eases reporting the alarm. Normally, multiple transmitters are received by the same directional antenna on a ratio of 1 receiver per 8 transmitters for the FSP-400-V.

a) Transmitter Module - Each transmitter transmits a unique set of two frequencies forming a frequency-coded zone. This is similar to a cellular phone system where each cell operates on a different set of frequencies. The transmitter is packaged in a tubular shaped housing designed for direct burial and water resistance. The transmitter comes in different output power levels (med 10dBm and high 20dBm) where the high power level is recommend for long perimeters. DC power is cascaded from transmitter to transmitter via the leaky coaxial cable designed to present a low voltage drop. The typical DC voltage is 48 Vdc, where 60 VDC is recommended for long perimeters.

b) Sensitive cable – The sensitive cable forms the RF detection field, which senses a disturbance from an intruder. Only a small trench of 2cm (1") wide by 5cm (2") deep is needed to bury the leaky coaxial cable. Since there is so little disturbance to the existing soil, the leaky coaxial cable becomes immediately hidden. For high traffic area or areas where vehicles might be crossing the cable it is recommended to use non-metallic conduit with drainage holes. Maximum length of transmitting sensitive cable is 50m (165ft), maximum length of receiving sensitive cable is 200m (656ft).

c) Non-sensitive Cable – Sections of non-sensitive cable can be inserted in between zones to form a non-detection section along the perimeter. For high traffic area or areas where vehicles might be crossing the cable it is recommended to use conduit, either metallic or plastic with drainage holes. The maximum length for non-sensitive cable is 150m (492 ft).

d) Receiving Antenna - The receiving antenna must be a directional, Yagi type with at least 20dB gain, placed on a high elevation point directed towards the entire length of the leaky coaxial cable. Vertical polarization presents a lower background noise level resulting in higher detection performance. The antenna must be mechanically stable to limit any displacement to less than +/- 2.5cm (1").

e) Receiver Module - The receiver module is frequency tuned to receive the frequency set of each of the 8 (FSP-400-V) zones. Since long perimeters will obviously have more than 8 zones, multiple receivers can be connected to a single receiving directional antenna via an active power splitter. An active power splitter consists of a low noise front-end amplifier followed by a passive power splitter.

f) Signal Processor - The signal processor is also located with the receiver and physically grouped in the same module. The signal processor controls the receiver, processes the RF signal, extracts intrusion conditions and reports intrusion alarms. The alarm can be annunciated via standard dry contact relay or via a serial communication link. Since long perimeters present a substantially high number of zones, the serial link is normally used. The sensitivity adjustment for each zone is done directly at the processor level and not at the transmitter. This allows system maintenance directly at the observation post. Note that the alarm conditions can be relayed between observation posts using a dedicated RF link that utilizes the existing array of Yagi antennas.

Example #1: A 0.8Km Sub-Section

2 FSP-400-V processors capable of protecting 16 zones of 50 m (165ft) each for a total perimeter of 0.8km (0.5 miles). By duplicating this 0.8 km (0.5 mile) sub-section for the adjacent observation post, the total distance between adjacent observation posts becomes 1.6 km (1 miles). This 1.6 km (1 mile) of secured perimeter is totally covert, invisible, with no exposed electronics.

Radiated Power

Transmitters are available with different output power depending on perimeter lengths. The chart below shows the output power needed for specific perimeter lengths. Note that all values are based on 50m zones.

Distance between Transmitter and Receiver	Transmitter Output Power
0.2 Km	10 dBm, 10 miliWatt
1 Km	20 dBm, 100 miliWatt

Alarm Annunciation

All alarms are reported via the RS-232 serial communication link on each processor. Since multiple processors are used, each processor is connected to a dedicated serial port of a PC. The PC runs the SureNet software that allows connection of up to 32 processors and 256 zones to a single PC. The PC can then report the alarms via a wide range of communication mediums, i.e.: Intranet, dedicated private RF network, dedicated private fiber optic network, cellular phone or satellite. A Graphical User Interface (GUI) based on touch screen technology is then used to indicate which section of the perimeter has an intrusion alarm.

System Adjustments

All adjustments required for initial system operation, such as upgrading the software, changing the sensitivity of each zone or downloading the alarm and monitoring logs are made directly at the observation post using the dedicated PC running the SURENet software.

Zone Tampering

If the leaky coaxial cable is tampered or cut only the zone of that transmitter is affected. Detection will be degraded only on the tampered zone while the rest of the perimeter will operate normally since DC power is supplied by both adjacent observation posts. The tampering zone will be reported with a “trouble” status at the processor.

Conclusion

In summary, the Wave-Guard "RF" IDS' covertness contributes to increasing the capture rate. By having a low maintenance sensor, the cost of operation is minimal. Having the transmitter operate in a daisy chain and having multiple receivers connected to a single directional antenna can economically address long perimeters. This flexibility makes Wave-Guard "RF" IDS an efficient sensor to use for long perimeters.

F*ig*. 1 -*burying a transmitter*

*F*ig. *2 - a typical observation post with the touch screen display for alarm annunciation (center) and a CCTV monitor (left).*

Fig 3 –Long fenced perimeter application

Fig 4 –Typical border application

Fig 5 –Typical command post for border application