Bandweaver

ZoneSentry

Perimeter Intrusion Detection System

Product Overview

Contents

ZoneSentry 1

Perimeter Intrusion Detection System 1

Product Overview 1

1. Introduction 3

1.1 Applications 3

1.2 System Advantages – Unique Selling Points 3

2. Principle of measurement 4

3. Typical Installation Configuration 4

3.1 Zone configuration 4

3.1.1 Types of zones 4

3.1.2 Zone Activation 6

3.1.3 Cable configuration 7

3.2 Configuration of cables and zones 9

3.2.1 Four zone perimeter – dual cable 9

3.3 Gates and other access points 11

4. Cable details 12

4.1 Cable fixtures 12

5. ZoneSentry Controller 13

5.1 ZoneSentry Summary Specifications 14

6. Cabinet Details 15

7. Configuration software 16

7.1 OFSS1000 Configuration Manager 16

7.2 Alarm configuration and zone management 17

8. System Integration 18

8.1 Zone Sentry configurations with DVR and CCTV 19

8.1.1 Single PTZ camera with 4 zone configuration 19

8.1.2 Single PTZ camera with 8 zone configuration 20

8.2 Multiple fixed cameras with 4 zone configuration 21

8.2.1 Multiple camera types with 8 zone configuration 22

8.3 MaxView integration and visualisation software 23

9. Accessory references 25

1. Introduction

The ZoneSentry™ system is based on fiber optic vibration monitoring technology. By attaching the fiber optic sensing cable to the external perimeter or on key assets you can detect the vibrations associated with intrusion events and rapidly detect and take action to prevent damage or theft.

The system is based on a zone based approach. The system can have up to 8 zones per unit and each zone can be 1km in length (with upto a 10km lead-in, insensitive length). Each zone is effectively a fiber optic loop with a Zone Activation Unit at the start of the zone which activates the zone and makes the zone sensitive to vibration. Each of the zones can be configured individually and so different sensitivities can be applied across the installation.

Some of the typical applications include the following:

1.1 Applications

- Petrochemical stations
- Solar farms
- Key government sites
- Mobile phone base stations
- Tanks farms / Pipeline block Valve stations
- Construction sites and storage yards
- Power utility stations and substations
- Cultural heritage sites / Residential complexes

1.2 System Advantages – Unique Selling Points

The Zone Sentry fiber optic PIDs system has some unique advantages over conventional perimeter based security systems. Some of the key advantages include:

- Simple and low cost of installation: No infield power or communications cables required
- Cable immune to Radio Frequency (RFI) or Electro Magnetic (EMI) Interference
- Extensive coverage from single unit: Up to 8 km of perimeter monitoring per unit
- Location of event to within user defined zone
- Custom configuration of zone sensitivity to within zone – minimise nuisance alerts
- Flexible and versatile – can be deployed on multiple fence types
- Simple integration with existing software (VMS / PSIM / BMS) and security system (CCTVC, beam detectors etc.)

2. Principle of measurement

The ZoneSentry system is based on the principle of the Sagnac interferometer. Fiber-based Sagnac loop sensors, as opposed to all other types of common interferometers, have the unique advantage of providing the same physical path for the two counter-propagating light waves that create the optical interference, hence eliminating signal fading problems due to path instabilities caused by environmental disturbances.

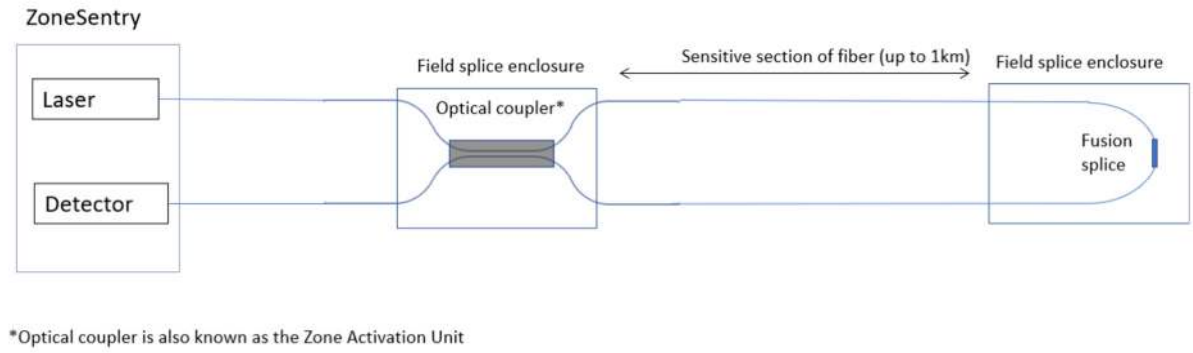

Figure 1 - Principle of Sagnac interferometer

This technology has a number of benefits including:

- High stability
- Self balancing characteristics
- Compact structure
- Simplicity – single zone activation unit and otherwise standard fiber optic cable.

3. Typical Installation Configuration

The ZoneSentry PIDs system is an extremely versatile system and can be deployed in a number of different ways in order to protect a wide variety of perimeters. Below are some examples and guidelines of how the technology can be deployed.

3.1 Zone configuration

3.1.1 Types of zones

Up to 8 zones can be configured per unit and depending on the specific requirements of the site these may be setup according to a number of different methodologies:

- Match geography of site (e.g. one zone per perimeter edge)
- Match fence/wall type (e.g. different zone for different fence types)
- Match other security systems (e.g. one zone per camera)
- Match security risk classifications (e.g. zone according to security risks)

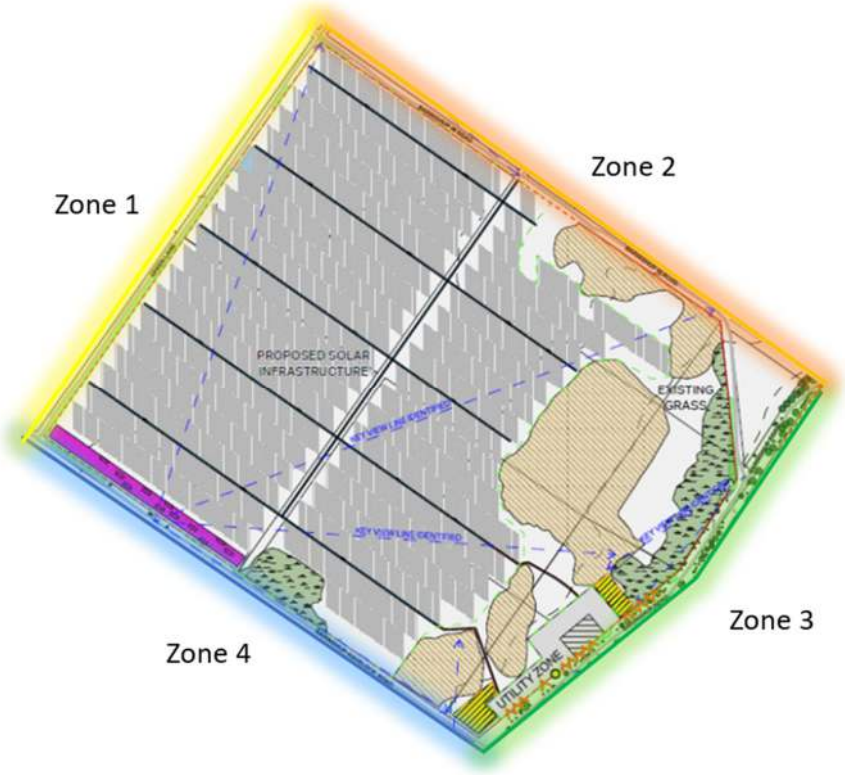

Figure 2 - Example of single zone per perimeter edge

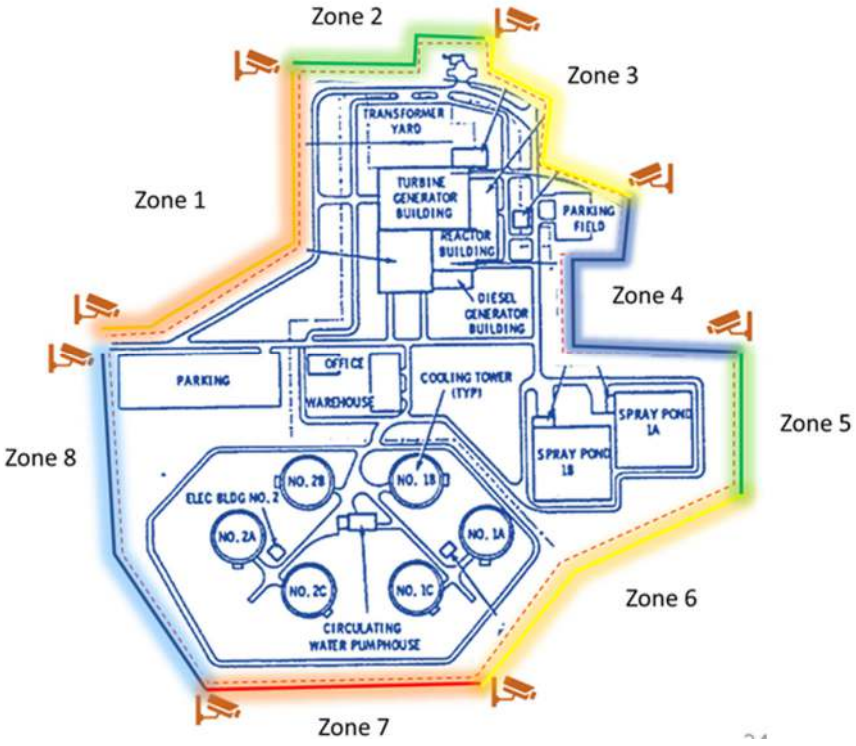

Figure 3 - Example of zones co-ordinated with CCTV

Figure 4 - Example of different fence types

3.1.2 Zone Activation

At the start of each zone a zone activation unit is utilised. This consists of a passive optical component (based on an optical couple). This component activates the sensing cable within the zone. At the end of the zone the two fibers are then spliced together to complete the loop. The splice and zone activation unit can be housed within a field splice enclosure

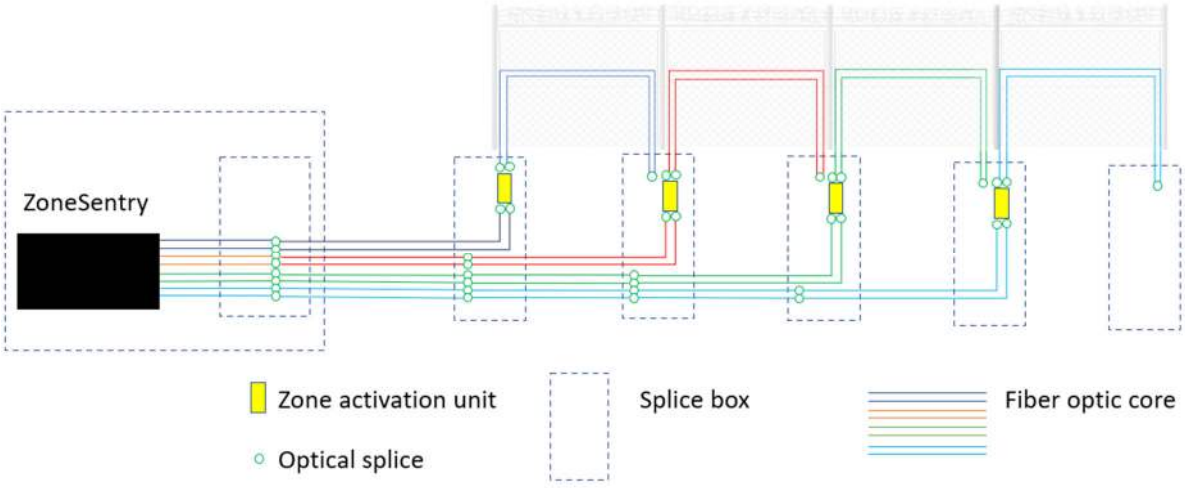

Figure 5 - Schematic of optical path - (all fibers housed within single cable)

3.1.3 Cable configuration

In most cases Bandweaver recommends the use of a single cable run along the fence which contains the sensing fibers.

The field splice enclosures that are deployed can either be buried covertly or deployed above ground according to the customer requirements. Below details some of the specific configurations.

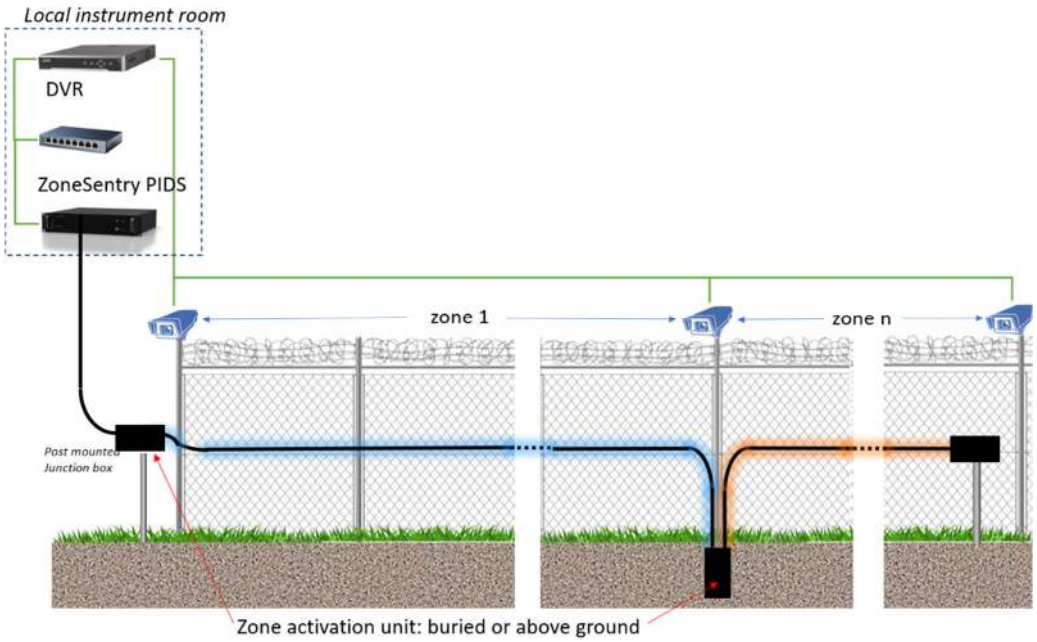

Figure 6 - Example of field splice enclosure placement

The cable can be deployed on the fence in several different methods according to the specific fence types. In some cases, it is deployed in a simple straight line but in others there may be more complex arrangements.

Figure 7 - Example of cable configurations

As you can see, depending on the fence or wall type the cable can be run in different configurations to amplify the sensitivity. This can involve vertical loops sections (often on the fence posts) or even serpentine configuration.

3.2 Configuration of cables and zones

For most perimeters, it makes sense to divide the perimeter into two or more cable runs. In the following examples it shows how a dual cable configuration is run for a four zone and eight zone scenario.

By using multiple cable sections you can reduce the number of cores you require per cable. Depending on how many cables are run, decides how many cores per cable are required.

3.2.1 Four zone perimeter – dual cable

The following example shows a perimeter using two cables with four zones in total (two zones per cable). For this example, a cable with four cores can be used

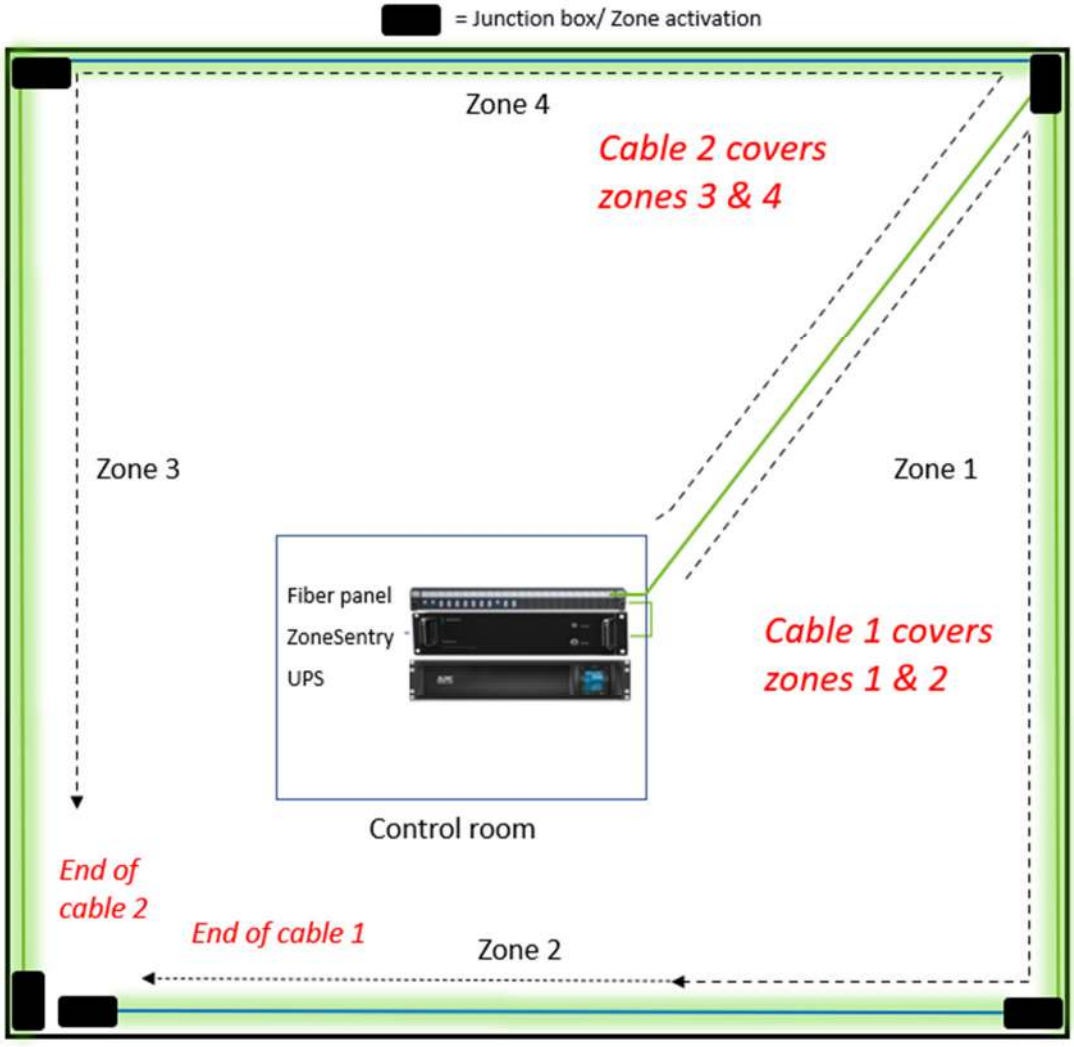

Figure 8 - Four zones and two cable configuration

In the following example there are eight zones and two cables. This means that there are four zones per cable and so each cable will need to have four independent optical loops. This means that eight cores will be required in the cable.

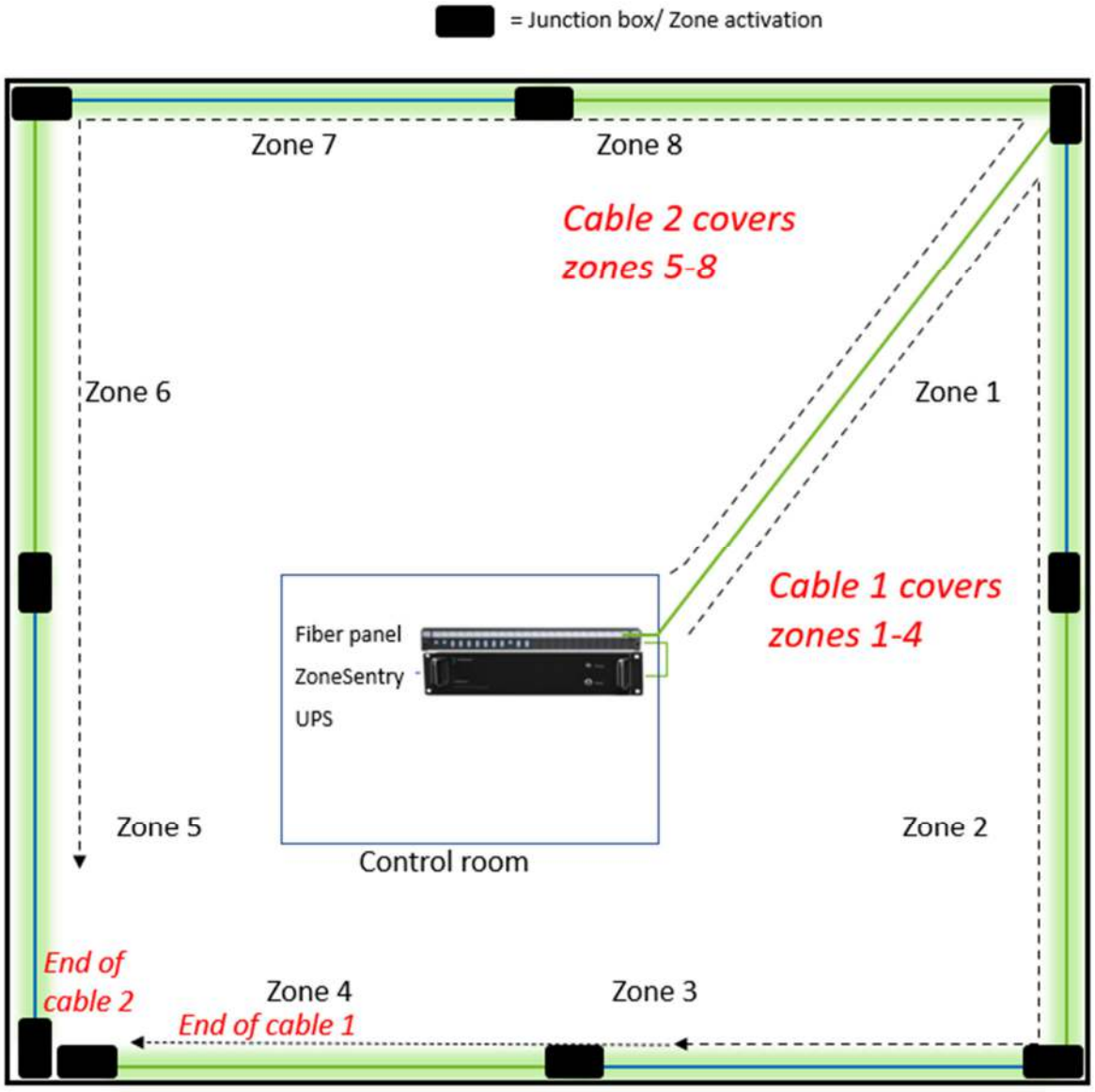

Figure 9 - Two cables and eight zone configuration

3.3 Gates and other access points

Typically around most perimeter there will be a main entrance and a number of other minor access points with varying frequency of usage. Generally, for gates which are monitored by other technologies and are in frequent use, then the ZoneSentry cable is not deployed on the gates but for un-monitored gates which are used less frequently, many asset owners choose to deploy the ZoneSentry PIDS on the gate to monitor it.

Figure 10 - Example of gate monitored by ZoneSentry

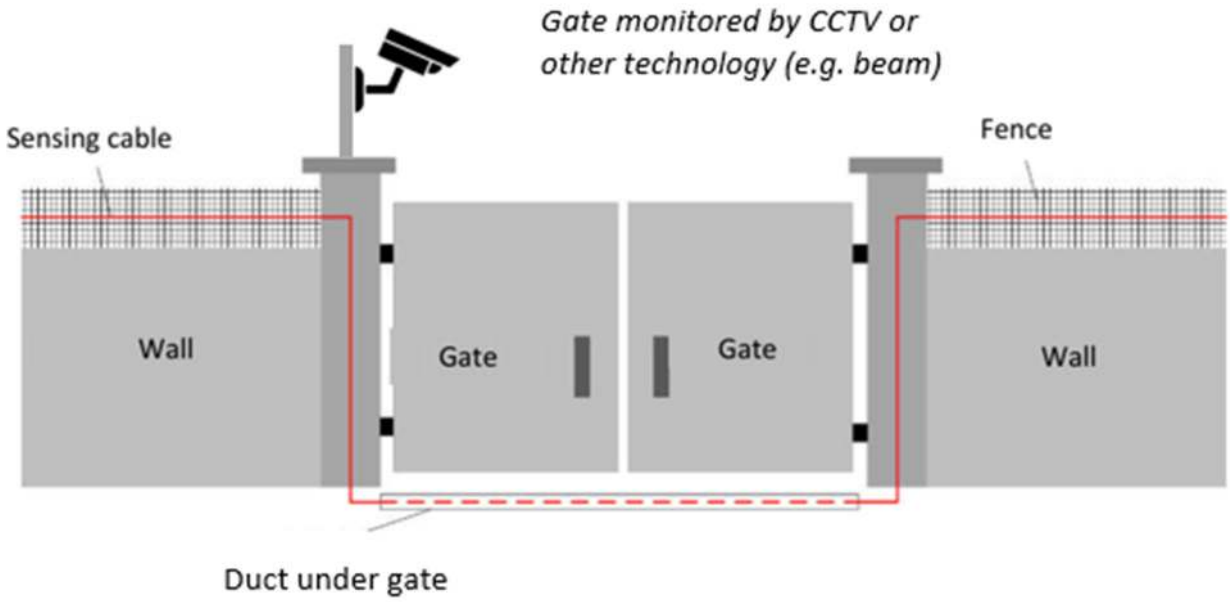

Figure 11 - Example of gate where ZoneSentry bypasses the gate

4. Cable details

One of the unique features of fiber optic sensing is that you can use the cable itself as the sensor and that standard telecoms fiber can be used. This means that a wide variety of cables can be used.

For use with the ZoneSentry, Bandweaver has tested and qualified the FenceLine cable. Below is the cross section of the FenceLine cable.

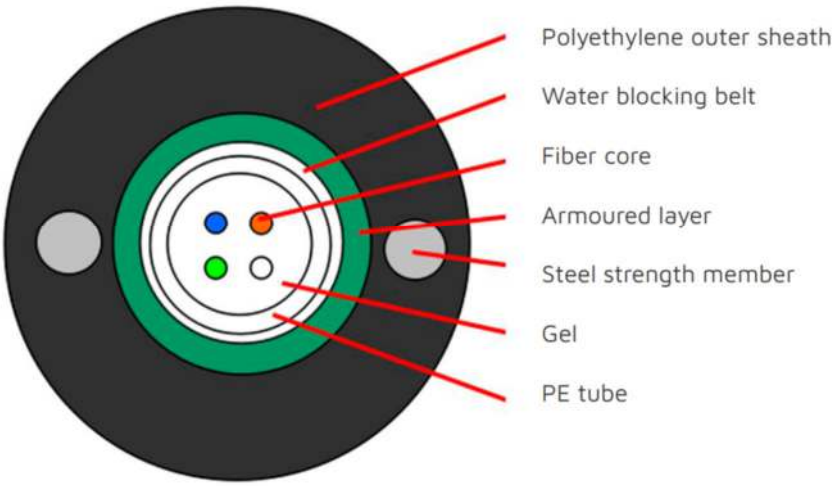

Figure 12 - Cross section of FenceLine cable

The cable has been designed to give the ideal mixture between strength, flexibility and sensitivity. As standard for ZoneSentry applications the cable comes in configurations of 8 & 16 fiber versions (but 4 fiber and 12 fiber versions are available on request).

4.1 Cable fixtures

There are a number of fixtures that can be used to secure the cable to the fence but the most common is to use UV resistant cable ties. Typically, the cable is secured at intervals of 30-50cm along the cable length to prevent any unnecessary movement or vibration of the cable.

5. ZoneSentry Controller

The ZoneSentry will typically be installed in a control room in a rack mounted configuration. It is designed for installation in a 19” rack and is a 2U height. It comes in 4 loop or 8 loop configurations (8 or 16 optical channels).

Figure 13 - ZoneSentry front view

Figure 14 - Zone Sentry - rear view

5.1 ZoneSentry Summary Specifications

Below are the summary specifications and features of the units

MEASUREMENT AND OPERATING SPECIFICATIONS		
Measurement Configuration	Loop measurement with Zone Activation Unit (ZOA)	
Number of Zones	4 or 8 zone configuration	
Connector Type	FC/APC	
Optical Fiber Type	Single mode fiber compliant to ITU-T G.652	
Measurement Range	1km per zone / 4km or 8km per unit Insensitive lead-in length up to 10km	
Alert Types	Intrusion, fiber cut – single report per zone	
Number of Alarm Logs	8,000 events	
Response Time	<2 seconds	
PHYSICAL CHARACTERISTICS AND INTERFACES		
Operating Voltage	12 / 24 V DC	
Average Power Consumption	<5W (4 zones) <10 W (8 zones)	
Operating (Storage) Temperature	-20°C ~ +70°C (-10°C ~ 85°C)	
Operating Humidity	10% ~ 95% relative humidity	
Laser Safety / Power	Class 1M	
Form Fit	19" rack mounted (2U)	
Weight Shipping Weight	5.1kg 9.1kg	
Dimensions Shipping Dimensions	88 / 384 / 430 mm (H / W / D) 260 / 530 / 570 mm	
Connectivity / System Interface	Electrical relay (10 or 18) / RJ45 / RS485 (Modbus RTU)	
Part number(s)	DAS-ZS-01-005-4CH (4 zones)	DAS-ZS-01-005-8CH (8 zones)
Standards & Approvals	CE Directive 2014/30/EU EN55032: 2015+A1: 2016, EN 55035:2017 EN61000-3-2: 2014. EN 61000-3-3: 2013 RoHS EC 2015/863 amending 2011/65/EU FCC Part 15, Subpart B, ANSI C63.4 – 2014 FDA Title 21, Part 1002 – Laser Products	

6. Cabinet Details

The ZoneSentry is typically installed in a 19” rack in a control room, instrument room on in the main security or control center.

Depending on the specific setup there are a number of different items installed within the rack. The schematic and photo below shows a typical configuration.

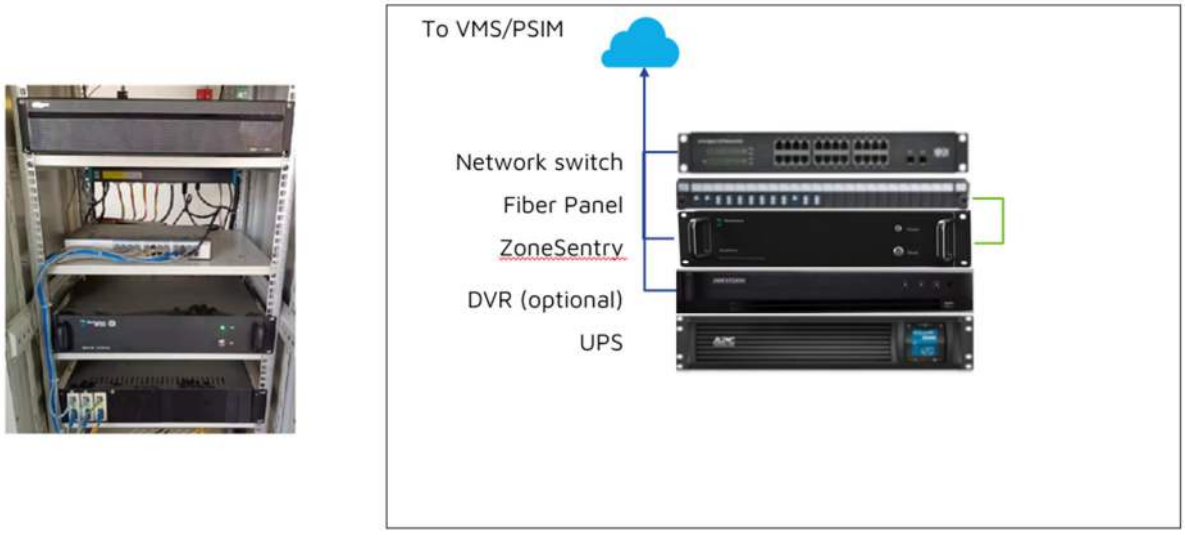

Figure 15 - Schematic and photo of 19" rack set up in control room

One of the elements that is always requires is the splice tray which connects the ZoneSentry to the sensing cable.

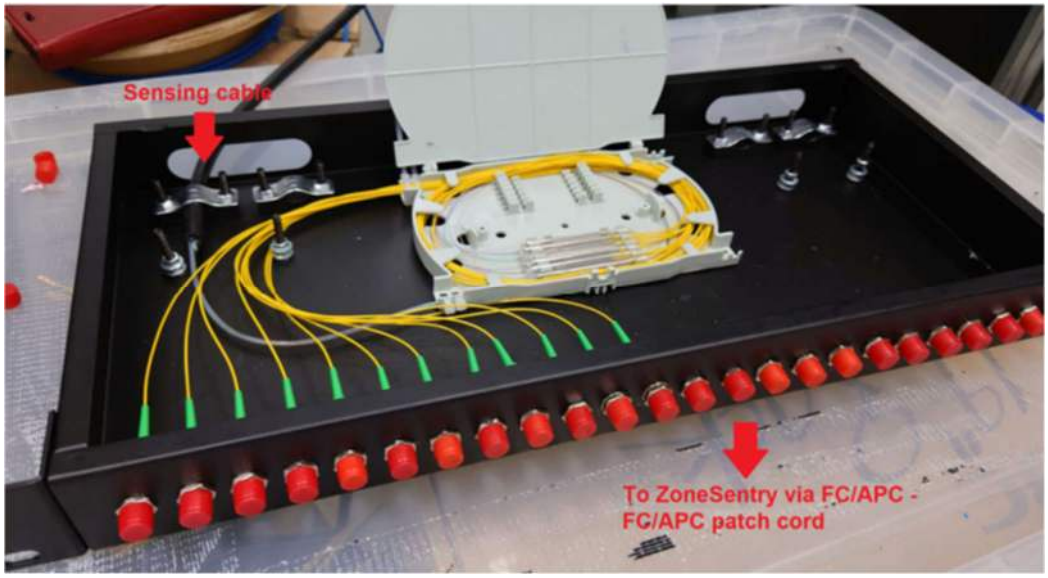

Figure 16 - ZoneSentry splice tray

7. Configuration software

7.1 OFSS1000 Configuration Manager

OFSS1000CM is the system configuration and monitoring software for the ZoneSentry product. The software is used to configure the system at the time of commissioning. Each zone can be configured separately in order to tune the environment to balance maximum sensitivity with the minimum number of nuisance alerts

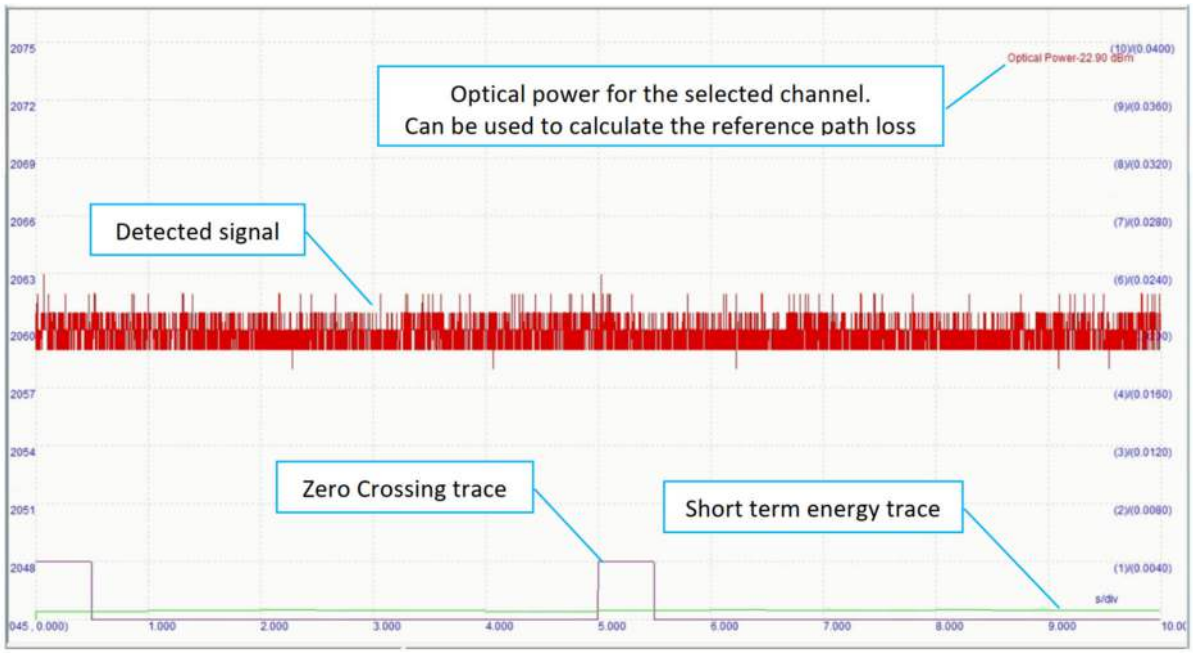

Figure 17 - Example of OFSS1000CM screenshot – signal trace

7.2 Alarm configuration and zone management

Within each zone there are a number of parameters that can be configured in order to maximise sensitivity while also minimising any potential nuisance alerts.

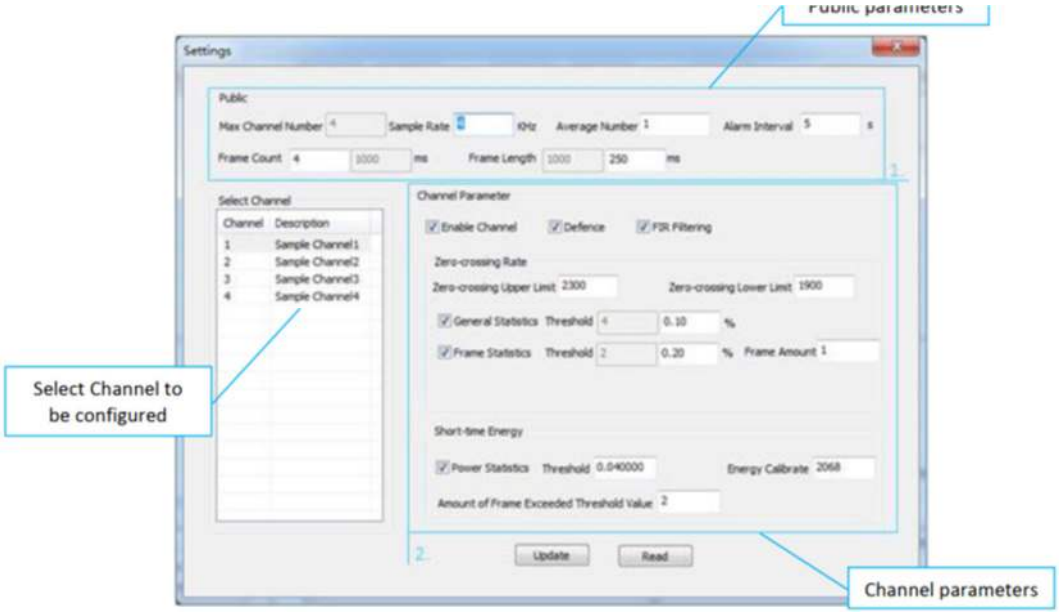

Figure 18 - Screenshot of parameter configuration

Below are some of the features that are incorporated which contribute to the robustness of the system:

- **Flexible configuration parameters** include signal energy, statistical and time related thresholds to give maximum flexibility in tuning of the systems.
- **Anti tamper capability:** As the cable senses any vibration, any attempt to tamper or remove the cable will be detected very early on
- **Broken fiber alarm**. In the event of sabotage or cable break the system will sound an alarm and location of the break can be determined
- **Completely passive in field components**, means that the system is completely passive, does not require in field power and has a design life of > 30 years.

8. System Integration

The ZoneSentry has a very open architecture where it can easily integrate with PSIM, VMS and BMS software platforms and integrate seamlessly. As standard this is achieved with the electrical relays or Modbus protocol. Below is a schematic detailing a typical integration with CCTV cameras.

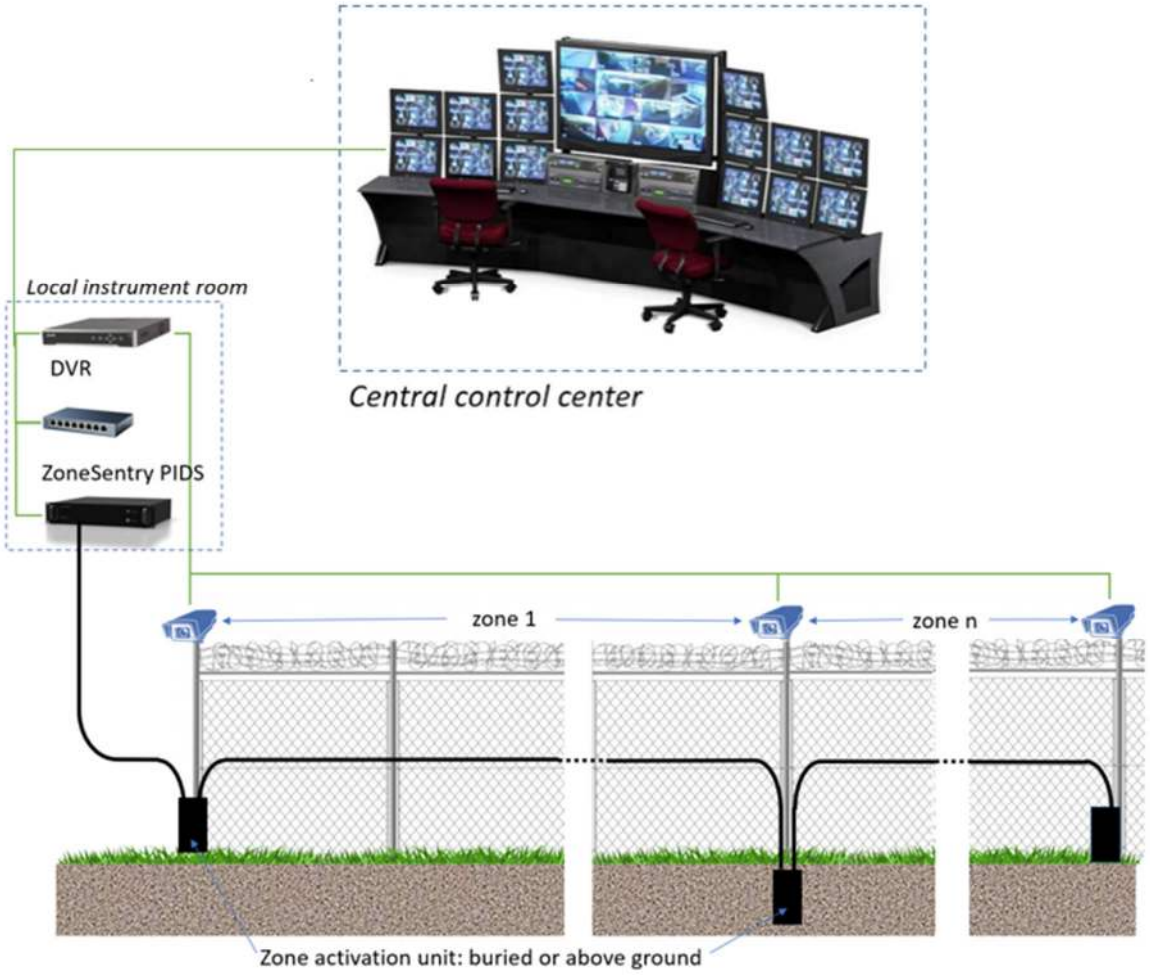

Figure 19 - Example of system architecture

8.1 Zone Sentry configurations with DVR and CCTV

8.1.1 Single PTZ camera with 4 zone configuration

One of the simplest configurations is to have a single PTZ camera located on a small site that potentially cover an entire zone (with the correct zoom and positioning).

The DVR/VMS can be programmed accordingly so that zone information can be sent to the DVR when the ZoneSentry alarms (via electrical relays).

On alarming the PTZ camera slews and zooms to the configured pre-set to view and record the intrusion event.

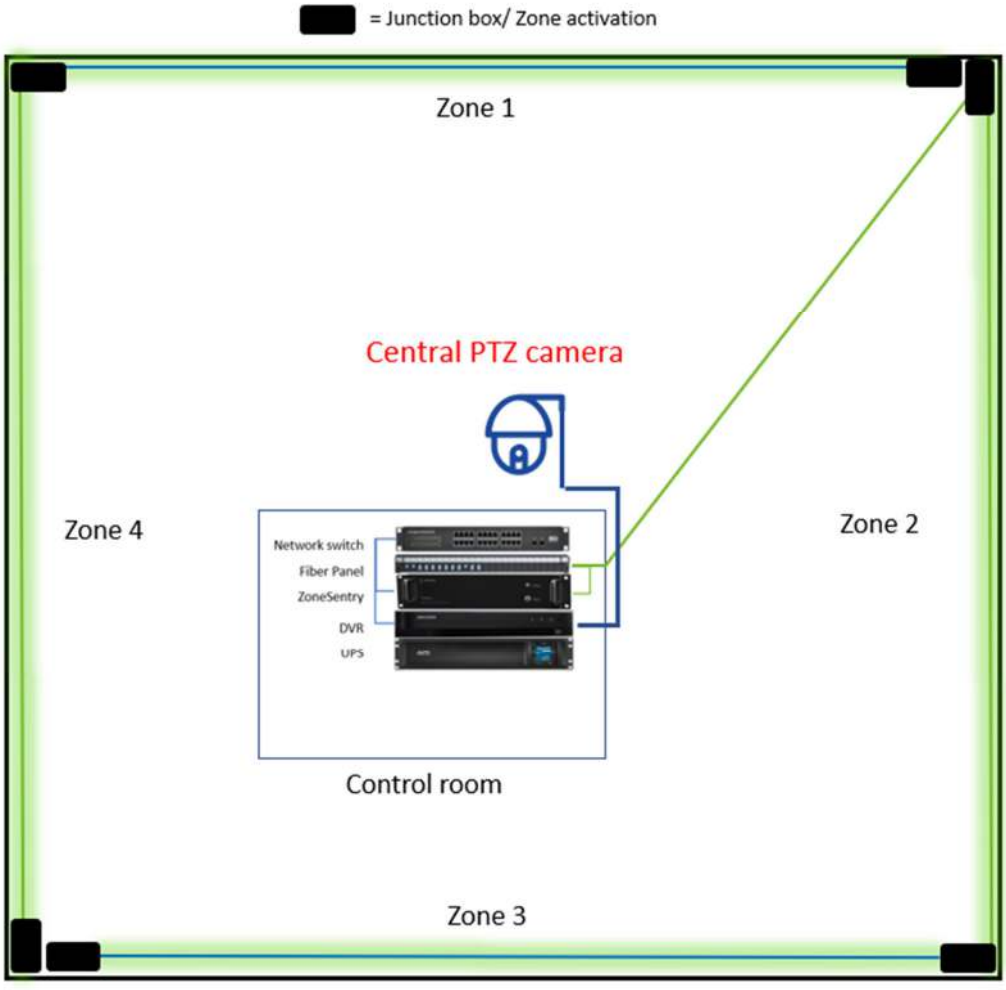

Figure 20 - Single PTZ camera 4 zones

8.1.2 Single PTZ camera with 8 zone configuration

This setup can be easily extended to cover 8 zones (with the 8 channel ZoneSentry)

The configuration below shows an example of how the 8 zones could be configured. Again the DVR can be configured so that in the event the ZoneSentry triggers an alarm the camera slews and zooms to the pre-set configuration to view and record the event.

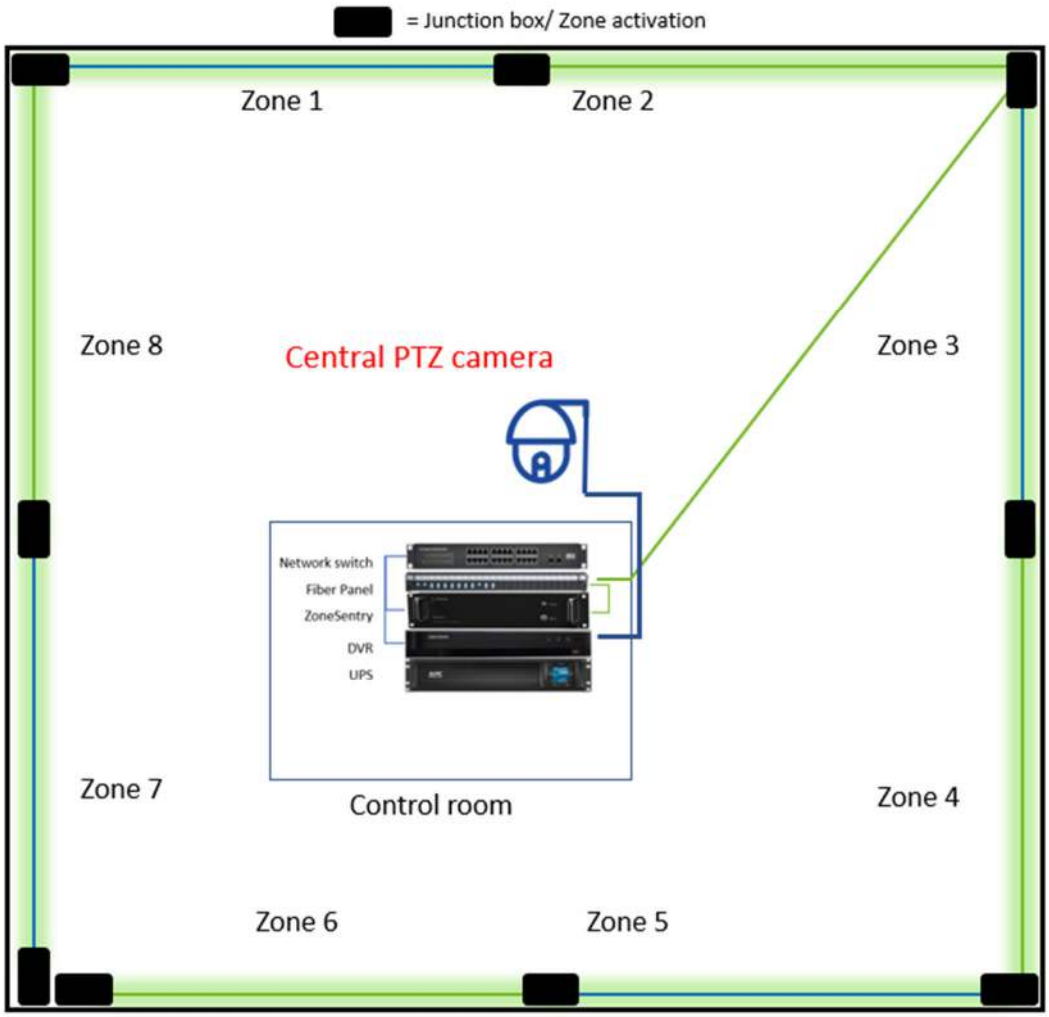

Figure 21 - Single PTZ camera 8 zones

8.2 Multiple fixed cameras with 4 zone configuration

The following example shows how multiple cameras can be deployed across a 4 zone system.

In this case there are 4 fixed cameras and each one is assigned to a single zone (in reality it can be a mix of fixed and PTZ cameras).

In the event of a ZoneSentry alarm it can trigger the DVR (using the electrical relays) to activate the specific camera and view and record data from the associated zone.

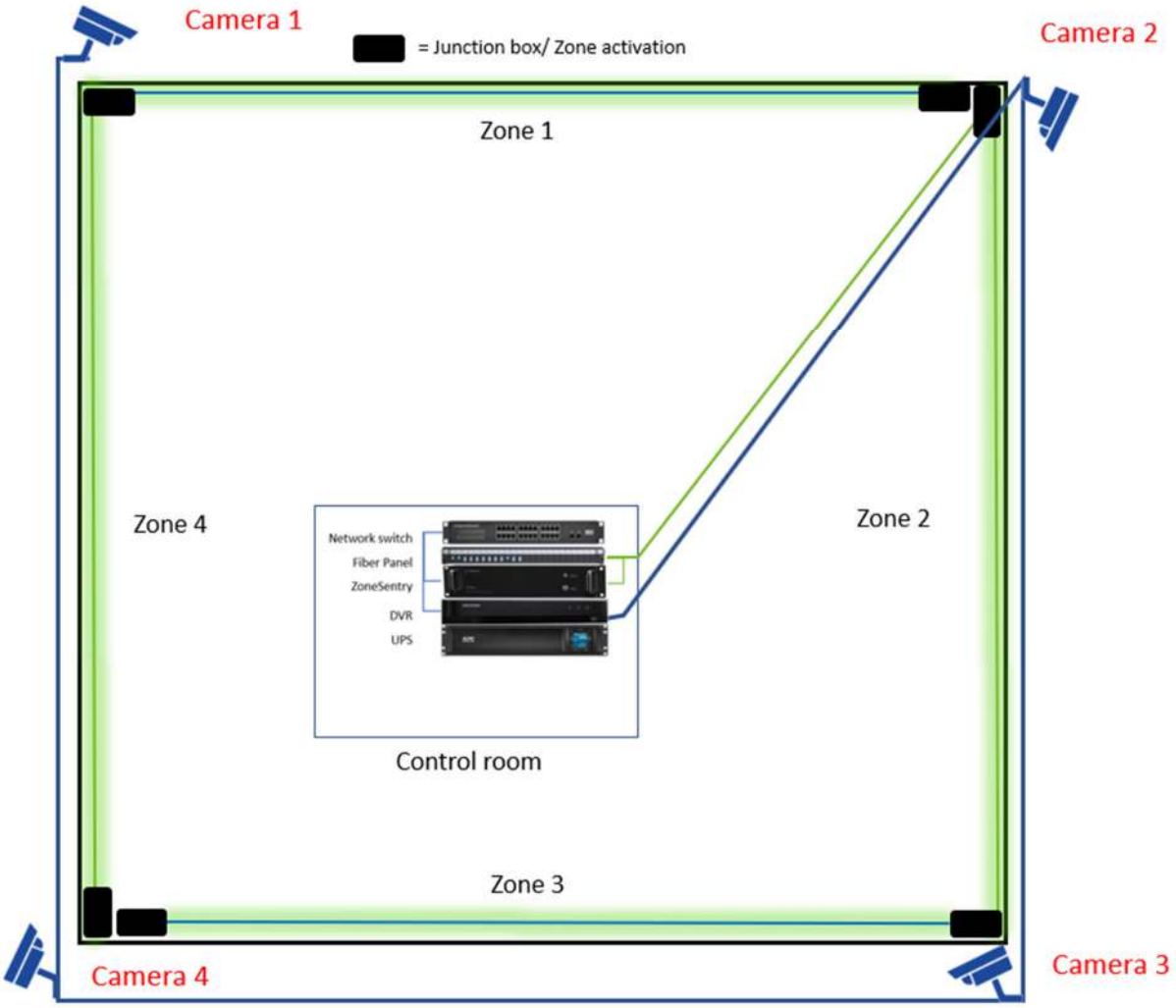

Figure 22 - Multiple camera 4 zone configuration

8.2.1 Multiple camera types with 8 zone configuration

The following examples shows an 8 zone configuration with multiple camera types (in this case 6 cameras).

In this scenario, depending on the specific zone or camera types the DVR will either switch on the camera to record or slew to the appropriate pre-set in the event of a ZoneSentry alarm.

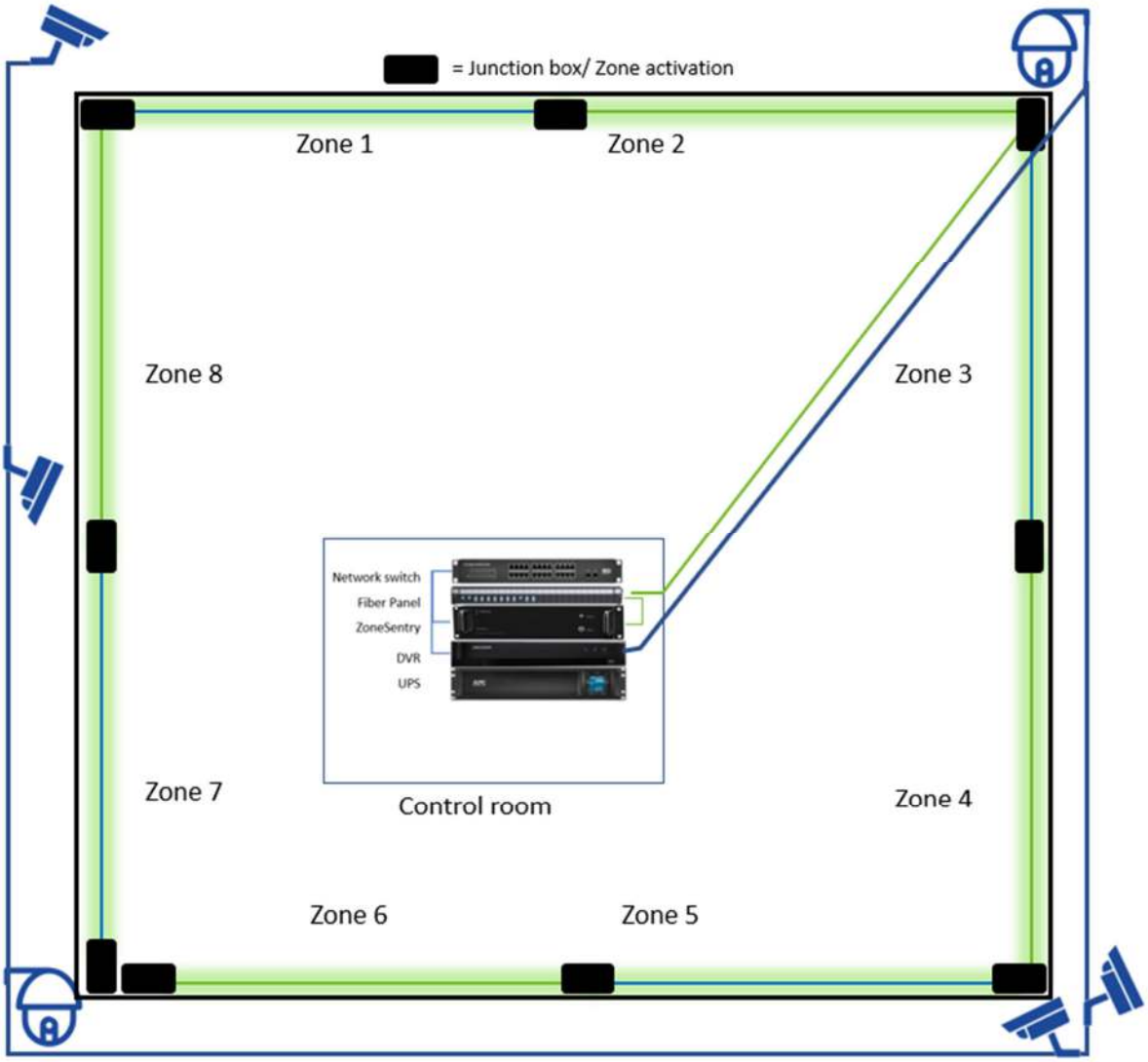

Figure 23 - Multiple camera types with 8 zone configuration

8.3 MaxView integration and visualisation software

If there is no VMS, PSIM or BMS on site then Bandweaver can supply it's MaxView software which can provide the integration with other systems and required visualisation.

At it's most basic, MaxView can integrate with the Video/CCTV and security light and sound alarm system.

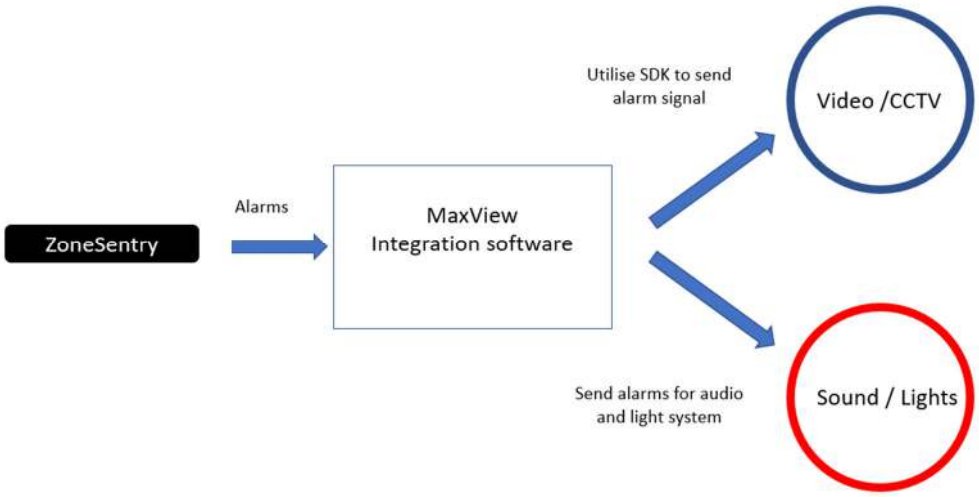

Figure 24 -Example of basic MaxView configuration

However for more advanced/complex applications, MaxView can also integrate additional security sensors and also interface either with Security packages (PSIM, VMS, BMS) and/or SCADA or industrial process systems

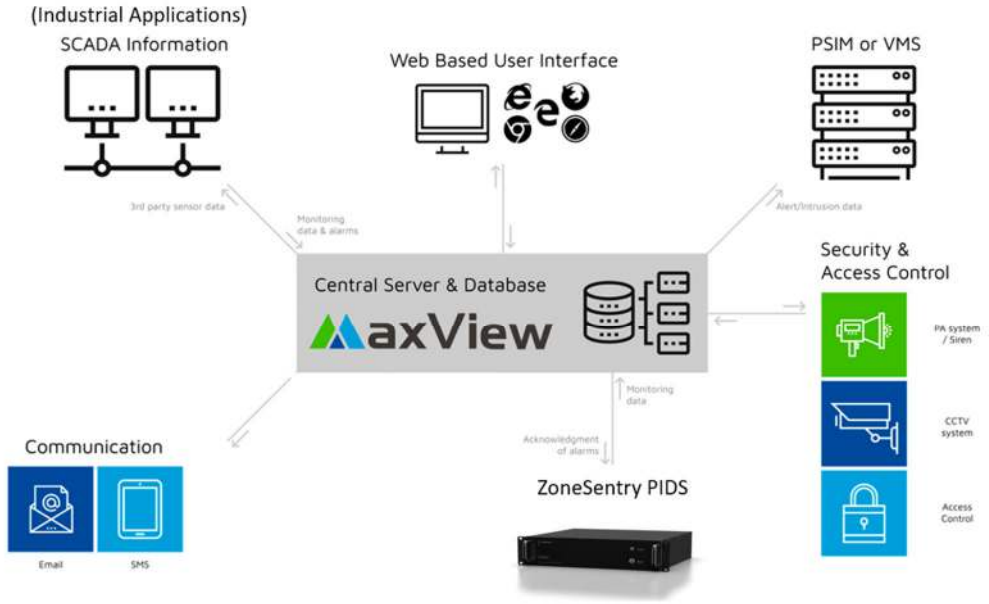

Figure 25 - MaxView system architecture for more complex integrations

Below is an example of MaxView software showing a site schematic. From this interface you can quickly and easily see:

- Location of all zones and location of alarm on map when alerted
- Status of 3rd party sensors and alarms

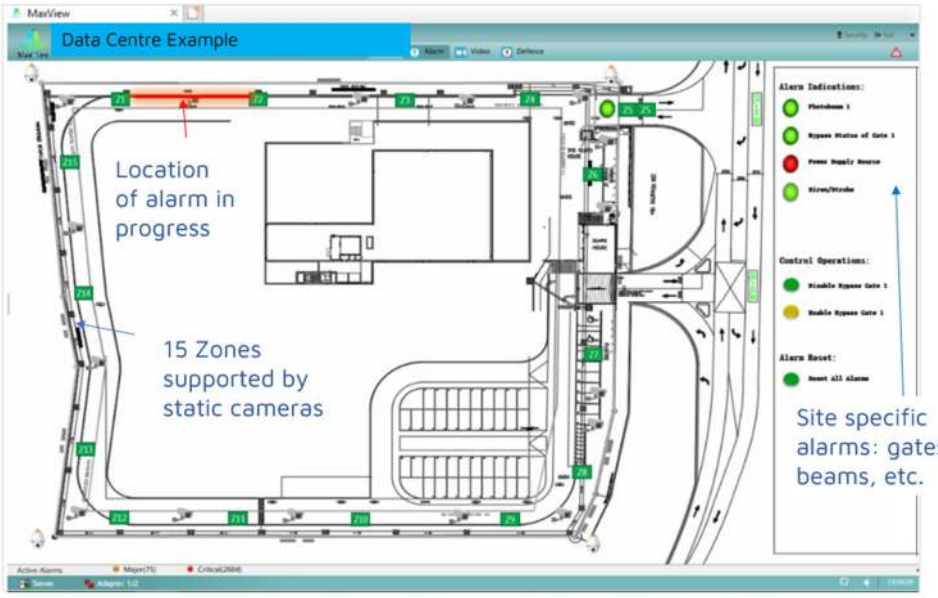

Figure 26 - Example of MaxView screen shot for data center PIDS system

When the alarm is activated, if there is an associated camera then the camera feed will automatically come into view in the MaxView interface. If it is a PTZ camera then pre-programmed positions can be input to the system and the camera will slew to the appropriate co-ordinate.

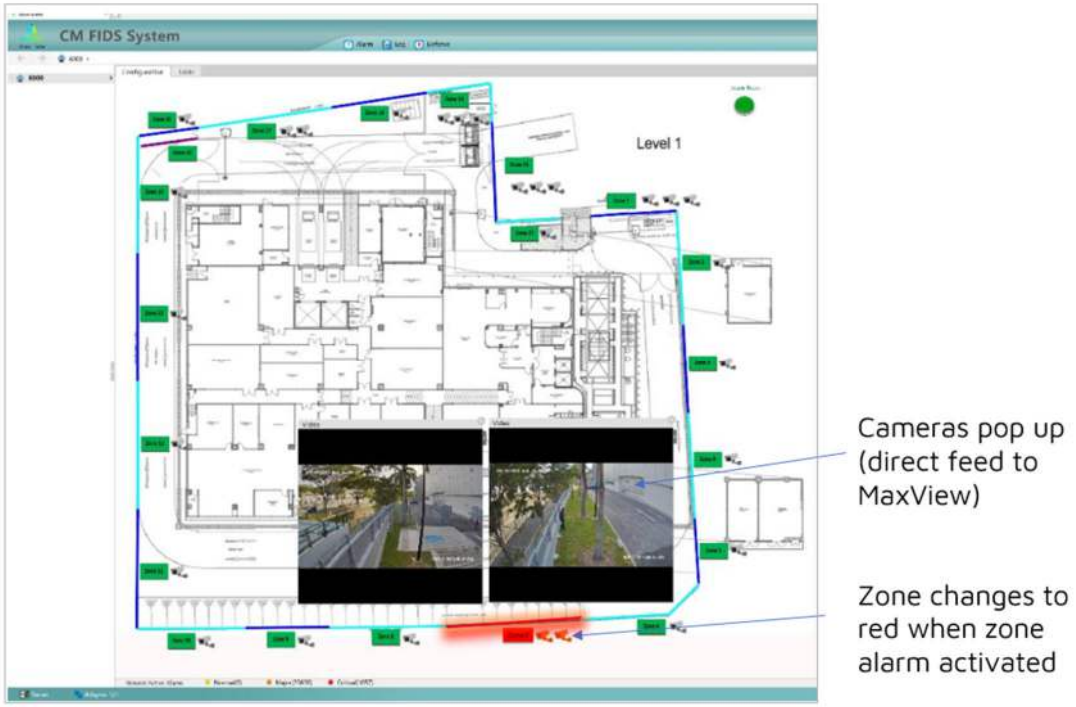

Figure 27 - MaxView screenshot with camera view

9. Accessory references

The table below details the part number of some of the recommended components

DESCRIPTION	PART NO.	COMMENTS
Zone activation unit	FID-ZS-ZAU-01	Included with ZoneSentry unit. One activation component per zone
Buried field splice enclosure	FIDS-ZS-JB-01	Can be deployed below ground or above ground. Can be used to house zone activation component
Rackmount splice tray (4 loop or 8 loop variant)	FID-ZS-ST-04 Kit FID-ZS-ST-08 Kit	Used within the control room to connect the ZoneSentry to the sensing cable. Housed within 19" rack
FenceLine Sensing cable	CAB-SM9_FS-08 CAB-SM9_FS-16	8 or 16 fiber cores as standard
UV resistant cable ties		Used to attach sensing cable to fence as per installation manual

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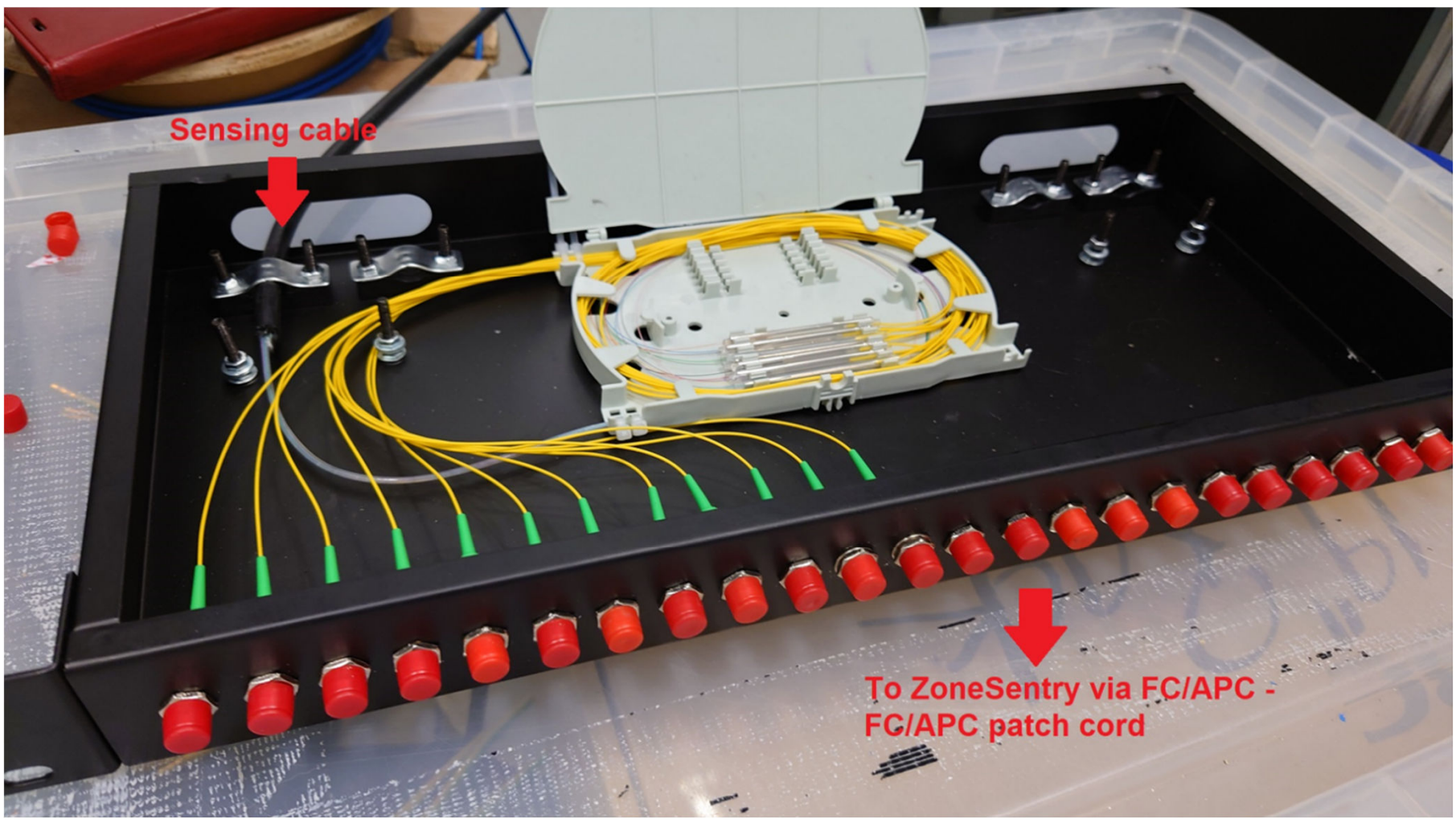
ZoneSentry Splice Tray Kit

This splice tray/patch panel is designed for use in control room applications and can be ordered in rack mount and wall mount options.

With a 44m profile (1U rack equivalent) it can manage the cable inputs for either a 4 loop or 8 loop ZoneSentry system. The kit includes all internal splice management trays, FC-APC pigtails and patch cords to connect to the ZoneSentry system.

The splice tray utilised a simple tool-free lock to open for fast operation. It is made from of high-quality cold-rolled steel plate. It has an electrolytic plating with an additional anti-static treatment.



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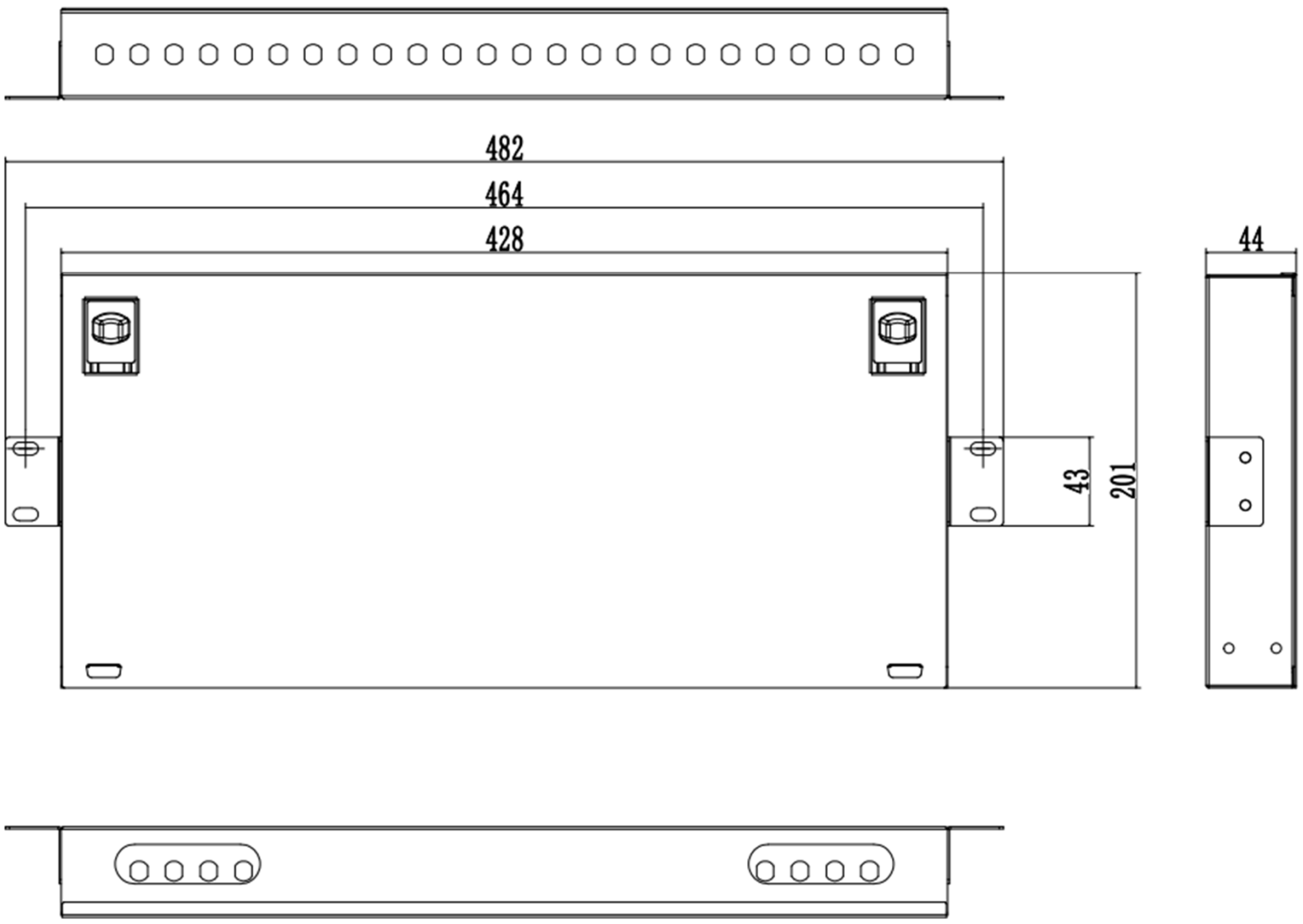
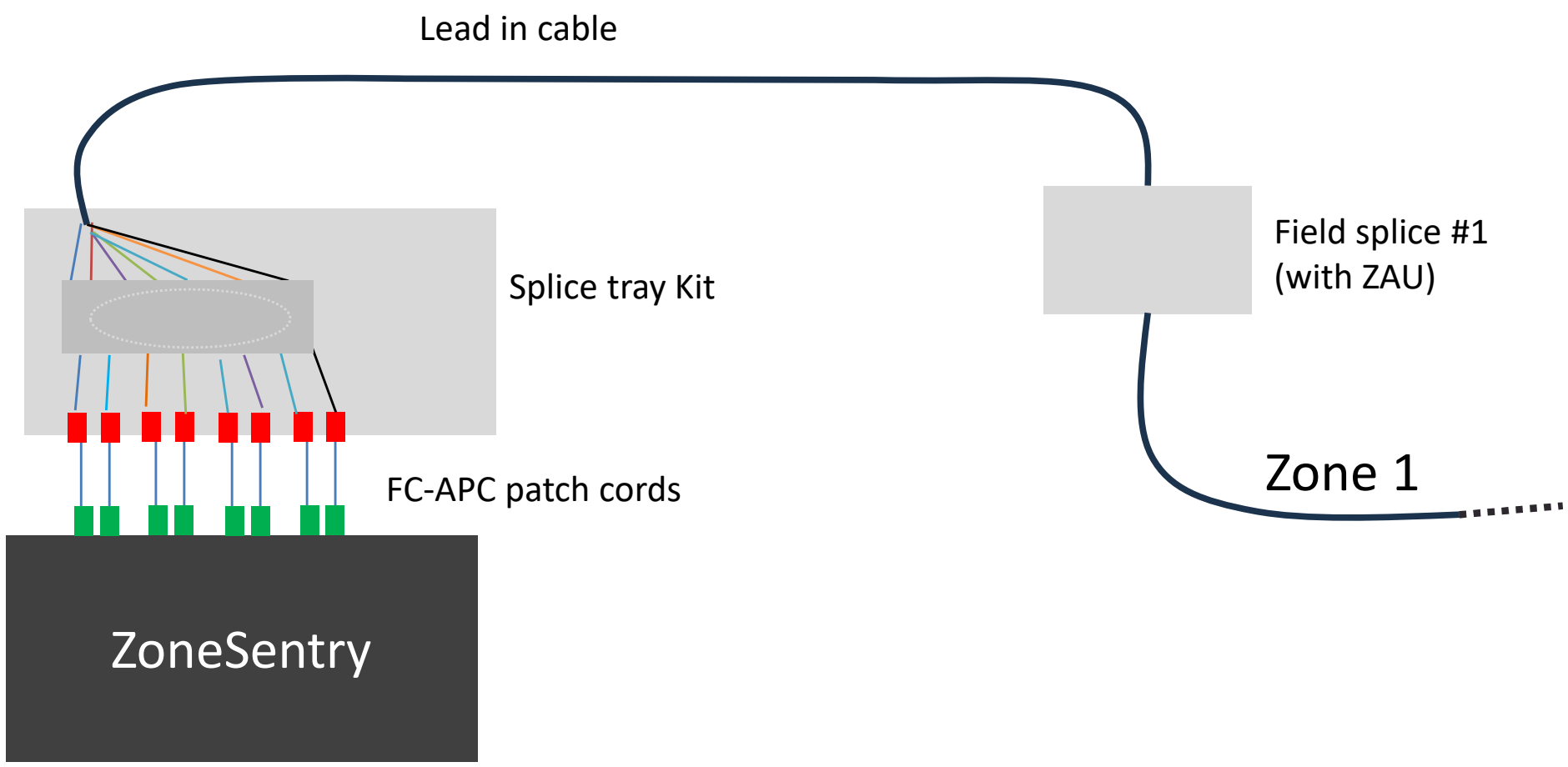
TECHNICAL INFORMATION

GENERAL	
Model No.	Rack Mount:FIDS-ZS-ST-04 Kit (4 ch.) / FIDS-ZS-ST-08 Kit (8 ch.) Wall Mount:FIDS-ZS-ST-W4 Kit (4 ch.) / FIDS-ZS-ST-W8 Kit (8 ch.)
Junction box size (L * W * H)	482mm (19”) *201mm (7.9”) *44mm
Rack height	44mm (1U equivalent)
Net weight	1.6kg (plus connector & patch cords)
Connector type	FC-APC (either 8 or 16 depending on configuration)
Simplex/duplex	Simplex
Number of ports	24
Splice cassette capacity	24 splices with heat shrinks, with storage area for bare fibers
Cable entry points	4 oval ports
Material	Cold rolled plate, SPCC
Material thickness	0.8mm
Colour	Black (RAL 9005)
Installation mode	Rack or wall mount
Application	Indoor use
FC-APC Insertion loss	0.25db
FC-APC additional	8° pre-angled ceramic ferrule, typical return loss of 60dB
FIBER DETAILS	
Fiber type	9/125µm
Single/ multimode	Single Mode
ENVIRONMENTAL CONDITIONS	
Operating temperature	-20°C ~ 70°C
Storage temperature	-20°C ~ 70°C

DIMENSIONS (incl wall mount rack brackets)



SYSTEM ARCHITECTURE



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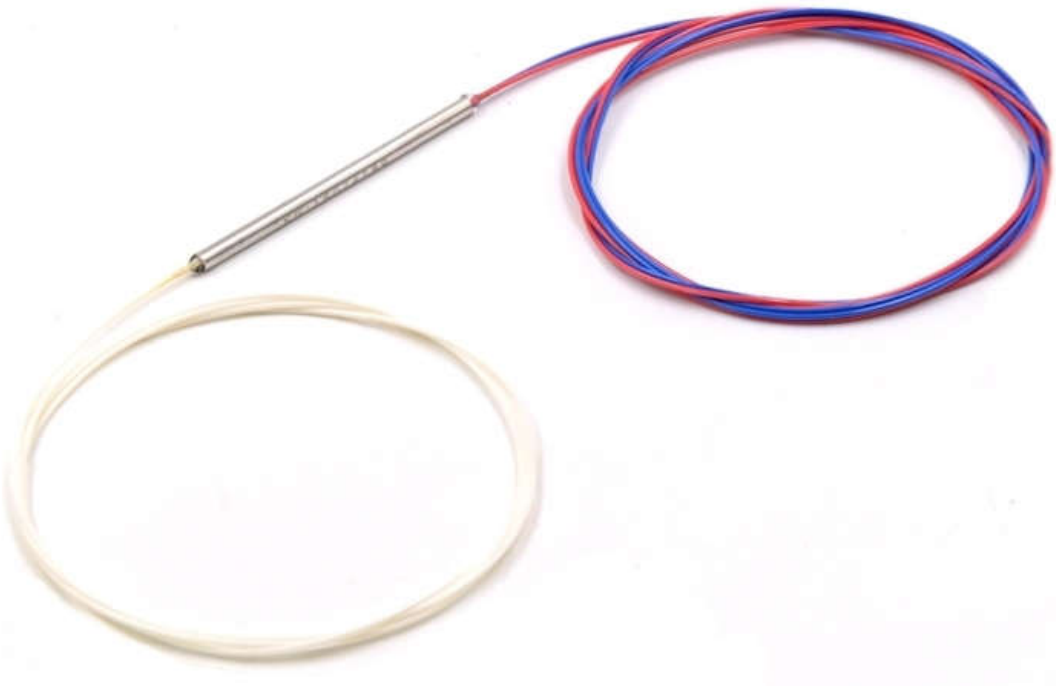
ZoneSentry™ Zone Activation Unit

The ZoneSentry utilises a Zone activation unit at the initiation of each of the zones. This component is spliced at the start of the zone loop and this activates the fiber loop that is downstream of the component.

This component is based on an optical coupler and is compact and completely passive. Typically these components are house in the *buried zone splice kit* which can be covertly buried in a secure manner or alternatively can be housed above ground.

The Zone Activation Unit requires a fusion splicer to attach to the fiber cores within the cable.



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TECHNICAL INFORMATION

GENERAL	
Model No.	FID-ZS-ZAU-01
Inputs/Outputs	2 x 2
Fiber OD	900 micron
Fiber type	SMF-28 singlemode
Pigtail length	1m
Component Dimensions	54mm x 3mm
ENVIRONMENTAL CONDITIONS	
Operating temperature	-40°C to +70°C
Storage temperature	-40°C to +70°C

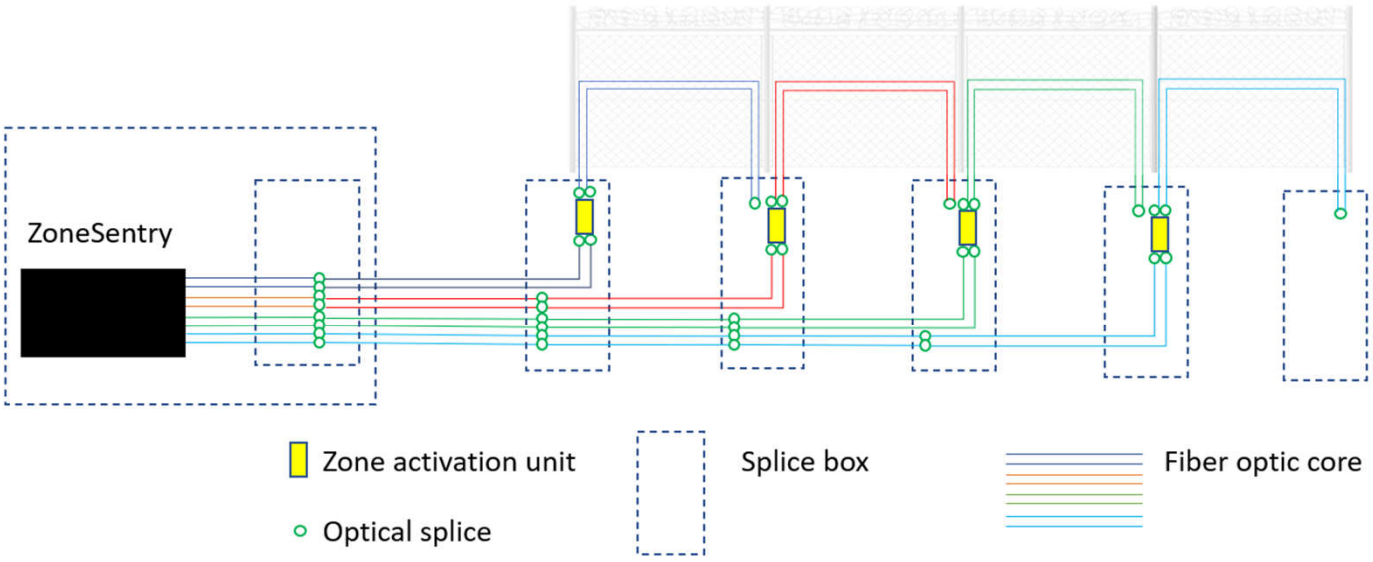


Diagram is for depiction of optical path. All cores typically in a single cable which is fence mounted

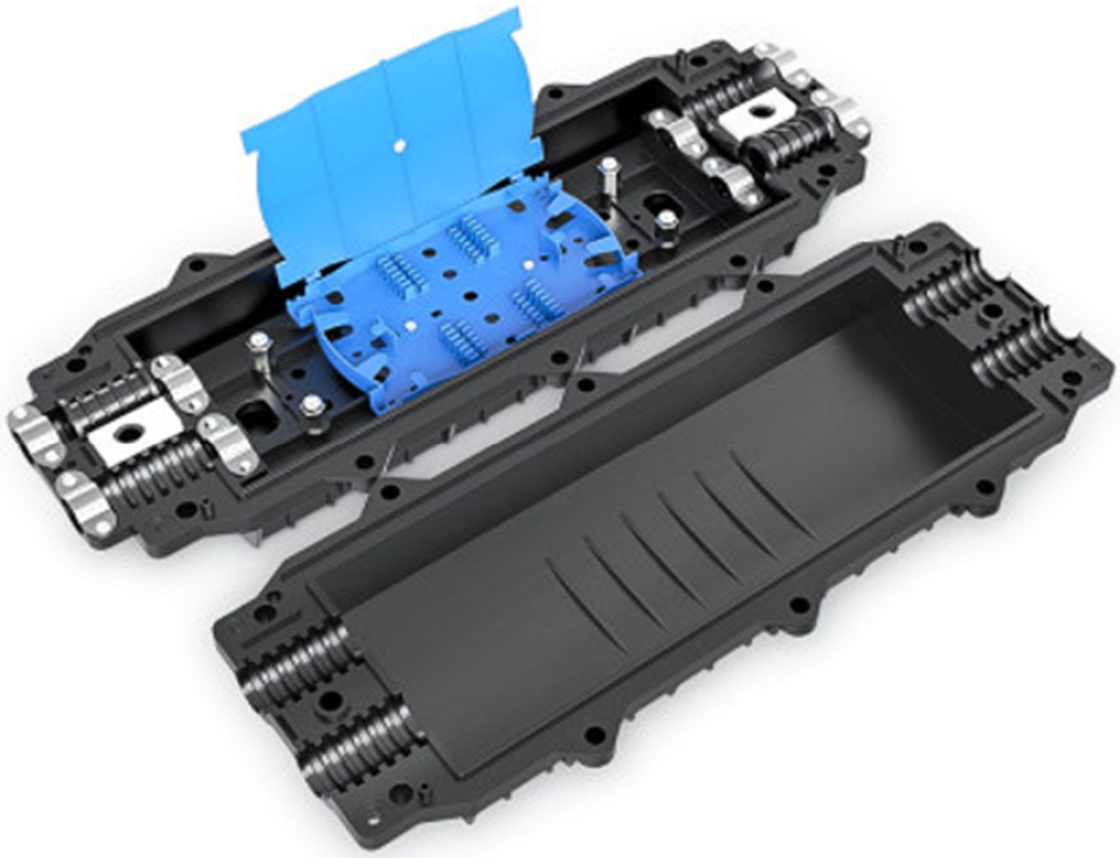
Bandweaver

DATASHEET

ZoneSentry
Buried Field Splice Enclosure

The ZoneSentry utilises a Zone activation components at the initiation of each of the zones. Typically these components are house in the *Buried Field Splice Enclosure* which can be either be covertly buried in a secure manner or housed above ground.

The unit is made from a high-strength engineered plastic housing (ABS) based on high-pressure injection moulding with anti-aging agent. It is light weight has a high mechanical strength, strong corrosion resistance, lightning resistance and long service life the ability to incorporate cables of diameter up to ϕ 22.



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TECHNICAL INFORMATION

GENERAL	
Model No.	FID-ZS-JB-01
Dimensions	325 x 120 x 55 mm
Number of cables	2 x input / 2 x output
Material	ABS Plastic
Fiber radius of curvature	>40mm
Colour	Black
Cable sizes	ϕ12.5, 17, 20, 22
Application	Aerial, duct and direct buried
Waterproof rating	Waterproof seals – requires additional sealing around cables
Pressure resistance	2000N/10cm
Shock resistance	20 Nm
Splice tray capacity	24 cores
Standard	YD/T 814-1996 IEC 1073-1-1994
ENVIRONMENTAL CONDITIONS	
Operating temperature	-40°C to +70°C
Storage temperature	-40°C to +70°C

Bandweaver

DATASHEET

ZoneSentry™ Cable Demonstration Reel Kit

The ZoneSentry demonstration reel kit provides an excellent fully functional demo reel kit for easily mounting to fences and demonstrating the full range of detection capabilities of the ZoneSenty Perimeter Intrusion Detection Systems (PIDS). The demo kit is very versatile and can be used in a number of scenarios, including but not limited to:

- Product demonstration at client sites
- Temporary or semi-permanent installation at demo site
- For use at sales exhibitions and conferences
- Proof of Concept (POC) demonstrations

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PRODUCT COMPONENTS

The ZoneSentry demonstration reel kit consists of 3 separate components for maximum versatility

RUGGEDISED SENSING REEL

The sensing reel is the heart of the demo kit and is the active section that is installed on the fence. It is comprised of a 100m length of cable on a ruggedised reel. The reel contains the Zone Activation Unit and a Turnaround Splice Unit and connectors. All the operator needs to do is simply connect the patch cords to the reel and to the ZoneSentry control unit.

FRONT VIEW

FC-APC connectors

Cover plate over ZAU

SIDE VIEW

Turnaround Splice Unit

RUGGEDISED CONNECTION REEL

The ruggedised connection reel is a 100m length of cable which connects the sensing reel to the ZoneSentry. This is often used when the ZoneSentry is situated at a distance from the fence and a connecting cable is required of upto 100m. For example for POC sites the ZoneSentry will often be located in the control room with the PSIM computer or other controllers/PC's *(note this is a connection reel only and is not sensitive to vibration).*

It is an easily deployable reel and so the patch cable can be run either simply laying on the ground or suspended or covered depending on the environment. The cable is a loose tube arrangement with an aramid protection making it suitable for most environments.

10 METER PATCH CORD

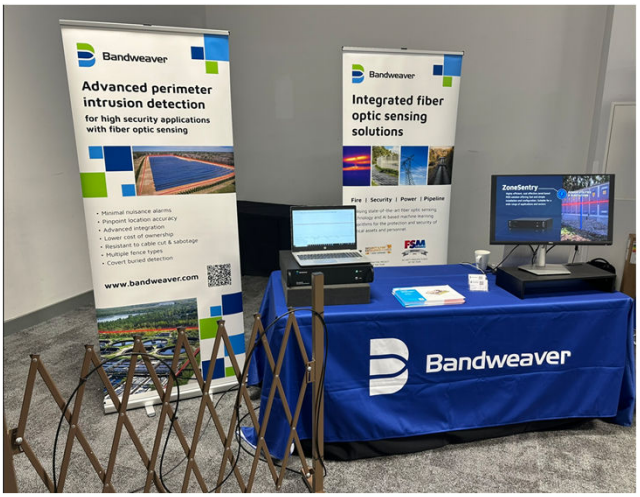
For shorter distances when the ZoneSentry is deployed in the field near the fence the shorter 10m patch cord can be used to connect the ZoneSentry to the ruggedised sensing reel.

RUGGEDISED CONNECTION REEL

10M PATCH CORD

SPECIFICATIONS

GENERAL			
Part no.	• ZoneSentry cable reel kit: *FID-ZS-Reelkit* • 4 channels demo unit & cable reel kit: *DAS-ZS-03-001-4CH Demo kit* • 8 channels demo unit & cable reel kit: *DAS-ZS-03-001-8CH Demo kit*		
Connectors	2 x FC/APC		
Cable OD	6.5mm		
Fiber type	SMF-28 singlemode, 4 fibers		
Tensile strength of cable	Long term: 200N	Short term 600N	
Crush resistance	Long term:100N/10cm	Short term 600N/10cm	
Minimum bend radius	Static: 10 x cable diameter Dyanmic: 20 x cable diameter		
ENVIRONMENTAL CONDITIONS			
Operating temperature	-40°C to +80°C		
Storage temperature	-40°C to +80°C		
DIMENSIONS			
Shipping weight & dimensions	**Item**	**Gross Weight (kg)**	**Dimensions (cm)**
	Sensing reel,	23.5	51 x 41 x 53
	Connection reel & patch cord	22	51 x 41 x 53
	Palletized Package	56.5	102 x 51 x 66



Example of ZoneSentry demo reel attached to expandable fence at security conference exhibiting ZoneSentry

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