SSOS SOFTWARE USER MANUAL

DISTRIBUTED ACOUSTIC SENSING

Bandweaver Product Family: **Horizon DAS**

DAS-HZ-02-MAN-002

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Contents

Revision History 2
1.1 Abbreviations 5
1.2 Lexicon 6
2 Product Description 8
2.1 Introduction 8
2.2 Operating Environment 9
2.2.1 Hardware Environment 9
2.2.2 Software Environment 9
2.3 Product features 9
2.4 Product Specifications 10
3 Product Installation and Start Up 11
3.1 Software Installation 11
3.1.1 Installation steps 11
3.1.2 Software Upgrade 14
3.2 Program Start-up 14
4 Operating Interface 15
4.1 Interface Overview 15
5 Map view 17
5.1 Start Location 18
5.2 Path 20
5.2.1 Adjust path sensitivity 21
5.2.2 Fiber break detection 22
5.3 Fiber 24
5.3.1 Calibration point 25
5.4 User 28
5.5 Landmark 30
5.6 Camera 30
6 Waterfall View 31
6.1 Change channel 33
6.2 Attenuation data 33
7 Alarm+Fault View 36
7.1 Alarm List 36
7.2 Fault List 38
7.3 Alarm+Fault Form Query 38
7.3.1 Operator 38
7.3.2 Simple Query 39
7.3.3 Combined Query 39
7.3.4 String Query 39
7.3.5 Example Fault Query 41
8 Video View 42
8.1 Automatic Mode of operation 42
8.2 Manually select camera 43
8.3 PTZ Control 43
9 System Menu 44
9.1 Login 44
9.2 Logout 44
9.3 Operation Rights 45
9.4 Account Management 46
9.4.1 Create Account 46
9.4.2 Viewing Accounts 46
9.4.3 Delete Account 47
9.4.4 Modifying an Account 48
9.4.5 Reset password 49

9.5 Video Management 50
9.5.1 Video Management 50
9.5.2 Preset Scope 52
9.6 Set Detector 54
9.7 Set Waterfall 57
9.8 Pattern Management 58
9.9 Data Management 60
9.9.1 Vibration data storage 60
9.9.2 Historical playback 63
9.9.3 Unit: Distance <-> Channel 65
9.9.4 Sample Query 65
9.10 Export 66
9.11 Language 66
9.12 View 66
9.13 About 67
9.14 System Exit 67
10 Alarm and Fault Management 68
10.1 Alarm Presentation 68
10.2 Fault Presentation 68
APPENDIX A: SSOS Config files 69
APPENDIX B: MAP SERVICE 70
APPENDIX C: Fiber Break for Horizon Version 1 72

1.1 Abbreviations

AA	*Adaptor for Alertor, alarm adaptation program*
ALG	*Algorithm, algorithm basis*
ALT	*Alert manager, alarm management*
AMK	*Alert Maker, alarm generation*
BRK	*Broken, fiber break detection*
CA	*Communication adapter*
CFG	*Configuration manager*
CLK	*Clock manager, clock management*
CU	*Control Unit*
DA	*Device Adaptor*
DAG	*DU Agent, detection unit agent*
DAS	*Distributed Acoustic Sensing*
DAT	*Data manager, data management*
DT	*Detector (a type of intrusion algorithm module)*
DTM	*Detector Manager, detector management*
DU	*Detection Unit*
FLT	*Fault manager*
FTR	*File Transfer*
GUI	*Graphical User Interface*
HIS	*Historical playback*
IPC	*Industrial Personal Computer*
LIC	*License manager*
LOG	*LOG manager*
OMC	*Operating and Maintenance Centre*
PCU	*Process and Control Unit*
PU	*Processing Unit*
SCADA	*Supervisory Control and Data Acquisition*
SMT	*System Monitor: system performance monitoring*
SSOS	*Software for use with Bandweaver's Horizon DAS*
TRC	*Trace manager*
TUI	*Text-based User Interface (also Textual User Interface or Terminal User Interface)*
VA	*Video Access; Video Adaptor*
VDM	*Vibration Data Manager*
VER	*Version manager*
WAV	*Wave process, sound processing of vibration data*

1.2 Lexicon

Map:
A map of the system monitoring area presented by the software view interface to identify the correspondence between paths, zones, user domains, environment domains, and monitoring scenes. You can choose to use offline or online maps.

Mark (Landmark):
An iconic building or natural object that can be displayed on a map to indicate a geographic location. Used to assist in describing where the intrusion alarm occurred. Sometimes called a landmark.

Label:
A textual description with attributes such as name, time, description, etc., used to identify historical vibration data. It is meant to serve as a memory prompt for the playback of this data, to remind the user of what was captured or the reason why the historical data was manipulated or recorded.

Path:
Corresponds to one detection fiber.

Line (Path):
Corresponds to one detection fiber.

Mode (pat):
The way in which data is transmitted over a line. A line can define several transmission modes. In principle, a line can have several modes working simultaneously to accommodate the transmission bandwidth and different detection requirements of the corresponding connection; currently, only one transmission mode operates on one line.

Environmental Zone (ez):
Different zones that are divided according to the geographic conditions of the area through which the path passes. The fundamental feature distinguishing different regions is that they have different characteristics of vibration propagation, such as the propagation rate of vibration and the change of vibration characteristics (amplitude, phase, frequency) during propagation. An environmental zone belongs to a path. For each environmental zone, you can define the detectors and activity detectors of interest.
This has been removed after V2.5.3.

User zone (uz):
A segment that divides lines according to the user's detection needs and the different characteristics of the detection area. After the alarm detected on the environment domain is delivered to the user domain, SSOS can filter the received alarm according to the rules configured by the user, and then determine whether to continue reporting to the defence zone.

Defence Zone (dz):
A defence zone that can be identified, or an administrative defence zone.
In general, a zone can contain one or several user zones, and a zone can also correspond to a person in charge of the user. For zones, users can arm and disarm them, as well as define several alarm filtering rules.
This has been removed after V2.5.3.

Detector (dt):
A detector is an intrusion algorithm. The same intrusion behaviour can have different algorithms. The parameters of the same algorithm can be different in value, so that different methods or parameters can be used to more accurately identify the intrusion of concern and try to avoid false negatives and false positives. The detector has categories and instances. SSOS currently supports four main types of intrusion, namely walking, manual digging, mechanical excavation and vehicles. In addition to these, there is also a miscellaneous **Activity** detector that can be configured. Furthermore, different types of each of the above intrusions can be identified by configuring different parameters. For example, several examples of mechanical excavation and examples of manual excavation can be configured.

Activity (evt):
A preliminary determination of the basic characteristics of a suspicious invasion. SSOS can extract features from the raw vibration data and initially determine if there is a possible intrusion based on these features or a combination of features. Such as hitting, knocking, rolling, etc. Also referred to below as an event.

Vibration data:
Data collected by the DU that reflects the vibration of the path.

Attenuation data:
Data collected by the DU that reflects the condition of the fiber connection (on-off) of the path.

Fiber position:
The position of the bits along the detection fiber identified by the offset relative to the beginning of the fiber. there start of the fiber is the point at which the sensing fiber is connected to the detection unit. The value of the fiber position can be positive or negative. The fiber position of any detection point within the detection unit chassis is negative, the fiber position of any point on the fiber outside the detection unit chassis is positive, and the fiber position of the connection between the chassis and detection fiber is 0.

Geographic location:
The location represented by the longitude, latitude, and altitude on the earth.

2 Product Description

The Horizon Distributed Acoustic Sensing system is a distributed fiber-optic acoustic detection system consisting of a host computer processing subsystem PU (processing unit), an interrogator or DU (detection unit), and a sensing fiber (sensor).

SSOS is a software subsystem that runs on the PU. It is responsible for data acquisition, data processing, behaviour recognition, alarm management, system monitoring, operation and maintenance.

2.1 Introduction

The SSOS contains at least one DU, one PU, and one sensing fiber.

The DU can be connected to one or two detection cables.

The DU and the PU are connected by 2 Gigabit Ethernet cables to transmit information in the TCP/IP protocol, including vibration data, commands, results, and status.

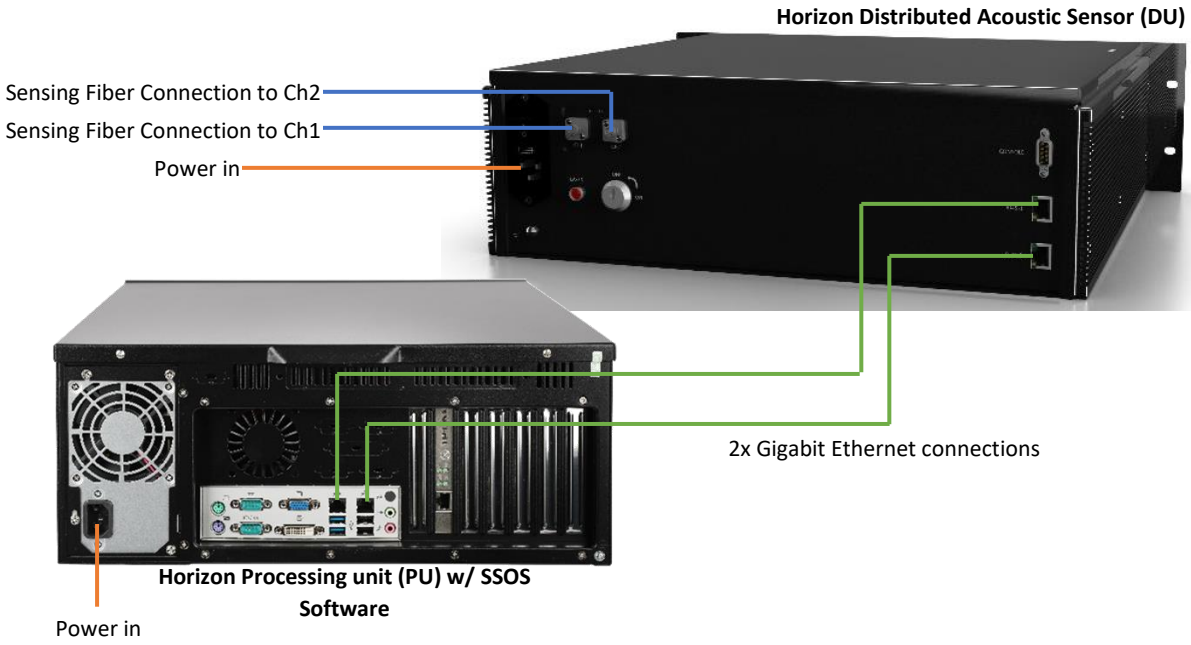


Figure 2-1 Horizon System Configuration

2.2 Operating Environment

2.2.1 Hardware Environment

1. CPU: I7, X64, frequency 3.3 GHz or more; the CPU running the algorithm must support the AVX instruction set.
2. Graphics card: The node running the GUI module shall be equipped with a separate Nvidia graphics card; the frequency shall not be less than 667MHz, and the memory not less than 1GB.
3. Display: The display resolution shall not be lower than 1920 * 1080.
4. Network: Connection DU node needs 2off 1Gbps Ethernet connections, other nodes need at least one additional Ethernet connection.
5. Hard disk: SATAIII interface, the space is not less than 1T. For the node running the DAT module, a solid-state drive is recommended.
6. Memory: Not less than 8GB.

2.2.2 Software Environment

1. Windows 10, x64 version recommended
2. Internet Explorer 11 recommended

2.3 Product features

The principal functions of SSOS is to collect the raw vibration data from the DU, process and analyse it to identify relevant intrusions, and report this to the user. This version of SSOS offers an improved user experience. It builds on the strengths of our previous interface and includes a wealth of new features. The principal features are described below:

Detect Intrusion behaviour

Detect intrusion behaviour, through processing, analysis from the vibration data collected by the DU is timely and accurately derived to cause vibration. Intrusion information is reported to the user in several ways:

1. Graphically report the type of intrusion and location of the intrusion in the corresponding location in the monitoring site map;
2. Display details of the intrusion in the alarm table;
3. Display the highest alarm level not currently processed in the status bar of the GUI in a different colour;
4. Save the alarm information to the database, the user can query any alarm record during the validity period;
5. The user can confirm the alarm;
6. Notify relevant users by SMS (optional feature: requires Bandweaver's MaxView software);

Detect Fiber Break

By using the received vibration and attenuation data, SSOS can determine the connection state of the optical fiber. SSOS can be configured to report a fault for a disconnected fiber or fiber break (both these are reported as a fiber break).

Rolling recording of energy data (waterfall data) with on demand viewer

SSOS can be configured to automatically record a user-configurable amount of waterfall data. The amount of data that can be stored is constrained by the allocated disk space. The oldest data is overwritten to store the latest data. This data can be viewed on demand or from the alarm table.

On-demand storage and playback of saved raw data

SSOS can store and play back the received vibration data and energy data on demand. During storage and playback, the user can tag the stored vibration data.

Self-monitoring function

SSOS also has a strong self-monitoring function to provide stable and reliable operation of the system. SSOS monitors the CPU usage, RAM usage, disk usage, and connection status of each process and its computer in real time and provides a fault alarm when necessary based on the threshold set by the user.

Configure, view and modify the operating parameters

SSOS has abundant operation and maintenance means for the user to configure, view, and modify the operating parameters of the system, in order to better adapt to different monitoring requirements of different users.

2.4 Product Specifications

- Max. number of DU connections: 1
- Max. number of channels / paths / patterns: 2
- Max. number of detectors: 32
- Max. number of zones per detector: 12
- Max. number of user accounts: 253
- Max. number of calibration points per line: 511
- Max. number of alarms displayed on the map at a time: 50
- Max. number of Untreated alarms: 3000
- Max. number of user zones per path: 255
- Max. number of rules per user zone: 8
- Max. number of landmarks per line: 255
- Max. number of SCADA connections: 4
- Max. number of cameras: 256
- Max. number of channels per camera: 128
- Max. number of video presets per channel: 10

3 Product Installation and Start Up

3.1 Software Installation

The software version is released under the name ssos-win-x64-VX.Y.Z.exe, where " VX.Y " is the version number and ".Z " is the release number.

The list of released files includes:

1. ssos-win-x64-VX.Y.Z.exe, the installation executable file;
2. Sample SSOS configuration file:

File name	Description
GuiNat\icons\alt\s	Alarm icon images
GuiNat\hw.ini	DU model configuration
GuiNat\config.run	Alarm type configuration
GuiNat\lib\Dt.conf.json	Detector configuration management
GuiNat\lib\table.json	Interface display table configuration
.default.run	System operation mode definition file
.pltdef.ini	The platform description
.ssos.ini	SSOS software specification definition
.prnctrl.ini	Print switch console initial definition
SsosDemoCfg.bin	SSOS configuration file (binary)
SsosDemoCfg.txt	SSOS configuration file (Text)
ThdPatfmCfg.txt	SSOS External communication adapter parameters

Table 3-1 SSOS configuration file

3.1.1 Installation steps

1. Uninstall any previous version of SSOS before starting the installation of a new version;

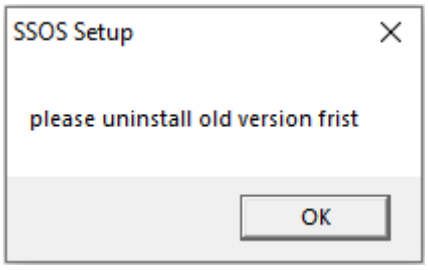


Figure 3-1 Uninstall any older versions of SSOS

2. Check the received SSOS installation package, including whether the version is correct, the content is complete, etc.

3. Check that the operating environment meets the requirements described in Section 2.2. Double-click ssos-win-x64-VX.Y.Z.exe to start the installation process.

4. Select the language (currently SSOS supports Chinese, English and Russian) as follows:

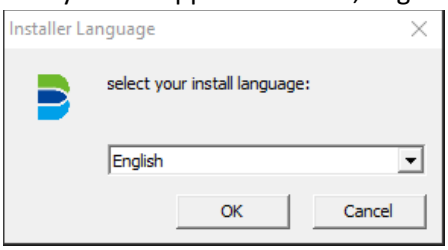


Figure 3-2 Select language

5. After selecting the language, click **OK** to enter the license agreement and click **I ACCEPT**. If English or Russian is selected, there is no such interface.

6. Next choose to install the components, as shown below, and click **Next** to continue.

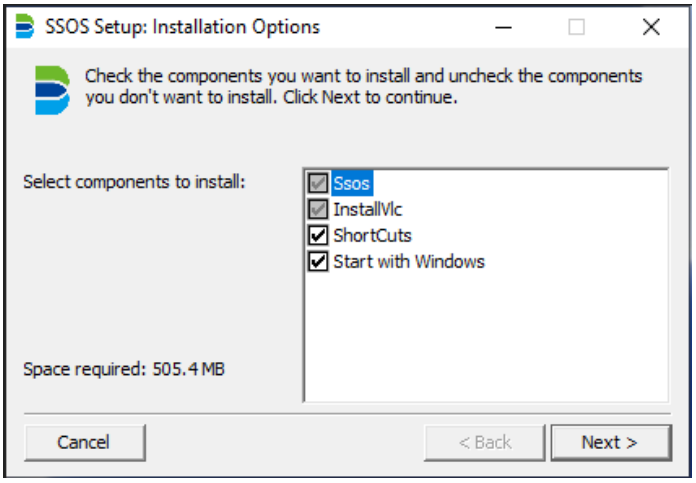


Figure 3-3 Select Components

7. The user can now select the installation and storage directories for SSOS. The default paths are shown in the image below:

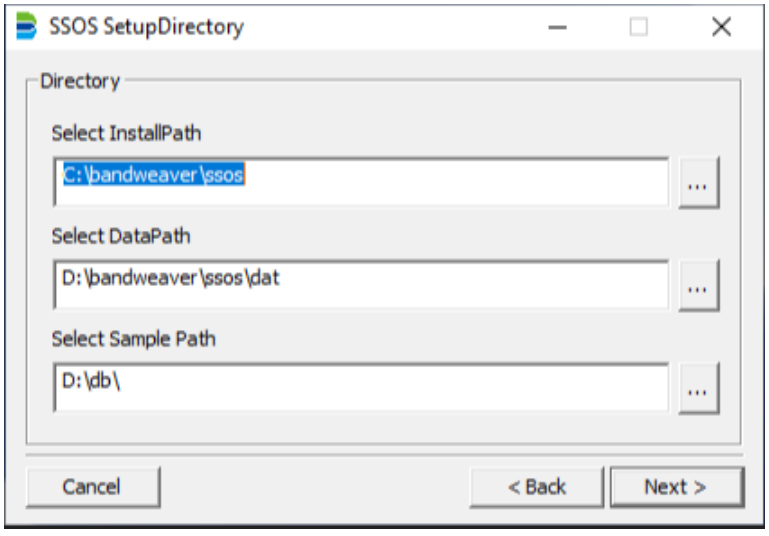
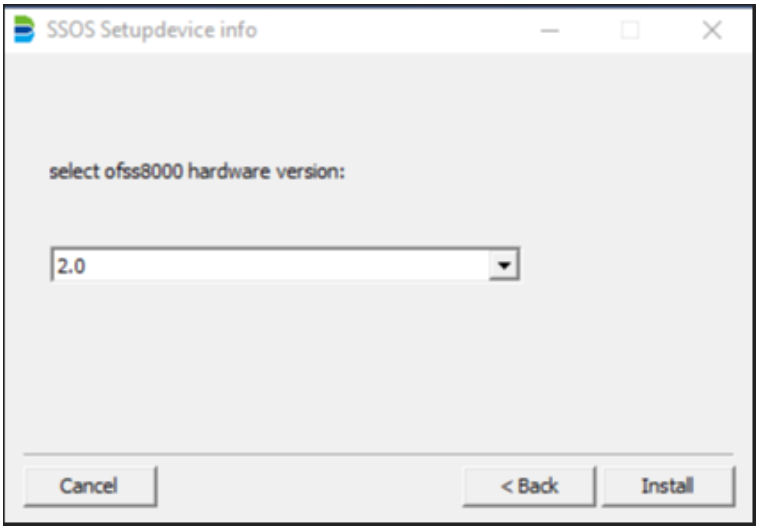
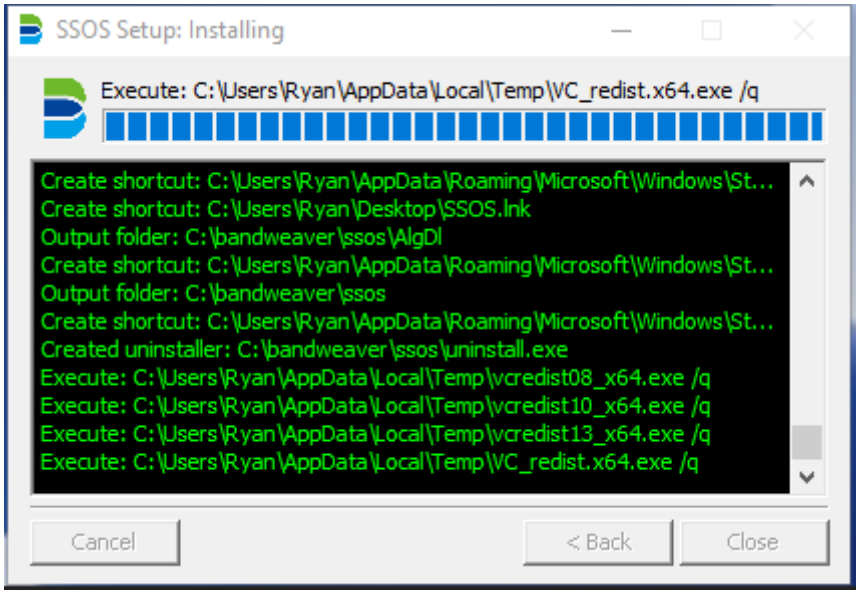


Figure 3-4 Set default paths

8. Select the hardware version of the DU. This can be found on the nameplate of the Horizon interrogator, in the model number field: DAS-HZ-0X-YY-ZCH, where X is the version.
   Note: This option must be correct as the software will crash if an incorrect version of hardware is connected.



9. Click the **Install** button to enter the program installation interface, as shown below:



10. After the installation is complete, click the **Close** button to complete the installation.

11. Double-click the SSOS program from the desktop to run it:

Figure 3-5 SSOS desktop icon

3.1.2 Software Upgrade

When upgrading the software, first uninstall the old version, then install the new version on the path of the old version.

The installer does not automatically install the previous configuration when upgrading. If the configuration is not compatible, the configuration must be upgraded manually.

3.2 Program Start-up

There are several ways to start SSOS:

Automatic start-up:
After the program is installed, SSOS will automatically start-up with the operating system and provide monitoring services for the user according to the existing settings and configurations.

Start menu:
After the program is installed, the software will be accessible from the Windows **Start** menu and **All Programs**. The user can manually start SSOS by clicking one of these options.

Double-click the executable program:
Double-click the executable program: After the program is installed, there will be a corresponding executable program **ssos.exe** in the resource browser. Like other Windows programs, users double-click on the program name to start SSOS live monitoring.

Desktop shortcut:
After the program is installed and if the user has selected this option during the installation, there will be a shortcut to SSOS on the Windows Desktop. Users can double-click the desktop shortcut to start SSOS.

By DOS window command line to start:
SSOS can be started from the command prompt.

By configuring the BIOS and Windows:
By configuring BIOS and Windows, SSOS can be configured to automatically start after the target computer is powered on.

4 Operating Interface

4.1 Interface Overview

The SSOS interface has been designed to dedicate as much screen space as possible to the most common information and operations. All other elements to be called up easily when required, and hidden when not in immediate use.

Only one user account can be logged in and operated at a time.

The SSOS interface is divided into six areas:

1. Map View;
2. Waterfall View;
3. Alarm+Fault View;
4. Video View
5. Status bar;
6. Title bar;

The title bar and the status bar belong to the GUI framework, and do not vary based on the application of the user. Other areas present the monitoring results of the SSOS system to the user and help the user to operate and maintain the software.

These vary depending on the monitoring and operations needs of the user.

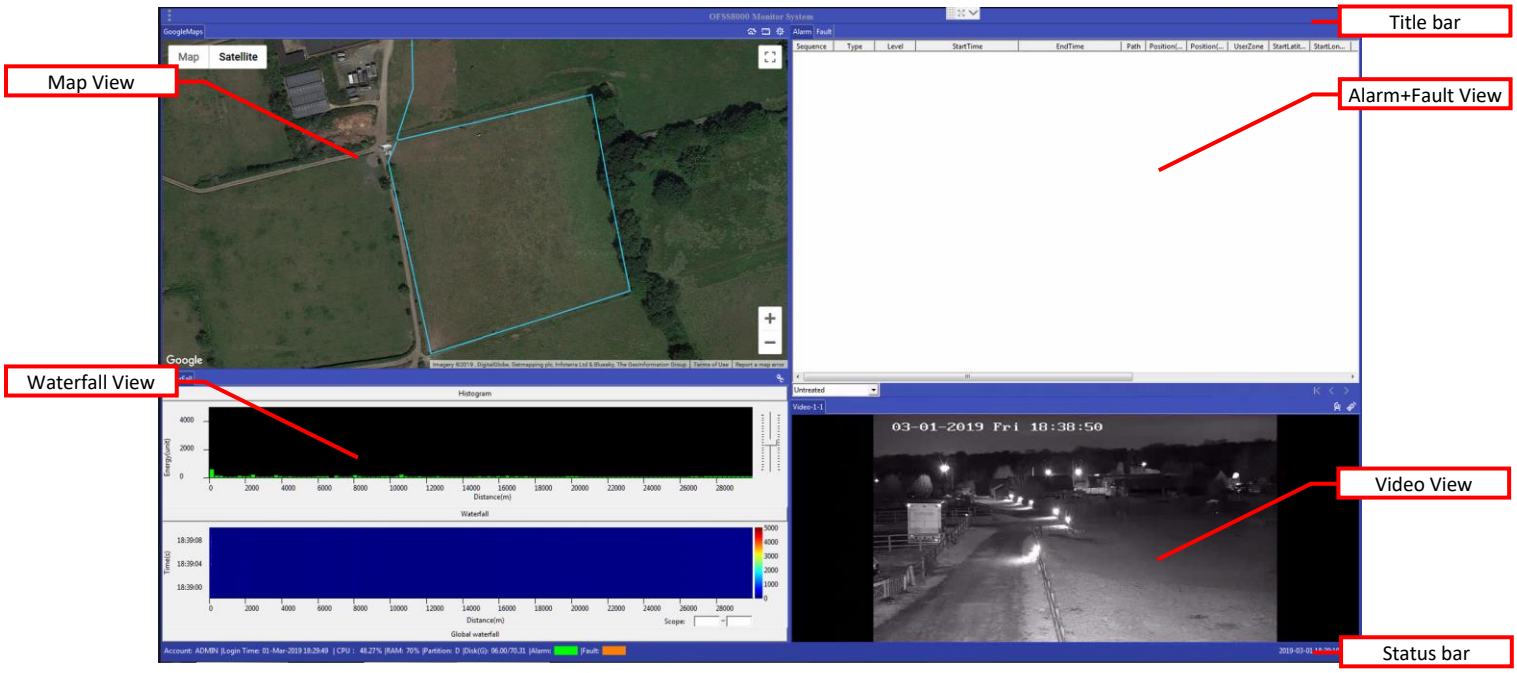


Figure 4-1 SSOS Main Interface

The title bar is at the top of the interface and is used to display the title of the monitoring system and select the system menu.

The colour of the title bar changes from blue to red when an alarm is raised:

Figure 4-2 Title bar - no alarm

Figure 4-3 Title bar - active alarm

The status bar is at the bottom of the interface and is used to display the account login status, system resource usage status, network connection status, alarm status, fault status, and the clock of the computer on which the interface resides.

The rest of the screen space is dedicated to the other views, which collectively occupy the largest area of the screen. Each of these have their own title bars with function buttons corresponding to operations that can be carried out within the view. Each can be displayed or hidden, based on the choice of the user. By default, all views are displayed.

Each of the views are described in the following sections, along with their associated menu options.

5 Map view

The **Map** display area can display the map of the monitoring path. The main Map View of SSOS covers the monitored routes of both channels.

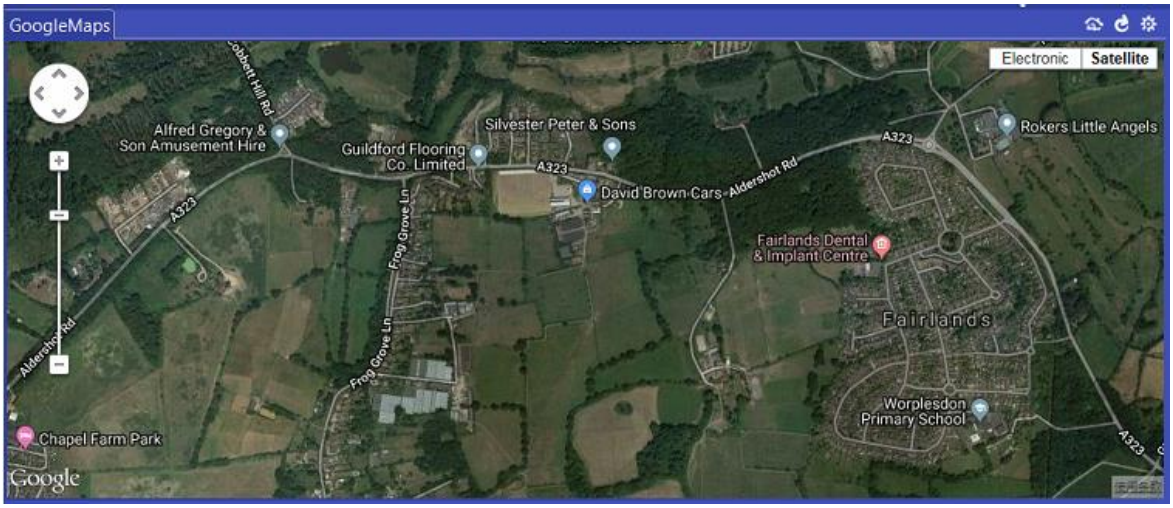


Figure 5-1 Main Map view

The title bar along the top includes 3 buttons:

Restores the moved map to the default coordinates/position.

Reload and reset the view

Opens the configuration layer of the selected path, as shown in Figure 5-2.

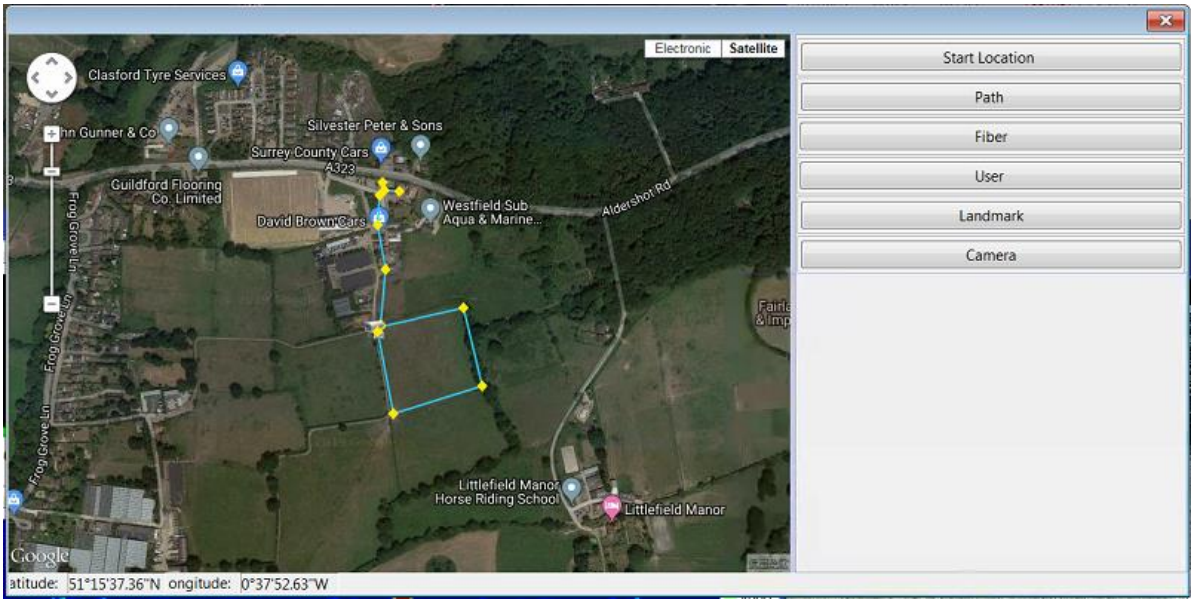


Figure 5-2 Set Default position in Configuration menu

5.1 Start Location

The starting position of the map is the centre latitude and longitude of the displayed map. When configured, click Reset and the map will return to the set map centre point.

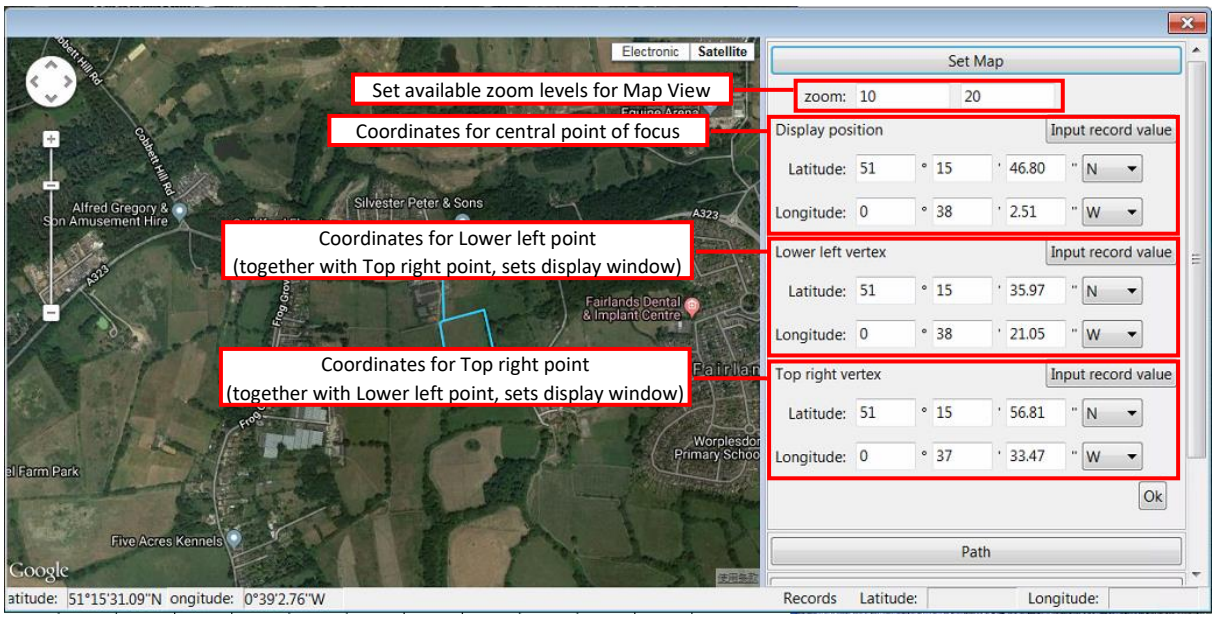


Figure 5-3 Start Location

Zoom — *Set the Minimum and Maximum zoom levels available to the user in the Map view. The maximum value must be less than or equal to the available zoom levels for the downloaded or customer provided map.*
This will allow the user to zoom in and out by the corresponding levels in the Map View.

Display position:

The **Display Position** is the central point of focus when the home or reset buttons are called on the Map View of the main display. Together with the **Lower left** and **Top right** coordinates, these set the Home display of the Map View.

Input record value — *If the map has already been downloaded correctly, this button can be used to avoid having to manually type in the latitude and longitude coordinates of the point of interest. On the map displayed in the left panel, simply click on the desired point and click Input record value. The latitude and longitude values of the point will be automatically filled in the boxes below.*

Latitude — *Latitude value. Can be manually entered or automatically populated by using the Input record value button. If manually entered, remember to also select the north (N) or south (S) from the drop-down.*

Longitude — *Longitude value. Can be manually entered or automatically populated by using the Input record value button. If manually entered, remember to also select the north (N) or south (S) from the drop-down.*

Lower left vertex:

The **Lower left vertex** is the bottom left point of the desired map when the home or reset buttons are called on the Map View of the main display. Together with the **Display Position** and **Top right** coordinates, these set the Home display of the Map View.

Input record value *If the map has already been downloaded correctly, this button can be used to avoid having to manually type in the latitude and longitude coordinates of the point of interest. On the map displayed in the left panel, simply click on the desired point and click Input record value. The latitude and longitude values of the point will be automatically filled in the boxes below.*

Latitude *Latitude value. Can be manually entered or automatically populated by using the Input record value button. If manually entered, remember to also select the north (N) or south (S) from the drop-down.*

Longitude *Longitude value. Can be manually entered or automatically populated by using the Input record value button. If manually entered, remember to also select the north (N) or south (S) from the drop-down.*

Top right vertex:

The **Top right vertex** is the top right point of the desired map when the home or reset buttons are called on the Map View of the main display. Together with the **Display Position** and **Lower left** coordinates, these set the Home display of the Map View.

Input record value *If the map has already been downloaded correctly, this button can be used to avoid having to manually type in the latitude and longitude coordinates of the point of interest. On the map displayed in the left panel, simply click on the desired point and click Input record value. The latitude and longitude values of the point will be automatically filled in the boxes below.*

Latitude *Latitude value. Can be manually entered or automatically populated by using the Input record value button. If manually entered, remember to also select the north (N) or south (S) from the drop-down.*

Longitude *Longitude value. Can be manually entered or automatically populated by using the Input record value button. If manually entered, remember to also select the north (N) or south (S) from the drop-down.*

Click **Ok** to save the new coordinates.

5.2 Path

After SSOS installation is completed, each channel corresponds to one path by default, and the user does not need to create a new one. Right click on either path to be able to **Edit** it:

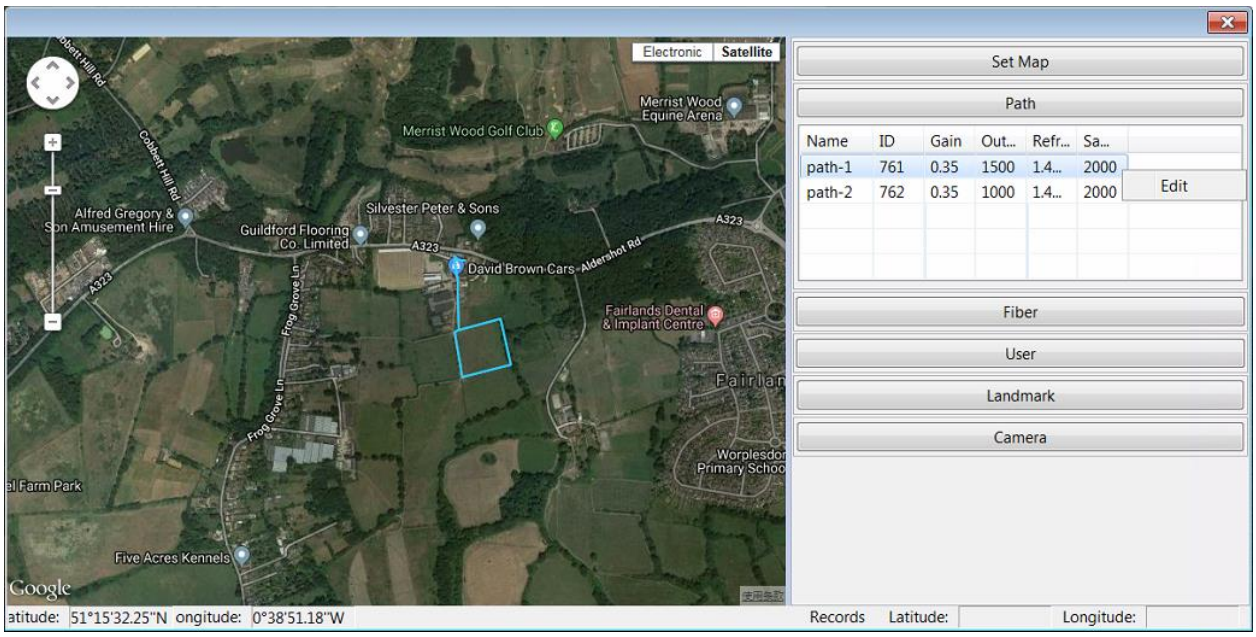


Figure 5-4 Settings – Path

Selecting **Edit** opens the following **Set Path** dialog:

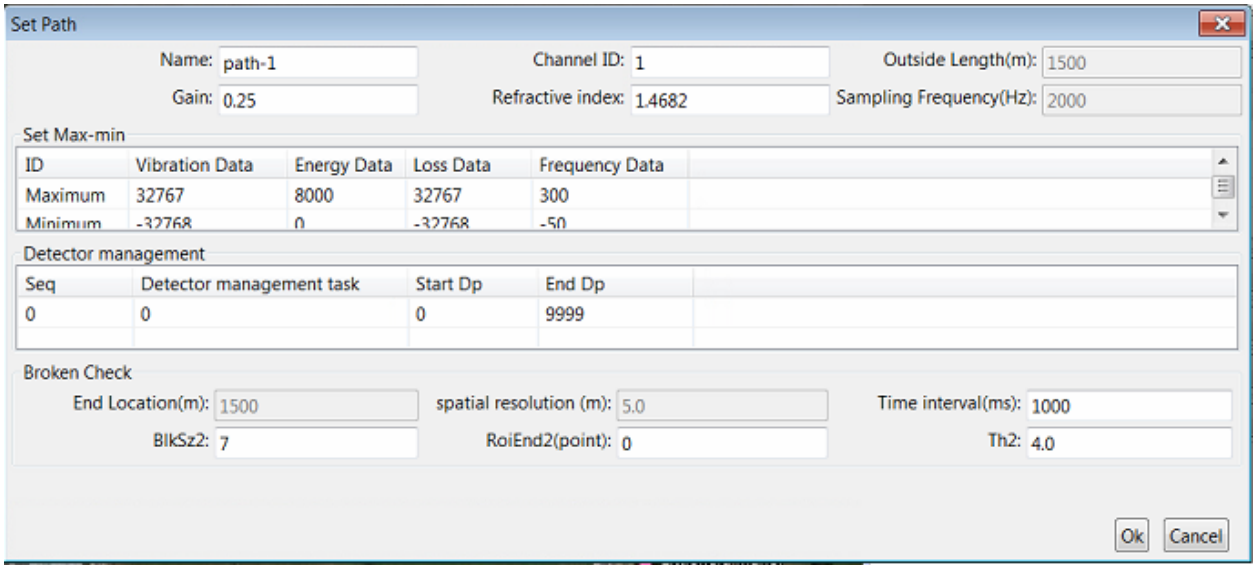


Figure 5-5 Set Path

Note:
The greyed-out parameters cannot be manually altered. They may automatically change based on parameters configured in other menus.

Name *path-1 or path-2. Do not change.*

Channel ID *Channel ID: 1 or 2. Do not change.*

Gain *Property of sensing fiber: Gain*

Refractive Index *Property of sensing fiber: Refractive index*

Outside Length *Length that is configured in Pattern Management (See 9.8)*

Sampling Frequency *Sampling Frequency configured in Pattern Management (See 9.8)*

5.2.1 Adjust path sensitivity

Set max-min:

The parameters in this section must be kept at their default values, except for the Maximum Energy Data, which can be used to adjust the sensitivity of each path. Do not change the value of any other parameter in this section. The Default values can be found below for reference.

Vibration Data *Default: Max = 32767, Min = -32768. Do not change.*

Energy Data *The Maximum Energy Data value sets the colour scale for the waterfall view:*
The energy of the signal is proportional to how red it appears on the waterfall. The system can be said to be more (or less) sensitive based on the same signal appearing more (or less) "red" on the waterfall view. The Maximum Energy Data value determines the scale to which the measured energy can be mapped.

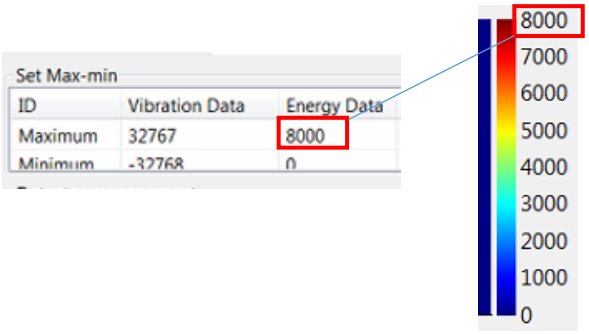


Figure 5-6 Sensitivity adjustment

It is therefore used to increase or decrease the sensitivity of the channel. Lowering the Max value increases the sensitivity and increasing it reduces the sensitivity. The sensitivity can be adjusted independently for path-1 and path-2.
Default: Max = 10000
Min = 0 (do not change)

Loss Data *Default: Max = 32767, Min = -32768. Do not change.*

Frequency Data *Default: Max = 300, Min = -50. Do not change.*

5.2.2 Fiber break detection

Broken Check:

The parameters in this section are used to set the fiber break detection for the system. All these values must be set for each detection channel. The fiber break algorithm is different for the different hardware versions of the Horizon DU. This section only refers to Horizon Version 2 and above.
For Version 1 settings, refer to APPENDIX C:

End Location(m) *Length that is configured in Pattern Management (See 9.8)*

Spatial Resolution (m) *Sift interval that is configured in Pattern Management (see 9.8)*

Time Interval (ms) *How frequently the system checks for fiber breaks.*
Default = 1000. Do not change.

BlkSz2 *The number of data points at the start of the trace that are used as reference.*
Default = 7.

RoiEnd2(point) *Real length of the fiber in channels. If the measured length is less than this, the system will raise this as a fiber break fault.*
Note:
The unit is channel (not meters)

Th2 *This value is set differently depending on the hardware version of the Horizon DU.*
For Horizon DU Version 1: Refer to APPENDIX C:

For Horizon Version 2: See description below.

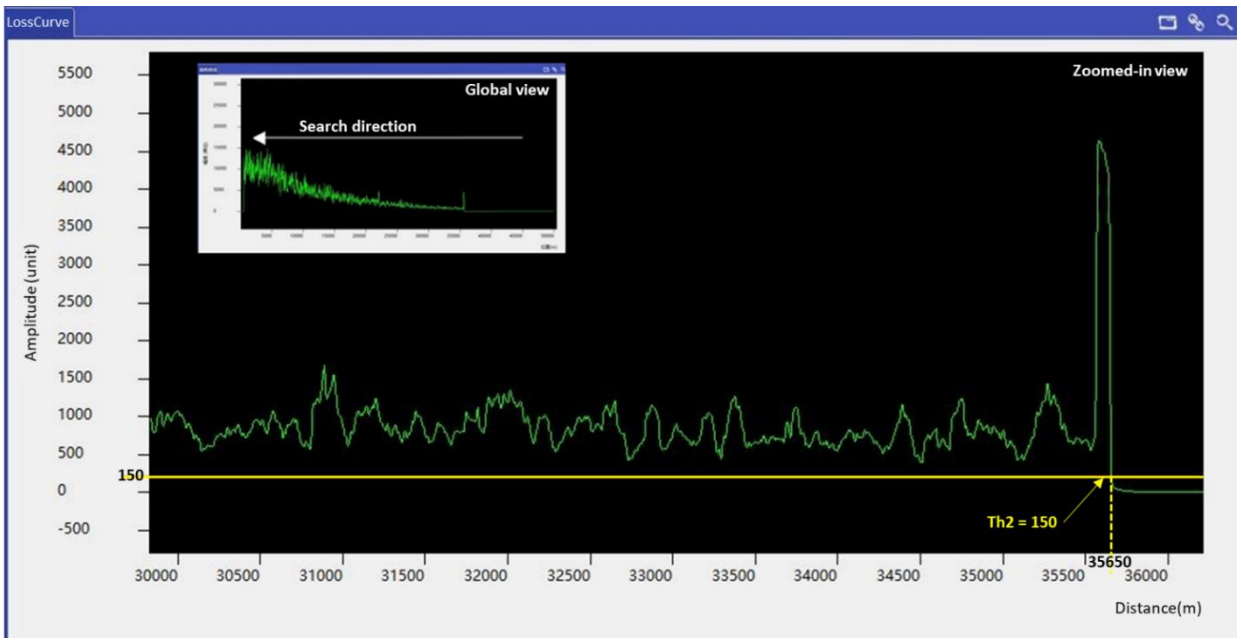


Figure 5-7 Overview of Fiber Break (V2)

The main values to be set for the fiber break detection, are the fiber length **RoiEnd2** the threshold value **Th2**.

The fiber break algorithm starts its search in the reverse direction, i.e. from the end of the linear attenuation trace towards the beginning, to find a point that matches the value of **Th2**. The first point found that meets this condition is determined as the current end of the fiber. If this value is lower that the value configured as **RoiEnd2**, this is flagged as a broken fiber**.**

To switch between waterfall view of Ch1 and Ch2	Refer to 6.1
To switch from Waterfall to the Linear Attenuation data (for Th2)	Refer to 6.2
To switch from meter to channel (for RoiEnd2)	Refer to 9.9.3

Click **Ok** to save or **Cancel** to discard changes before exiting.

These path parameters can also be adjusted for path-2 (Channel 2).

5.3 Fiber

The fiber laying in SSOS is the electronic equivalent to the layout of the fiber/cable in the ground and is required for the convenience of visual positioning of the alarm.

This is done by adding calibration points and automatically joining the lines in the order of addition. The calibration point represents the distribution of the fiber, and it includes the length of the fiber and data acquisition information. Before the fiber route is laid in the software, it is necessary to complete the survey of the actual cable route and have the complete line survey information recorded.

Under the **Fiber** tab, a drop-down is available for channel selection – path-1 for Ch1 or path-2 for Ch2. Select the desired path from the drop-down list as shown in Figure 5-8.

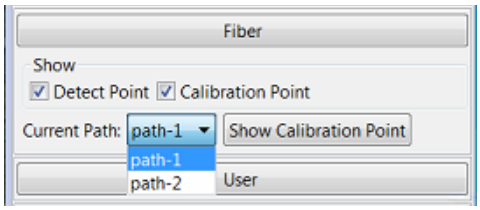


Figure 5-8 Settings - Fiber: Channel selection

The two checkboxes allow the user to configure how the fiber is displayed in the main Map view.

Detect Point *Select to show the interconnections between the Calibration Points*

Calibration Point *Select to show the Calibration points on the map*

Clicking the **Show Calibration Point** button will display the information of the calibration point on the right side. Once this list is displayed, the user can edit and delete it, as shown Figure 5-9.

The path is represented primarily by calibration points on the map.

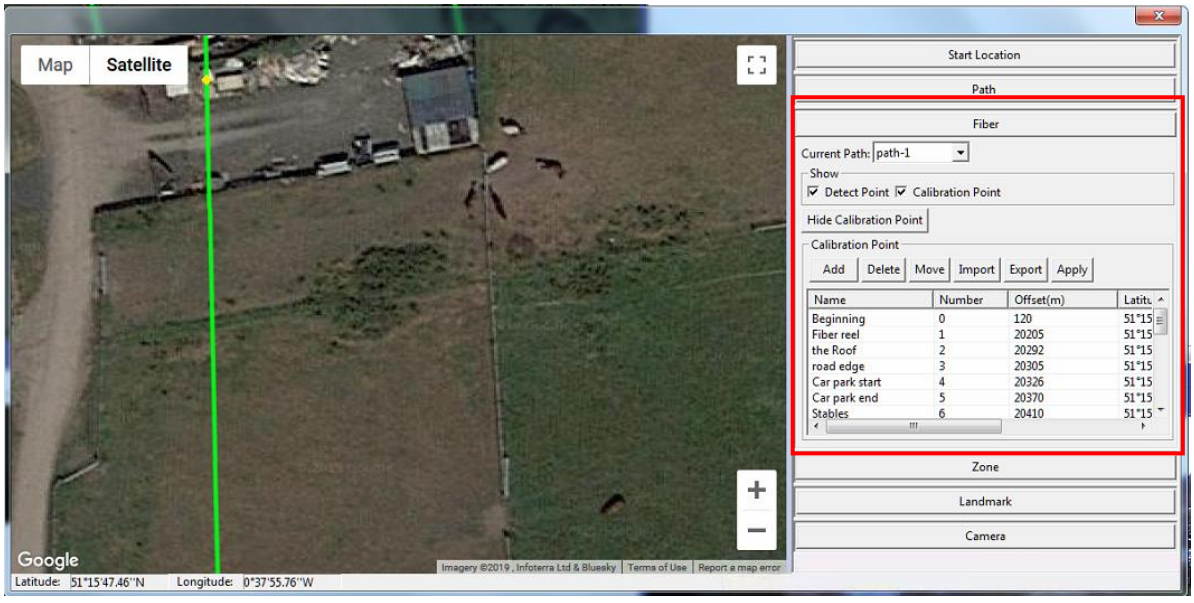


Figure 5-9 Fiber

5.3.1 Calibration point

A calibration point is used to indicate the path distribution and real meter length of the fiber at that point.

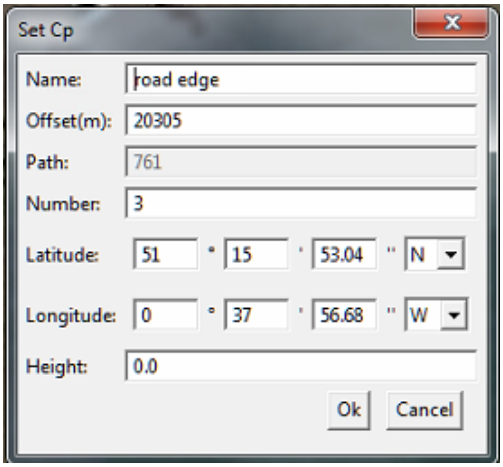


Figure 5-10 Calibration point parameters

Name *Descriptive title for the calibration point*

Number *Sequence number of this calibration point*

Offset *Length of the fiber at this point, or meter position of this point on the fiber*

Latitude *Latitude position of this point on the map*

Longitude *Longitude position of this point on the map*

Height *Altitude of this point (optional – enter **0.0** if not used)*

5.3.1.1 Add calibration point

In Figure 5-11, on clicking the **Add** button under the calibration point, the button text changes to **Cancel**. While the **Add** function is active, the mouse can be used to add calibration points by clicking in the left-hand map panel.

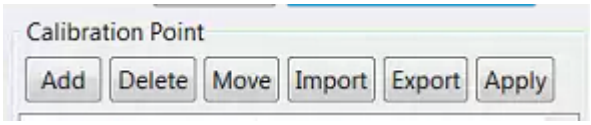


Figure 5-11 Calibration point operations

Click on the map in the left hand panel to add the point and wait for the calibration point icon to appear on the map as shown in Figure 5-12. Click again to add the next connecting point, and so on, until the monitored route has been appropriately captured.

Switch paths from the drop down to add the route for the next channel in the same map.

Once the required changes have been made, click **Apply** to save and apply the changes. For long or complex routes, click **Apply** periodically to save the configuration.

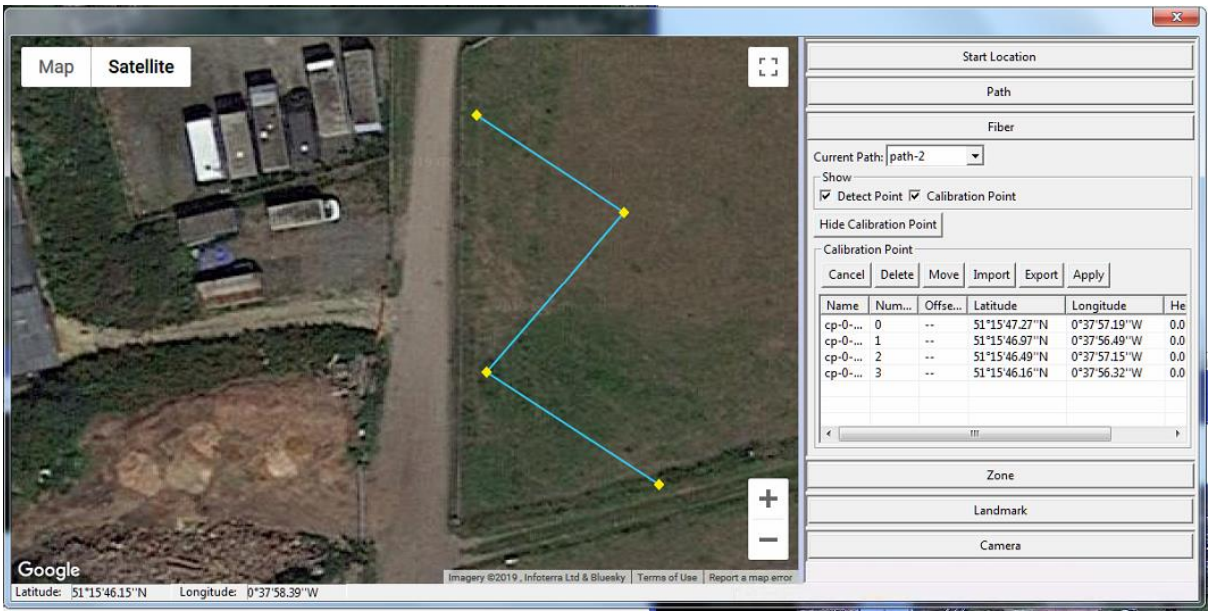


Figure 5-12 Click to add a calibration point

After the addition is complete, click the **Cancel** button to complete the calibration point on the background image. After the addition is completed, the system will automatically assign the serial number, name, and geographic location, but the fiber offset position needs to be provided by the user in the table shown in Figure 5-13 below:

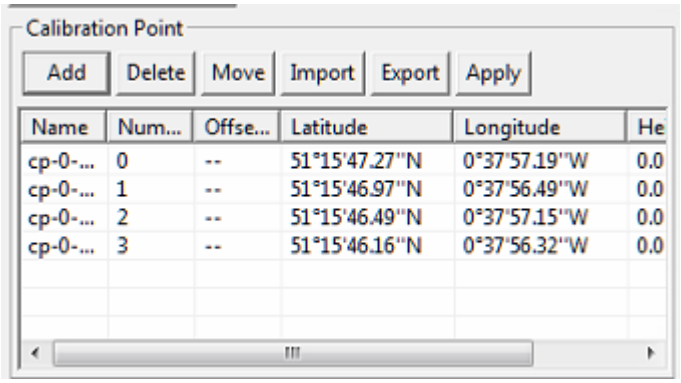


Figure 5-13 Table of calibration points

5.3.1.2 Delete calibration point

In Figure 5-13, on clicking the **Delete** button under the calibration point, the button text changes to **Cancel**. While the **Delete** function is active, the calibration points to be deleted can be simply clicked in the map panel on the left to delete them.

Watch for the change of the mouse pointer to when deleting or moving calibration points.

After deleting the required points, click the **Cancel** button to end the deletion function.

Once the required changes have been made, click **Apply** to save and apply the changes. For long or complex routes, click **Apply** periodically to save the configuration.

5.3.1.3 Move the calibration point

In Figure 5-13, on clicking the **Move** button under the calibration point, the button text changes to **Cancel**. While the **Move** function is active, the calibration points to be moved and be simply clicked and dragged to the desired position in the map panel on the left.

Watch for the change of the mouse pointer to when deleting or moving calibration points.

After moving the required points, click the **Cancel** button to end the **Move** function.

Once the required changes have been made, click **Apply** to save and apply the changes. For long or complex routes, click **Apply** periodically to save the configuration.

5.3.1.4 Import calibration points

SSOS allows the user to import the calibration points from a previously exported file. Alternatively, the user can assemble the calibration points in Notepad in the correct format, and import them into SSOS, rather than inputting the details of the calibration points one at a time.

The file format is as follows:

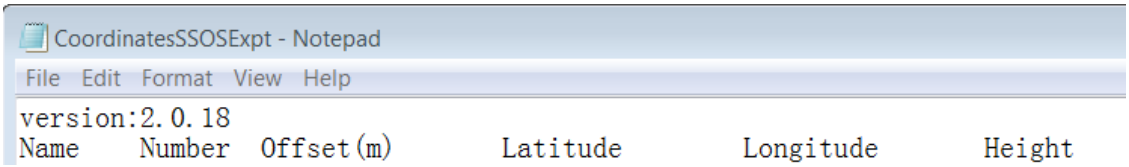


Figure 5-14 Import calibration points

In Figure 5-13, click the **Import** button under the calibration point to open the file selection dialog. Select the corresponding file to import.

5.3.1.5 Export calibration points

In Figure 5-13, click the **Export** button under the calibration point export the current calibration configuration. Select the export directory and confirm.

5.4 User

The **User Zone** is a segment that divides the path according to the user's detection requirements and the characteristics of the detection area.

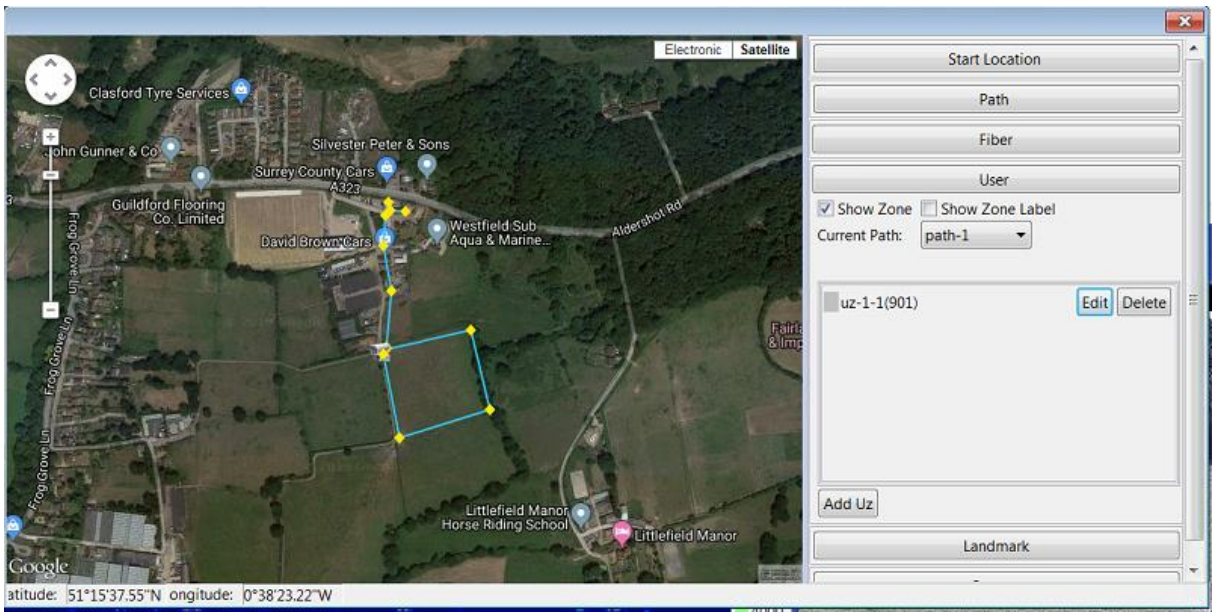


Figure 5-15 User zones

After the alarm detected is delivered to the user domain, SSOS filters the received alarms according to the rules configured by the user, and consequently determines whether to continue reporting the alarm. Use this feature for setting alarm schedule restrictions – for example, supress all intrusion alarms during the day and only report intrusions that occur at night.

A user zone filters alarms according to the following process:

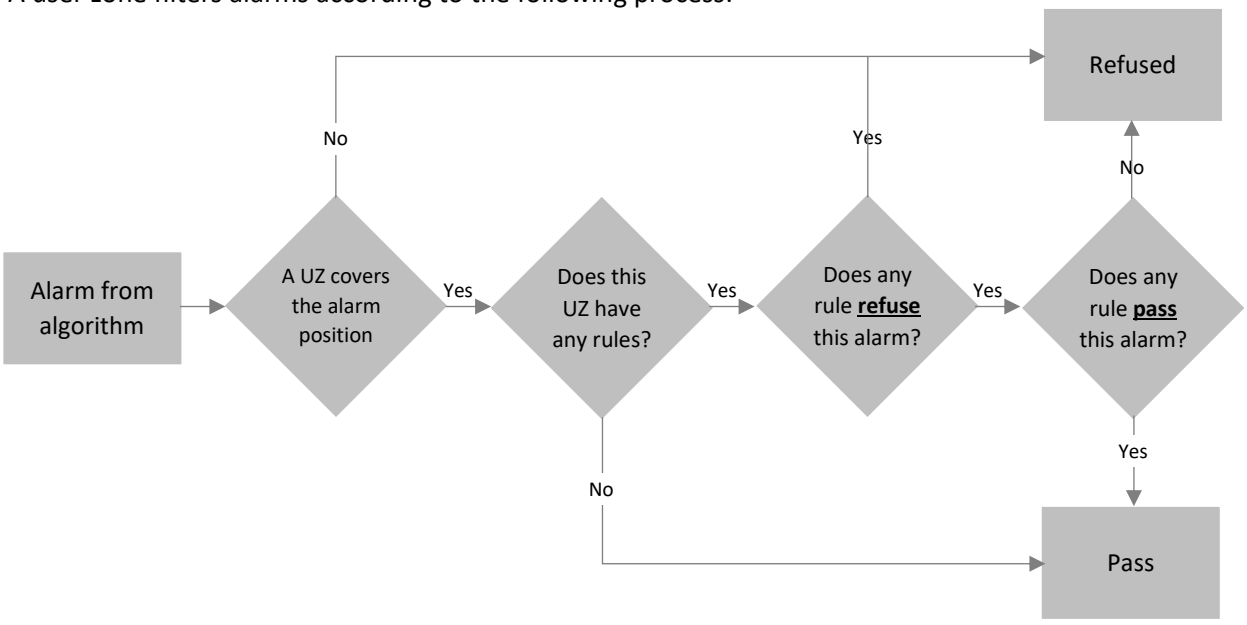


Figure 5-16 User zone filter process

At least one user zone is required that covers all areas of interest. The default configuration of SSOS includes one user zone by default.

5.4.1.1 Add Uz (User Zone)

In Figure 5-15, click the **Add Uz** button. A new **Create Uz** interface pops up, where the new user zone can be configured. Refer to Figure 5-17.

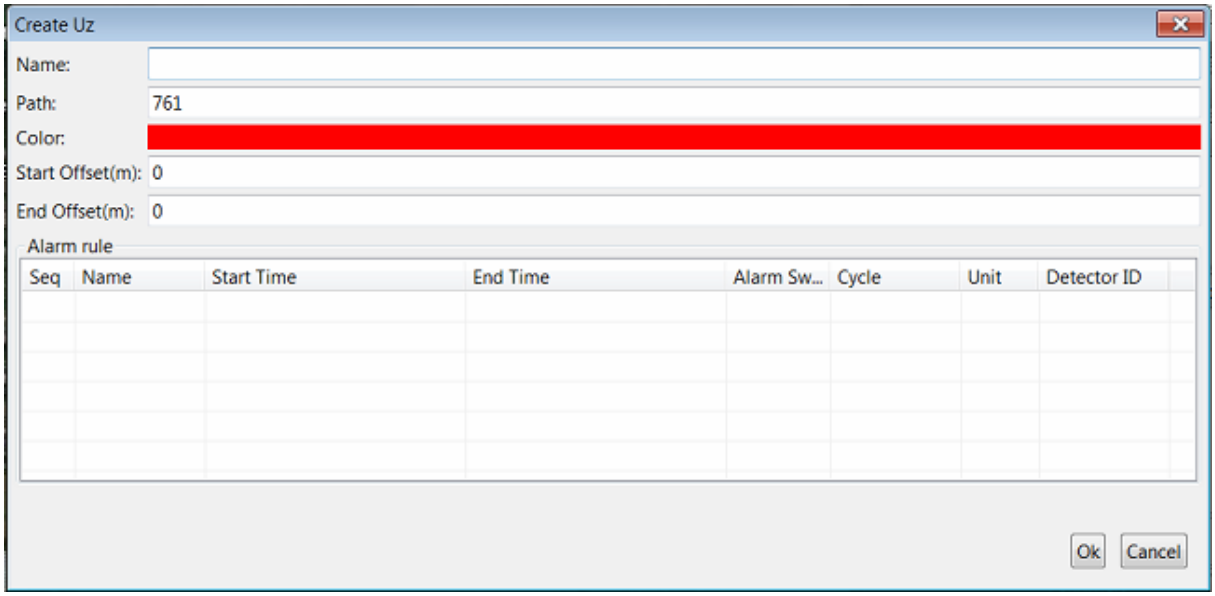


Figure 5-17 Create Uz

5.4.1.2 Modify Uz (User Zone)

The Edit button can be used to make changes to any user zone. This opens the **Set Uz** interface shown in Figure 5-18. Right-click in the alarm rule list to add conditions:

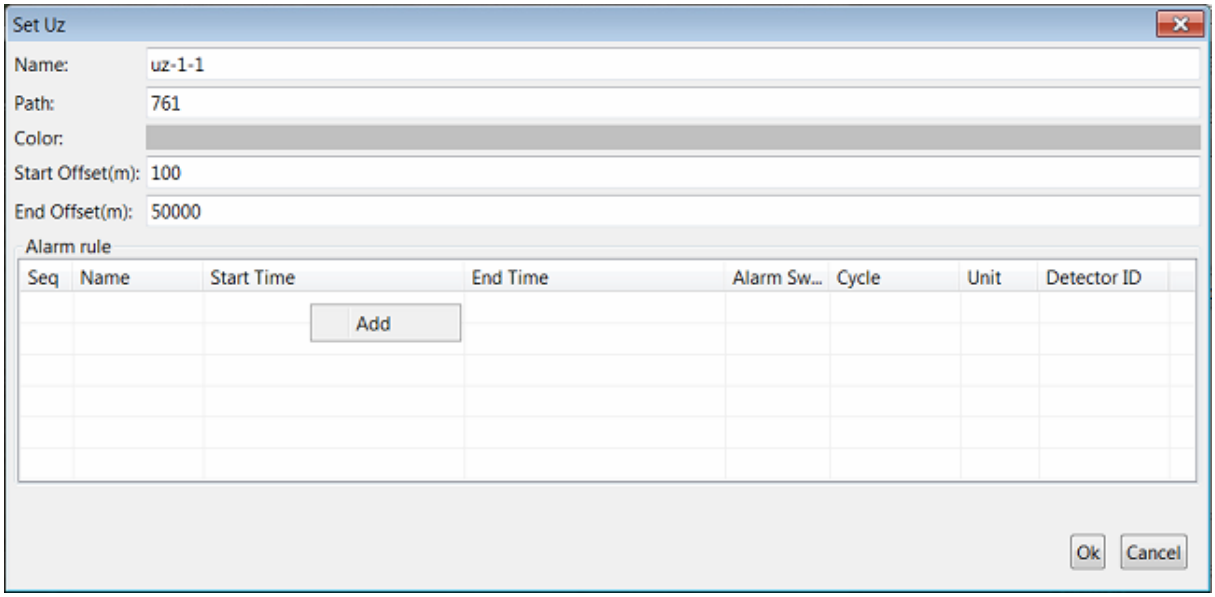


Figure 5-18 Set Uz

SSOS allows various options to filter or enable or disable the monitoring according to a user defined schedule. Some possibilities can be seen in Figure 5-19 below.

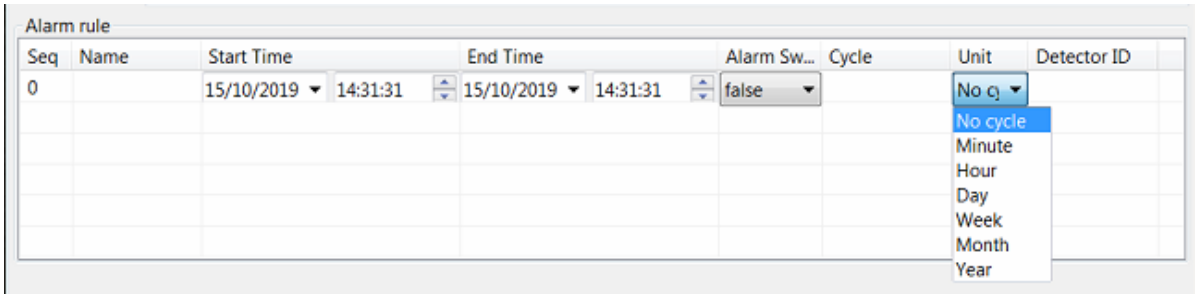


Figure 5-19 User zone configuration

5.4.1.3 Delete Uz (User Zone)

Go to the user zone configuration interface and click the **Delete** button to delete the corresponding user zone.

5.5 Landmark

These are user defined objects that can be displayed on the map. The available categories are:

- Mountain
- Lake
- Desert
- Hill

The user is able to add the location and an icon for this to be displayed on the map.

5.6 Camera

Similar to the Landmark function, the Show Camera checkbox may be ticked to allow SSOS to display the location of the cameras that have been configured.

For the camera icon to be displayed, the latitude and longitude location of the camera must be configured in 9.5.1.2.

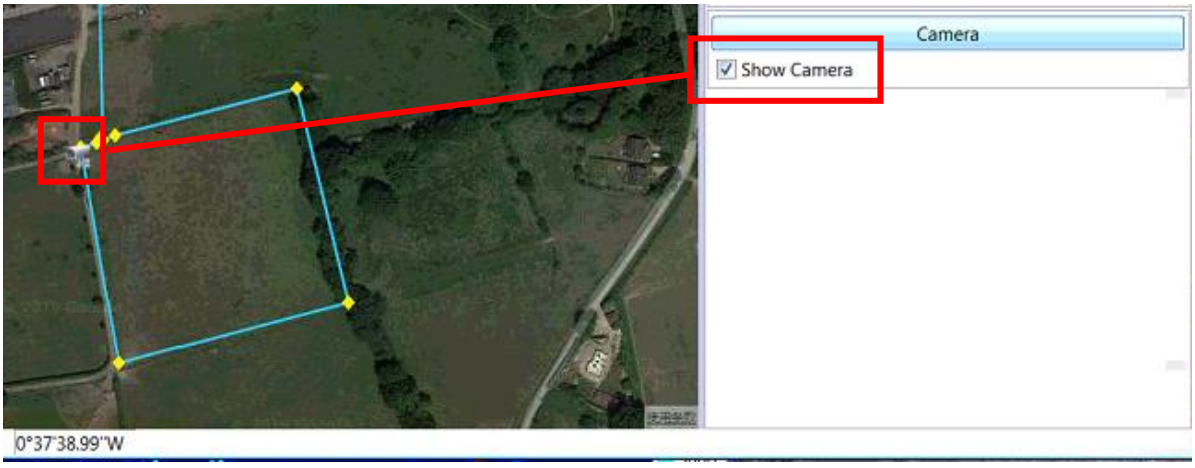


Figure 5-20 Show Camera

6 Waterfall View

The **Waterfall** display area is used to display the vibration condition of the corresponding path, such as a waterfall chart, a histogram. It also allows the user to switch been the original vibration curve and the attenuation curve of the display path.

When the software starts, the data view displays the waterfall view data view of path-1 by default:

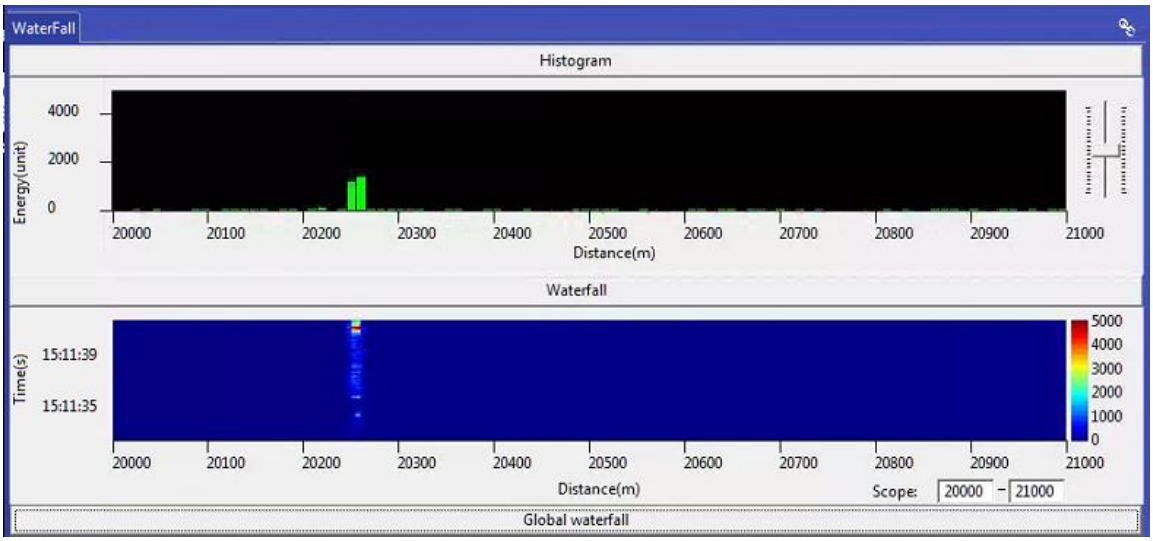


Figure 6-1 Normal Waterfall View

The Histogram is a graphical display of energy vs distance, and shows the real-time energy data along the length of the sensing fiber:

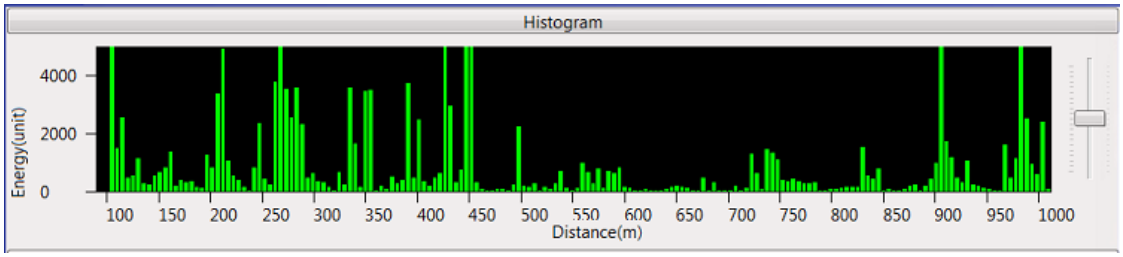


Figure 6-2 Histogram view

The Waterfall is a graphical display of colour-coded acoustic signal intensity along the length of the sensing fiber over time. The newest information is at the top of the waterfall, and the oldest is at the bottom. Acoustic signals appear on the waterfall as blotches, coloured on a scale from blue to red, with blue representing low intensity, and red representing high intensity signals.

The following operations may be used on the waterfall:

- Click and drag — Zoom in on a section of the waterfall
- Double click — Reset to the full waterfall view
- Right click — Displays the option to view the Spectrogram

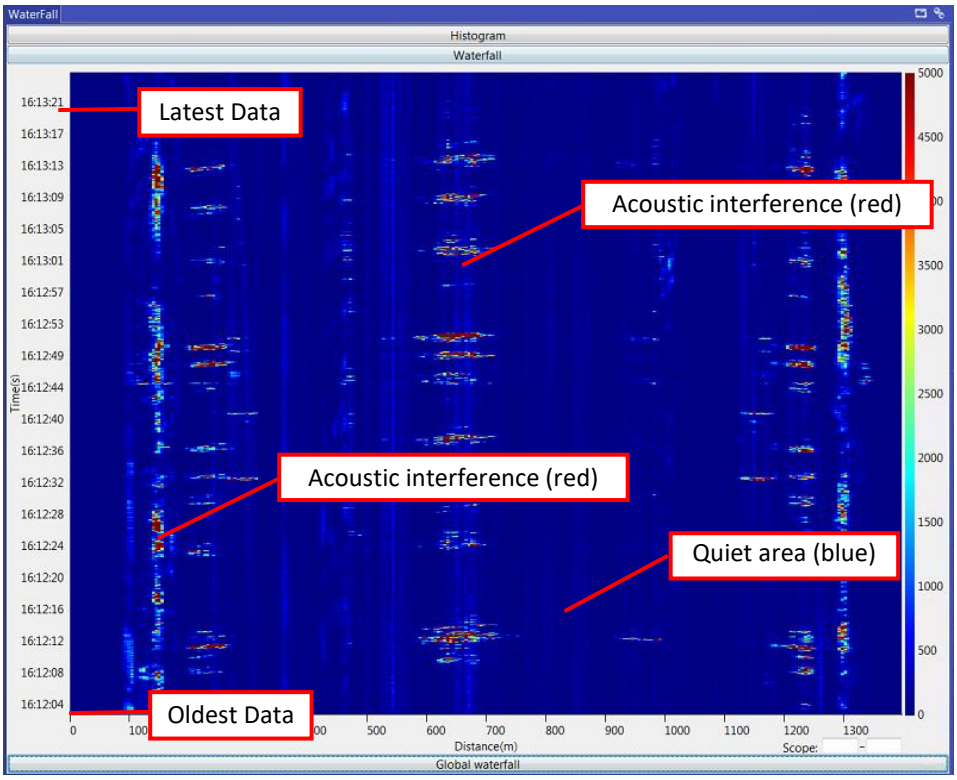


Figure 6-3 Waterfall

The user can also view the global waterfall, and a subsection of this waterfall simultaneously. This allows the user to zoom in on an area of interest without missing interference in another area.

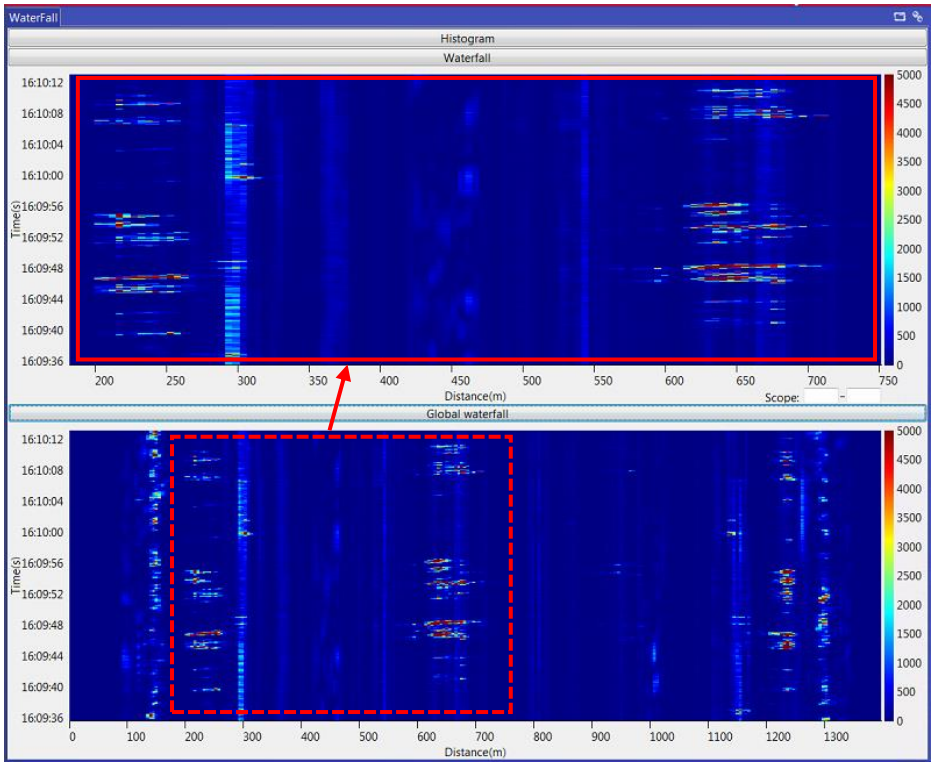


Figure 6-4 Waterfall and Global Waterfall

Besides the Waterfall and Histogram, the Waterfall View also contains the following views:

6.1 Change channel

Use the button to switch between the waterfall of Channel 1 and Channel 2:

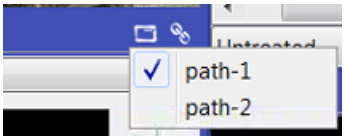


Figure 6-5 Waterfall - switch between Ch1 and Ch2

6.2 Attenuation data

Click the "Data Switch" button in the upper right corner to switch between **Vibration Data** or **Attenuation Data**. Selecting **Attenuation Data** displays the attenuation curve of the fiber.

By default, this displays the linear attenuation curve, as shown in Figure 6-6 below.

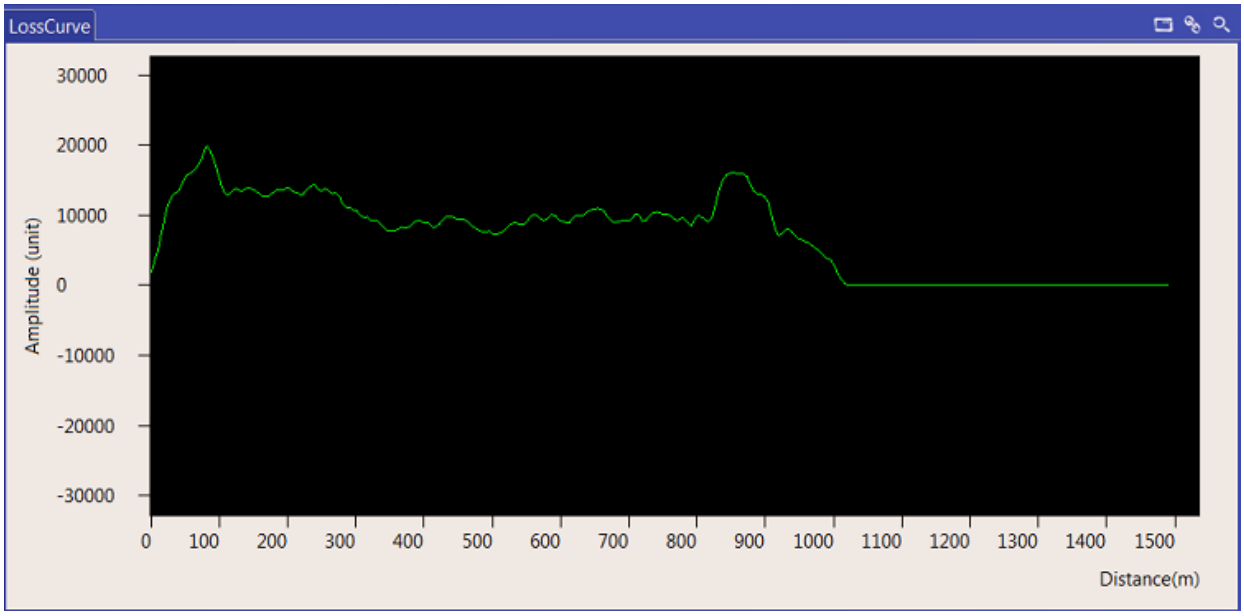


Figure 6-6 LossCurve View – Attenuation data (linear)

Once in the LossCurve view, the user can right-click on the graph to switch between linear and logarithmic curves:

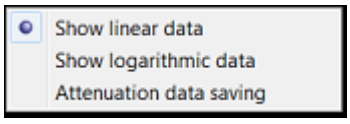
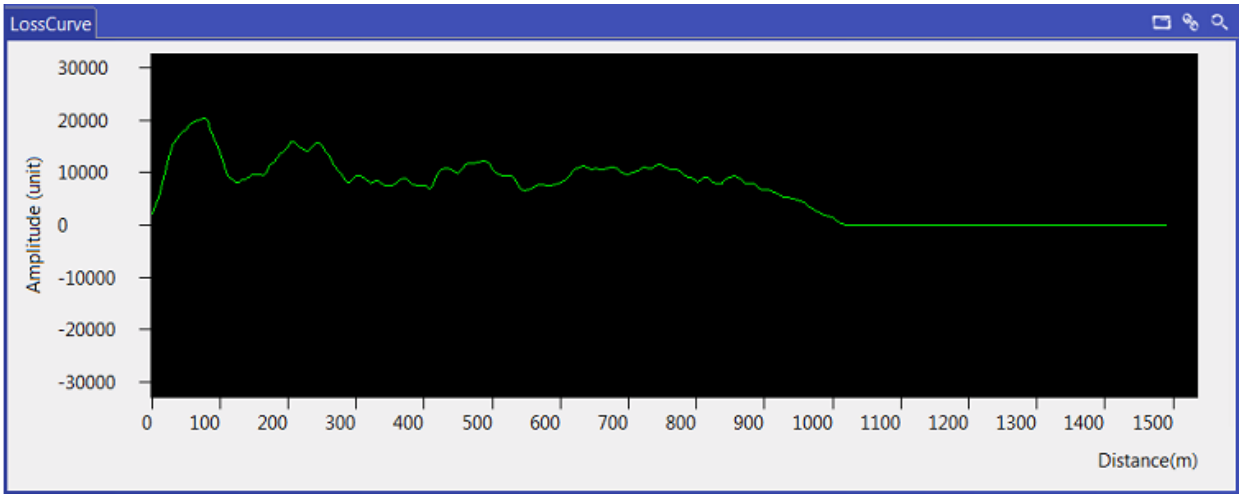
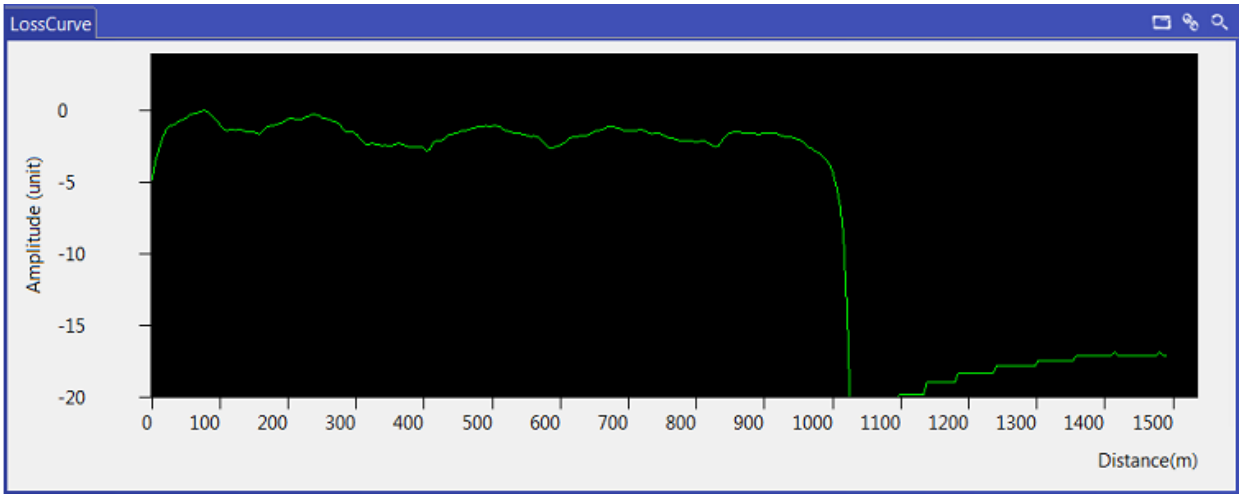


Figure 6-7 Switch between linear and logarithmic attenuation curves

The two types of curves are shown in Figure 6-8 below.



Linear: Graphical Display of Signal Amplitude vs. Distance (linear scale) – Use for fiber break detection.



Logarithmic: Graphical Display of Signal Amplitude vs. Distance (log scale) – Use for fiber break detection.

Figure 6-8 Attenuation curve: Linear vs. Logarithmic

To set the Frequency band of the Waterfall: Refer to 0

To change between channels and meters: Refer to 9.9.3

To configure fiber break detection: Refer to 5.2.2

On the waterfall, histogram or original vibration curve, right click on a certain detection point and select “Show Spectrogram” to display the spectrum information of the specified detection point.

The spectrum of multiple detection points can be simultaneously displayed, as can be seen in Figure 6-9.

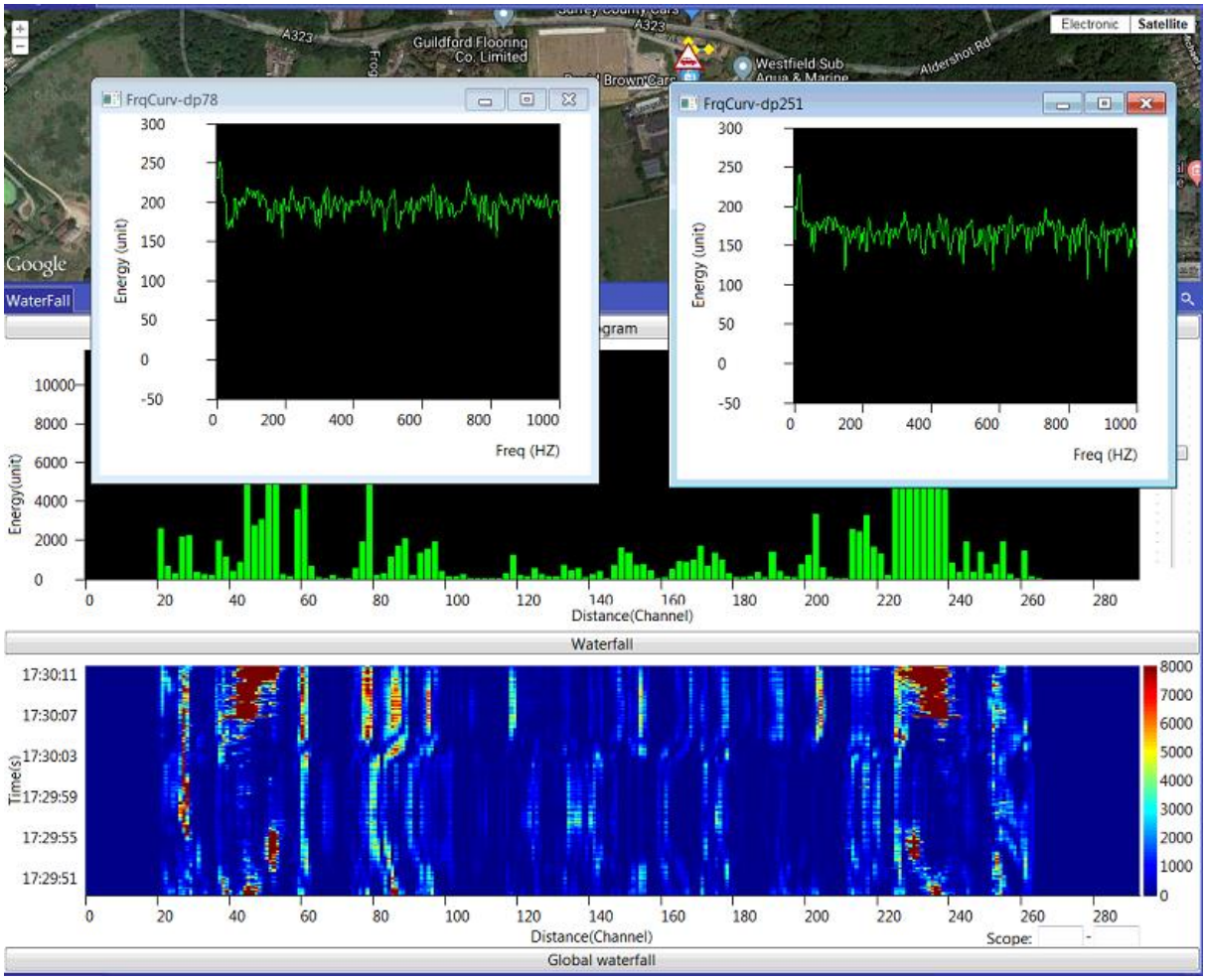


Figure 6-9 Spectrogram display

7 Alarm+Fault View

7.1 Alarm List

When an intrusion event is detected, and if the alarm form is open, SSOS will present the intrusion event alarm on the **Alarm+Fault** area. Each row represents an alarm, which is arranged according to the alarm time.

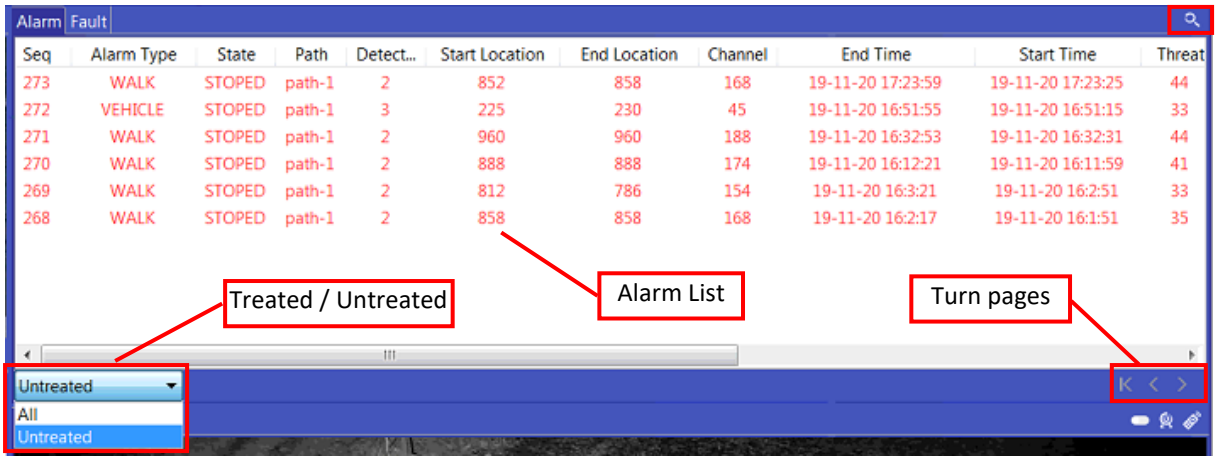


Figure 7-1 Alarm List

Alarms and fault records are displayed in the above list view. When a new alarm is generated, the latest alarm will appear at the top of the list, and the user can scroll the mouse wheel or drag the scroll bar on the right side of the table to view the previous alarms. A page displays up to 50 most recent alarms. View more records by using the turn page buttons.

Switch between **All** and **Untreated** below to display alarms selectively. **Untreated** alarms are alarms that have not been acknowledged or processed by any user. Once an alarm has been confirmed, cleared etc. it is no longer considered an **Untreated** alarm.

Right-click on the alarm to be processed to pop-up the alarm processing menu shown in Figure 7-2 below. The available operations in the menu will vary depending on the logged in user. Admin users can process alarms in batches.

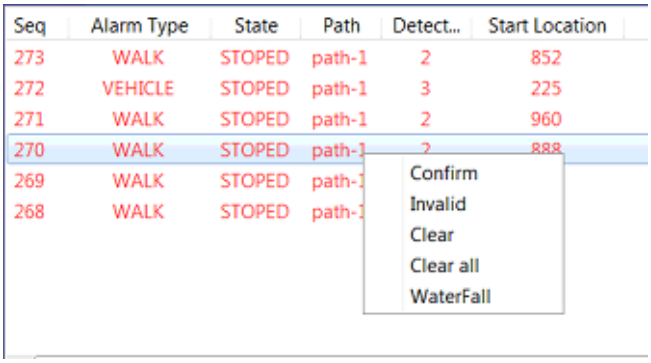


Figure 7-2 Alarm processing

Alarm Processing:

Confirm *Confirms the alarm as a genuine alarm*

Invalid *Confirms the alarm as an invalid alarm*

Clear *Clears the alarm*

Clear all *Clears all alarms*

Waterfall *Shows the recorded waterfall of the selected alarm*

Click the corresponding menu item to enter the processing interface as shown below, enter the username and password (required) and the comment information (optional) and click **OK**.

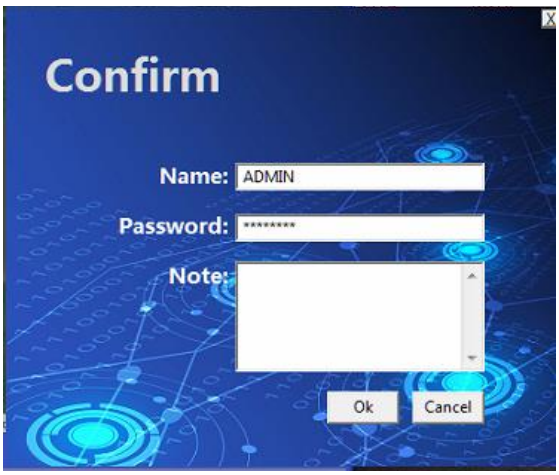


Figure 7-3 Confirm alarm or fault

After the alarm is successfully accepted, the **Accept** column value of the processed line will change to **true**, the **Accept Time** column value will display the accepted time, and the **Recipient** column value will display the account number filled in when accepting, **Accepted** The column value will display the comment information filled in when the message is accepted;

After the alarm confirmation is successful, the value of the **Confirm** column of the processed line will change to **true**, the value of the **Confirm Time** column will display the confirmed time, and the **Confirmer** column will be displayed. The value will display the account number filled in the confirmation. The value of the **Confirmed Comment** column will display the comment information filled in.

When the alarm is cleared successfully, the **Clear** column value of the processed line will change to **true**, **Clear Time** column. The value will show the time of the clearing, the **Clearer** column value will display the logged in account number when cleared, and the **Clear Annotation** column value will display the comment information filled in when cleared.

Click the **Query** button in the upper right corner of the list to set the query conditions and then query the alarm/fault log. [Refer to 7.3]

7.2 Fault List

The fault list mainly shows the network connection between the upper and lower computers, and the abnormal records of some devices within the DU.

Click the **Query** button in the upper right corner of the list to set the query conditions and then query the alarm/fault log. [Refer to 7.3]

7.3 Alarm+Fault Form Query

In SSOS, alarms, faults, and logs are presented in tabular form in the interface. Users can query their respective records by using the Form Query button . The characteristic of this general query is that users can combine query items to form query conditions like **(a> b) and (c<d) or..**.

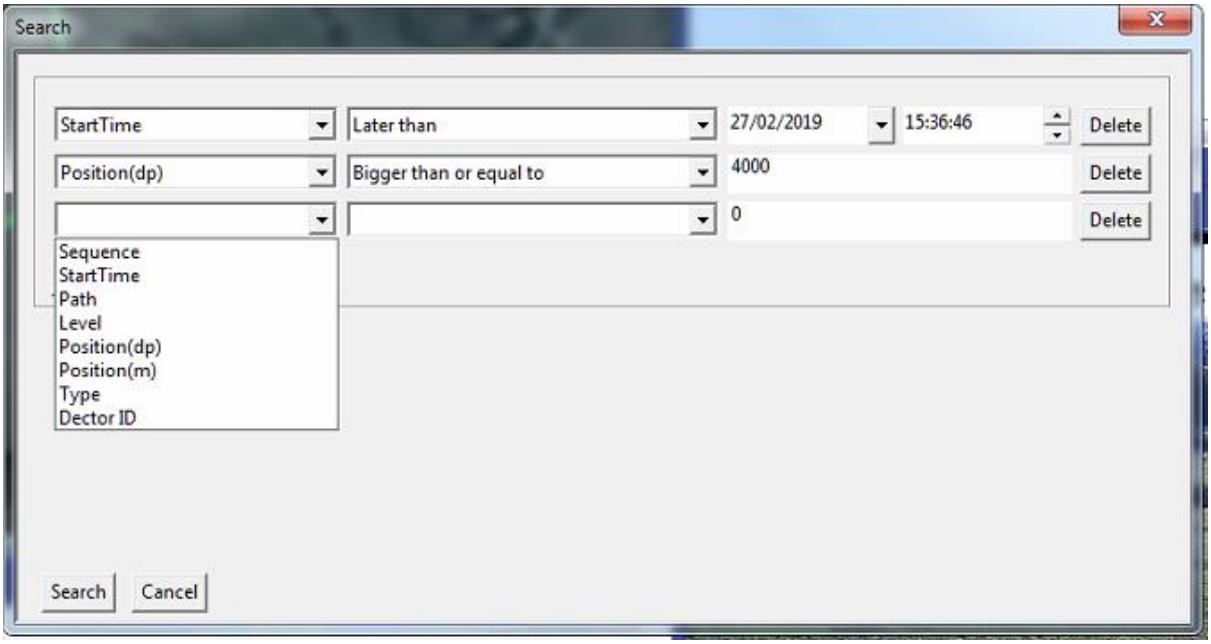


Figure 7-4 Alarm log query interface

The table query rules in SSOS have three levels of operators, operands, and expressions.

For binary operations, the left operand is the column name of the table, and the right operand is the corresponding range of desired values. The expression is a Boolean expression that combines several operators, operands, and logical operators.

This is a general query logic editing interface, users shall select the combination of the required conditions that are reasonable and effective. Due to the versatility of logical combinations, some conditions will be unreasonable, and users should ignore these combinations.

7.3.1 Operator

The following table lists the operators that are available to users in SSOS. In practice, the optional operator is related to the query item selected by the user.

Symbol	Meaning
<	A column is less than the specified value, or earlier than the specified time
<=	A column is less than or equal to the specified value, or no later than the specified time
>	A column is greater than the specified value, or later than the specified time
>=	A column is greater than or equal to the specified value, or no earlier than the specified time
=	A column equals the specified value or occurs at the specified time
!=	A column is not equal to the specified value, or does not occur at the specified time
And	Satisfy a rule and another rule
Or	Satisfy a rule or another rule
Contain	Contains a substring

Table 7-1 Alarm query operators in SSOS

7.3.2 Simple Query

The basic query rule consists of **column - operator - value**, which can be selected by querying the column and then selecting the query rule.

Then select the operator, enter the specific expected value and click **Query**.

7.3.3 Combined Query

The basic query rules can be logically combined with **and** / **or** according to the query requirements. After creating a basic query rule, select the logical operators of **and**, **or**, and then click **Add**. A basic query rule is added to form a combined query rule, and the combination can be continued based on the combined query rules.

A combined query can have two levels, that is, you can create a query expression similar to the following:

Example 1: (A > 10 and b < 20)

Example 2: (c >= 2014.10.1) and (d != “abc”)

Within the same level, the sums of the sums are the same; the order of operations is from left to right.

7.3.4 String Query

When querying by string type column, **string comparison** uses common software practices (for example, Search engine, MS Excel search function, etc.), the principle is as follows:

General principle:

The comparison between strings is done character by character from left to right. The size of the character is determined by the ASCII value of the character. Characterless (null characters) are

smaller than characters; characters with small ASCII code values are smaller than characters with large ASCII code values.

Equal:

Indicates that two strings are exactly the same, otherwise they are not equal.

For example: “A” is equal to “A”

“AB” is not equal to “AC”

“A” is not equal to “AB“

“ ” is not equal to “A”

Less than:
If String 1 is less than a string 2, there are two possible reasons:

1. the ASCII code value of a character of string 1 is smaller than the ASCII code value of the same position in string 2;
2. String 1 character 2 strings short, i.e., traversing two strings character by character from left to right, string 1 has no characters, and the string 2 has characters.

For example: “ “ < “0”

“ “ <= “0”

“A” < “AB”

“A” < “B”

“AB” < “AC”

Greater than:
If String 1 is greater than a string 2, there are two possible reasons:

1. The ASCII code value of a character in string 1 is greater than the ASCII code value of the same position in string 2;
2. String 1 character 2 strings long, i.e., traversing two strings character by character from left to right, strings 2 has no characters, and String 1 has characters.

For example: “0” >”

“0” >= “ ”

“AB” > “A“

“B” > “A”

“AC” > “AB”

Contains:
Contains: String 1 contains string 2, which means that substrings that are exactly equal to string 2 can be found in string 1.

For example: “ABCDEFG” contains “BCDE”

7.3.5 Example Fault Query

The basic query rules consist of "column-operator-value", which can be selected by querying the column.

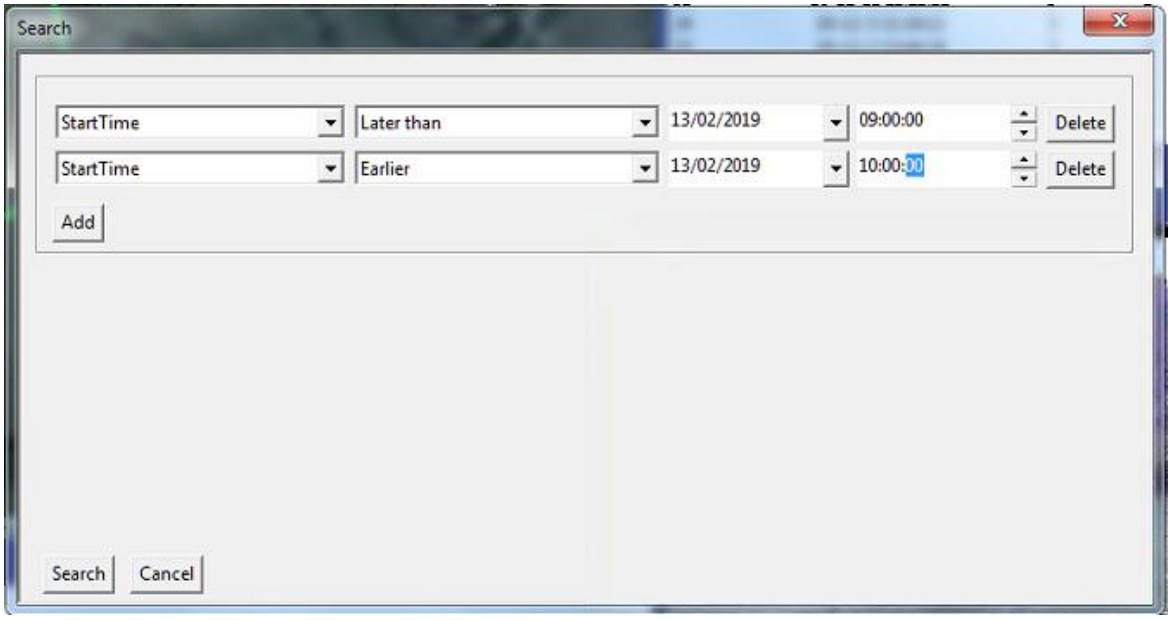


Figure 7-5 Sample Query - Faults between 9am and 10am on 13-Feb-2019

Click Search at the bottom to evaluate the query and see the results.

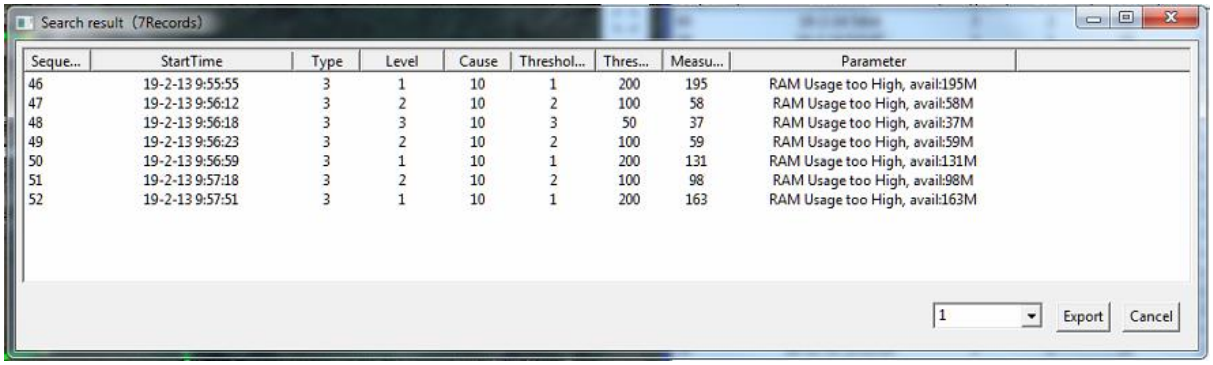


Figure 7-6 Results of the query shown in the previous figure

8 Video View

The **Video** display area is used to display the feed from the connected video camera or recorder.

See Section 9.5 for details on how to configure the Video view.

Figure 8-1 Video View

8.1 Automatic Mode of operation

When this switch is on, SSOS is given control of the cameras. When an alarm is raised in a monitored location, SSOS automatically switches to the associated camera or present in the case of a PTZ camera. This mode avoids user delays in manually switching to the relevant video feed.

As the camera is switched every time there is an alarm, the video view displays the video feed for the most recent alarm.

For this mode to function correctly, the camera connection, presets and preset scope must all be correctly configured:

Camera/NVR connections: Refer to 9.5.1

Associations with monitored areas: Refer to 9.5.2

Any manual operation of the camera(s) will automatically disable this mode.

8.2 Manually select camera

Click the **Video Switch** button in the upper right corner to select the video server and video channel to be displayed in the video view, as shown in the figure below.

Figure 8-2 Manually Switch video

For this feature to function correctly, the camera/NVR connections must all be correctly configured:

Camera/NVR connections: Refer to 9.5.1

8.3 PTZ Control

For PTZ cameras, SSOS includes a control to pan, tilt and zoom the camera from within the software itself. The PTZ remote control appears as a pop-up and is shown in xxx below:

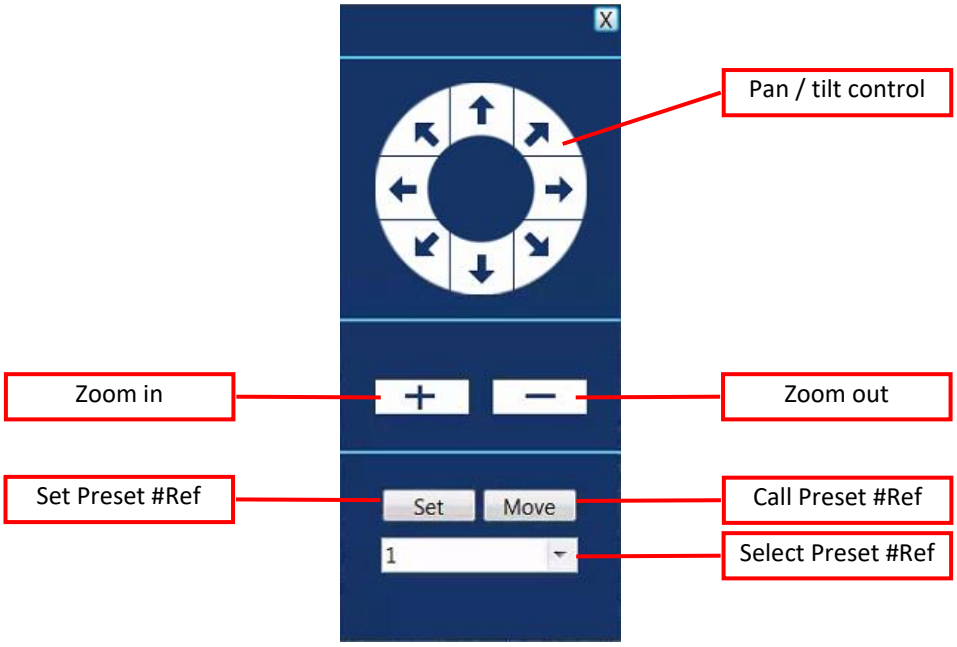


Figure 8-3 PTZ remote control

This control can also be used to call or set preset positions for the PTZ camera.

Note: No other buttons, controls, menu options are available while the PTZ remote is active.

For this feature to function correctly, the camera/NVR connections must all be correctly configured:

Camera/NVR connections: Refer to 9.5.1

9 System Menu

9.1 Login

Figure 9-1 Initial login status

As shown in the figure above, the lower left corner of the GUI is the account information area. In the initial state this displays "Account: None | Login time: None."

To log in, select **Login** in the system menu, then enter the corresponding user name and password in the pop-up dialog box, click OK, as shown in Figure 9-2 below:

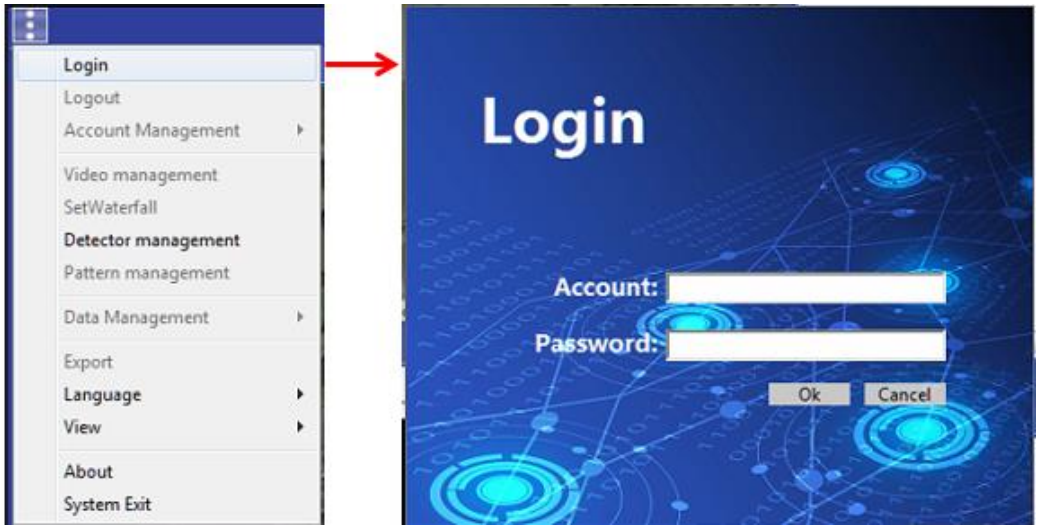


Figure 9-2 System login

After successful login, the login account and login time will be displayed in the lower right corner of the GUI, as shown in Figure 9-3 below:

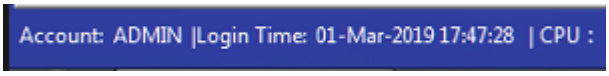


Figure 9-3 Status of successful login

SSOS standard installation includes one default account. Any other required user accounts must be configured by the System Administrator.

User	***admin***
Password	***adminpwd***

9.2 Logout

Select **Logout** in the system menu to log out of the current user account.

The software asks the user to confirm the logout as shown in Figure 9-4 below.

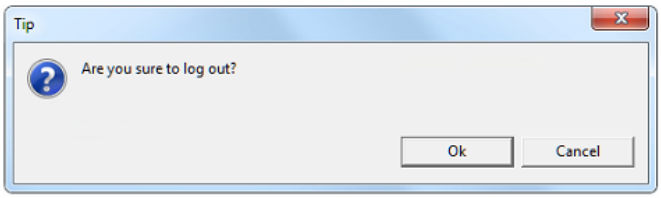


Figure 9-4 Confirm logout

9.3 Operation Rights

No.	Scope	Operation name	Minimum required Permission
1	Account	Account creation	Manage accounts and above
2		Modify and delete other accounts	The account level to be modified must be lower than this account
3	Title bar menu	Video management	Operator
4		Set up the detector	None: view only Administrators: To set up/edit
5		Set up a waterfall chart	Operator
6		Model management	Operator
7		Data management	Operator
8		Export configuration	Operator
9		Switch language	None
10		Interface view	None
11		About the system	None
12		System exit	None
13	Map Interface	Map interface operation buttons	Operator
14	Data interface	Waterfall and graph right-click menus	None
15	List operations	Alarm query	Above regular account
16		Fault inquiry	Administrator
17		Log query	Super user (Bandweaver account)
18		Setting save rules	Administrator
19		Accept, confirm, clear	Operator
20		Query waterfall	Operator
21	Video Interface	Linked with alarm switch	None
22		Video switching	None
23		Video control	None

Table 9-1 Operation Rights

9.4 Account Management

Use this option to create user accounts, change passwords and view account information.

9.4.1 Create Account

Adding an account requires administrator privileges.

When the administrator is logged in, select **Account Management** and **Create Account** in the system menu, as shown in Figure 9-5 below, and complete the required details.

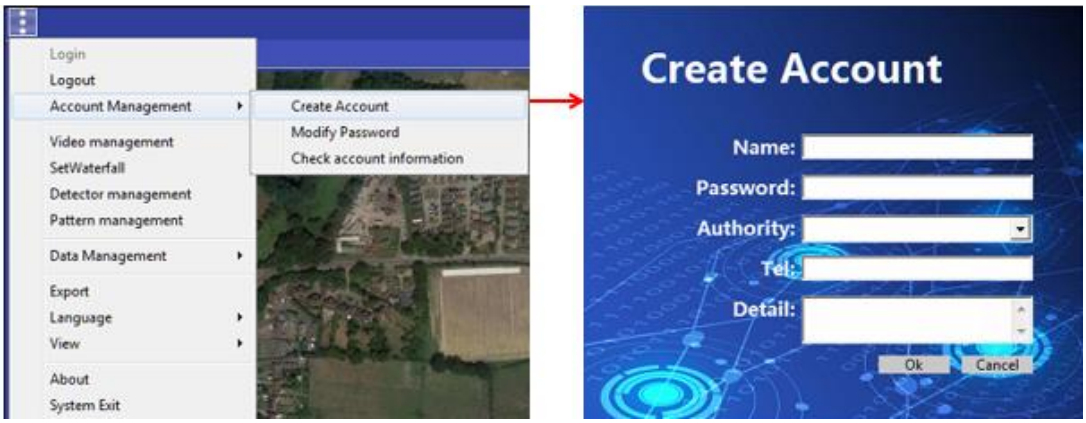


Figure 9-5 Create a new user account

9.4.2 Viewing Accounts

Users can view the account information through the **Check account information** option in the system menu.

This opens the dialog shown Figure 9-6 below:

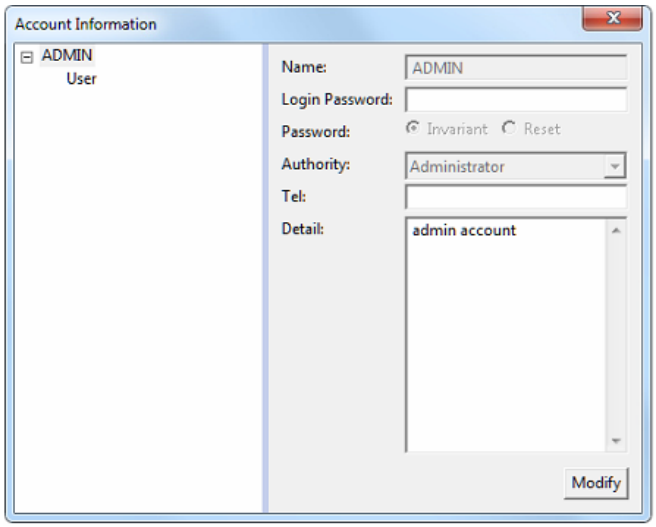


Figure 9-6 Check user account information

9.4.3 Delete Account

The administrator can delete an account that can be viewed in the view account information window (see Figure 9-6). Right-click the mouse button on the account name to be deleted.

The **Delete** option will pop up as shown in the figure below.

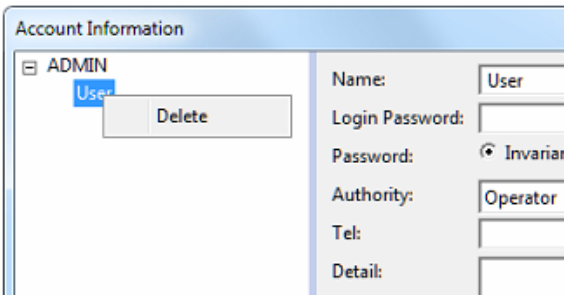


Figure 9-7 Delete user account

After selecting **Delete**, the delete account interface will pop up. The administrator must enter their password and click **OK** to continue.

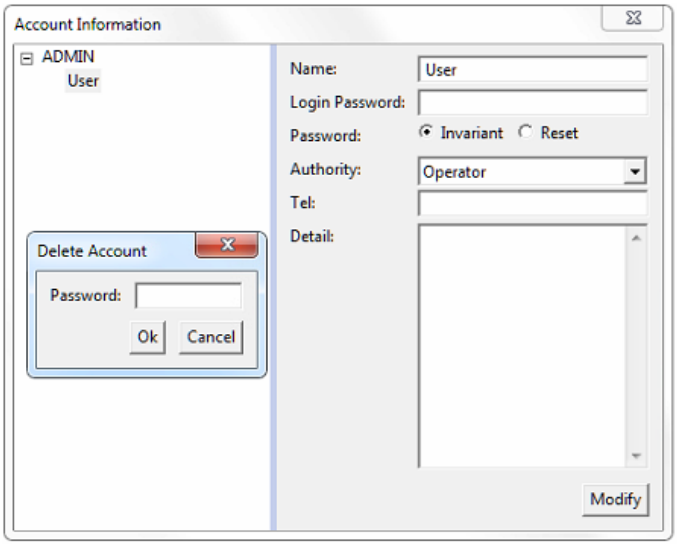


Figure 9-8 Enter password to delete account

SSOS confirms that the account has been successfully deleted.

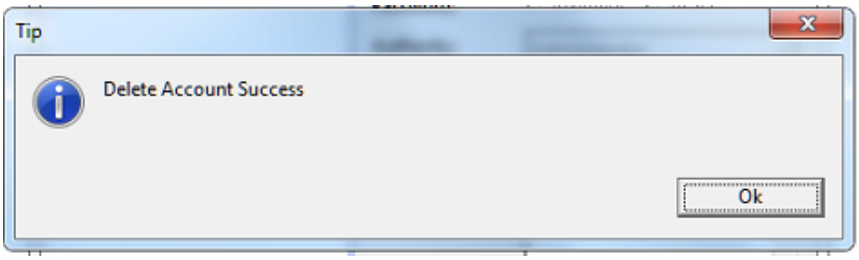


Figure 9-9 User account successfully deleted

9.4.4 Modifying an Account

The user can modify the password of the corresponding account through the **Modify Password** option in **Account Management** menu. Enter the old and new passwords and select **OK** to save the new password.

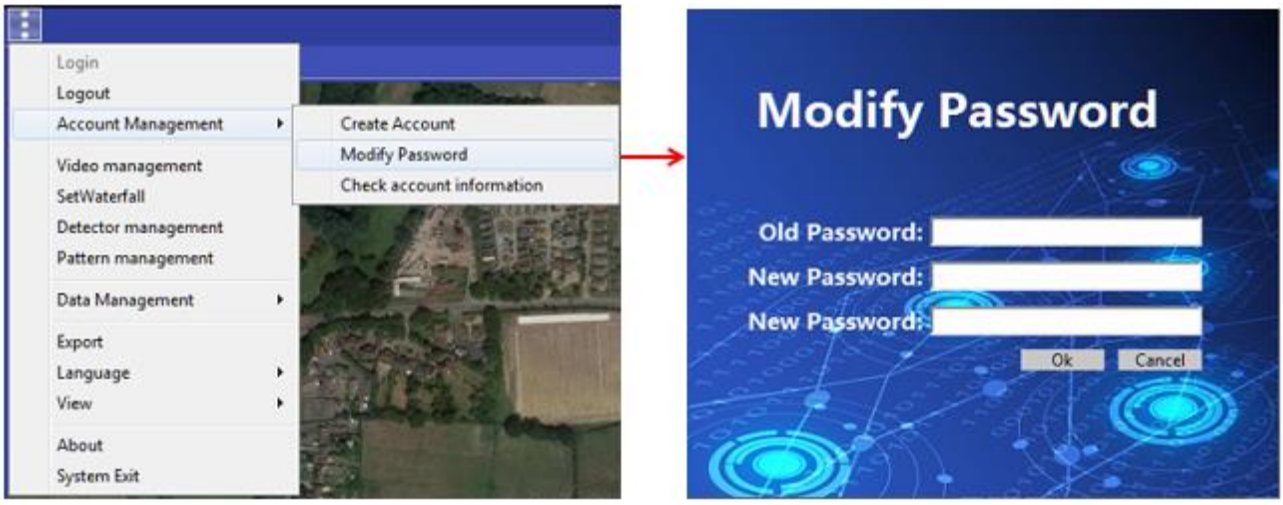


Figure 9-10 Modify User password

The user's information can also be modified in the account information interface as shown in Figure 9-11 below.

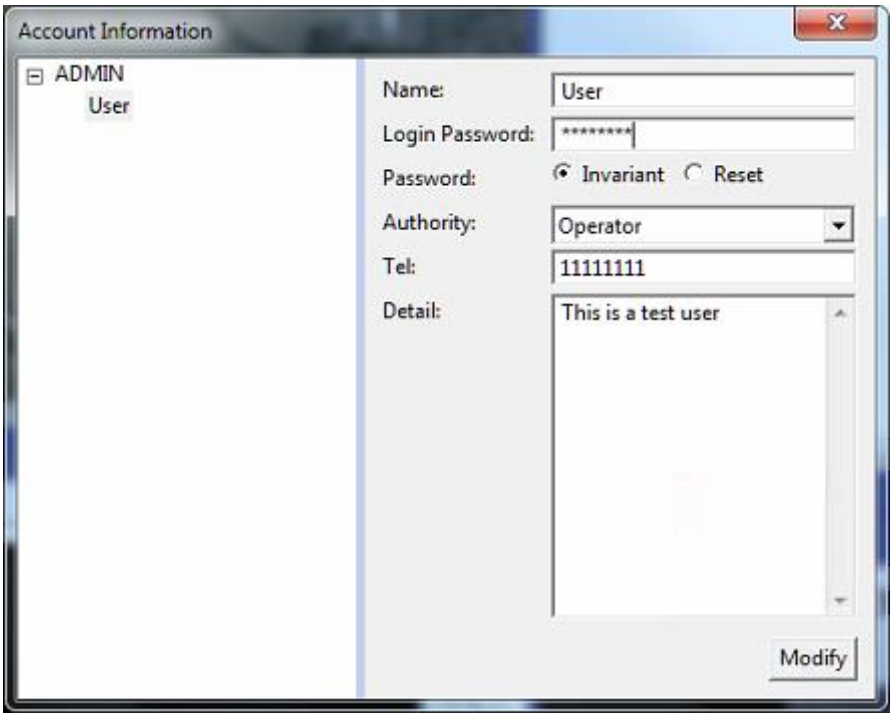


Figure 9-11 Modify user information

The administrator must enter the administrator password in the **Login Password** and click **Modify**.

After the modification is successful, a dialog box will pop up to inform the user.

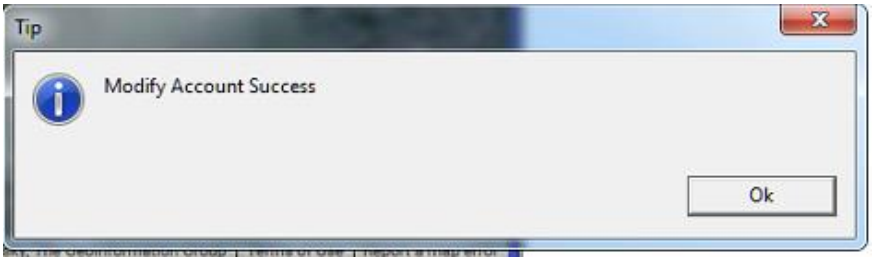


Figure 9-12 User information successfully modified

9.4.5 Reset password

In the **Account Information** window, the administrator can perform password reset operation on an account that can be viewed (generally used when a user forgets their password).

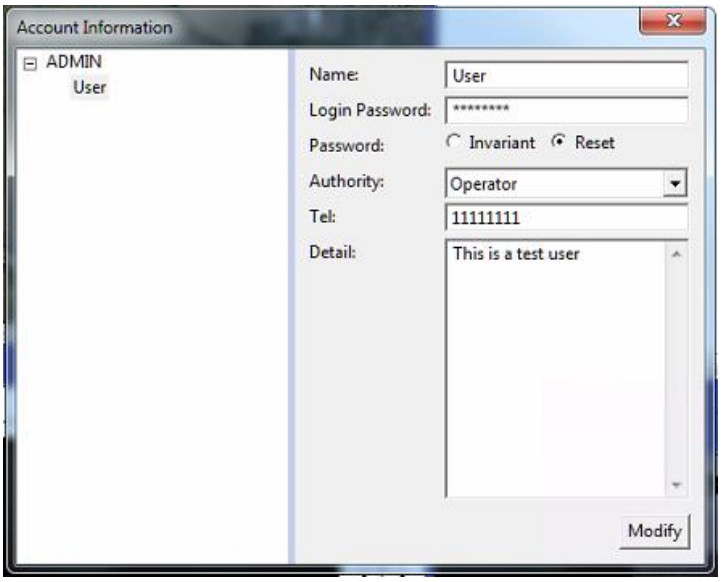


Figure 9-13 Reset user account

Select the account to be reset and enter the administrator's own login password in the **Login Password** input box on the right information bar. And select the **Reset** option on the right side of **Invariant**.

Click **Modify** to save the changes.

The account password for this user is now reset to **123456**.

9.5 Video Management

The VLC player (vlc-2.2.4-win64.exe in the installation package) needs to be installed before using the video feature.

9.5.1 Video Management

In the system menu, select **Video Management** to enter the video management interface, as shown below:

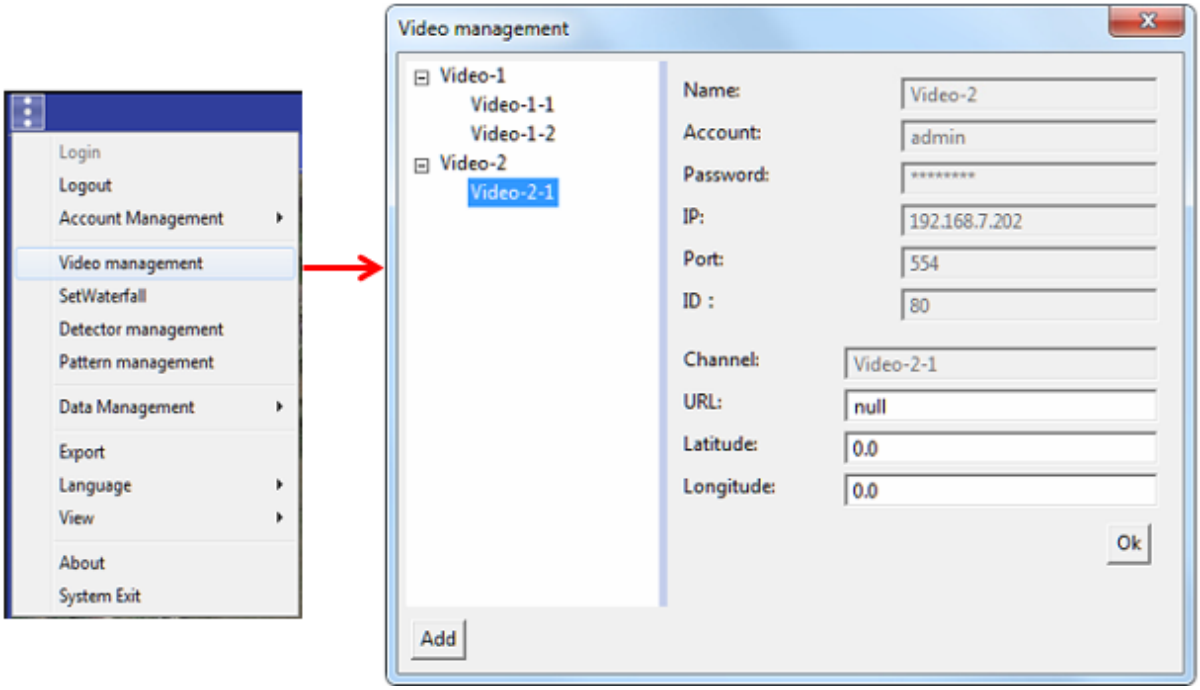


Figure 9-14 Video Management interface

9.5.1.1 Video Server

The user can select an existing video server for editing and modify it directly in the right-hand panel. Alternatively, click **Add** at the bottom left corner to enter the video recorder interface and complete the related information.

Account/password *The account and password for logging in to the video server (NVR / DVR / Camera), provided by the video server manufacturer*

IP address *The IP address of the video server*

Port number *Refers to the RTSP port number of the video server*

ID *Used for video control, the HTTP port of the video server*

9.5.1.2 Video Channel

After the video server information is complete, the user can right click on a node in the video tree on the left and display the operation menu to add video channels or delete the video server, as shown in Figure 9-15. Figure 9-16 shows the interface for adding a video channel.

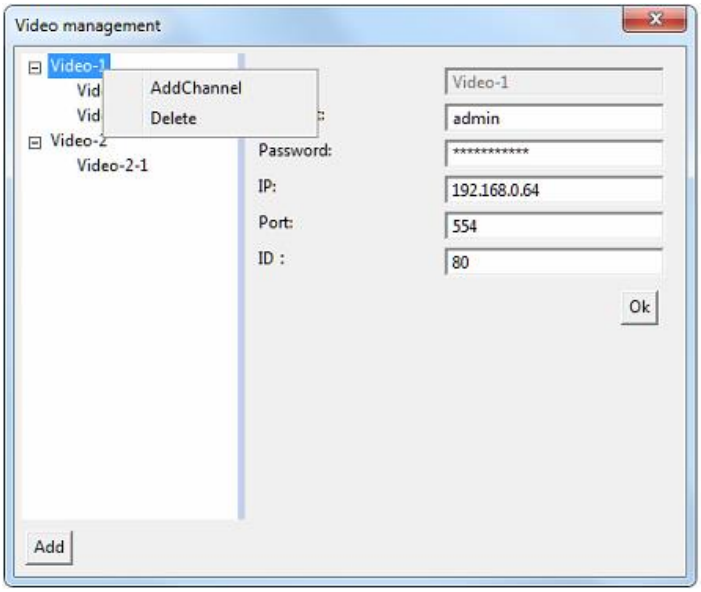


Figure 9-15 Right-click on the video server node

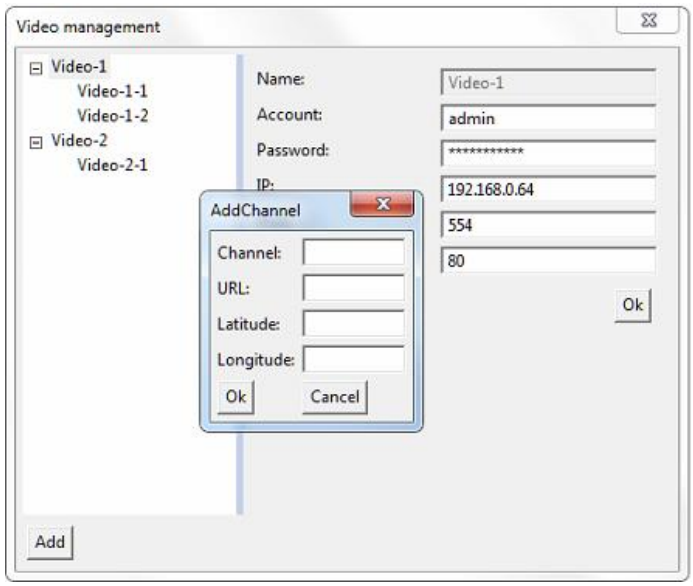


Figure 9-16 Adding a video channel

Channel *User reference for the channel being configured, e.g.* ***Channel 1***

URL *Supplied/specified by the video server manufacturer*

Latitude / Longitude *The coordinates used to display the video icon on the map. Clicking the camera icon on the map, opens the corresponding video feed in the video view. If the location is unknown, use 0 as the value cannot be null.*

9.5.2 Preset Scope

This interface allows the user to configuration the associations between the various cameras or presets and the monitored area that each of these can cover. SSOS uses these associations for the correct functioning of the automatic video view mode – refer to section 8.1.

Right-click anywhere in the Preset Scope blank space to **Add** a preset scope:

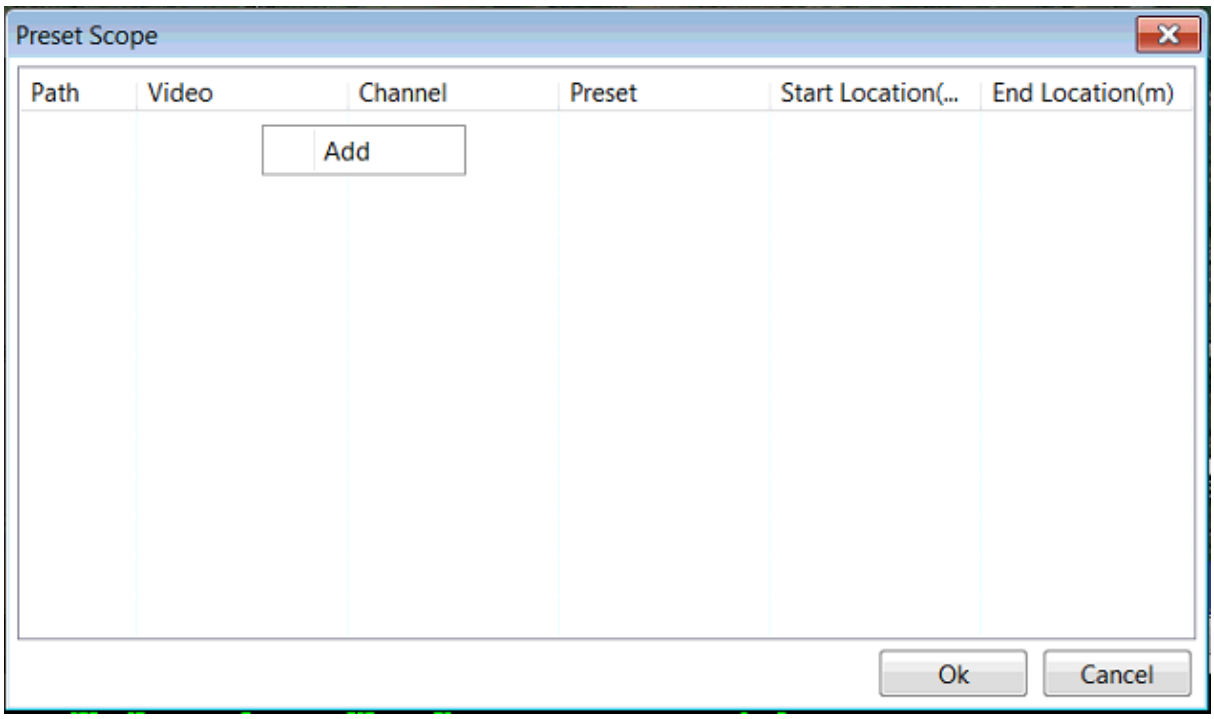


Figure 9-17 Add preset scope

This will open an Add Preset Scope pop-up:

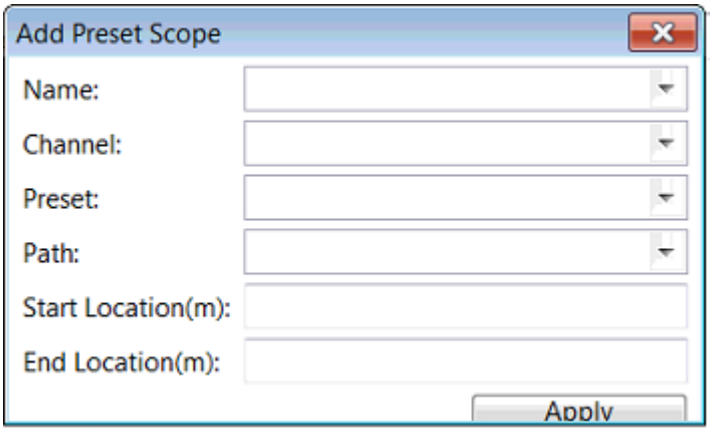


Figure 9-18 Add new preset scope

Name *Drop-down list of available video servers*

Channel *Drop down list of available video channels for the selected video server*

Preset *Drop down list of available presets for the selected channel*

Path *Drop down list for selection between path-1 (Ch1) and path-2 (Ch2)*

Start Location (m) *Start location of corresponding monitored area in meters*

End Location (m) *End location of corresponding monitored area in meters*

Example:

In the following example, SSOS will display the video feed from channel PTZ of video server HZ-PTZ if an alarm is raised between 100m and 150m of the fiber connected to channel 1 (path-1):

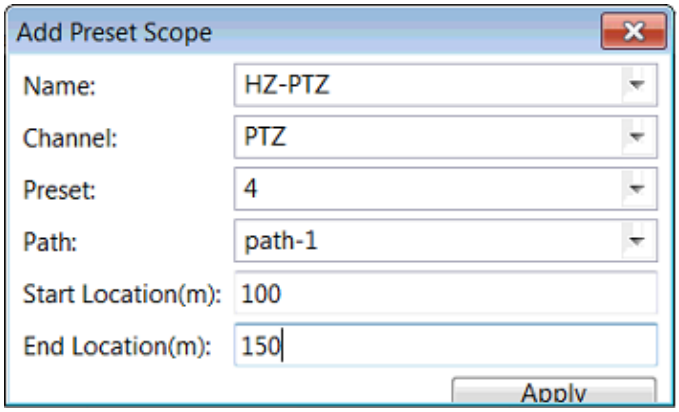


Figure 9-19 Add Preset Scope – Example

To use the automatic video view mode in SSOS, configure a preset scope for every section of the monitored area.

Warning:
DO NOT associate any monitored meter position with more than one video feed – i.e. the various monitored sections may not overlap:

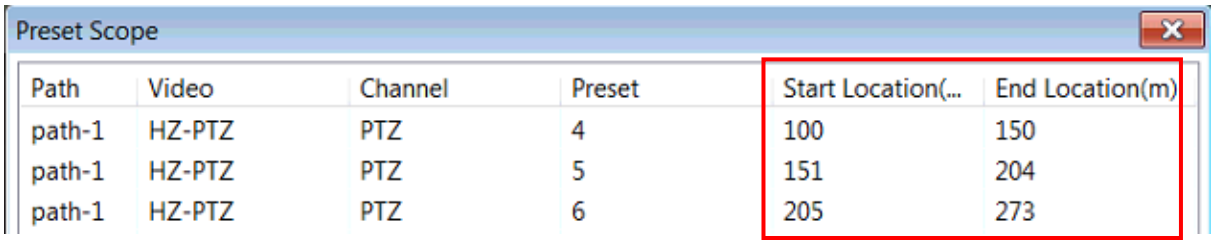


Figure 9-20 Preset scopes must be non-overlapping

9.6 Set Detector

SSOS allows for a total of 32 separate detectors of varying types to be configured. Each of these must have a unique **instance** ID between 0 to 31. The types of detectors are as follows:

- Mechanical Digging
- Manual Digging
- VEHICLE
- DNN
- ACTIVITY
- WALK

The appropriately authorised user can right click on an existing detector to modify it or delete it, or click the **+** button to Add a new detector:

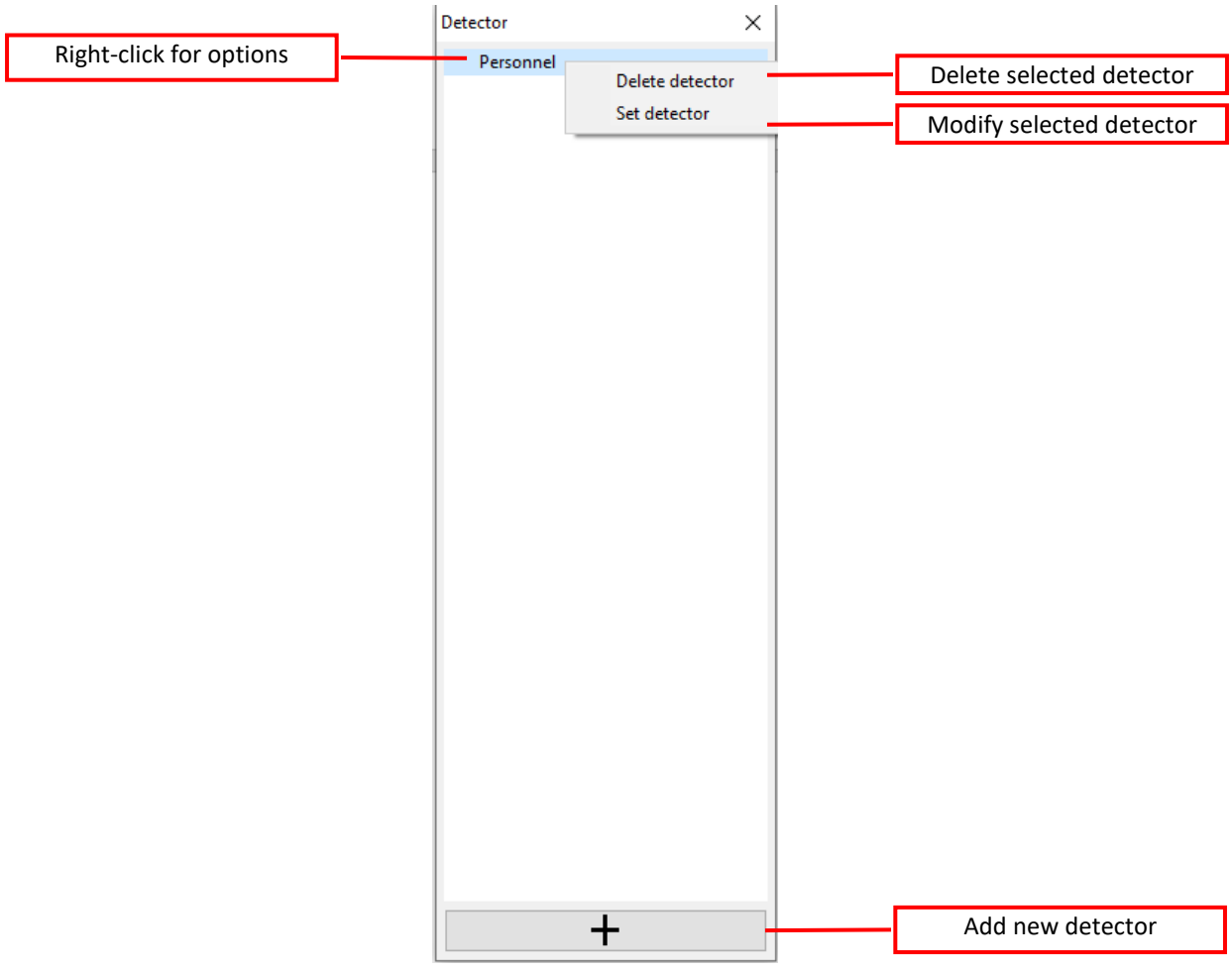


Figure 9-21 Add, modify or delete detector

A left-click on the detector name in Figure 9-21, opens the specific detector waterfall in the main waterfall view. To go back to the normal view, switch to vibration data from the waterfall title bar.

Clicking the add detector + button, opens the new detector window shown in Figure 9-22:

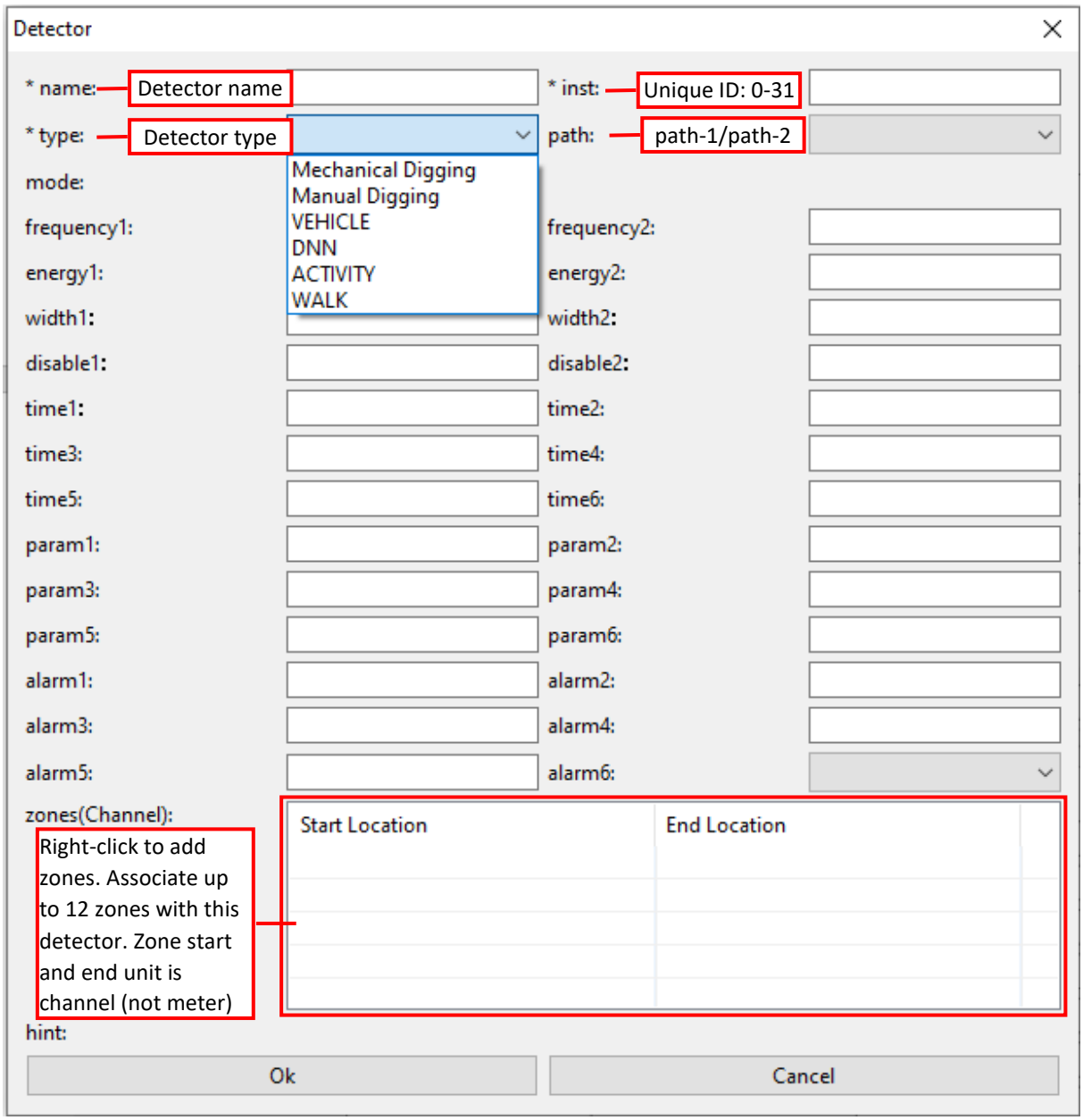


Figure 9-22 Add new detector

Four main parameters are required for all detectors:

name *User configured name*

inst *Instance: unique identifier for the detector.*
Valid value: 0 – 31

type *Select detector type from drop-down*

path *Select path-1 or path-2 from the drop down to select the path/channel to which the detector relates.*
*The path may also be set to **null** to deactivate the detector.*

The remaining values vary depending on the detector type selected. When a detector type is selected, all required parameters are auto-filled with default values. These values must be tuned for each site.

Tuning of the detectors is outside of the scope of this document. Detector tuning must be performed by Bandweaver engineers or our trained and authorised partners.
Training courses are available: please contact your Bandweaver sales representative for further information.

The bottom of the detector configuration window has a zone table. This table is used to assign section of monitored fiber to which this detector will apply. Up to 12 separate sections of fiber can be added to each detector.

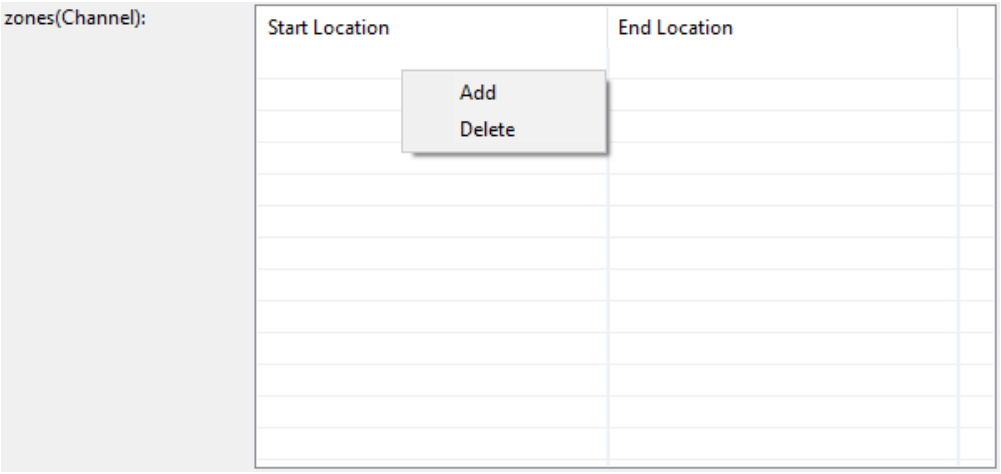


Figure 9-23 Add zones to detector

The unit of measurement for adding zones is channel, not meters. To change the display unit to channel: Settings < Data Management < Unit:Distance <-> Channel

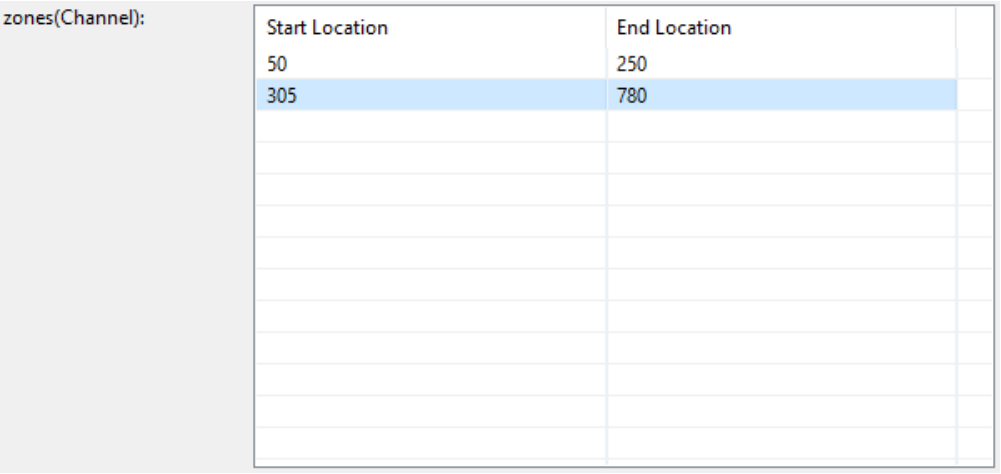


Figure 9-24 Add zones with start and end channels

9.7 Set Waterfall

The Set Waterfall interface allows the user to opt on storing the waterfall data or not, and the corresponding space allocation, and also the frequency spectrum of the waterfall in the main display.

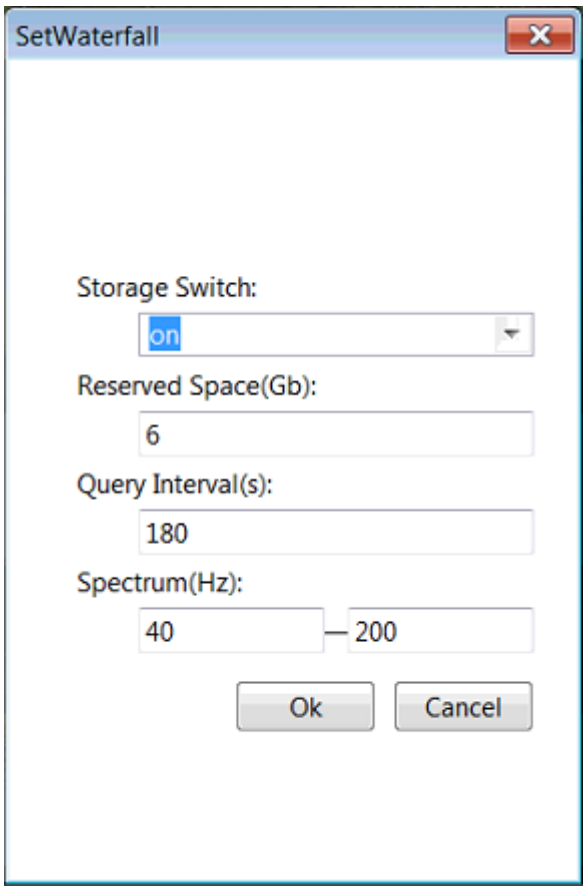


Figure 9-25 Set Waterfall

Storage Switch *On = Waterfall data is stored*
Off = Waterfall data is not stored

Reserved Space(GB) *Disk space reserved for Waterfall data in GB*

Query Interval(s) *Query interval for Waterfall data (not user configurable)*

Spectrum(Hz) *Start and End frequencies in Hz of the spectrum to be displayed on the Waterfall*

Note:
The Spectrum settings in this view relates only to the Waterfall displayed in the main view. The frequency spectrums in use by the various detectors may or may not be the same as these.
For standard intrusion detection application, it is recommended that all the detector frequency spectrums match the **Spectrum** settings in the **SetWaterfall** interface.

9.8 Pattern Management

The pattern refers to the mode of data transmission between the DU and the host computer, including the sampling frequency, spatial resolution, and the start and end positions of the fiber.

These parameters are all mutually constrained and can only be configured in one of the configurations listed in Table 9-2. Please refer to this table when configuring the DU.

Click **Pattern Management** in the main menu, then enter the pattern setting interface, as shown below:

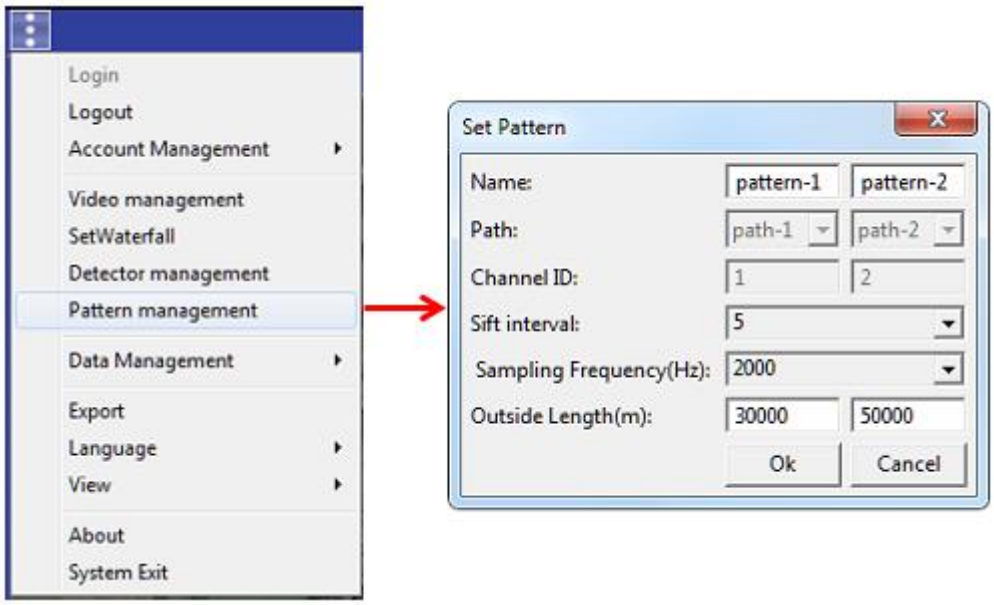


Figure 9-26 Set Pattern

Sift interval — *Spatial resolution in meters.*
The range of values that may be set are 20, 10, 5, 2.
Refer to Table 9-2 for details on the constraints for each of these values.

Sampling frequency — *Sampling frequency of the signal in Hertz.*
The supported frequencies are: 1K, 2K, 4K, 10K, 20K.
Refer to Table 9-2 for details on the constraints for each of these values.

Length — *The end position of the fiber. This parameter can be modified according to the length of the actual connected cable. At the same time, it will affect the display length of the waterfall chart and the horizontal axis of the histogram.*
The pattern length has a relationship with other configuration items that satisfies the constraints in Table 9-2.
Refer to Table 9-2 for details on the constraints for each of these values.
Note 1:
The Outside Length must be set less than or equal to the maximum range of the purchased model, or the DU will not initialise. Incorrect setting may present as a communication error.

Depending on the application for which the system has been purchased and the model of the DU, some or many options in Table 9-2 may not be available.
For standard use of the equipment, only the default Configuration 6 is used in all applications.
For unusual or exploratory applications that do not require the use of Bandweaver's detectors or algorithms, these must be discussed with Bandweaver in advance, so that any necessary sampling frequencies or specific configurations can be made available.

No.	Sampling Frequency (Hz)	Sift interval (p)	Outside Length (m)
1	1,000	10	65,000
2		5	50,000
3		2	10,000
4		1	10,000
5	**2,000 [Default]**	10	50,000
6		**5 [Default]**	**50,000 [see Note 1]**
7		2	10,000
8		1	10,000
9	4,000	10	25,000
1 0		5	25,000
11		2	10,000
12		1	5,000
13	10,000	10	10,000
14		5	10,000
15		2	4,000
16		1	2,000
17	20,000	10	5,000
18		5	5,000
19		2	2,000
20		1	1,000

Table 9-2 DU Pattern configurations

For intrusion detection applications, where Bandweaver standard detectors will be implemented, the default configuration must be used:

Sampling frequency: 2000

Sift interval: 5

Outside length: Min. value for Outside length: 1000
Max. value for Outside length depends on Horizon model:
For Horizon 5 and Horizon 10: 5000
For Horizon 20 and Horizon 40: 20000
For Horizon 50 and Horizon 100: 50000

Note:
All paths of the same DU must be configured with the same sampling interval and sampling frequency.

9.9 Data Management

9.9.1 Vibration data storage

During the running of the system, the user can save the raw data of a selected path for a selected period of time. The amount of data that can be stored will depend on the available disk space on the PU.

Open the raw data storage settings by the following path:

Menu → Data Management → Vibration Save

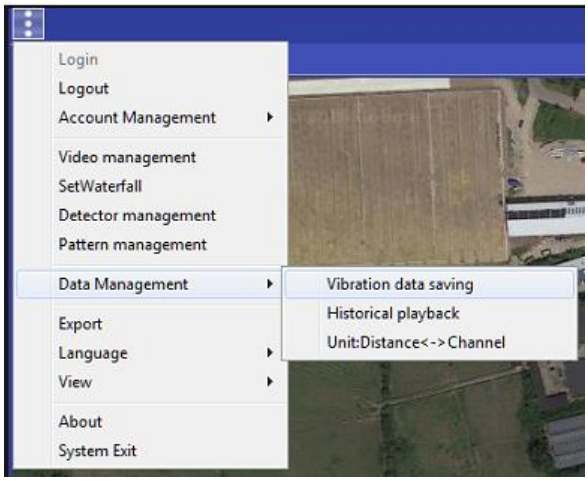


Figure 9-27 Open the raw data storage menu

The vibration save interface appears, as shown below:

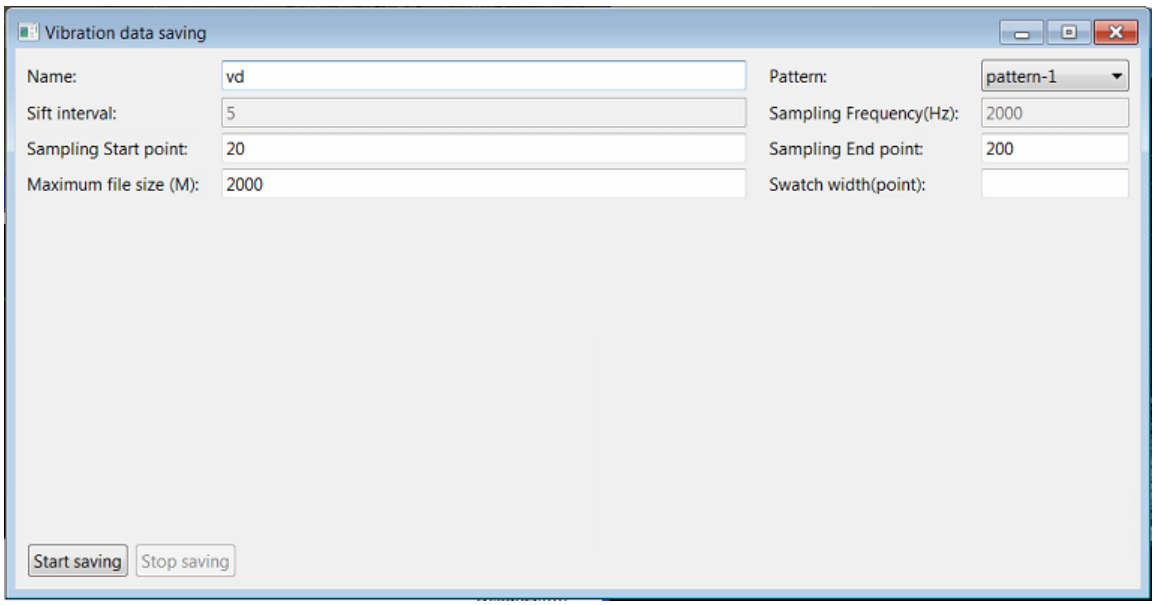


Figure 9-28 Raw data storage interface

In Figure 9-28, the following parameters need to be confirmed and set before saving the data.

Some parameters cannot be changed from their default values. The User can modify the rest according to the site requirements.

Name: *The name of the vibration data saved; the beginning of the corresponding data file name;*

Pattern: *Use the drop-down box to select the pattern to be saved;*

Sift interval: *Indicates the interval between two adjacent points of the saved data, in meters. Equivalent to the spatial resolution. Auto-filled from Pattern settings. Cannot be change from this menu interface.*

Sampling frequency: *Indicates how many frames per second of saved data, in Hertz. Auto-filled from Pattern settings. Cannot be change from this menu interface.*

Sampling Start point: *The start location for the data storage (unit = channel)*
Note:
The unit of measurement for this parameter is channel, not meters.
If unsure of the start channel, change the display unit to channel from Settings < Data Management < Unit:Distance <-> Channel.

Sampling End point: *The end location for the data storage (unit = channel);*
Note:
The unit of measurement for this parameter is channel, not meters.
If unsure of the end channel, change the display unit to channel from Settings < Data Management < Unit:Distance <-> Channel.

Maximum file size(M) *Maximum file size in MB. Each time the maximum size is reached, the software creates a new time to continue saving the raw data*
Default = 1024

Swatch width(point) *Leave blank.*
This is for Bandweaver use. It is used for manually saving samples of raw data for machine learning training.

Function buttons:

Start Saving *Start saving the raw vibration data.*
*After configuring the parameters, click **Start saving** to store the data. If there is sufficient space and the parameters are correct, the new data sent by the DU will be saved to the data file.*
Note:
*The path of the file storage can be found in the value of the **datpath** parameter in the **.default.run** file.*

Stop Saving *End the storage of vibration data.*
Note:
*The path of the file storage can be found in the value of the **datpath** parameter in the **.default.run** file.*

As the vibration data is saved, the waterfall is also displayed in the Vibration data saving window:

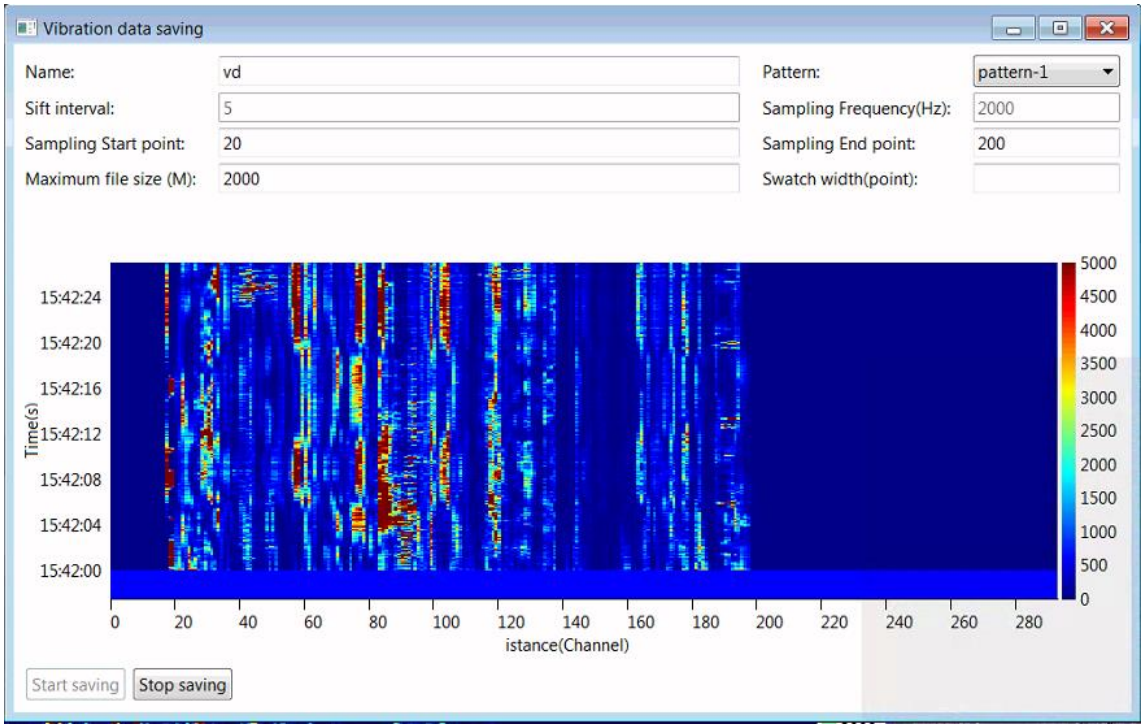


Figure 9-29 Vibration data saving in action

The user can also right-click on the waterfall to manually save a sample. This is used to save samples for DNN training and is not for general use. If a user has accidentally right-clicked to save a sample, right-click again to stop.

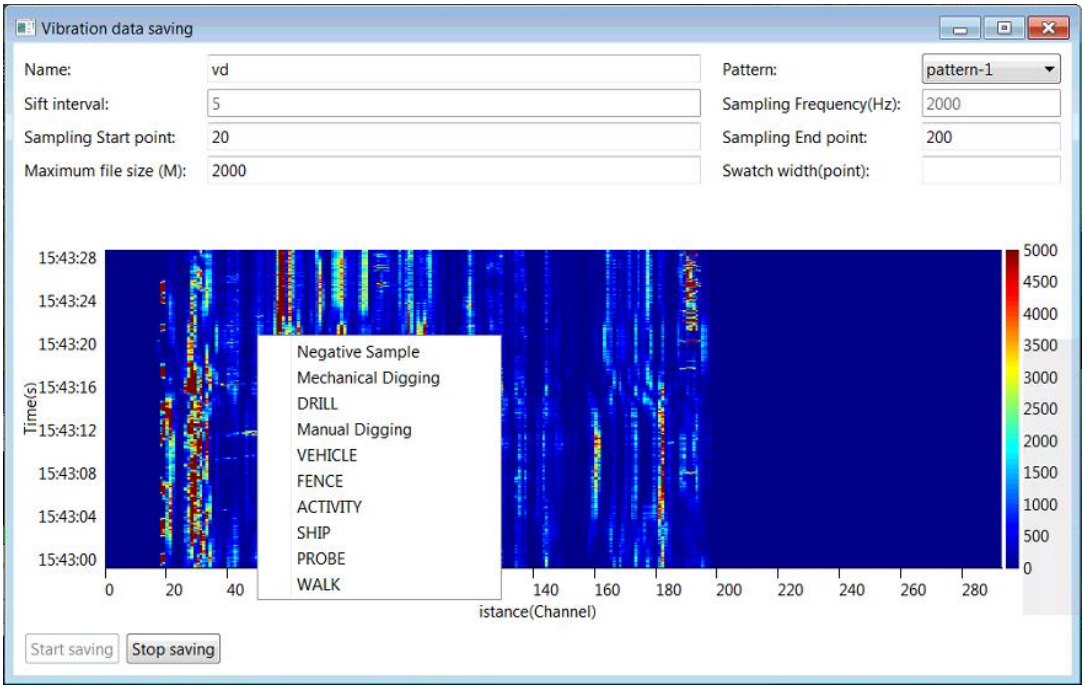


Figure 9-30 Manually save a sample intrusion – do not use

9.9.2 Historical playback

The Historical playback function sends the raw data saved by the vibration data management to the algorithm module. Administrator privileges are required to use this feature.

At the user's play command, it performs algorithm processing, and presents the result through the interface. This tool can be used to facilitate research and development or enable the engineering personnel to carry out a system analysis and engineering debugging.

Unlike the real-time monitoring mode, the playback data is not collected in real time, and the data sent to other modules does not need to be saved repeatedly. Any generated alarms are not sent to the alarm adapter and will not be stored in the database.

The functions supported by historical playback are:

- specify the position to start playback
- play;
- pause / resume;
- stop;

Open the **Historical playback** by the following path:

Menu → Data Management → Historical playback

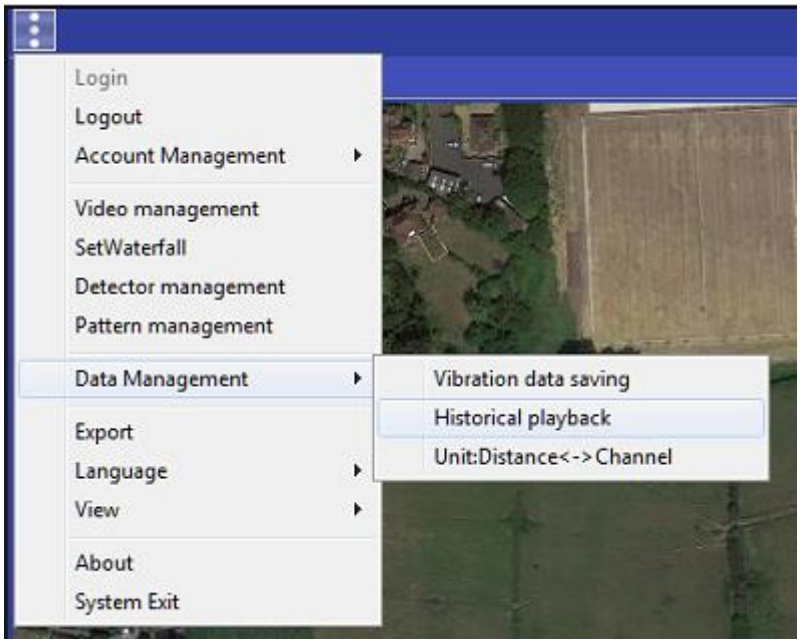


Figure 9-31 Open the Historical playback menu

The historical playback interface appears, as shown below:

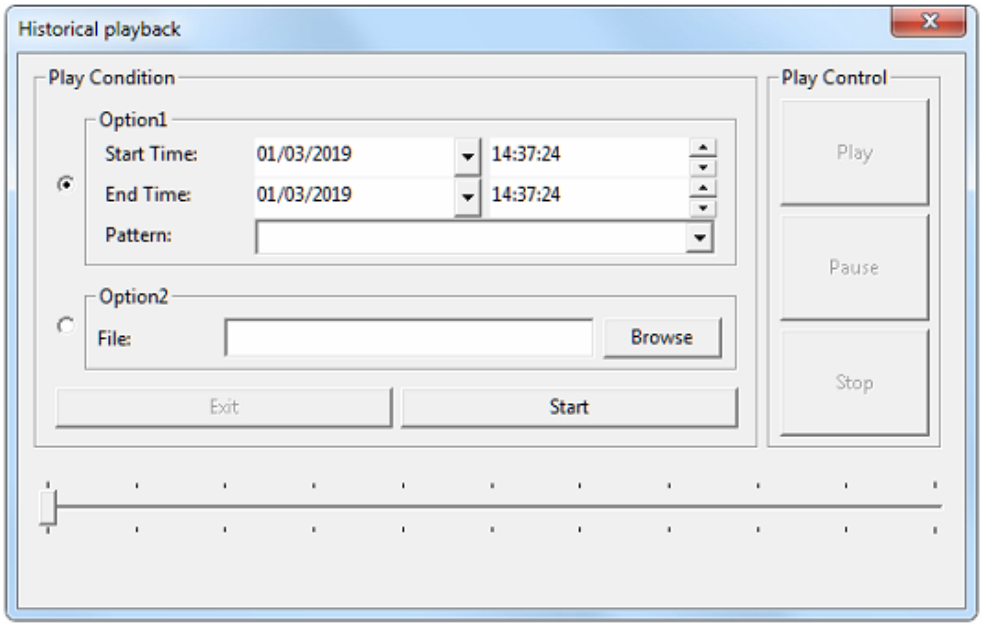


Figure 9-32 Historical playback interface

As shown in Figure 9-32, the main interface is divided into two parts:

- Play condition;
- Play control;

9.9.2.1 Play condition

This module provides two historical playback modes:

- Option 1: Historical playback over a selected period.
- Option 2: Playback of specific vibration data files.

When you select the **Browse** Import button after the file path, the file selection dialog box will appear. The user can click to select the vibration data file to replay. This is the playback of a single file. In this case, .**vd** is the only valid file extension that can be opened.

If the Start button is clicked without selecting a file for playback, the system will default to the second mode of playback: a period of historical playback.

There are some restrictions on the data source for playback. The parameters are as follows:

Pattern *Select the desired pattern for playback from the drop down;*

Start time *Specify the start time of playback;*

End time *Specify the end time of playback;*

9.9.2.2 Play Control

Click **Start** to begin playback.

The start and end time (accurate to milliseconds) of the actual playback will appear at the left and right ends of the progress bar respectively. The progress bar can be dragged to reposition the playback of the raw data.

The play, pause and stop buttons on the playback interface also become active. A short description of each is below:

Play *Plays the prepared data. The selected data is played in the **data view**, and the historical data playback replaces the live real-time data.*

Pause *The pause button pauses the data replay. Once clicked, pause is replaced by the resume function, which can be clicked again to continue playback.*

Stop *This stops the playback without a way to resume playback from the stop position. The data view reverts to displaying the real-time vibration data again.*

9.9.3 Unit: Distance <-> Channel

Depending on the feature of SSOS in use, the unit of distance measurement may be meters or in channels. The user can switch between the two for the waterfall and histogram views by using this control in the Settings : Data Management menu.

See also the features below for reference on which features require which units

Channel	**Set Detector** settings: all Start and End locations **Vibration data saving**: Sampling start and end points **RoiEnd2(point)** in Set Path for fiber break setting
Meter	**Preset Scope** of video management: all Start and End locations **Offset** in **Calibration point** configuration **Offset** in **Set Uz** for Start and End Offset

9.9.4 Sample Query

This is a Bandweaver R&D only option and is used for Neural Network training.

9.10 Export

This option is used to export the current SSOS configuration. It is not for use by the end user. However, if input is required by Bandweaver engineers to troubleshoot a system, this configuration file should be exported and sent to Bandweaver to assist with the troubleshooting.

Selecting Export opens a Windows file saving dialog and the configuration is saved as a .txt file.

A sample export output file is shown in Figure 9-33.

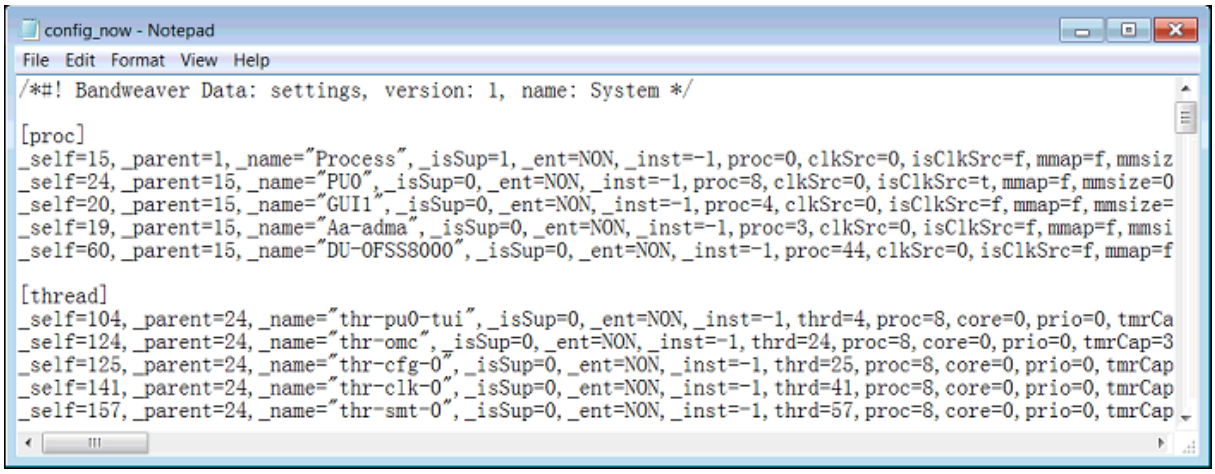


Figure 9-33 Export

9.11 Language

Interface language selection. The following languages are currently available:

- Chinese
- English
- Russian

9.12 View

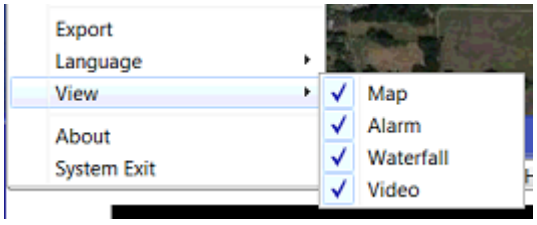


Table 9-3 View

The submenu of this item includes the 4 main views, with a checkbox option against each of these.

Click a checked item to deselect it and vice versa. Checking a view means it will be displayed in the main SSOS interface. If a view is unchecked, it will not be displayed in the main interface.

This function is useful for temporarily removing the map and video display during commissioning of the system. This allows for a clearer waterfall and histogram display to make detector configuration and tuning easier.

9.13 About

Displays the software version and details:

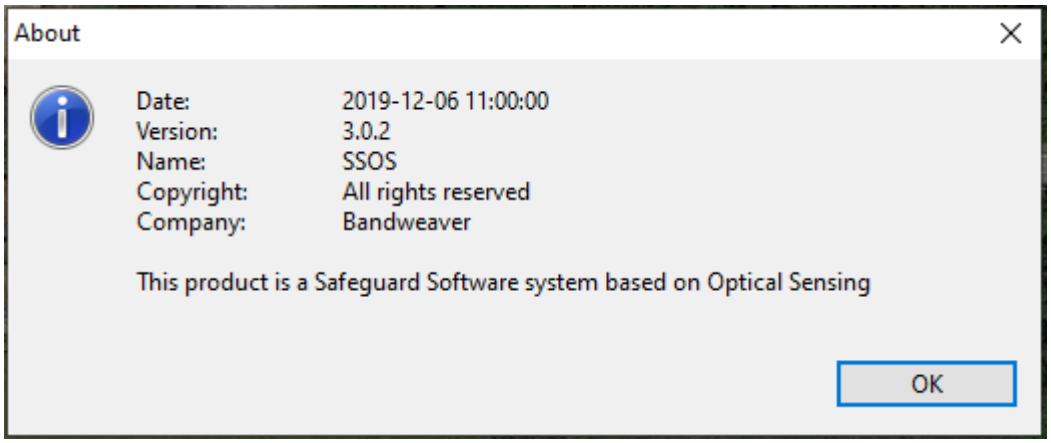


Table 9-4 About

9.14 System Exit

Use this option to close the SSOS software and exit. This option requires the user to input their account details to authorise closing the interface.

Table 9-5 System Exit

10 Alarm and Fault Management

10.1 Alarm Presentation

On the GUI, the alarm is mainly presented to the user in three ways: map, table, and status bar.

1. **Map rendering:**
   When an intrusion event is detected, if the corresponding map is open, SSOS will flash an icon corresponding to the intrusion type on the corresponding fiber location (the location where the event occurred) on the map, such as the car in this example. Move the cursor anywhere on the map, and the latitude and longitude of the location and the fiber offset will be displayed below the map.

2. **List presentation:**
   Refer to Section 7.
   Each item in the table is shown in the following table:

3. **Status bar**:
   SSOS will reflect the highest level of all unprocessed alarms on the task bar at the bottom of the interface. The levels, listed from low to high, are green, yellow, orange and red. The colour of the status bar will change according to the reported alarms and the user's handling of the reported alarms. The colour will always reflect the most serious of all current unprocessed alarms.

10.2 Fault Presentation

On the SSOS GUI, the fault is presented to the user in two ways: table and status bar, as shown in the figure below.

1. **List presentation**:
   Refer to Section 7.

2. **Status bar presentation**:
   SSOS will reflect the highest level of all unprocessed faults on the task bar at the bottom of the interface. The levels, listed from low to high, are green, yellow, orange and red. The colour of the status bar will change according to the reported faults and the user's handling of the reported faults. The colour will always reflect the most serious of all current unprocessed faults.

APPENDIX A: SSOS Config files

SSOS configuration is divided into system configuration and user configuration. User configuration is stored as a binary file; system configuration is stored as a text file.

- System configuration includes: platform specifications, system specifications, and operating modes. Configured by the files **.pltdef.ini** and **.ssos.ini**.
  - The platform specification defines the maximum capacity of the platform;
  - The system specification defines the maximum capacity of the SSOS system;
  - The system deployment defines the number and interrelationship of platform elements within the system, including processes, threads, tasks, and communication connections between processes.

- User configuration includes system deployment and user objects. The corresponding configuration item is configured by the **.default.run** file.
  - User objects come from user monitoring requirements such as DUs, lines, environment domains, user domains, zones, and more.

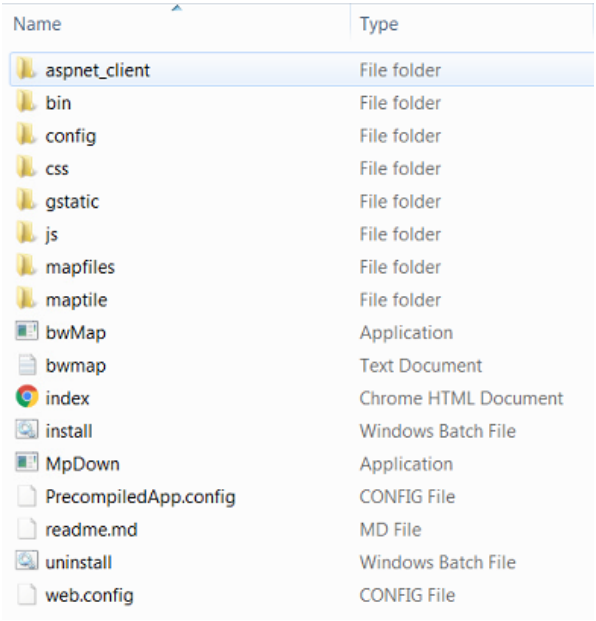
User configuration is common to all processes within the SSOS system, and system configuration varies by process. SSOS configuration work also includes configuration of related adapters, but the configuration of these adapters often varies from adapter to adapter and is outside the scope of this document.

APPENDIX B: MAP SERVICE

Please refer to https://www.google.com/intl/en-US_CN/help/terms_maps/ for the applicable terms of service. Agreement with these terms is essential for the use of Google Maps with SSOS.

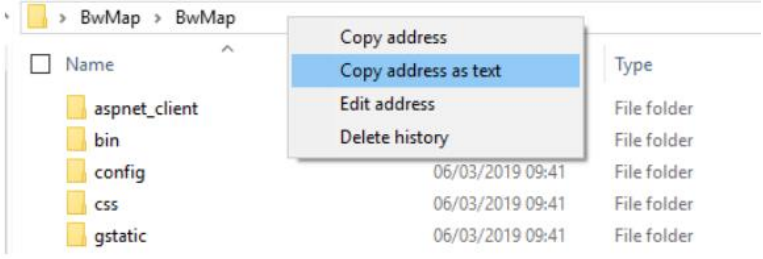
Alternatively, Bandweaver must be provided with a project map or site plan for use with SSOS.

The installation file of SSOS includes the folder **BwMap_en_US.zip**. This folder can be found in the SSOS installation folder under **Tools**, and the contents are as follows:



The installation steps are as follows:

1. Run **install.bat** with Administrator privileges;
2. Run **MpDown.exe** with Administrator privileges;
3. Right-click on the directory path and select Copy address as text:



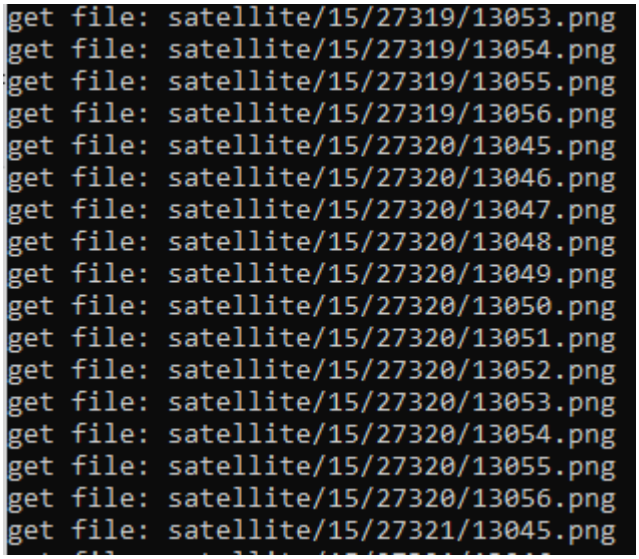
4. Open notepad and paste the text for use later:

5. Download the map:
    a. Start cmd.exe

    b. Change the directory to the map service root directory.
    Type the following command at the prompt and press **Enter**:
    cd <paste the link here from the notepad>
    Example:
    cd C:\Users\Username\Desktop\BwMap\BwMap
    or
    cd C:\Users\shuang.xia\Desktop\BwMap

    c. Use MapDown.exe to download the map area. You will need the top right and bottom left coordinates of the area of interest in decimal degrees. Type the following command at the prompt and press **Enter**:
    MpDown.exe -bottomLat <w.w> -topLat <x.x> -leftLong <y.y> -rightLong <z.z> -layer 15 -map satellite
    Command Example:
    MpDown.exe -bottomLat 34.3 -topLat 34.4 -leftLong 120.1 -rightLong 120.2 -layer 15 -map satellite
    Note:
    If required, use MpDown.exe -h to get help.

    d. If the command is successful, the tiles will start to download:



    e. Lastly, check that there are maptiles in the Maptile folder: **BwMap < maptile < satellite**

To uninstall the service, run **uninstall.bat** with administrator privileges.

APPENDIX C: Fiber Break for Horizon Version 1

This section applies only for Horizon DU version 1. For other versions, please refer to Section 5.2.2.

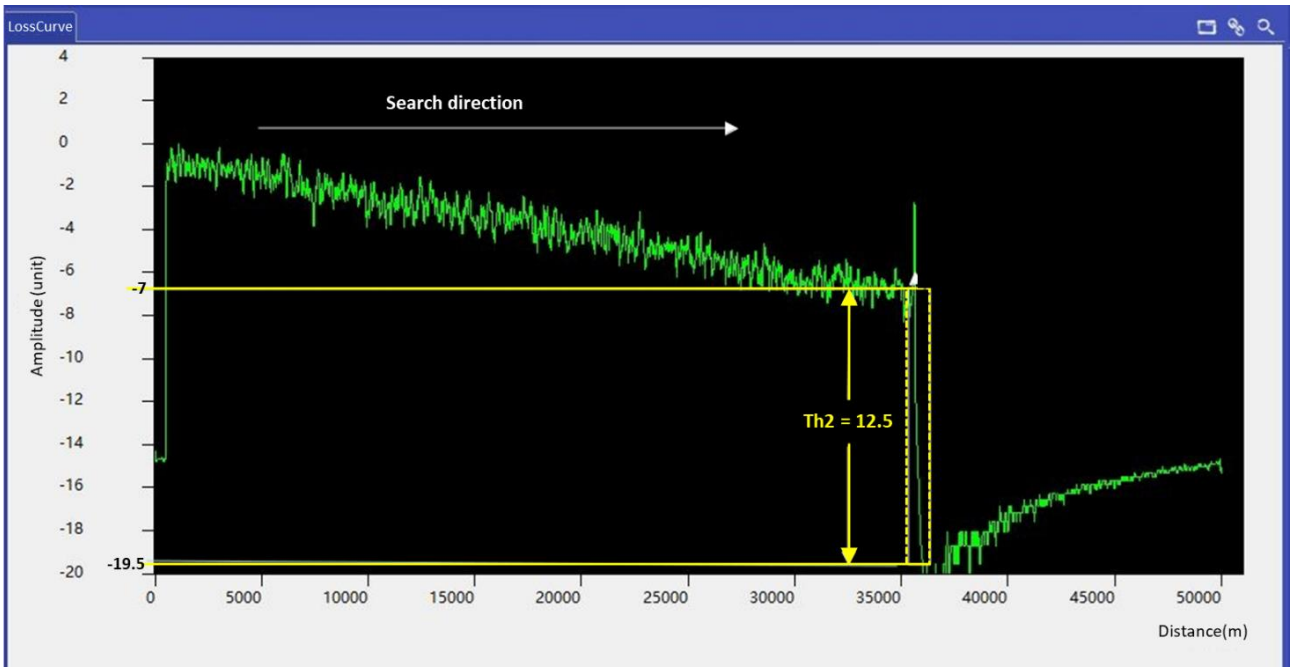


Figure 10-1 Overview of Fiber Break (V1)

The fiber break algorithm for the version 1 Horizon DU, works slightly differently to the newer algorithm for version 2. The meanings of the terms remain the same, with a small exception for Th2. Although this remains the Threshold value, the way that this value is determined, and set is different.

End Location(m) — *Length that is configured in Pattern Management (See 9.8)*

Spatial Resolution (m) — *Sift interval that is configured in Pattern Management (see 9.8)*

Time Interval (ms) — *How frequently the system checks for fiber breaks.*
Default = 1000. Do not change.

BlkSz2 — *The number of data points at the start of the trace that are used as reference.*
Default = 7.

RoiEnd2(point) — *Real length of the fiber in channels. If the measured length is less than this, the system will raise this as a fiber break fault.*
Note:
The unit is channel (not meters)
To change the display unit to channel:
Settings < Data Management < Unit:Distance <-> Channel

The main values to be set for the fiber break detection, are the fiber length **RoiEnd2** the threshold value **Th2**.

Unlike for version 2, the fiber break algorithm starts its search in the forward direction, i.e. from the start of the logarithmic attenuation trace towards the end, to find a point that matches the value of **Th2**. The first point found that meets this condition is determined as the current end of the fiber. If this value is lower that the value configured as **RoiEnd2**, this is flagged as a broken fiber**.**

Note also that it's the logarithmic attenuation view that must be used, and that the Th2 value is the dB value of the drop in amplitude, and not an threshold value that must be crossed value.

In the example in Figure 10-1, the **Th2** value is 19.5 – 7 = 12.5.
In this case, SSOS is configured so that drop of 12.5 corresponds to the location of the end of the fiber. If this is less than the RoiEnd2 value, this constitutes a broken fiber.

To switch between waterfall view of Ch1 and Ch2	Refer to 6.1
To switch from Waterfall to the Logarithmic Attenuation data (for Th2)	Refer to 6.2
To switch from meter to channel (for RoiEnd2)	Refer to 9.9.3

Click **Ok** to save or **Cancel** to discard changes before exiting.

The same settings also apply to path-2 (Channel 2).