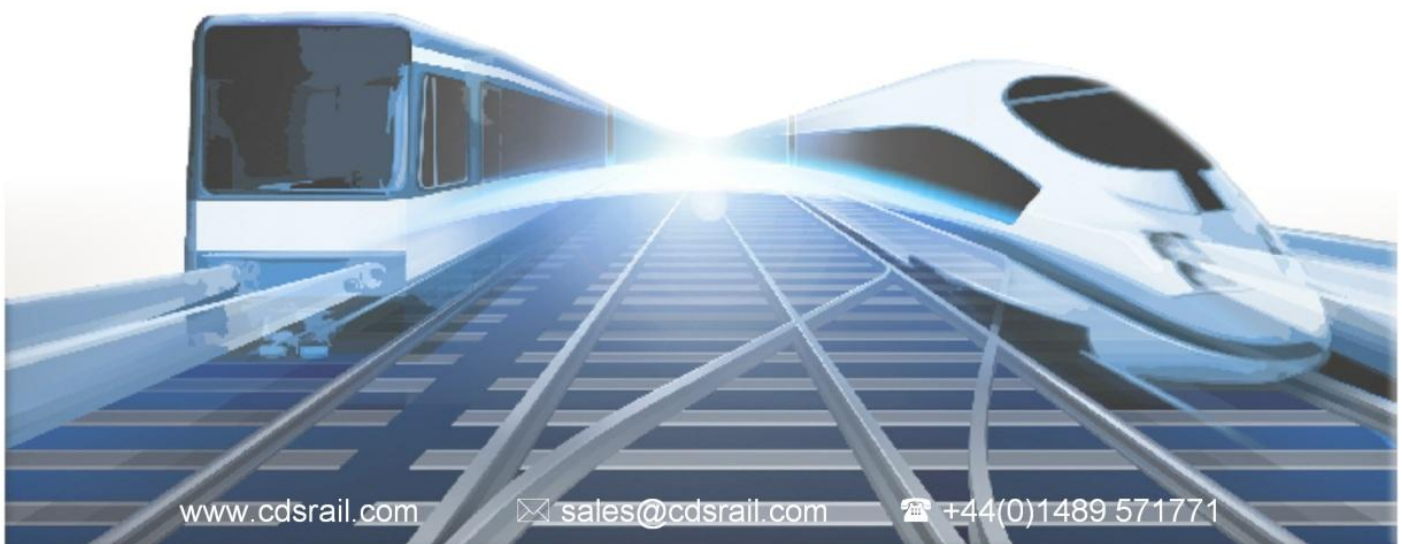




Asset Monitoring Software



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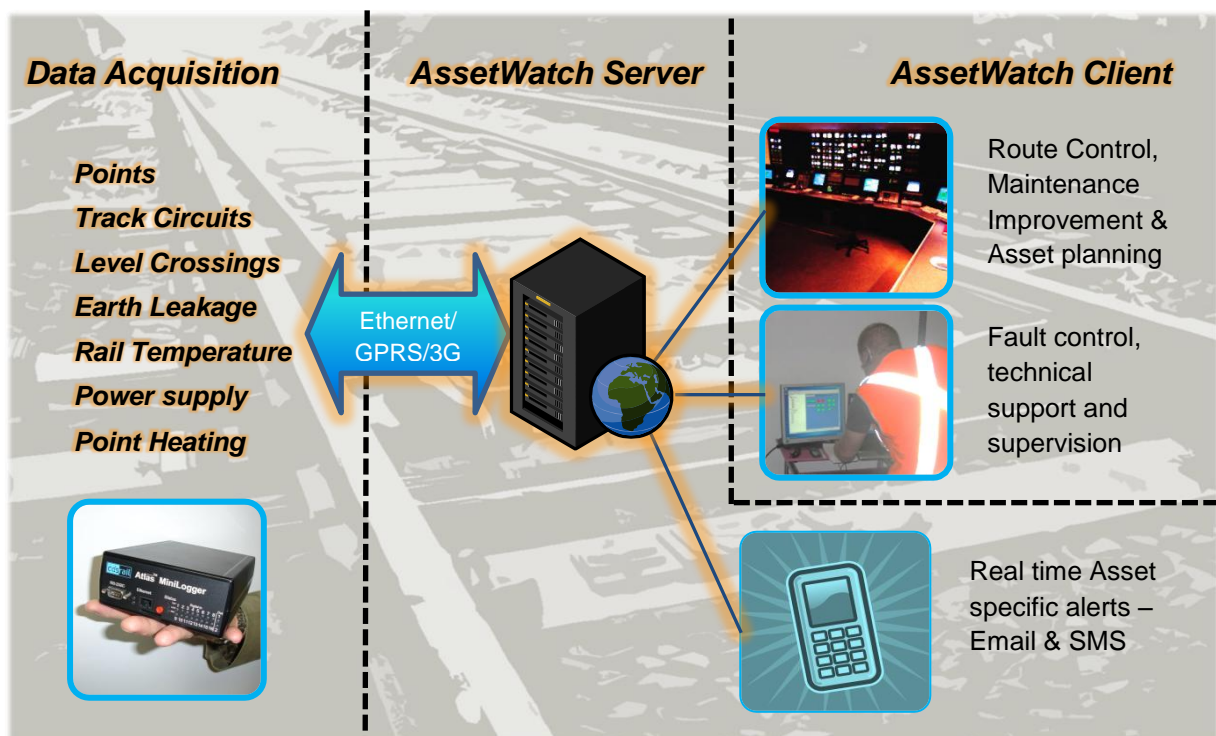
BACKGROUND & INTRODUCTION

CDS Rail was one of the first companies to successfully implement remote condition monitoring technology on the UK rail infrastructure. Since 1998 the company has focussed exclusively on rail, designing robust intelligent hardware for the most challenging environments and modular software platforms which give users remote visibility of asset status, detailed performance data and SMS/Email alerts. The AssetWatch software platform is an integral part of the product portfolio which has been developed with rail maintainers to offer a full suite of tools for the archiving and analysis of real time asset performance & condition data collected by the trackside sensors & data acquisition hardware. This overview explores some of the general and application specific features of AssetWatch.

Key Features

- **Web enabled:** Accessible and manageable over the internet. Remote deployment of upgrades and support.
- **No special software requirements:** Users just require Java, all use common AssetWatch client software which automatically updates from the server.
- **Flexible licensing options:** Customers can purchase a perpetual royalty free licence with no limit on number of users. Server can be owned and managed by the railway.
- **Adaptable to communications architecture:** Server can support fixed network, wireless or dial up connection to field units, with data push or pull.
- **Configurable user interface:** Navigator and mimic screens can be customised.
- **Easily expanded:** Same core software supports all asset monitoring applications.
- **Able to integrate:** Can accept input direct from assets & third party monitoring hardware and output data to external management systems.

AssetWatch Intelligent Infrastructure



USER INTERFACE

The heart of the AssetWatch client software is an intuitive graphical interface which makes it easy to gauge asset status and performance with traffic light style indicators to show instantly which sites or assets are in alarm or alert.

The AssetWatch Navigator menu is always found on the left hand side of the screen and contains everything that can be accessed from the AssetWatch client and can be customised according to user requirements.

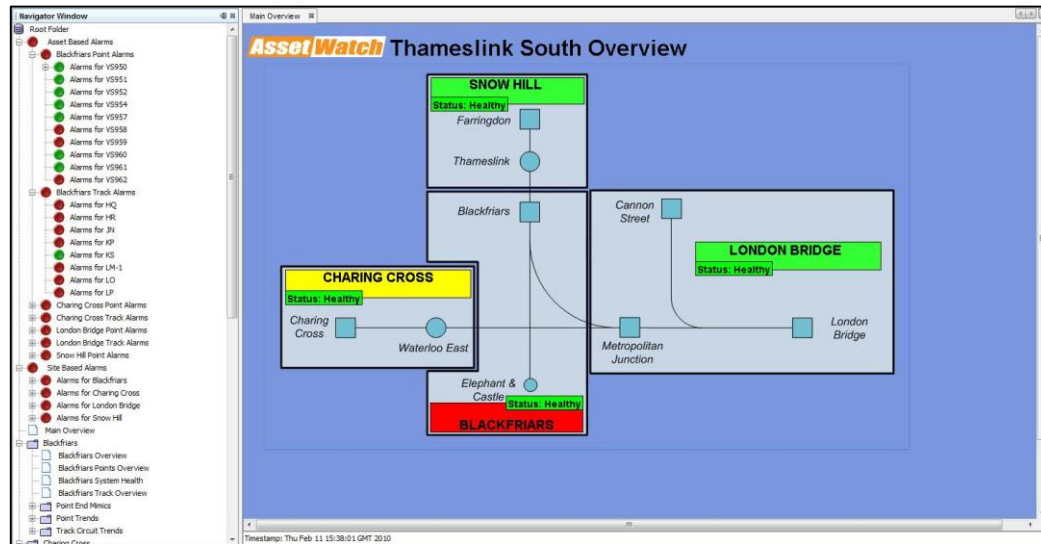


Figure 1: Typical Main Overview Screen

Once AssetWatch opens, the first screen that will appear is the Main Overview. The presentation and style of this screen can be determined by the end user at the design stage. It often represents an area map, or a simplified schematic view of the area monitored. All information can be accessed from here by using the Navigator pane on the left or clicking on the buttons or areas of the Overview screen as required.

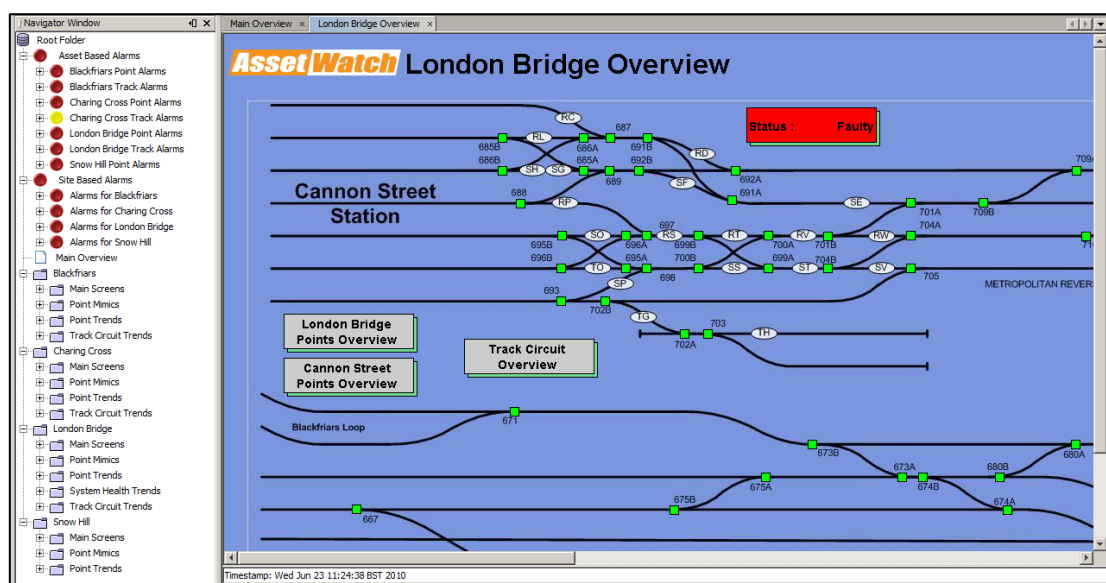


Figure 2: Site Overview

Depending on the size of the area monitored, a number of different screens may be accessed through the main overview. Ultimately the user will arrive at a Site Overview like the examples shown in Figure 2, this is often a track layout, but could be a schematic representation of the system monitored.

All asset information for a particular site can be accessed from here. Assets are generally shown as a small box within the track plan, its colour indicating their current status:

Green shows that operation is good

Yellow shows that they generated an Alert

Red signifies that they generated an Alarm

A shortcut button is normally provided on the Site Overview screen to allow the user to open up Asset Overview screens showing more detailed information.

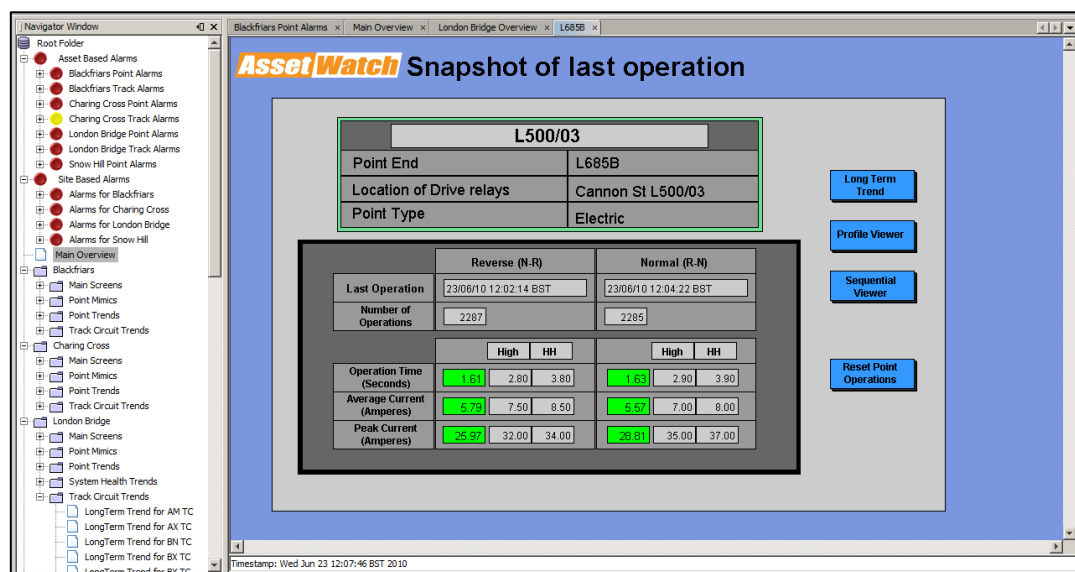


Figure 3: Example Asset Overview – Points Monitoring

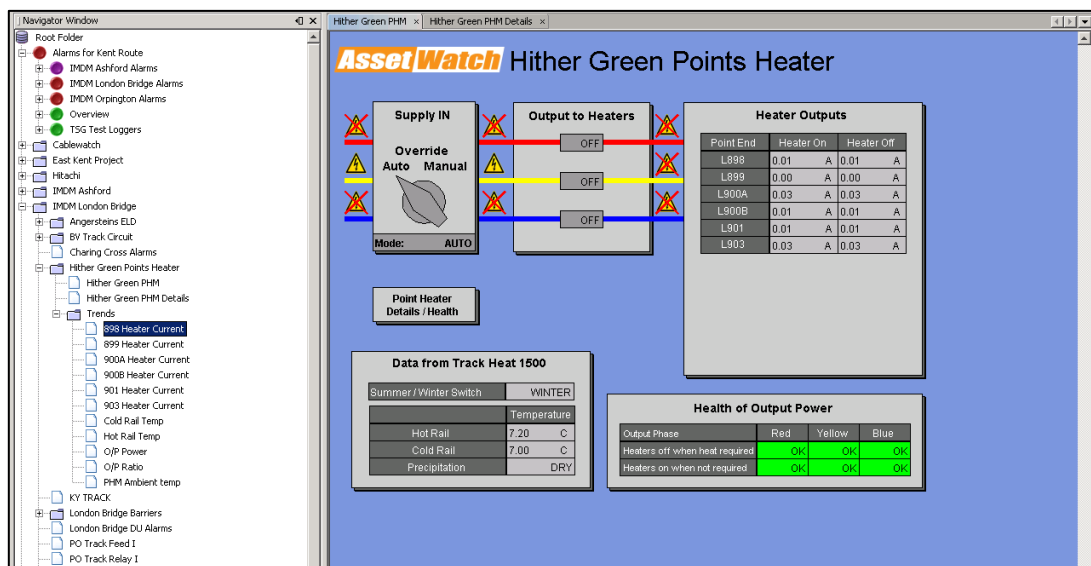


Figure 4: Example Asset Overview – Points Heating System

The other indicator usually present on the Site or Main Overview screens is 'System Status'. The colour of this tells the user whether the site monitoring hardware is operational.

Green shows that monitoring system is operating correctly

Red signifies that one or more of the monitoring units on the site is faulty

If the system status button is then clicked it will open up the System Health screen for the area which will show a breakdown of the individual units, the example below shows a typical System Health screen for a site with multiple MiniLogger units.

Mini Loggers				
Loc L500/6C - TCM	Module Health	Healthy	Supply	11.73 Volts
	Ambient Temp 1	22.80	Temperature	32.00 Deg C
Loc L500/7C - TCM	Module Health	Healthy	Supply	11.73 Volts
	Ambient Temp 1	22.80	Temperature	30.60 Deg C
Loc L500/7C - L701 to L705	Module Health	Healthy	Supply	11.63 Volts
	Ambient Temp 1	22.80	Temperature	29.90 Deg C
Loc L500/8B - L709 + TCM	Module Health	Healthy	Supply	11.76 Volts
	Ambient Temp 1	20.40	Temperature	29.20 Deg C
Loc L500/9B - L710 + TCM	Module Health	Healthy	Supply	11.66 Volts
	Ambient Temp 1	21.80	Temperature	30.40 Deg C
Loc L500/12 - L711	Module Health	Healthy	Supply	11.79 Volts
	Ambient Temp 1	30.40	Temperature	39.10 Deg C
Loc L500/13/14 - L712 to L713 + TCM	Module Health	Fault	Supply	11.73 Volts
	Ambient Temp 1	27.60	Temperature	40.00 Deg C
Loc L500/19 - L719 + TCM	Module Health	Healthy	Supply	11.73 Volts
	Ambient Temp 1	28.80	Temperature	35.40 Deg C
Loc L500/20 - L718 + TCM	Module Health	Healthy	Supply	11.66 Volts
	Ambient Temp 1	30.40	Temperature	35.30 Deg C
Loc L500/22 - L723 + TCM	Module Health	Healthy	Supply	11.69 Volts
	Ambient Temp 1	26.40	Temperature	39.20 Deg C
Loc L74 - TCM	Module Health	Healthy	Supply	11.60 Volts
	Ambient Temp 1	28.00	Temperature	38.70 Deg C
Loc L75 - TCM	Module Health	Healthy	Supply	11.79 Volts
	Ambient Temp 1	28.00	Temperature	35.00 Deg C

Figure 5: System Health

ALARM MANAGEMENT

The 'traffic light' indicators within AssetWatch show the user what alarms are present and have not been acknowledged. In the Navigator these are usually grouped to cover related assets or certain geographical areas. For example:

- Point ends at a junction
- Track circuits at a single location
- Number of circuits being monitored for Earth Leakage Detection

Double clicking on the 'traffic light' in the Navigator brings up a screen like the one shown below which lists alarm events. These can be sorted by time or by channel using the 'Sort by' menu. They can also be filtered by alarm type where more than one alarm type is included in the same alarm log.

Most AssetWatch alarms are configured as two levels, e.g. high and critical. Alarms in the logs have colour coded backgrounds in accordance with their severity:

- Green** No alarms present
- Yellow** Alert or first stage of a two stage alarm
- Red** Alarm or second stage of a two stage alarm

The screenshot displays the 'Blackfriars Point Alarms' window. The 'Sort by' dropdown is set to 'Channel', and the 'Filter' is set to 'PCM Setpoint Alarms'. The 'Hide Acknowledged Alarms' checkbox is checked. The table below shows the following data:

Site	Channel	Alarm	Value	Alarm Time	Alarm Cleared	Alarm Count
Loc BS47 Case D	VS958A	TIME H RN	2.92	23:15:23 20/6/10 ...	23:16:28 20/6/10 ...	1
Loc BS47 Case D	VS958A	AV I HH RN	9.5019	12:04:39 21/6/10 ...	12:05:58 21/6/10 ...	12
Loc BS47 Case D	VS958A	AV I H RN	9.5019	12:04:39 21/6/10 ...	12:05:58 21/6/10 ...	12
Loc BS47 Case D	VS958B	TIME HH RN	7.82	23:18:36 20/6/10 ...	23:55:57 20/6/10 ...	1
Case D	VS958B	TIME H RN	7.82	23:18:36 20/6/10 ...	23:55:57 20/6/10 ...	2
Case D	VS958B	AV I HH RN	9.0519	12:04:39 21/6/10 ...	12:05:58 21/6/10 ...	13
Case D	VS958B	AV I H RN	9.0519	12:04:39 21/6/10 ...	12:05:58 21/6/10 ...	13
Case C	VS961A	TIME HH RN	4.64	23:36:28 20/6/10 ...	23:56:04 20/6/10 ...	3
Case C	VS961A	TIME H RN	4.64	23:36:28 20/6/10 ...	23:56:04 20/6/10 ...	3
Case C	VS961A	AV I HH RN	6.9877	23:36:28 20/6/10 ...	23:56:04 20/6/10 ...	6
Case C	VS961A	AV I H RN	6.9877	23:36:28 20/6/10 ...	23:56:04 20/6/10 ...	6
Case C	VS961B	TIME HH RN	4.28	23:29:59 20/6/10 ...	23:56:04 20/6/10 ...	1
Case C	VS961B	TIME H RN	4.28	23:29:59 20/6/10 ...	23:56:04 20/6/10 ...	1
Case C	VS961B	AV I HH RN	6.5016	23:29:59 20/6/10 ...	23:56:04 20/6/10 ...	4
Case C	VS961B	AV I H RN	6.5016	23:29:59 20/6/10 ...	23:56:04 20/6/10 ...	4

Figure 6: Alarm List

From the Alarm list, Individual alarm events can be selected and acknowledged, and at this point the user will be prompted to enter a suitable comment which will be visible to others – this helps share information about the cause of the alarm or other relevant details.

AssetWatch also includes a mail-server tool which allows the system to forward Email and SMS messages to users in response to incoming alarm events. Users with appropriate access rights can configure which alarms are sent as SMS/Email messages and who they are sent to based on shift patterns etc.

Where alarms are created as a result of routine maintenance – e.g. block tests on a turnout or shunt tests on a track circuit, Sites or areas within AssetWatch can be placed into a ‘maintenance mode’ – either using the client application or by sending an SMS to the server. Maintenance mode can be switched on and off manually, activated for a fixed time or regularly scheduled to match engineering hours. All alarms generated in a maintenance period are logged in the normal way, but SMS/Email messages are suspended and the alarm records are coloured purple to distinguish them.

Site	Channel	Alarm	Value	Alarm Time	Alarm Cleared	Alarm Count
Loc L500/22	GO_TRACK	MI	205.89	9:18:27 23/6/10 B...		19
Loc L500/22	GO_TRACK	LO	155.53	8:50:01 23/6/10 B...		30
Cannon Street L50...	RD_TRACK	LO	102.11	7:43:30 23/6/10 B...		7
London Bridge RR...	LE_TRACK	HI	300.52	3:53:52 23/6/10 B...		6
London Bridge RR...	LE_TRACK	MI	259.62	3:52:29 23/6/10 B...		18
London Bridge RR...	LE_TRACK	LO	62.118	3:30:52 23/6/10 B...		10
Loc L500/7C TCMA	RW_TRACK	LO	192.16	2:41:04 23/6/10 B...		1
Loc L500/7C TCMA	SV_TRACK	LO	63.339	9:58:45 22/6/10 B...		1
London Bridge RR...	ME_TRACK	MI	146.37	2:15:07 22/6/10 B...		1
London Bridge RR...	MD_TRACK	MI	102.11	23:42:26 20/6/10 ...		5
London Bridge RR...	LD_TRACK	MI	104.55	21:19:51 20/6/10 ...		4
Cannon Street L50...	RC_TRACK	LO	149.42	13:57:53 20/6/10 ...		7
Cannon Street L50...	RD_TRACK	HI	298.69	12:54:38 20/6/10 ...		3
Cannon Street L50...	RD_TRACK	MI	296.55	12:44:06 20/6/10 ...		2
Cannon Street L50...	RC_TRACK	MI	154.91	10:08:49 20/6/10 ...		1
London Bridge RR...	KC_TRACK	MI	291.67	9:44:53 20/6/10 B...		2
London Bridge RR...	LB_TRACK	MI	268.16	9:44:40 20/6/10 B...		4
London Bridge RR...	LB_TRACK	LO	101.5	9:43:34 20/6/10 B...		1
Cannon Street L50...	SG_TRACK	LO	101.19	8:40:05 17/6/10 B...		1
Loc L74	AX_TRACK	HI	448.57	13:16:52 9/6/10 B...		11
Loc L74	AX_TRACK	LO	205.59	17:57:05 8/6/10 B...		1
Loc L500/22	GO_TRACK	HI	302.35	8:13:20 4/6/10 BST		1

Figure 7: Purple Alarms – generated during maintenance

GRAPHICAL TOOLS

AssetWatch includes two powerful graphical tools to visualise data and assist in fault diagnosis. The Long term trend viewer is used for any parameter measured over a relatively long period of time – e.g. hours to months.

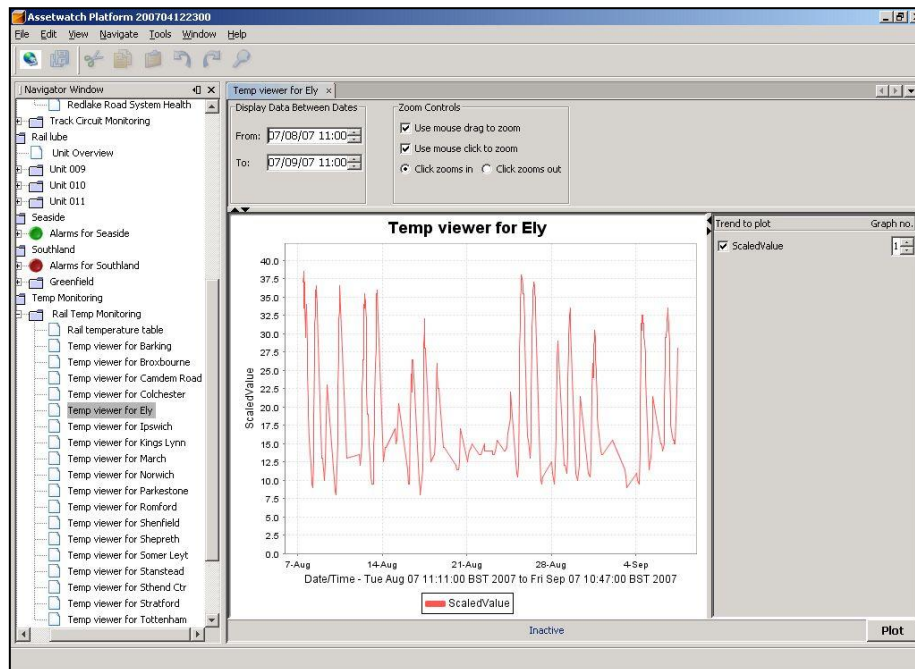


Figure 8: Long term trend – Rail temperature over 1 month

Data is displayed for a period between two dates/times defined by the user and the user can zoom in and out of the graph around points of interest. The trend viewer can plot multiple parameters on a common axis and also display alarm thresholds. For points monitoring, the long term trend is an invaluable tool to illustrate how the condition of the asset is changing over time.

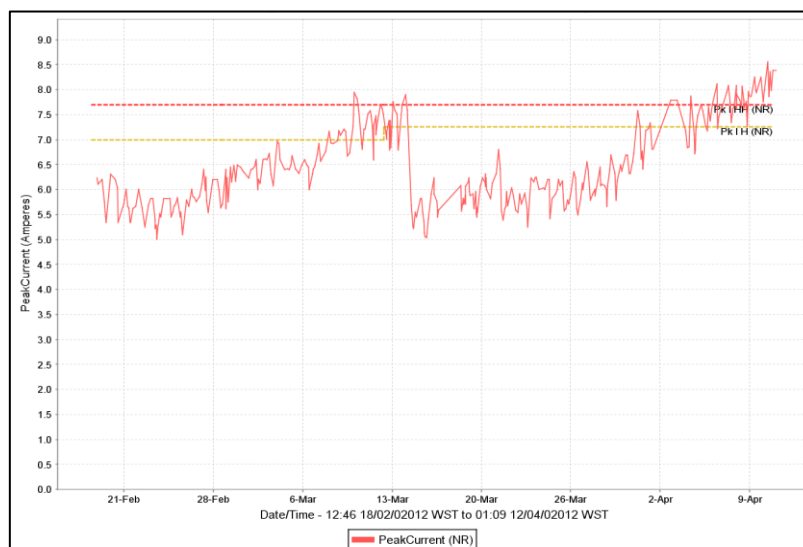


Figure 9: Long term trend – peak current per point movement over 9 weeks

Figure 9 plots the peak current for each point movement over a period of 9 weeks, and shows clearly how the current consistently increases close to the alarm level over a 3-4 week period before dropping significantly after maintenance work (e.g. lubrication is carried out).

The long term trend viewer is also used for track circuit monitoring, where it allows users to zoom into an individual track circuit transition or view a much wider period of activity with alarm bands overlaid.

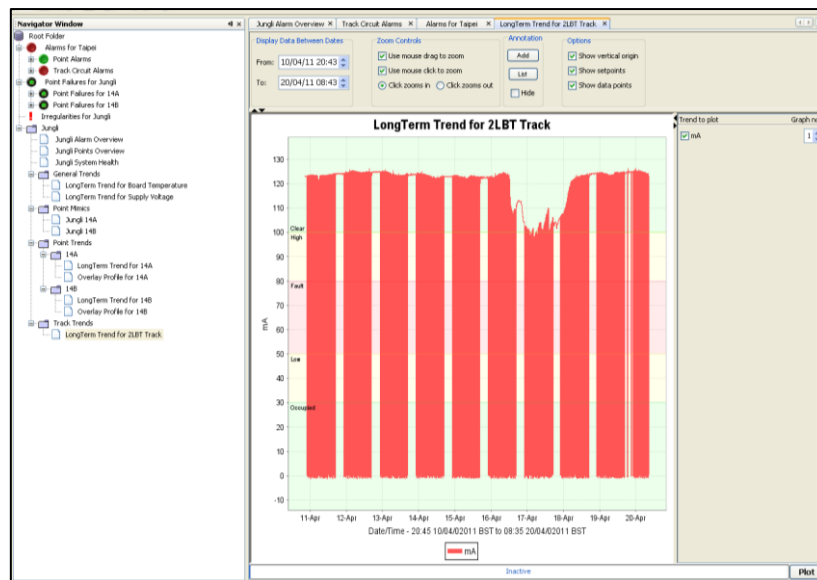


Figure 10: Track Circuit trend – over 9 days.

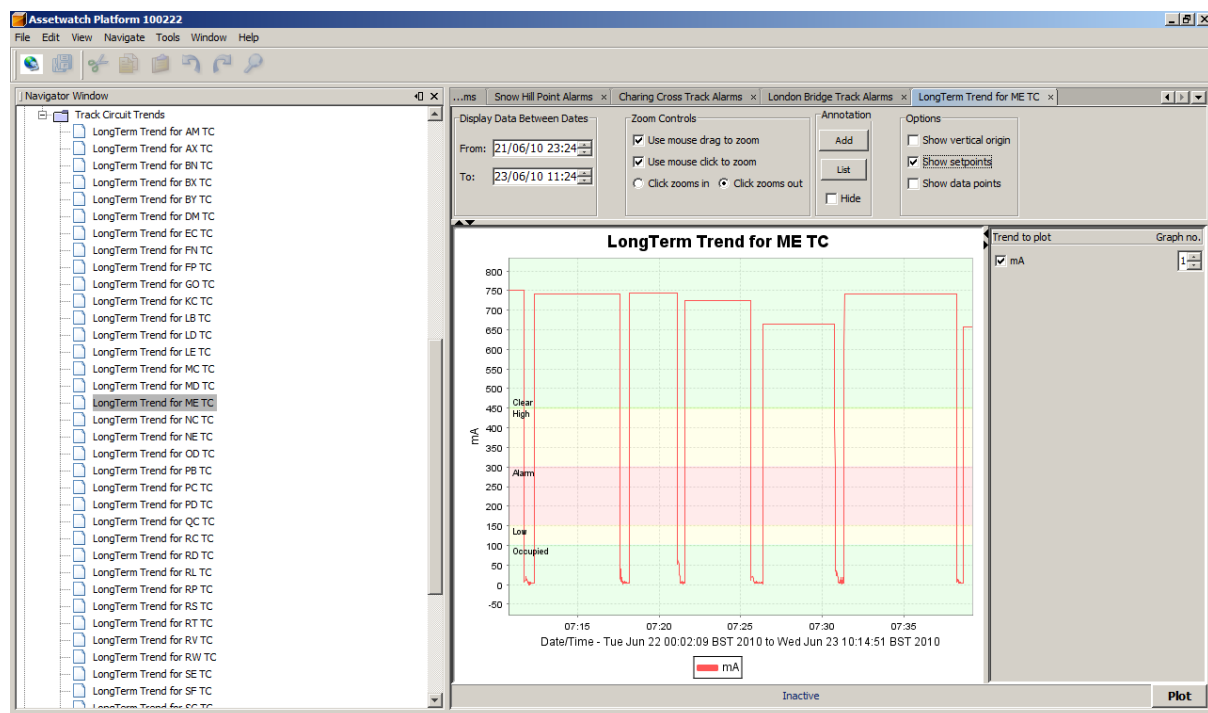


Figure 11: Track circuit trend zoomed in to show a small number of occupations

For parameters which are acquired at a much faster rate – e.g. ‘profiles’ of point movements or level crossing barrier activity, one of the most powerful features of AssetWatch is the profile viewer, which allows point movement profiles recorded by the system to be plotted against time for detailed analysis. Multiple profiles can be selected and precisely time-aligned and viewed on a common graph for comparison:

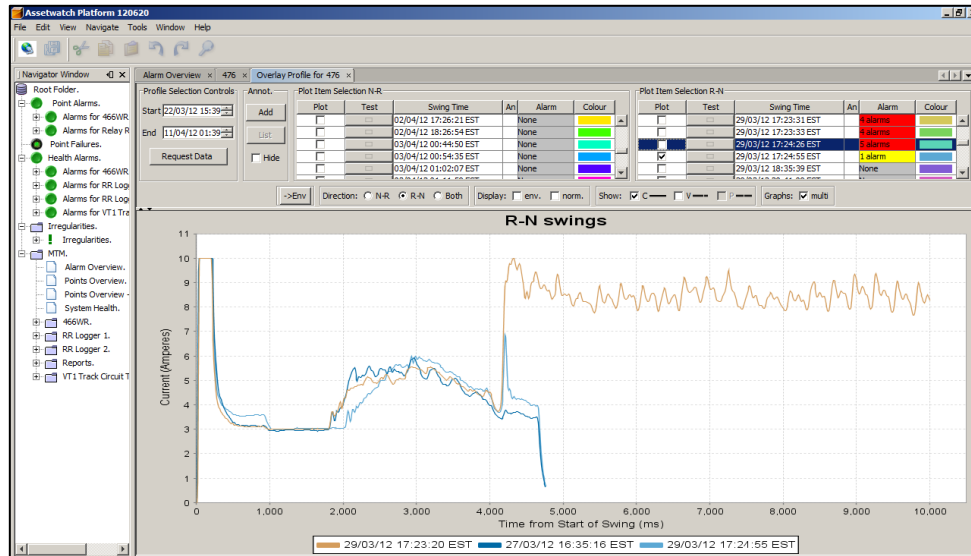


Figure 12: Profile Overlay – Point Motor Current

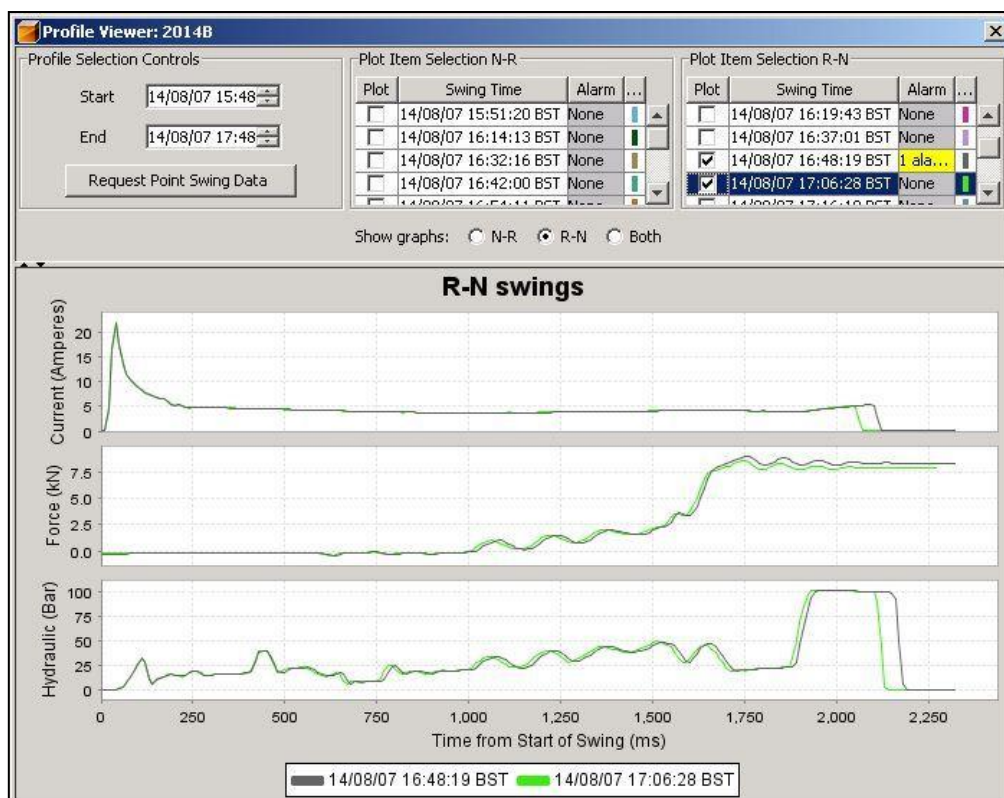


Figure 13: Profile Overlay – PCM System with current, force & hydraulic pressure

Unlike some similar systems, all graphical information in AssetWatch is presented in data rich format which captures all measurement points allowing users to quickly zoom in to areas of interest, changing scaling as required.

REPORTING

As part of the Email server tool, AssetWatch can automatically produce a daily email report of active alarms which will be circulated to selected users. A set of dedicated reporting tools also enables maintainers to display and export specific parameters relating to asset performance and develop their own custom reports. Examples include number of operations, failures, alarms or irregularities for a particular asset or group of assets. These reports can be exported/saved in a number of different file formats or Emailed to any user registered in AssetWatch

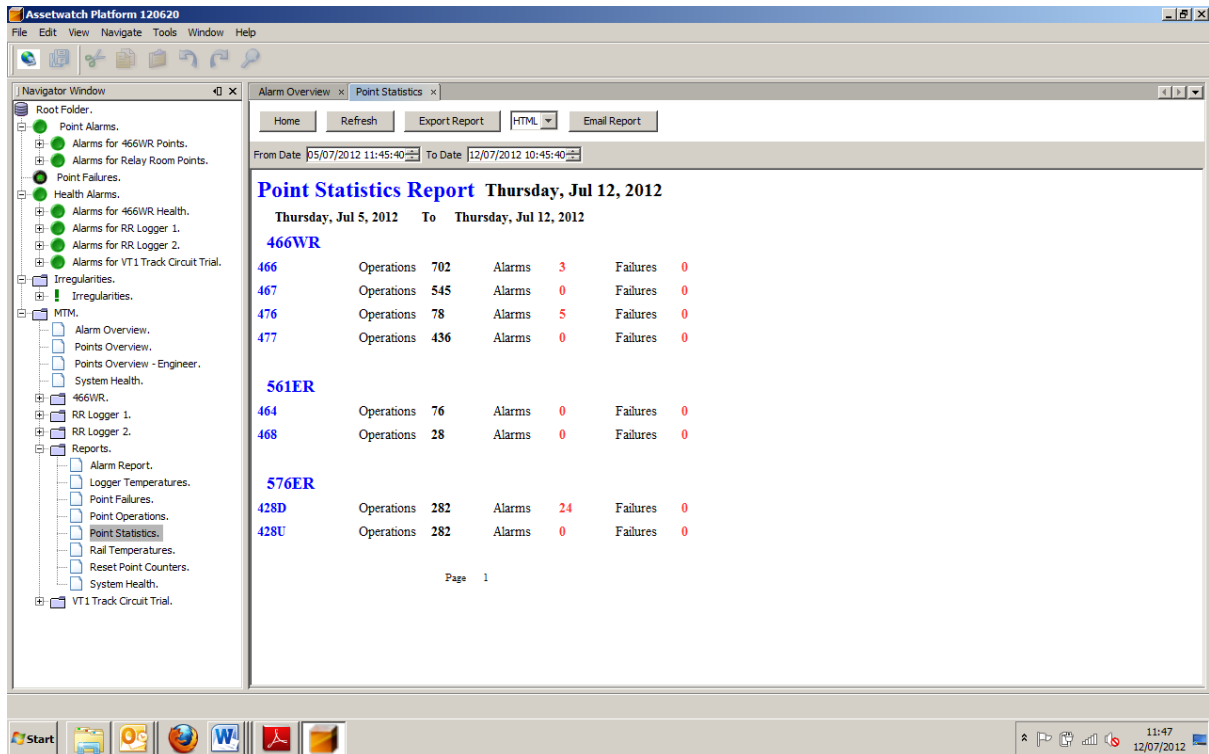


Figure 14: Creating a custom report

INTELLIGENT ALARMING – PCM

For Points monitoring, AssetWatch can generate a number of different alarm categories relating to asset condition/performance. For example, a single irregular point operation may be beyond alarm or alert thresholds for multiple parameters – such as average or peak current, and movement time. This could lead to several alarms associated with a single fault, which would make it labour intensive for the operator to review all the data. A further problem is that an actual points ‘failure’ where detection isn’t made or a situation where the points are called and then cancelled will also generate a similar set of alarm events to a fault.

AssetWatch addresses these issues by treating each individual occurrence of abnormal asset behaviour as an ‘irregularity’ rather than an alarm. Each irregularity is given a different weighting, depending on the threshold which has been exceeded – e.g. H (alert) = 1/2 and HH (alarm) = 1. Alarm records are only produced when the sum of the irregularities exceeds a pre-defined threshold. This can be due to an accumulation of irregularities over a number of operations or a number of consecutive irregularities. All parameters are configurable allowing alarm reporting to be tailored to the asset type and its frequency of operation.

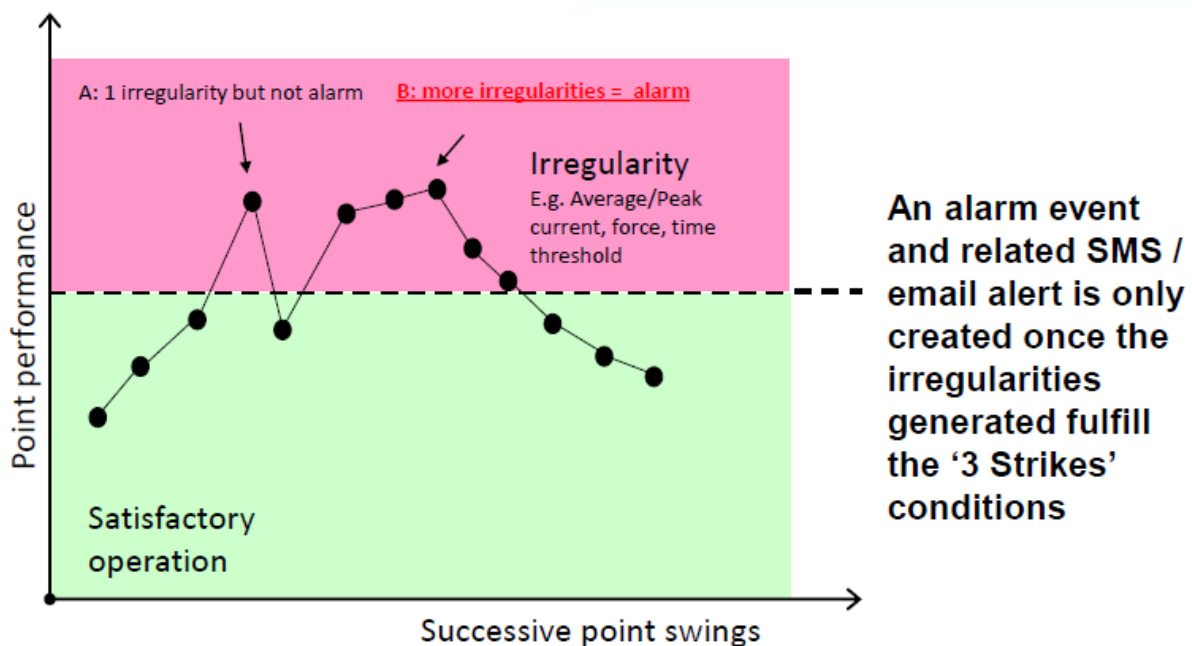


Figure 15: AssetWatch PCM Alarm logic – Basic principle

This technique, known as ‘3-Strikes’ uses a rolling window, in which the irregularities are summed together. All parameters, like the sample size of the window, the irregularity total which must be reached before an alarm is announced and the number of consecutive irregularities which generate an alarm are all fully user configurable.

The system automatically filters out point swings which are actual failures so that they cannot be confused with condition based alarms which indicate potential point failure.

Three Strikes

Three Strikes Configuration

Sites Australia - Glenfield PCM - Glenfield GD2

Channel Name	Channel Type	Num Samples	Alarm Threshold Count	Consecutive Count
39A	PE	5	3	4
39A M Current	AI	1	1	1
39A NWR	DI	1	1	1
39A RWR	DI	1	1	1
39B	PE	5	3	4
39B M Current	AI	1	1	1
39B NWR	DI	1	1	1
39B RWR	DI	1	1	1
AMBIENTL PM011	TI	1	1	1
AMBIENTL PM011	AT	1	1	1
Door Switch	DI	1	1	1
Engineers Switch	DI	1	1	1
MODULE_HEALTH	DI	1	1	1
Master Supply	SV	1	1	1
Master Temp	BT	1	1	1
ONLINE	DT	1	1	1
PM011 Board Temp	BT	1	1	1
PM011 Supply	SV	1	1	1
Rail Temp PCM01	AI	1	1	1
SEQUENCE_ERROR	DT	1	1	1
Spare DI011 IP5	DI	1	1	1
Spare DI011 IP6	DI	1	1	1
Spare DI011 IP7	DI	1	1	1
Spare DI011 IP8	DI	1	1	1

Num. Samples

Alarm Threshold Count

Consecutive Count

SET

Figure 16: Configuring 3 Strikes parameters

Three separate logs are generated within AssetWatch, for Alarms, Irregularities and Failures. Only the actual alarms are reported and sent out via Email.

- Alarms (condition based) are to highlight imminent failures requiring attention
- Irregularities are to use to validate and investigate alarms
- Failures are used as a reference as these are generally not condition based but a one off failure, often due to engineering works

For Points Monitoring the '3-Strikes' technique is a reliable method of distinguishing 'one-off' conditions, such as a stiff/slow swing when the points are first operated for the day, or a temporary obstruction of the switch rail from real deterioration in asset condition. This means users get consistent early warning of potential failure, without excessive false alarms.

EVENT MONITORING

Event monitoring systems for relay based Interlockings produce a log of time stamped 'events' showing the status of various controls & indications which can then be analysed by engineers to ascertain if the signalling system was operating correctly.

To assist in the analysis of recorded data, and expedite investigation, AssetWatch includes an event browser and graphical replay options which enable events stored by the data logger to be converted into a visual representation of signaling activity, consistent with what would be seen on a control panel. These tools can save valuable investigation time following an incident or allegation involving the signalling system.

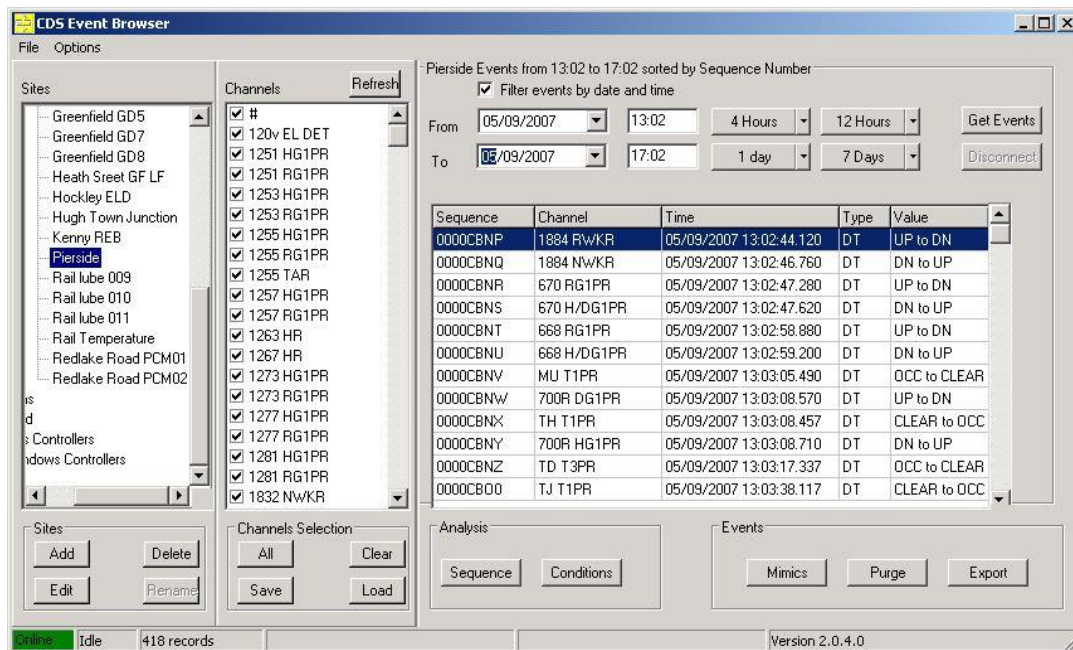


Figure 17: Event Browser

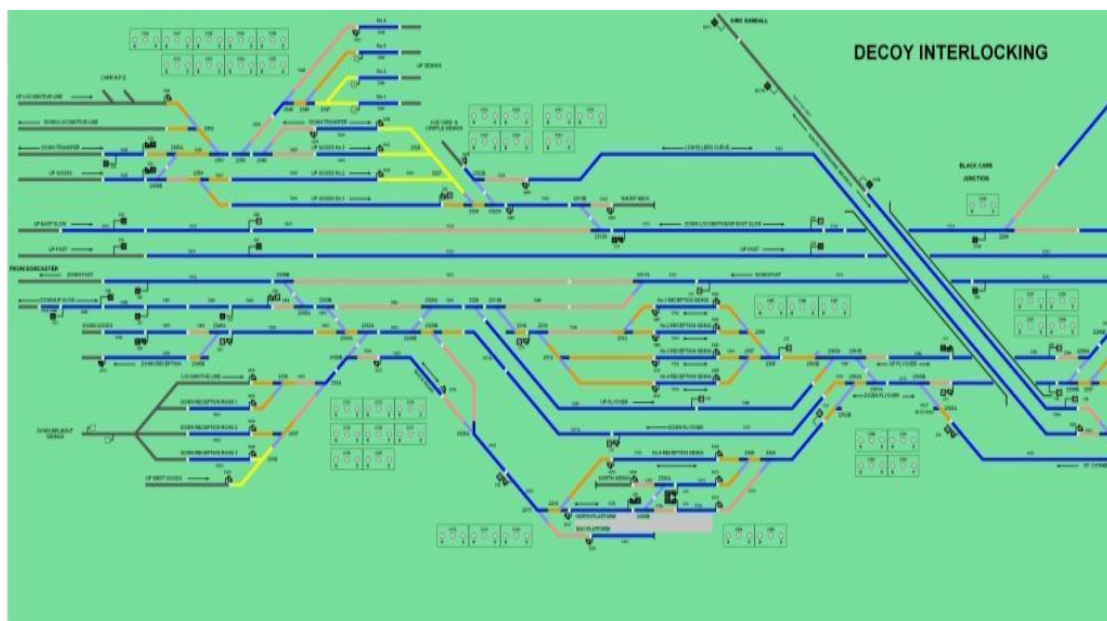


Figure 18: Typical Mimic for Graphical Replay

Intelligent software modules within AssetWatch also allow users to set alarm events, which would be generated by specific signaling behavior.

The AssetWatch **Alarm Event module** allows individual events to be designated as alarms, and also allows alarms to be generated from combinations of events using Boolean logic and timers. This module has numerous practical uses including detecting signals passed at danger (SPAD), approximating train speed.

Figure 19: Configuring a logical alarm using the alarm event module

The AssetWatch **Point module** module is designed to raise an alarm should the operation of the points exceed a given time or if there is a momentary loss of detection – e.g. due to the weight of a train or as a result of switch creep in hot conditions. The Point module uses a configuration ‘wizard’ that allows a particular point end to be selected and a flicker/point movement thresholds set.

Figure 20: Configuration Wizard for point module

As incoming data is processed by AssetWatch the events associated with the point end channels will be checked by the point module. If the operation of the points exceeds the point movement threshold an alarm will be raised by Point module. This alarm will be displayed in AssetWatch and could also be sent to the user as an email or SMS message.

If the points indication is lost and then returns within the point flick threshold, a point flicker has occurred and an alarm will be raised by AssetWatch. This alarm will be displayed on an alarm viewer and could also be sent to the user as an email or SMS message. If the loss and return of the indication exceeds the threshold, no alarm is raised. This could be a point movement

The **Track Circuit module** operates in a similar way to detect track circuit 'flick', a condition where a track circuit momentarily changes state, either 'Occupied – Clear – Occupied' or 'Clear – Occupied – Clear'.



Figure 21: Configuration Wizard for the Track circuit module

As incoming data is processed by the AssetWatch server, the events associated with any channel where TC Flick alarming has been configured will be checked by the Track Circuit Flick module. If the transition from the first state to the third state is less than the threshold an alarm will be raised by the TC Flick module. This alarm will be displayed on an alarm viewer within AssetWatch and could also be sent to the user as an email or SMS message.

The normal operation of a track circuit will always be in excess of 1000ms (which is the maximum allowable flick threshold) so will never be detected by this module.

LEVEL CROSSINGS

For systems where controls & indications are monitored at Level crossings, AssetWatch includes a fully featured Level Crossing module, which monitors data from every crossing operation to perform continuous analysis of crossing performance. Automatic checks include:

- Yellow road lamps lit for correct time
- Red road lamps lit for correct time
- Barriers lowered within specified time (actual time recorded)
- Barriers raised within specified time (actual time recorded)
- Check crossing starts within specified time of strike in
- Road closed time
- Train speed

The module can be easily setup to cover different crossing configurations and provides early warning if any part of the crossing is operating outside of normal parameters.

Level Crossing

Site: Acton Central ELD

Road Signals Barriers Timings

Lowering Delay

Red signals flashing: <Not selected> changes to: [dropdown] ⓘ

Barriers start to lower: <Not selected> changes to: [dropdown] ⓘ

Acceptable range: 4 secs 0 msecs to 8 secs 0 msecs ⓘ

Cut off: 10 secs 0 msecs ⓘ

Lowering Time

Start to lower: <Not selected> changes to: [dropdown] ⓘ

Barriers lowered: <Not selected> changes to: [dropdown] ⓘ

Acceptable range: 6 secs 0 msecs to 8 secs 0 msecs ⓘ

Cut off: 10 secs 0 msecs ⓘ

Raise Time

Start to raise: <Not selected> changes to: [dropdown] ⓘ

Barriers raised: <Not selected> changes to: [dropdown] ⓘ

Acceptable range: 3 secs 0 msecs to 7 secs 0 msecs ⓘ

Cut off: 10 secs 0 msecs ⓘ

Barriers Hunting

Hunting: <Not selected> changes to: [dropdown] ⓘ while: <Not selected> is: [dropdown] ⓘ

Figure 22: Configuring barrier parameters in the Level Crossing module

Level Crossing

Site: Acton Central ELD

Road Signals Barriers Timings

Yellow Road Signals

Yellow signals on: <Not selected> changes to: [dropdown] ⓘ

Yellow signals off: <Not selected> changes to: [dropdown] ⓘ

Acceptable range: 3 secs 0 msecs to 5 secs 0 msecs ⓘ

Cut Off: 10 secs 0 msecs ⓘ

Red Road Signal Lamp Failure

while: <Not selected> is: [dropdown] ⓘ

YN: <Not selected> changes to: [dropdown] ⓘ

YO: <Not selected> changes to: [dropdown] ⓘ

ZN: <Not selected> changes to: [dropdown] ⓘ

ZO: <Not selected> changes to: [dropdown] ⓘ

Aux1: <Not selected> changes to: [dropdown] ⓘ

Aux2: <Not selected> changes to: [dropdown] ⓘ

Alarm Reset: <Not selected> changes to: [dropdown] ⓘ

Red Road Signal Lamp Failure

Signal Failure: <Not selected> changes to: [dropdown] ⓘ

Figure 23: Configuring road lamp parameters in the Level Crossing module

Level Crossing

Site:

Road Signals Barriers Timings

Select LC type:

Distance A: yds m

Line Speed: mph km/h

UP Strike in A TC UP Exit B TC

UP Direction DOWN Direction

D TC C TC

DOWN Exit

DOWN Strike in

Line Speed: mph km/h

Distance C: yds m

Barrier Events

Barriers lowered: changes to:

Acceptable Ranges

UP Strike in: secs msec to: secs msec

Figure 24: Configuring timing parameters in the Level Crossing module

Swineshead LX

Time Selection

From: To:

Operations

Time

31/00/1969 04:00:00.000 PST

20/59/2011 02:59:07.780 PDT

20/58/2011 03:58:15.130 PDT

20/59/2011 04:59:20.880 PDT

20/33/2011 05:33:23.400 PDT

20/58/2011 05:58:05.630 PDT

20/59/2011 06:59:28.140 PDT

20/55/2011 07:55:37.250 PDT

20/57/2011 08:57:14.410 PDT

Alarms

Yellow Lights Time (5.44)

Red Lights switched on too long (7.94)

Barriers lowered too quickly (6.07)

ZN Red Road Signal Lamp Out (0.00)

ZO Red Road Signal Lamp Out (0.00)

Barriers raised too quickly (4.27)

Timings

Strike to CONSR(secs) 13.5

Yellow Road Lights (secs) 5.44

Red Road Lights(secs) 7.94

Barrier Lowering 6.07

Down Time(secs) n/a

Barrier Raise Time(secs) 4.27

Average Down Train Speed n/a

Average Up Train Speed 9.23

Strike To Exit Up(secs) 49.1

Strike To Exit Down(secs) n/a

Key

UP Strike in DOWN Strike in DOWN Exit UP Exit

Events

Sequence No.	Channel	Time	Transition
1MFY8	A ATC SR	04:59:20.880 PDT	DOWN
1MFY9	Y TR	04:59:34.310 PDT	DOWN
1MFYA	Y TPSR	04:59:34.350 PDT	DOWN
1MFYB	U130 NSR	04:59:34.360 PDT	DOWN
1MFYC	HER	04:59:34.400 PDT	DOWN
1MFYD	CON R	04:59:34.420 PDT	DOWN
1MFYE	U130R H/EPR	04:59:34.480 PDT	UP
1MFYF	Y1/2 QCSR	04:59:34.580 PDT	DOWN
1MFYG	RER	04:59:39.860 PDT	DOWN
1MFYH	DELAY JR	04:59:39.860 PDT	DOWN
1MFYI	ZN/ZO RECR's	04:59:39.900 PDT	UP
1MFYJ	YN/YO RECR's	04:59:39.900 PDT	UP
1MFYK	YN/YO RECR's	04:59:40.570 PDT	DOWN
1MFYL	ZN/ZO RECR's	04:59:40.580 PDT	DOWN
1MFYM	ZN/ZO RECR's	04:59:40.820 PDT	UP
1MFYN	YN/YO RECR's	04:59:40.830 PDT	UP
1MFYO	CON JPR	04:59:47.280 PDT	DOWN
1MFYP	CON JR	04:59:47.360 PDT	DOWN
1MFYQ	UP KR	04:59:47.800 PDT	DOWN
1MFYR	UP KJPR	04:59:47.820 PDT	DOWN
1MFYS	DN KR	04:59:53.870 PDT	UP
1MFYT	REJR	04:59:54.100 PDT	UP
1MFYU	Y3 QRSR	05:00:03.420 PDT	UP
1MFYV	DN KJPR	05:00:03.800 PDT	UP
1MFYW	Y4 QNSR	05:00:05.150 PDT	DOWN
1MFYX	Y4 QRSR	05:00:05.240 PDT	UP
1MFYY	Y5 QNR	05:00:07.020 PDT	DOWN
1MEYZ	U130 GR	05:00:07.030 PDT	DOWN

Figure 25: Level Crossing performance report