CDSRail
a voestalpine company
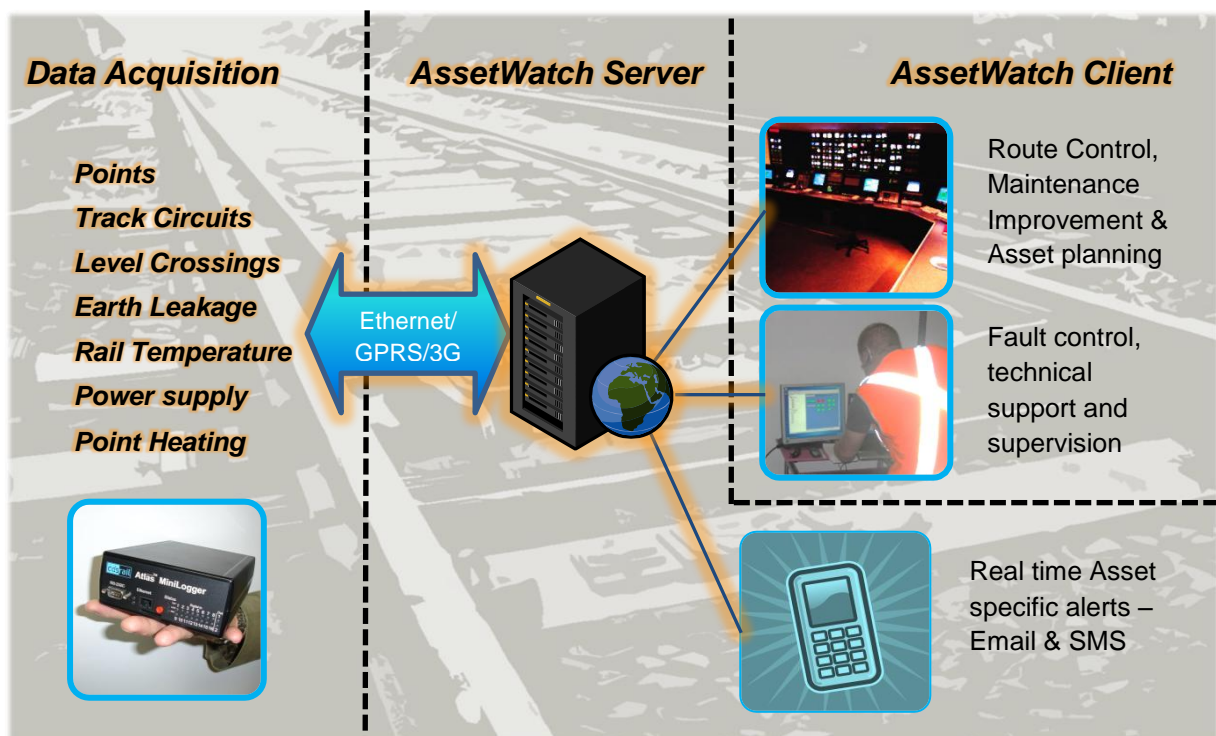
AssetWatch

Asset Monitoring Software
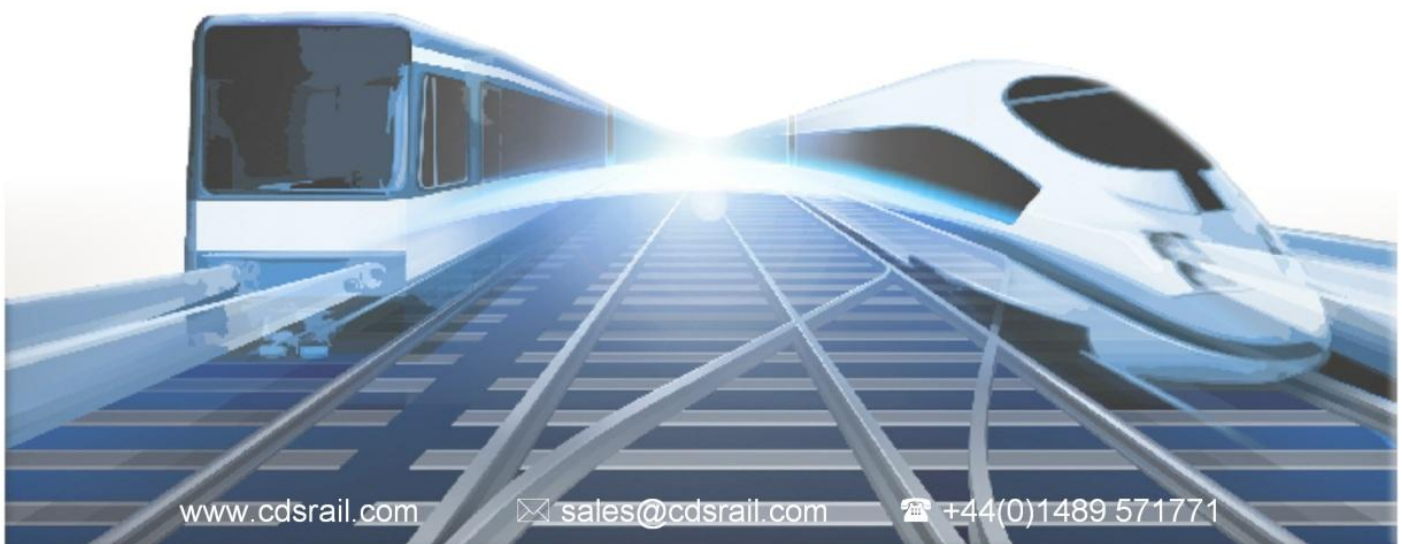
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BACKGROUND & INTRODUCTION

CDSRail 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.
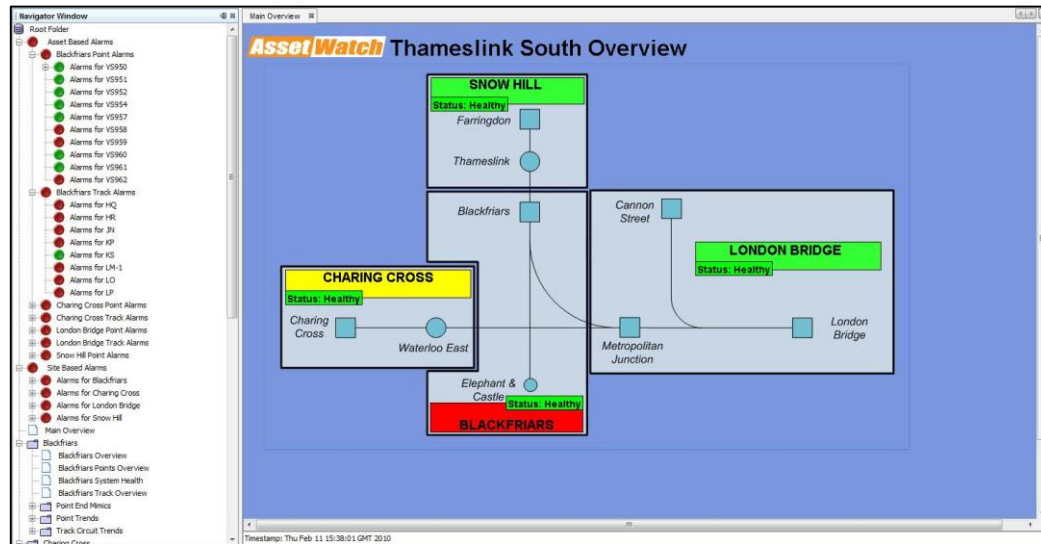

Figure 1: Typical Main Overview Screen

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.
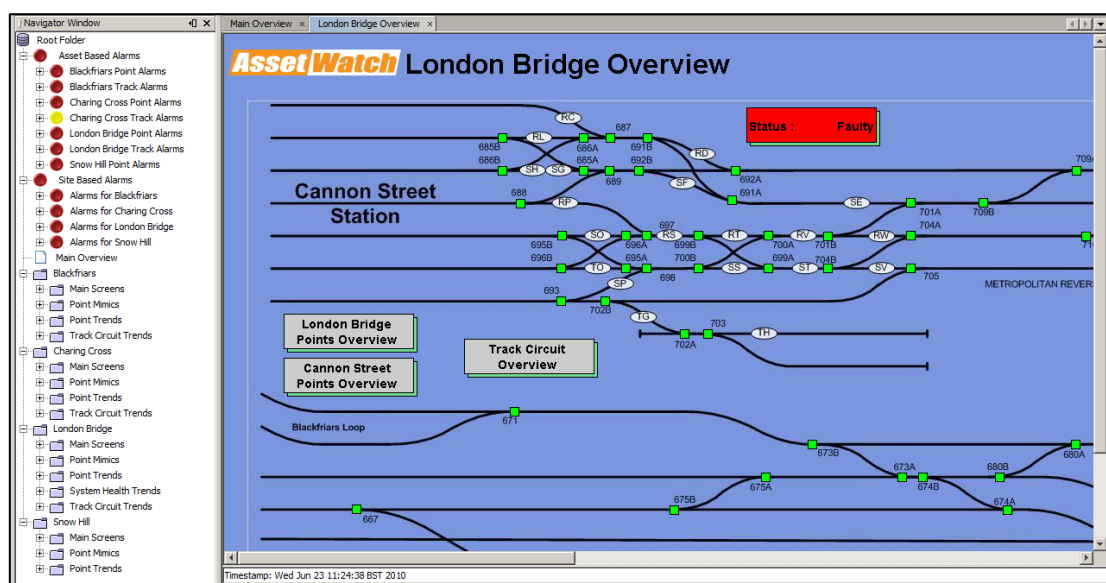

Figure 2: Site Overview

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.
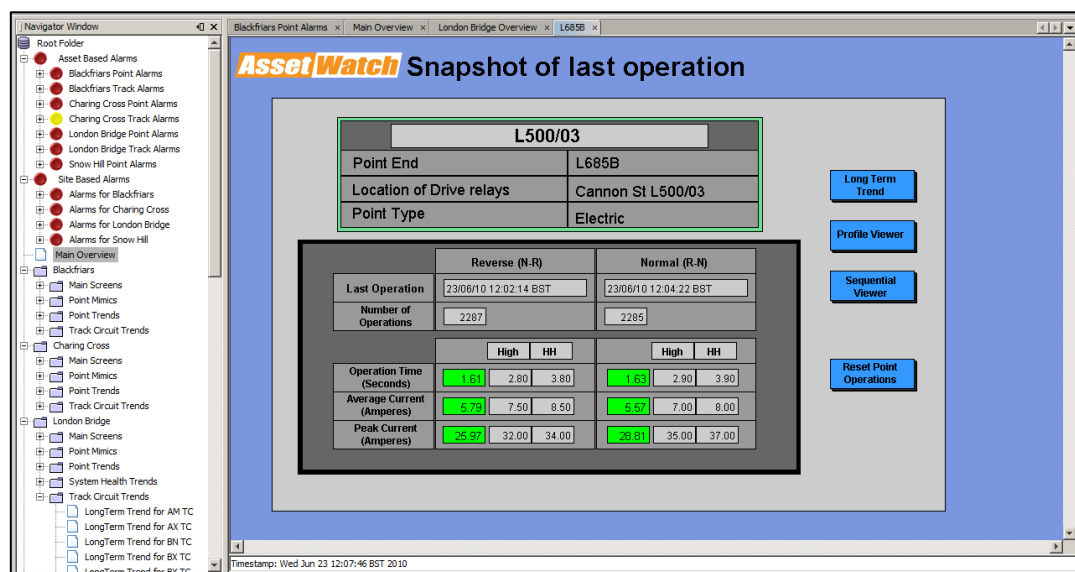
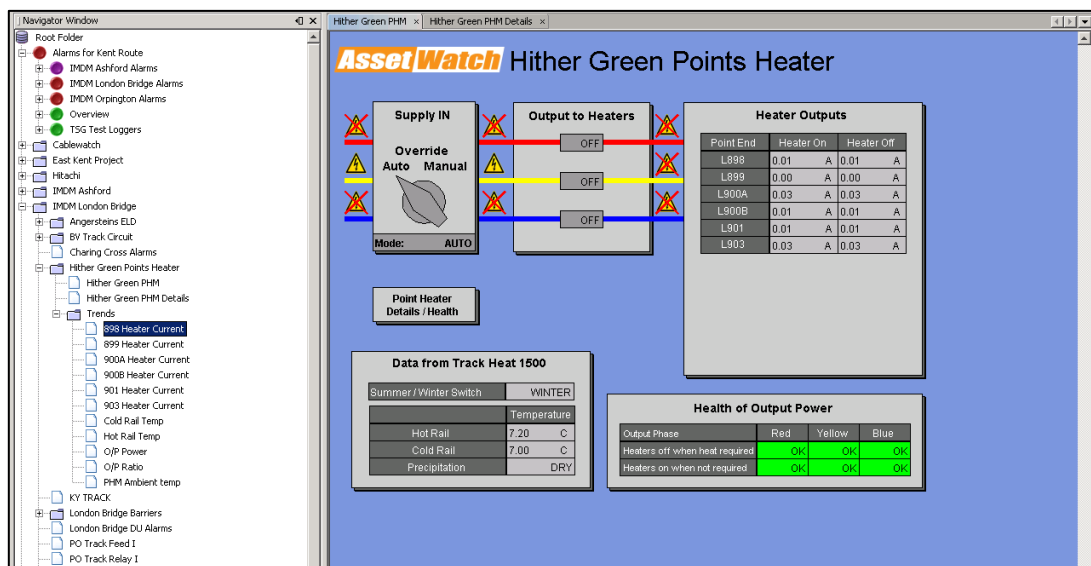**Figure 3: Example Asset Overview – Points Monitoring**

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.

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

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.

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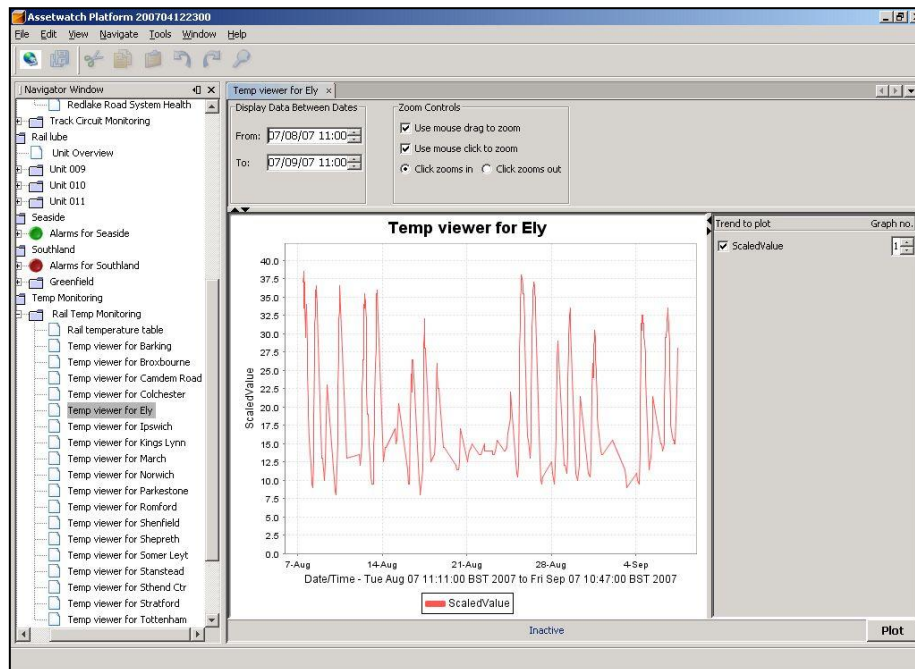
Figure 8: Long term trend – Rail temperature over 1 month

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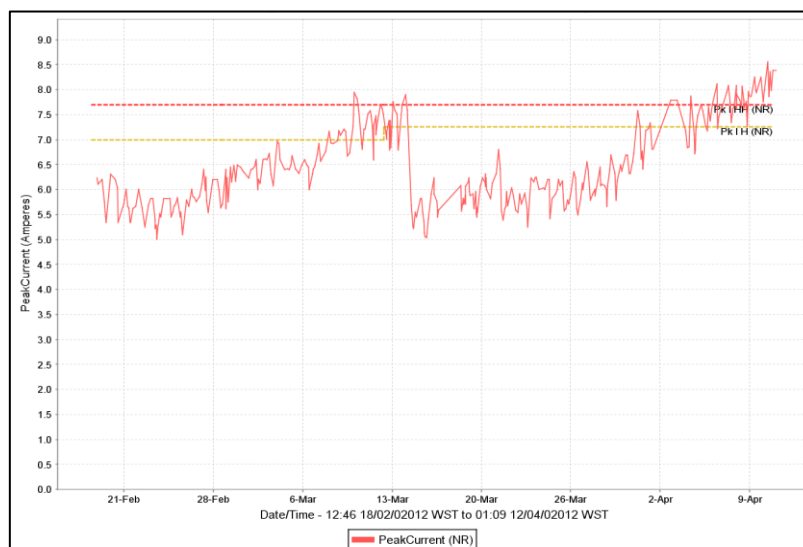
Figure 9: Long term trend – peak current per point movement over 9 weeks

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

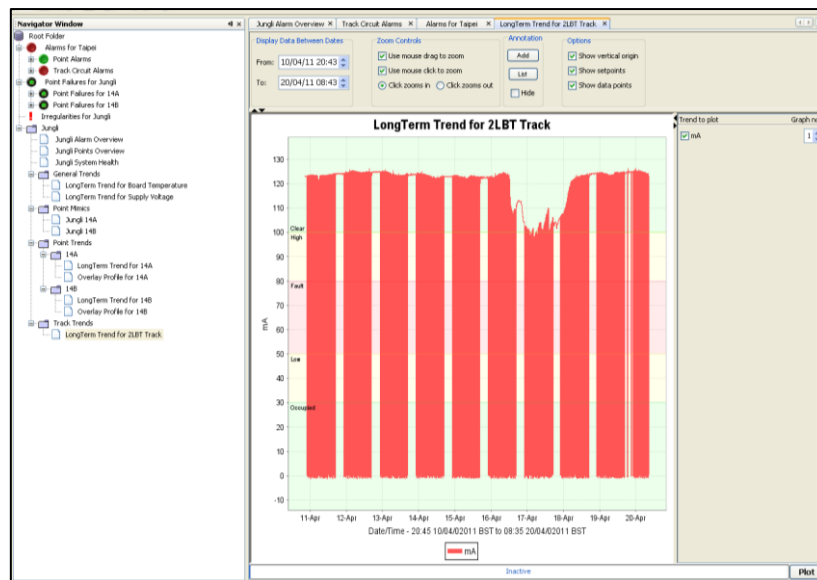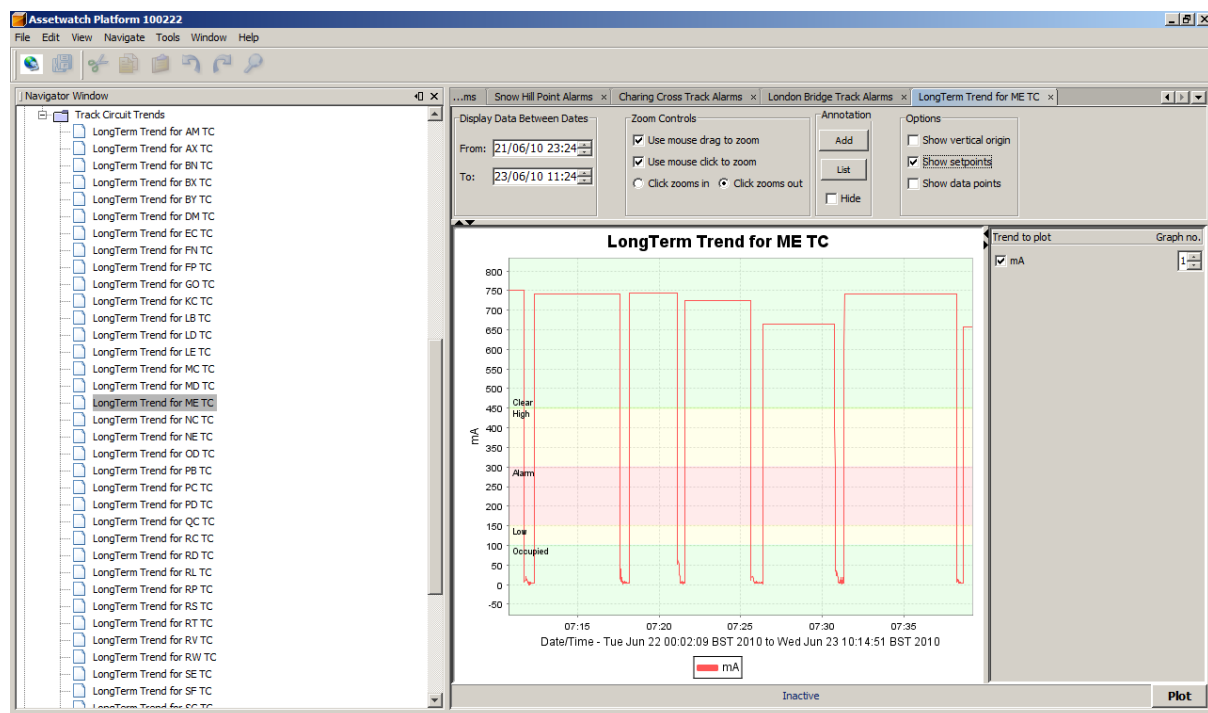For parameters which are acquired at a much faster rate – e.g. 'profiles' of point movements or level crossing barrier activity, one of the most powerful features of AssetWatch is the profile viewer, which allows point movement profiles recorded by the system to be plotted against time for detailed analysis.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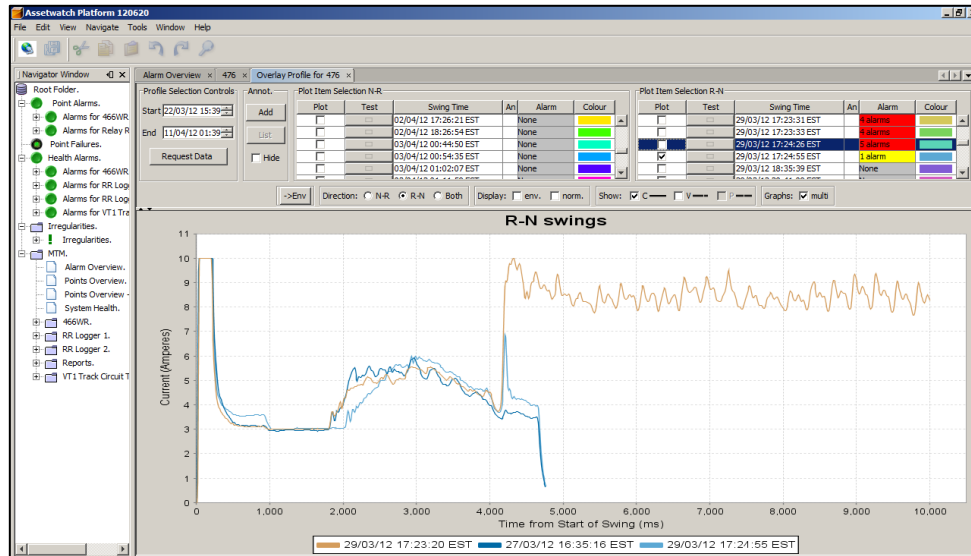

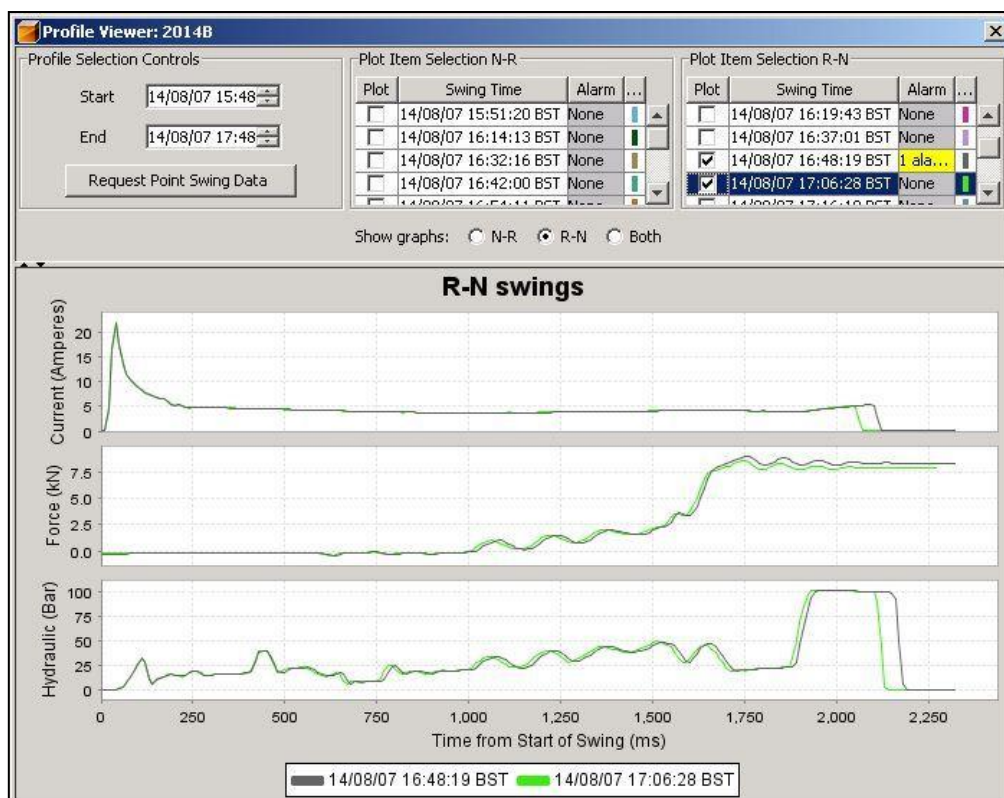**Figure 12: Profile Overlay – Point Motor Current**

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
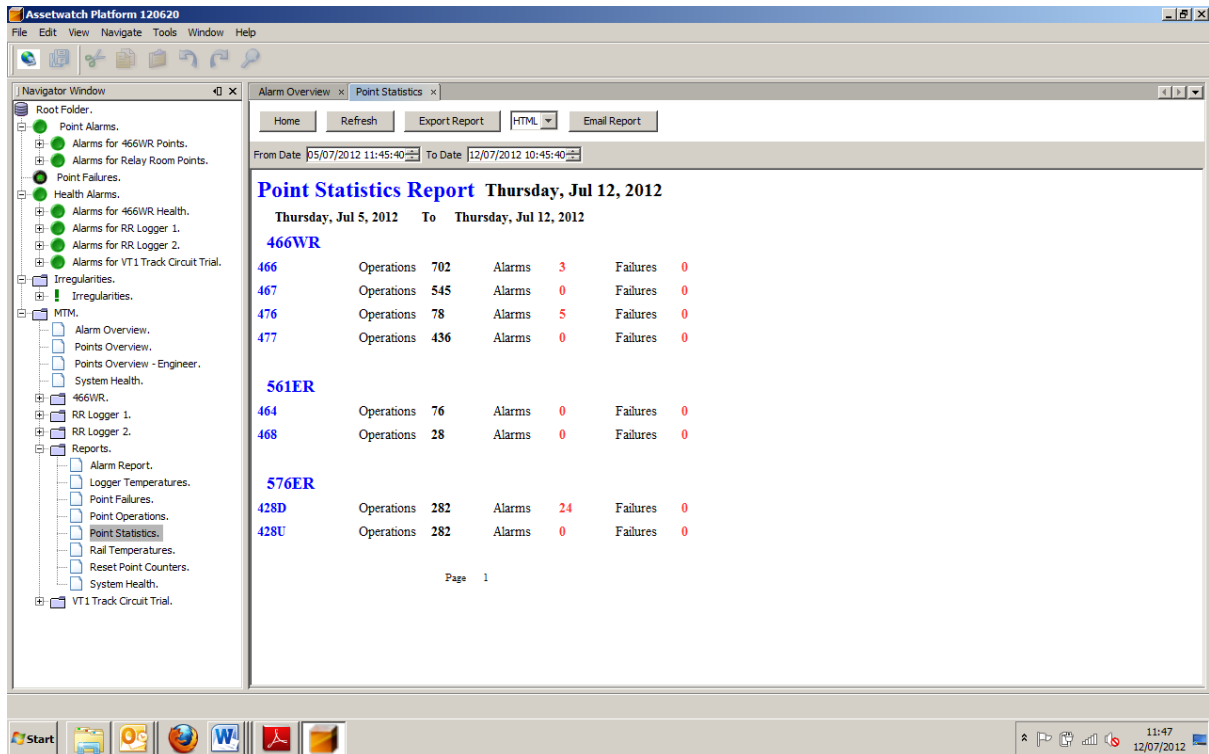

Figure 14: Creating a custom report

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.
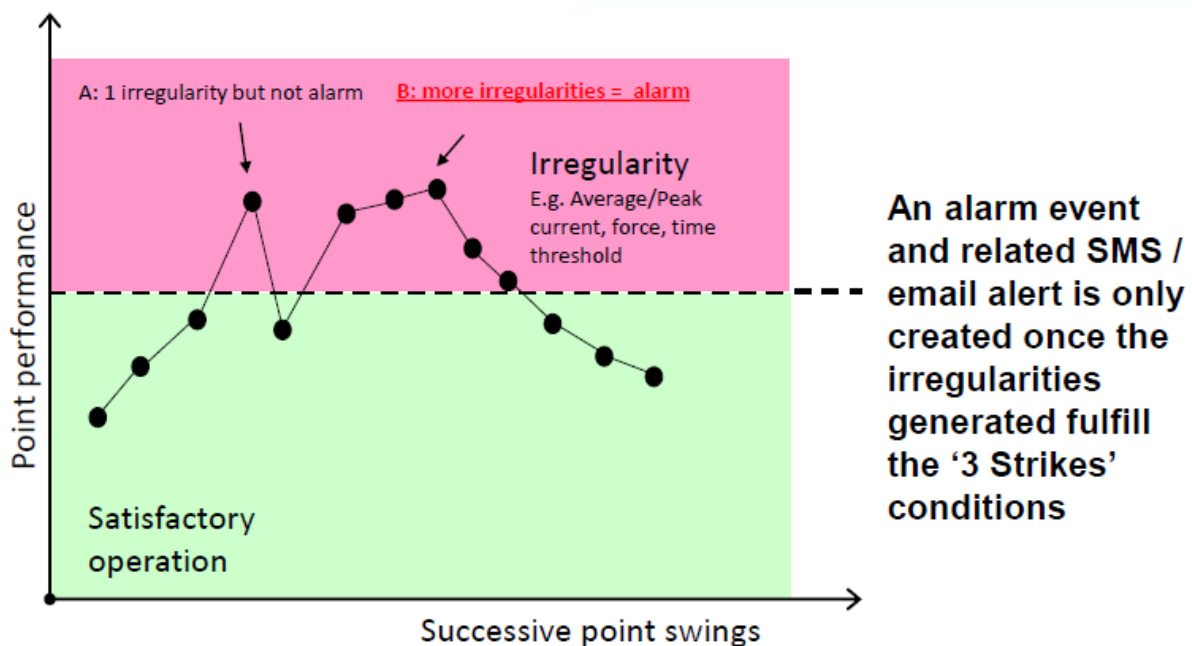

Figure 15: AssetWatch PCM Alarm logic – Basic principle

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
AMBIENT 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 DIO11 IP5	DI	1	1	1
Spare DIO11 IP6	DI	1	1	1
Spare DIO11 IP7	DI	1	1	1
Spare DIO11 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.
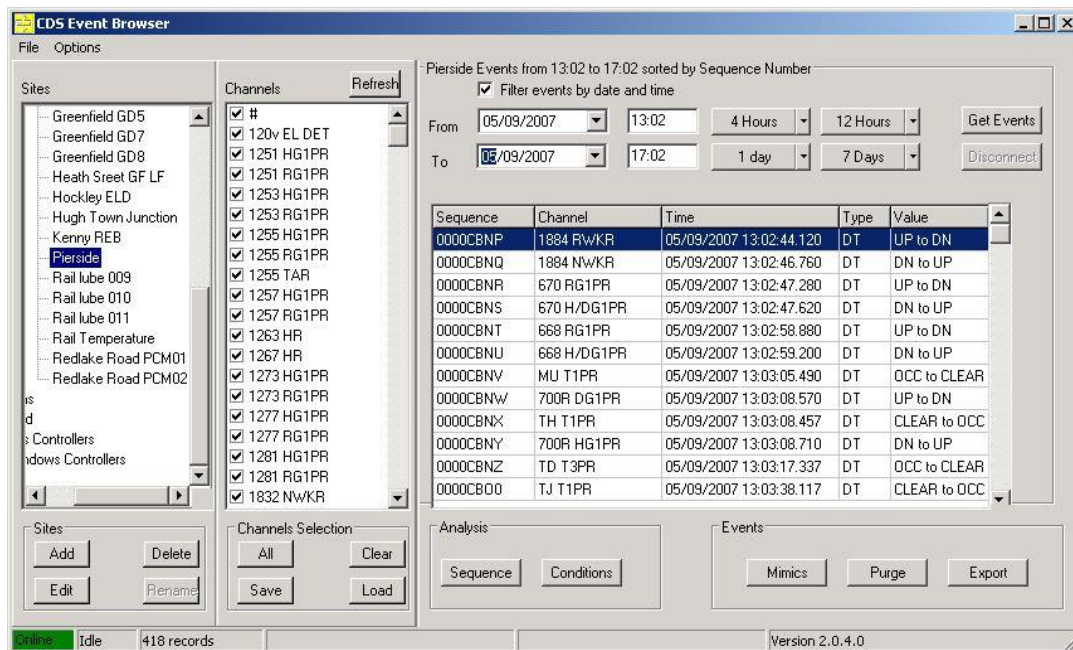
Figure 17: Event Browser
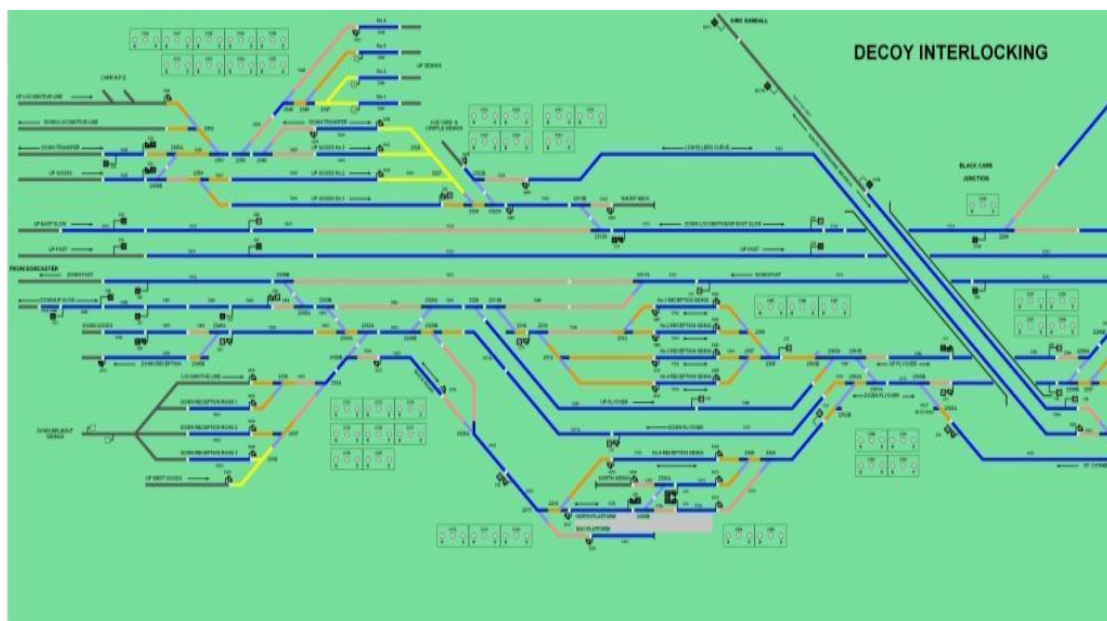
Figure 18: Typical Mimic for Graphical Replay

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.

Figure 22: Configuring barrier parameters in the Level Crossing module

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

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Figure 24: Configuring timing parameters in the Level Crossing module

Figure 25: Level Crossing performance report