STEP (Short TErm Prediction)

User Interface Specification

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Executive summary

This document details the proposed User Interface that will be presented to potential users of the short term predictors in the UK Pilot to allow assessment and evaluation of how those potential users might use that interface to support decision making in their strategic management of the road network.

In order to minimise development and concentrate on operational principles, the interface will be based on the proven Mott MacDonald Osprey[1] product (currently used by a number of English Local Authority traffic management teams); specifically, the Web-Client application which provides a front-end to the Osprey common database. This approach allows the use of a proven and comprehensive UTMC common database and product toolset which is easily enhanced with additional features to support the STEP user interface evaluation trial.

[1] Osprey is the brand name of the Mott MacDonald product to support UTMC common database systems.

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1 Introduction

"ERA-NET ROAD – Coordination and Implementation of Road Research in Europe" was a Coordination Action funded by the 6th Framework Programme of the EC. The partners in ERA-NET ROAD (ENR) were United Kingdom, Finland, Netherlands, Sweden, Germany, Norway, Switzerland, Austria, Poland, Slovenia and Denmark (www.road-era.net). Within the framework of ENR this joint research project was initiated. The funding National Road Administrations (NRA) in this joint research project are Belgium, Switzerland, Germany, Netherlands Norway and United Kingdom.

The research project as a whole is described in the STEP Project Inception Report (Ref [1]). The report is aligned with Work Package 3 "WP3 - Preparing Pilot Software Development of tools for scenario development and decision support".

Work Package 2 "Identifying User Requirements", canvassed a number of potential users of short term prediction data and the results of that exercise are described in the WP2 User Requirements Report (Ref [2]). This report recommended a way forward with both UK and Dutch trials which would investigate the potential ways in which users may view and apply the information generated from a short term prediction model to support their operational management of the strategic road networks. Users were divided on the type of user interface; some interested in an alerting type interface and others interested in graphical representation of the predictions. The combination of the UK and Dutch trials aim to investigate both mechanisms.

In terms of visualisation, the Work Package 2 User Requirements report identified that:

- The use of colour-coded links overlaid on a map view was the most popular response accompanied by alerts or alarms in case of abnormal conditions; and
- The level of manual intervention when using the tool should be kept to a minimum and automation should be provided to help the operators.

In order to address these views, this document describes the proposed way forward for the UK based trial using an alerting type mechanism to advise operators when traffic conditions are predicted to be different from the operational norm and provide a minimal user workload associated with using the tool. The Mott MacDonald product 'Osprey', which is currently in use by a number of Local Authorities in the UK in support of management of their road networks, will be enhanced as described in this document to provide the additional features relating to short term prediction alerting. This approach maximises benefit of an existing product and technologies (standard UTMC common database and web based display capability) without major development of new tools and products. It allows the project team to concentrate on the user interface to the short term prediction mechanisms needed rather than developing new tools and products to support the trial.

The approach will also lead itself to more straight-forward evaluation and adaptation to assess different operational regimes and environments. The principles proposed for embodiment in this tool will be easily transferable to other tools and products.

Screen images are used in this document to give representative views of what the STEP web-client might look like. These images have been taken from similar installation of the Osprey product, mock-ups and prototype screens.

1.1 References

[1] STEP Project - Inception Report, dated October 2011

[2] STEP Project: WP2 – User Requirements Report, dated June 2012.

1.2 Acronyms

CDB	Common Database system
MIDAS	Motorway Incident Detection and Automatic Signalling
NTIS	National Traffic Information Service
SWRCC	UK South West Regional Control Centre
TCD	Traffic Count Data

2 STEP User Environment

2.1 Environment

The UK STEP pilot system will take near real-time traffic data (flow and speed) from MIDAS sites via the MIDAS Gold system and road link based averaged data from NTIS services covering trunk roads where there is little or no MIDAS site coverage. These data feeds will be combined and compared and then fed into an analysis model to predict short term (up to an hour ahead) the likely changes in flow and speed along the roads selected as part of the pilot system.

The predicted flow and speed characteristics will be stored in the Common Database and presented to users in a number of ways to help support decision making on how the road network might be managed in the short term.

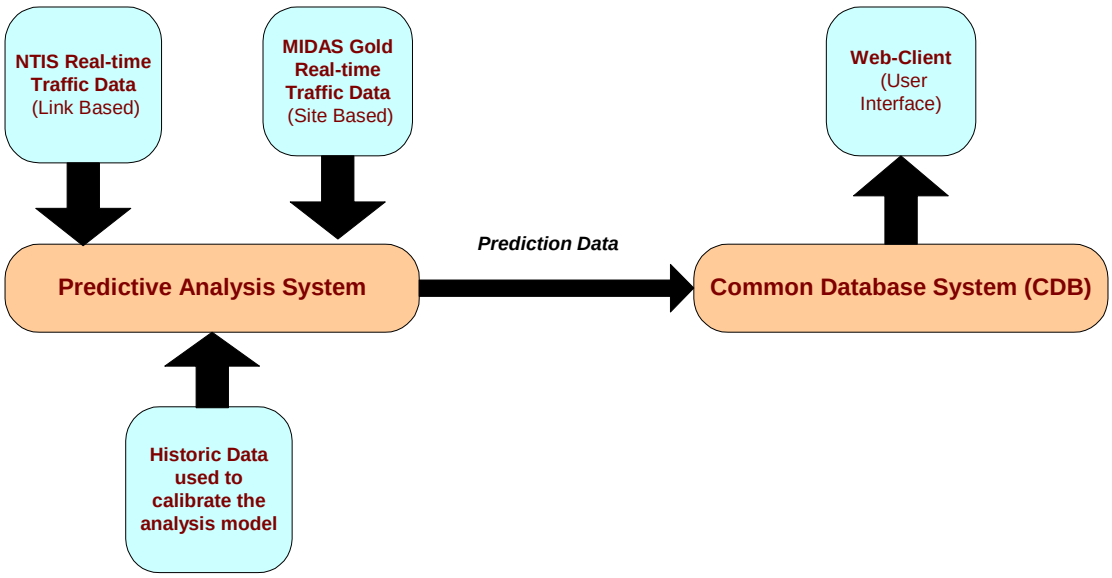


Figure 1: Trial System Environment

2.2 Basis of Trial

There are a number of ways for a user to monitor how the prediction model is anticipating the traffic characteristics changing over the next period of time. This trial assumes the need for users to not be continuously monitoring a screen in order to anticipate problems arising on the road network. This is based on experience of the users of the Osprey product and the practicality that the STEP user interface will be displayed on a separate (additional) screen to those the user would normally be using to manage the road network. This was reinforced during discussions held with the Highways Agency Regional Control Centre in the South West of England, where the Agency's Area 2 management team manage, monitor and maintain the strategic highway network. Given the wide variety of tasks that the team already has to perform, it was concluded that a permanent screen was not practical and would interfere with daily operational activities. In addition, the target users already have a number of screens (map based and tabular information) on their operations desk with limited space for an additional screen to be monitored. Therefore it was concluded that the UK trial would therefore concentrate on prototyping an alerting mechanism to attract the attention of a user to possible issues in the near future so that decisions might be made based on those predictions.

3 User Interface

3.1 Why Osprey?

The User Interface will be implemented as an enhancement to the Mott MacDonald Osprey Web-Client product, which is currently in use by a number of English local authorities, to meet the additional and specific requirements of this trial. This proven product and toolset comprises a UTMC compliant database which will require little enhancement to support the trial and an application server environment that can quickly be used to integrate the additional data interfacing requirements.

The standard Osprey web-client provides all standard features required of such a product for secure logon, map display, dialogs, tabular data presentation and graphical data presentation. The Web-Client user interface already supports the standard features for any such tool requirement for the user interface evaluation of operating principles including a basic alerting mechanism. These facilities will simply be adapted to support this trial.

The enhancements (based on existing functionality, database structures and software modules) and development environment (using engineers familiar with the use of the product in the user installations) of the Osprey product will provide a sound basis for user evaluation and subsequent adjustment in line with feedback from users.

3.2 User Logon

The Web-Client is activated through a standard internet browser application such as Microsoft Internet Explorer.

When activating the Web-Client user interface, the user must supply a username and password in order to gain access to the tool.

Figure 2: Logon Dialog

As well as providing secure access to product (and hence to the information held by the product), these user details dictate what authorities and facilities that the user has access to and what fuctions may be performed using the web-client. Except where specifically noted in this document, all features and facilities described will be available to all users of the trial system. For this trial, all users will have the same operator access that will allow them to see acknowledge and display information on all alerts raised.

3.3 General Screen Layout

Once the user has successfully logged into the web-client, a multi-tabbed screen such as that shown below will be displayed. By default, the map tab will initially be displayed

indicating the alert status of the road network.

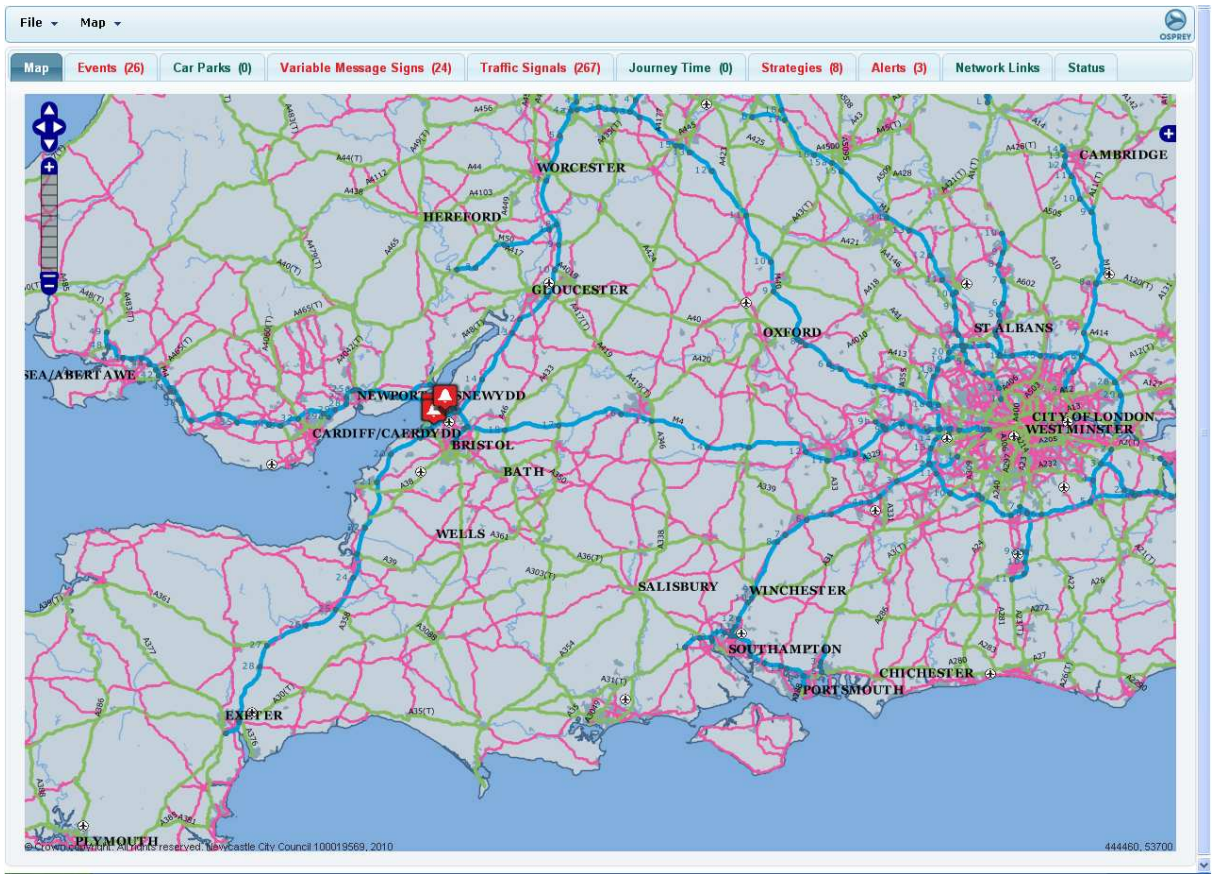


Figure 3: Main Screen Showing Map Tab

The screen lists the following tabs which are applicable to the trial:

- Map Tab (see below)
- Alerts Tab (see below)
- Links Tab (see below)

The following standard tabs are not applicable to the trail:

- Events Tab
- Car Parks Tab
- Variable message Signs Tab
- Traffic Signals Tab
- Journey Times Tab
- Strategies Tab
- Status Tab

3.4 Map Tab

The map shows both the strategic road network and the unmanaged road network. Whilst the user requirements study suggested that users would like to see colour-coded links and alerting mechanisms, a decision was taken to not introduce colour coding of links on the map in this UK trial system. This will allow users to concentrate on the alerting mechanisms and allow evaluation of how alerts might be viewed, managed and used to support the operation of the road network. The inclusion of link colouring of links would distract from this aim.

The zoom level of the map is adjusted by the control in the top left corner of the map window.

The following icons will be used on the map:

Unacknowledged Alert – Note red bar at top of icon.

Acknowledged Alert – Note Amber bar at top of icon.

Alert Cluster – Indicates that more than one alert is present at the indicated location on the map.

These icons will appear on the map attached to the section of road that raised the alert.

Clicking on the alert will display a dialog box containing information about that alert.

The map may be re-centred by holding down the left mouse button and dragging the map in the required direction.

See section 4.1 “Alert Lifecycle” for a description of the Alerts, how and when they are created, acknowledged and cleared.

An alert will be displayed at the start of a section of road (see Links Tab below) for which a prediction is calculated. Road sections are typically 100m-300m in length and so a number of alerts along a road will indicate the extent of the predicted congestion.

3.5 Alerts Tab

Figure 4: Alerts Tab

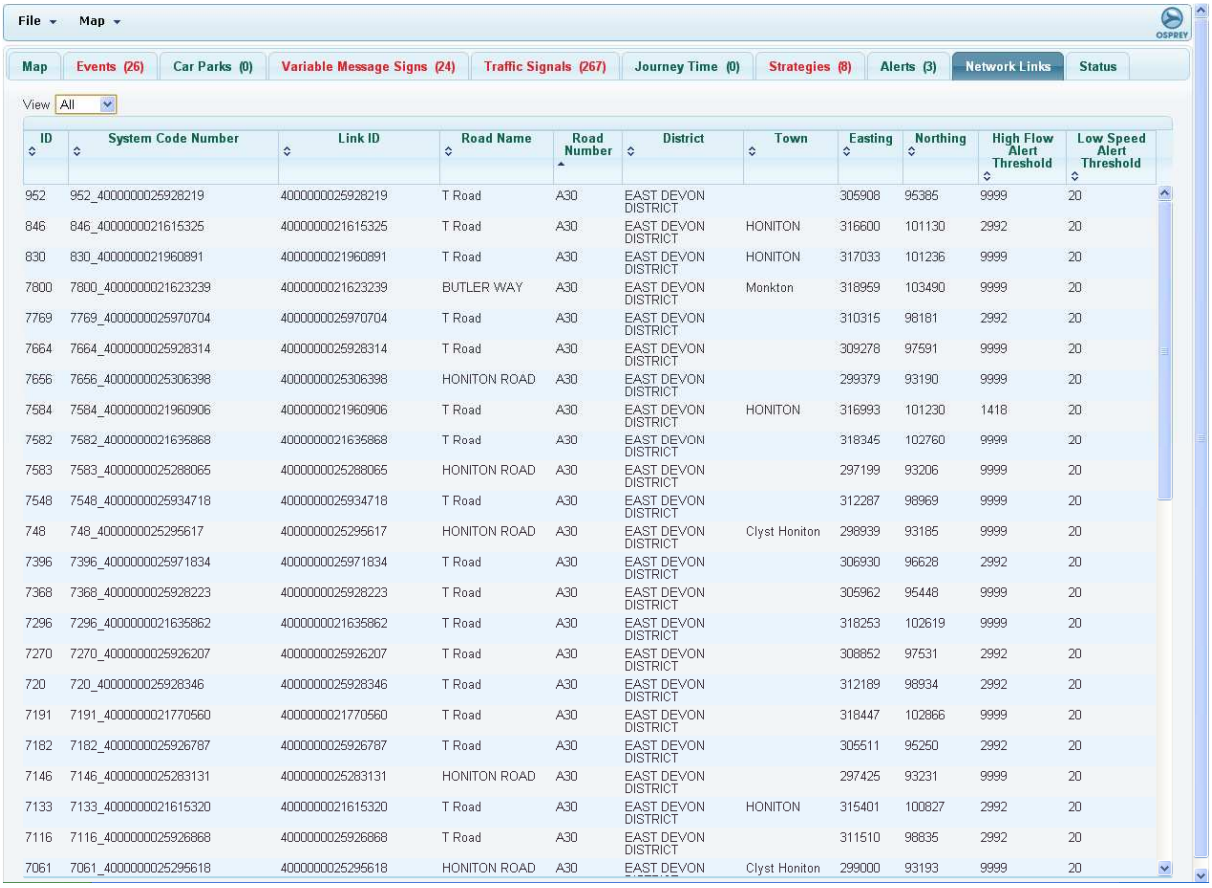
The alerts tab displays all active alerts (Unacknowledged or acknowledged). Once an alert clears, it disappears from the tab.

Each row on the tab contains the following information:

- <blank> - Currently either blank for an acknowledged alert or a red bar (as shown above) for an unacknowledged alert.
- Alert code – an internal code that describes the type of alert. Only two codes are currently supported; those corresponding to High Flow Alert and Low Speed Alert.
- Alert Description – The text 'High Flow' or 'Low Speed'. See 4.2 "Types of Alert".
- Location Description – the description stored in the common database describing the section of road on which the alert has been raised.
- Severity - all alerts will be initially configured at the same severity 'Attention'. These may be modified in the course of the trial by Mott MacDonald if users are able to define criteria by which different severities can be assigned by the tool.
- Status – either 'Unacknowledged' or 'Acknowledged'.
- Data Source – not implemented for this trial since only a single data source is used and would therefore add no value to the information presented.
- Last Updated – the timestamp when the alert record was last updated either by a user or by the alert generation function.

Double clicking on any alert on this tab will display the dialogue containing details of the alert.

3.6 Links Tab



ID	System Code Number	Link ID	Road Name	Road Number	District	Town	Easting	Northing	High Flow Alert Threshold	Low Speed Alert Threshold
952	952_4000000025928219	4000000025928219	T Road	A30	EAST DEVON DISTRICT		305908	95385	9999	20
846	846_4000000021615325	4000000021615325	T Road	A30	EAST DEVON DISTRICT	HONITON	316600	101130	2992	20
830	830_4000000021960891	4000000021960891	T Road	A30	EAST DEVON DISTRICT	HONITON	317033	101236	9999	20
7800	7800_4000000021623239	4000000021623239	BUTLER WAY	A30	EAST DEVON DISTRICT	Monkton	318959	103490	9999	20
7769	7769_4000000025970704	4000000025970704	T Road	A30	EAST DEVON DISTRICT		310315	98181	2992	20
7664	7664_4000000025928314	4000000025928314	T Road	A30	EAST DEVON DISTRICT		309278	97591	9999	20
7656	7656_4000000025306398	4000000025306398	HONITON ROAD	A30	EAST DEVON DISTRICT		299379	93190	9999	20
7584	7584_4000000021960906	4000000021960906	T Road	A30	EAST DEVON DISTRICT	HONITON	316993	101230	1418	20
7582	7582_4000000021635868	4000000021635868	T Road	A30	EAST DEVON DISTRICT		318345	102760	9999	20
7583	7583_4000000025288065	4000000025288065	HONITON ROAD	A30	EAST DEVON DISTRICT		297199	93206	9999	20
7548	7548_4000000025934718	4000000025934718	T Road	A30	EAST DEVON DISTRICT		312287	98969	9999	20
748	748_4000000025295617	4000000025295617	HONITON ROAD	A30	EAST DEVON DISTRICT	Clyst Honiton	298939	93185	9999	20
7396	7396_4000000025971834	4000000025971834	T Road	A30	EAST DEVON DISTRICT		306930	96628	2992	20
7368	7368_4000000025928223	4000000025928223	T Road	A30	EAST DEVON DISTRICT		305962	95448	9999	20
7296	7296_4000000021635862	4000000021635862	T Road	A30	EAST DEVON DISTRICT		318253	102619	9999	20
7270	7270_4000000025926207	4000000025926207	T Road	A30	EAST DEVON DISTRICT		308852	97531	2992	20
720	720_4000000025928346	4000000025928346	T Road	A30	EAST DEVON DISTRICT		312189	98934	2992	20
7191	7191_4000000021770560	4000000021770560	T Road	A30	EAST DEVON DISTRICT		318447	102866	9999	20
7182	7182_4000000025926787	4000000025926787	T Road	A30	EAST DEVON DISTRICT		305511	95250	2992	20
7146	7146_4000000025283131	4000000025283131	HONITON ROAD	A30	EAST DEVON DISTRICT		297425	93231	9999	20
7133	7133_4000000021615320	4000000021615320	T Road	A30	EAST DEVON DISTRICT	HONITON	315401	100827	2992	20
7116	7116_4000000025926868	4000000025926868	T Road	A30	EAST DEVON DISTRICT		311510	98835	2992	20
7061	7061_4000000025295618	4000000025295618	HONITON ROAD	A30	EAST DEVON	Clyst Honiton	299000	93193	9999	20

Figure 5: Links Tab

This tab lists all of the links for which prediction data is generated. Each section between junctions is made up of a number of links which are typically 100m-300m in length.

Double clicking on any link will display the dialog containing the speed/flow prediction graphs irrespective of whether the road link is in alert or not.

3.7 Alert Pop-Ups

Whenever a new alert is raised based on the received prediction data, a pop-up dialog box will be displayed at the lower right corner of the browser window. An example is shown below.

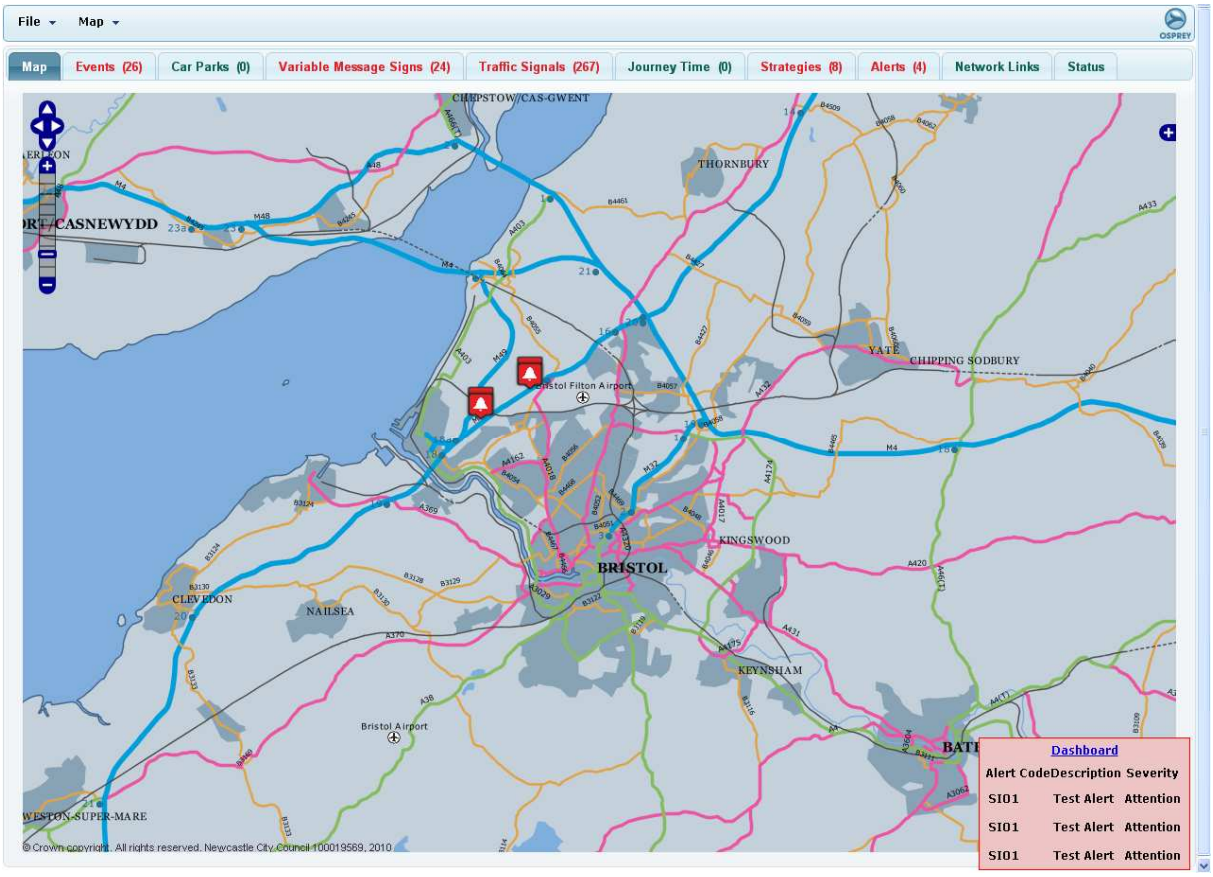


Figure 6: Alerts Pop-up dialog

This dialog shows the list of all currently unacknowledged alerts with the newest prominently at the top of the list. This dialog will automatically disappear after a configured period of time (nominally 30 seconds).

Whilst the dialog box is visible, the user may click on the Alert link to the dashboard (see section 3.8 for further details) in order to acknowledge the un-acknowledged alerts.

3.8 Dashboard

A dashboard has become a common tool for operator work stations to allow the collection and summary display of a wide variety of metrics related to the system being managed. Mott MacDonald has built a number of Dashboard facilities for our supported systems showing various configurable system metrics to allow a user to get a quick overview and appreciation of the state of the road network, and the monitoring/control equipment along that network, at a glance.

We have chosen the dashboard approach to demonstrate the minimalist approach to highlighting when roadside issues are predicted to arise and allow the user to recognise that they have been noted or actioned.

Since the UK STEP pilot is very specific in the facilities being offered to users and to concentrate the users on the STEP evaluation, a very basic dashboard will be provided with only those facilities appropriate to the evaluation (i.e. without other facilities that might normally be expected to be included). The dashboard will show only the latest unacknowledged Flow/Speed alerts recorded by the system. This will highlight to the users what potential problems may arise in the near future and that will require some action to decide whether changes to signage may be required. As soon as the alert has been acknowledged, it will disappear from the dashboard.

The simplicity of the dashboard will encourage discussion with the users to see how they consider the dashboard might be developed in the future.

To aid understanding the scope and extent of predicted traffic issues the dashboard provides a total of unacknowledged and acknowledged alerts currently recognised by the common database.

The dashboard is activated from the File menu on the top line of the window.

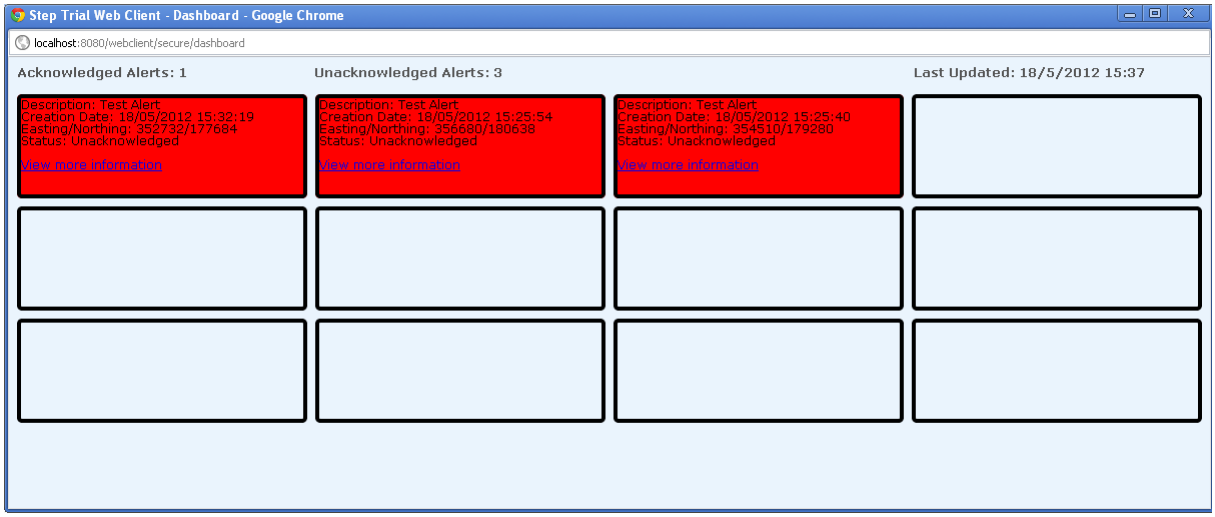


Figure 7: Dashboard Layout

3.9 Trend Prediction Graphs

Any active alert (unacknowledged or acknowledged but not cleared) may be selected by the user to display the predicted traffic characteristics of that segment of road. Selection of an alert for this can be from the alert listed in the alerts tab.

The prediction data for any link (in alert or otherwise) can be displayed by clicking on the corresponding link in the Network Links tab.

Two trends are presented on a single graph; one line for speed prediction and one for flow prediction. A sample graph is shown in Figure 8 below.

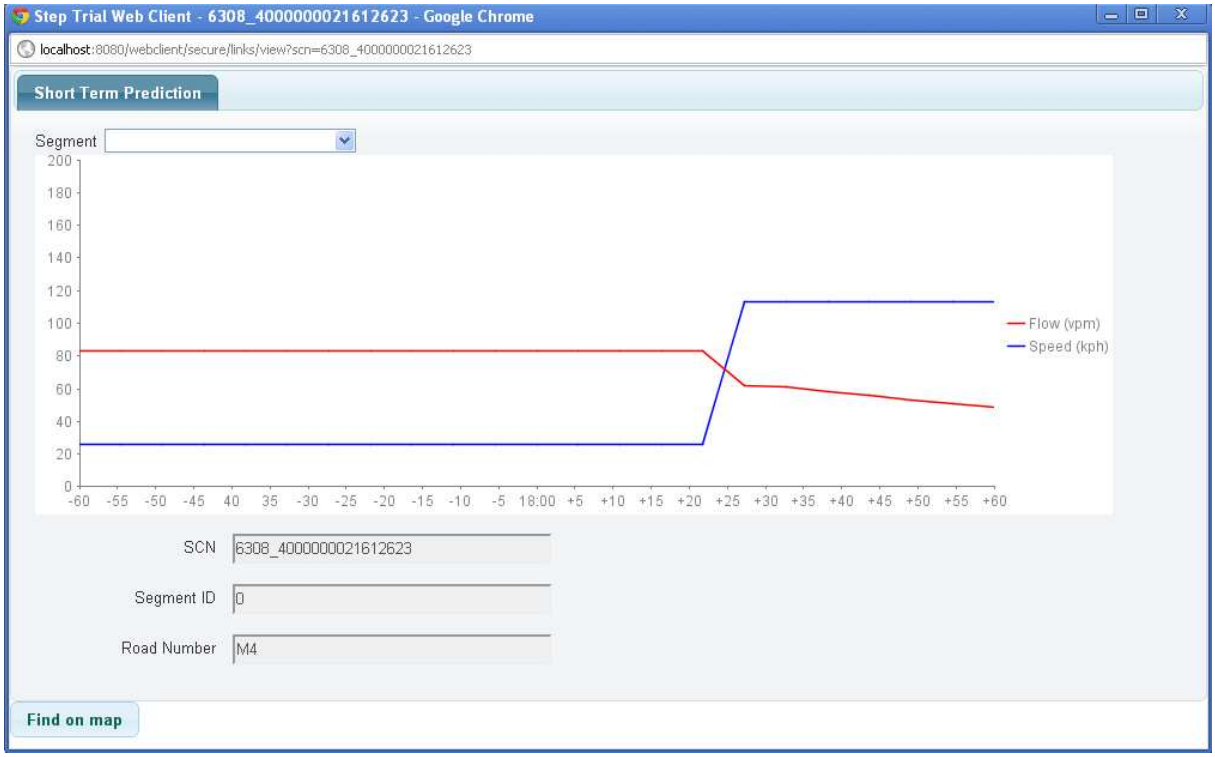


Figure 8: Short Term Prediction Trend Graphs

The trend lines on these graphs are made up of two parts. The first part, which covers the previous 60–minute period, shows the estimated actual value of flow/speed. These values are referred to as 'estimated actuals' since they are derived by the prediction tool using algorithms to combine data from multiple count sites to estimate what the actual values would be at along the road section being reported. The source data may be combined from any number sites at some distance prior to and after the particular road section.

The second part shows, from time-now up to 60 minutes in the future, the predicted values of flow/speed from the prediction model.

Figure 8 above shows the prediction for the first section of the road link indicated. The dropdown list just above the graph allows selection of sections along that road link.

4 User Interface Operation Principles

4.1 Alert Lifecycle

Alerts have three states as shown in the diagram below:

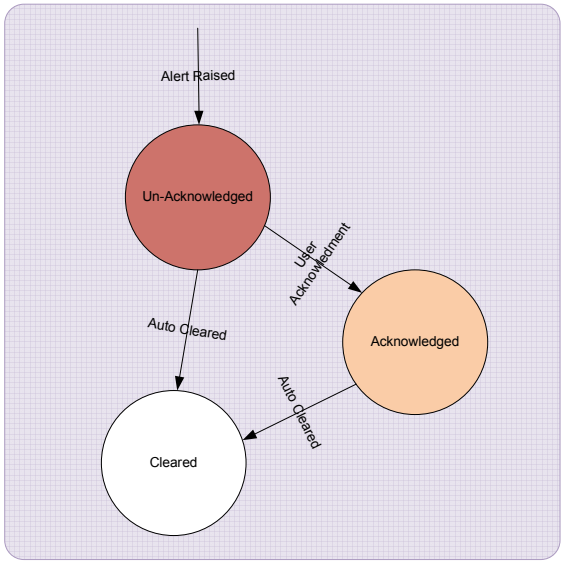


Figure 9: Alert Lifecycle

Alerts are raised by the database when a configured threshold (high or low) is exceeded. The alert automatically enters the 'Unacknowledged' state awaiting an operator to recognise that it has been raised and acknowledge it.

By acknowledging an alert, an operator recognises that some action may be required and takes responsibility for initiating any appropriate action. The alert will remain in this state until automatically cleared by the database when the data causing the alert reduces/increases below/above the configured threshold.

The database implements hysteresis on the setting and clearing of alerts to prevent minor fluctuations of the triggering data about the threshold. Whilst the width of the hysteresis band is configurable, it has been set in this implementation to ±5% of the range of the values.

Once an alert enters the cleared state, it effectively no longer exists apart from acting as a history of past events affecting a particular road section.

Users may only affect Alerts by acknowledging them. This reduces their prominence on the user interface by removing them from the Dashboard and removing them from repeated indication in the pop-up dialog whenever a new alert is raised. This action signifies that the user is aware of the alert and will take appropriate action to manage the road conditions to minimise the impact of the issue.

4.2 Types of Alert

Two types of Alert are configured for the STEP UK trial system:

- High Flow Alert
- Low Speed Alert

High Flow Alert

Each section of road has a nominal capacity (vehicles per hour). Whenever the predicted flow at any time in the prediction window (presently configured as 60 minutes) exceeds a configured percentage of that capacity (nominally 70%), a High Flow Alert will be raised against that section of road. The configured threshold has been set as an initial value to provoke comments from users and allow tuning on a road section by road section basis. This domain knowledge must come from the users based on their experience and knowledge of the roads and normal operating parameters. The value can be adjusted on a per road section basis as needed.

That alert will remain active (unacknowledged or acknowledged) until the predicted flow for the whole of the prediction period falls below the configured threshold. Hysteresis will be applied to prevent jitter of setting/clearing of an Alert over a small number of data samples.

Low Speed Alert

Each road section also has a configured speed below which is considered to be anomalous traffic movement or congestion. This is initially configured as 20kph for all road sections to give users the opportunity to decide what the real values should be during live operation. This again is configurable on a per road section basis.

If the average speed of vehicles is predicted to fall below this threshold at any time in the prediction period then a Low Speed Alert will be raised against that road section. Note that the alert will only be set if the vehicle flow is predicted to exceed 1 vehicle/hour.

The alert will remain active until the predicted speed for the whole prediction period is either above the alert threshold or no vehicles are predicted to be travelling in that section.

4.3 Automatic Alert Clearance

Alerts are cleared and removed from user awareness automatically by the system on detection that the alert condition has disappeared. This leaves the user interface uncluttered, showing only those alerts that require the user to be aware of and possibly perform some action to minimise their potential impact. The cleared alerts are maintained by the database for offline analysis as required.

4.4 Changing Alert Characteristics

For this trial, all characteristics listed below will be fixed at the start of the trial and not modifiable by local users or operators. Review stages will address suitability of the configured values and make appropriate changes. Interim changes may be carried out by the system administrator (Mott MacDonald) through direct database access on request.

- Road Section Capacity
- Road Section High Flow Alert Threshold
- Road Section Low Speed Alert Threshold

Nuisance, inappropriate or ill-configured alerts may be disabled or re-configured as needed.

Requests for changes should be addressed to the Trials Support Team – see section 5 for contact details

5 Trial System Support

Throughout the UK trial of the STEP system, support to users will be provided through the Mott MacDonald Transport Technology System Support/Help Desk. Contact details for the helpdesk are as follows:

Email: Helpdesk.tts@mottmac.com

Tel: 0141-222-4666

Fax: 0141-222-4667

The helpdesk is manned between the hours of 08:00hrs and 17:00hrs Monday to Friday excluding English bank holidays.