UNDER DOG SOFT WARE

Third Party Control of UTC Via SPRUCE

Tony Smith - Underdog Software

Table of Contents

1 Executive Summary

SPRUCE has now been operational in four major districts within the UK for approximately nine years.

A large amount of experience has been amassed and the system has grown in size from providing bus priority on a few trial junctions to controlling city wide co-ordinated bus movements, two historically different tram networks and emergency vehicle priority systems.

Whilst historically designed purely for public transport management, the capability for other traffic management tasks has long been recognised.

The case study of traffic management around the Elland Road stadium in Leeds has shown that SPRUCE could be used to give organisations outside the Local Authority, limited control of the road traffic network in special circumstances, without unduly affecting the rest of the network.

2 Introduction

With todays Local Authority cost cutting an increasing number of UTC centres are seeing their operating hours cut.

On the other hand, there exists a growing demand for traffic management from large entertainment and retail complexes.

Third parties are now requesting control over parts of the road network pertaining to their business activities out of UTC control room hours.

This is being achieved via a multitude of unsightly hacks of existing UTC systems in ways which they were never designed or intended for.

This paper aims to introduce an alternative way of releasing control to external agencies, whilst still retaining full authority over the UTC system.

3 History

Current active traffic control systems have evolved over the years.

Beginning with independent outstations around 1925, these proliferated in an uncontrolled manner with little or no co-ordination.

Studies in the 1950s lead to junction co-ordination via fixed time cable-less linking.

During the 1970s with the introduction of cheap reliable communications links, control in urban areas became increasingly centralised.

Many of todays cities are under fully co-ordinated control via a single computer system, controlled by a single local authority, in a single control room.

As these systems have become highly centralised and co-ordinated, control and access are restricted by Local Authorities as independent local control may cause disruptions to the rest of the system.

Where local control exists it is minimal and generally offered only to emergency services and/or other government bodies.

4 Current Methods Of Local Control

4.1 Local Requests

Commonly used in emergency vehicle stations with an adjacent junction or wig-wag.

A local push button is provided within the stations linked directly to the junction controller, operation of the button sends a demand to the central UTC system which then shifts normal operation of the system to provide a Hurry Call and/or Green Wave for the emergency vehicle.

As this is a wired system it is:

- Physical, which means it must be designed and built, usually on a case by case basis.
- Inflexible, if a change in purpose or location is desired then design and installation must usually begin from scratch.

An example of a fire station control box can be seen below.

4.2 Remote Requests

The request panel used in a local request is connected via a dedicated OTU to the UTC system. A demand is then sent to the UTC system and responded to.

This has the advantage of not requiring a local junction controller. However it is still traditionally a wired system along with the disadvantages that that entails.

4.3 Timetabled Plans

Pre-booked plans that are usually actioned on a timetable basis. Used when the UTC control centre will not be manned during an event.

These do not take into account any variation of timing or length of the event requiring the change or any other circumstances that may occur during the event.

4.4 Manual Co-ordination

Phone contact is made with the UTC control room and requests are actioned manually.

Whilst this is the most flexible it is also the most manpower intensive and requires manning in the UTC Centre. In most cases local authorities are unable to cater to the demands of all users.

5 Future Methods Of Local Control

To enable off-loading of traffic management tasks to third parties, future methods of local control should be:

- Flexible - Requirements will inevitably change, also road conditions and layouts are not static.
- Easy to use - User will not be trained traffic engineers.
- Easy to deploy - Ducting and other hardware modifications are expensive.
- Limited - Control schemes should be conservative until fully proven.
- Reversible - User control should be able to be overridden by the UTC centre.
- Secure - To prevent abuse by unauthorised use.

6 SPRUCE

SPRUCE is a Strategic Traffic Management tool working in tandem with an existing UTC server.

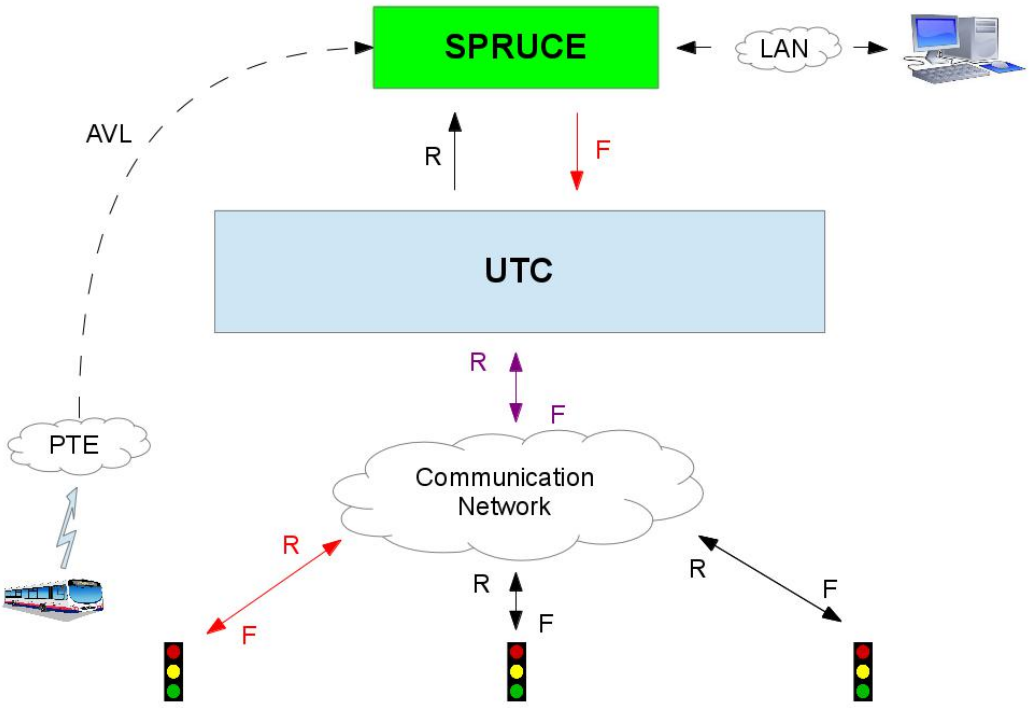
It monitors Reply Bits from the UTC server and Automatic Vehicle Location (AVL) messages from the Public Transport Executive (PTE).

When it determines that a specific bus strategy needs to be implemented it takes control of the appropriate junction(s) from the UTC server.

The chosen strategy is then applied to the junction(s). When the individual strategy has ended, normalisation is applied before the junction is handed back to central UTC control.

A Graphical User Interface is provided on a desktop PC in the UTC Control Room for control and monitoring purposes.

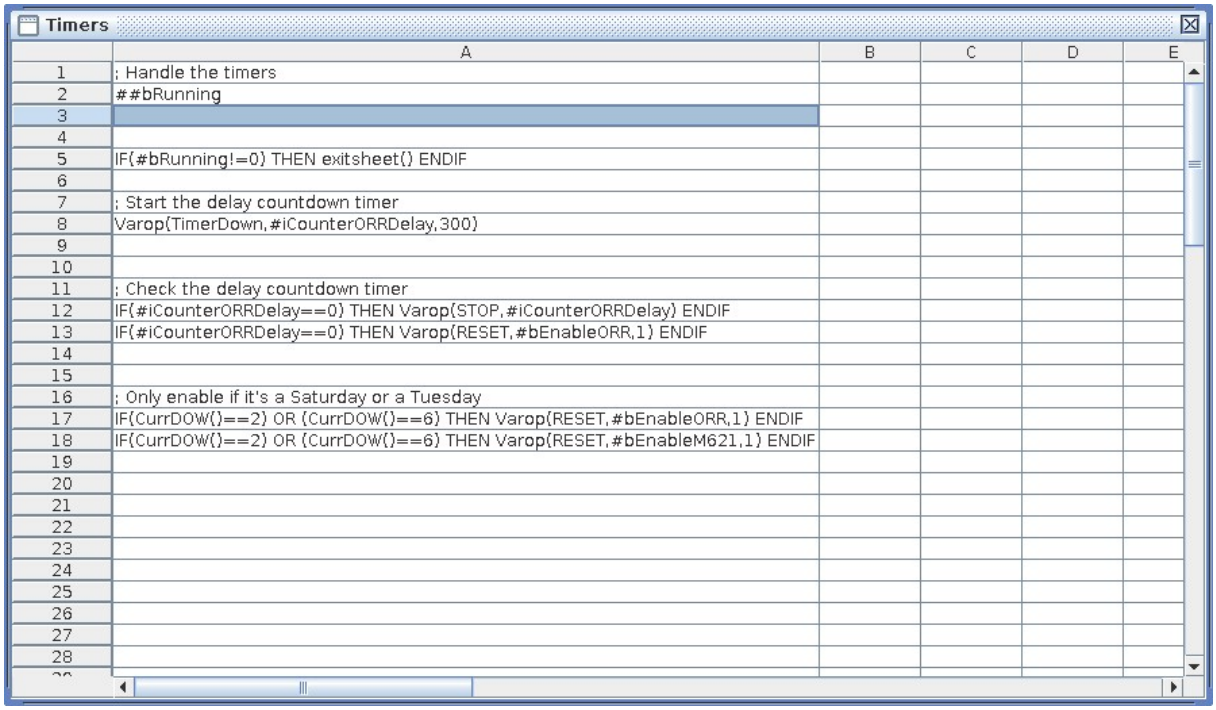
SPRUCE is seen below controlling a single junction while other parts of the traffic network are co-ordinated by the central UTC system.



6.1 Decision Making

Decision making within SPRUCE is by means of a free form cell based language similar to Microsoft Excel macros.

Logic to control countdown timers and enable/disable by day of the week can be seen below.



6.2 Graphical Displays

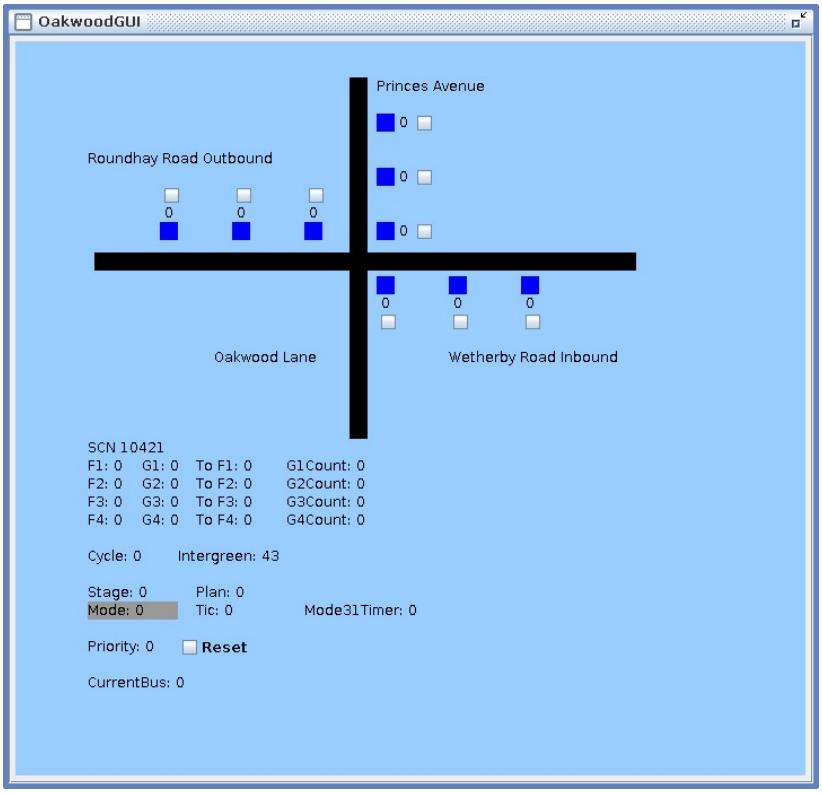
Graphical displays can be defined using elements consisting of:

- Basic road symbols
- Text
- Numerical variable values
- Detector bit displays
- Tick boxes
- Slider bars
- Drop down menus
- Push buttons

Display elements may display numerical values corresponding to variables within the logic and/or have their visible attributes modified by variables within the logic.

Control elements affect values of variables within the logic and enable the operator to modify the behaviour of the logic.

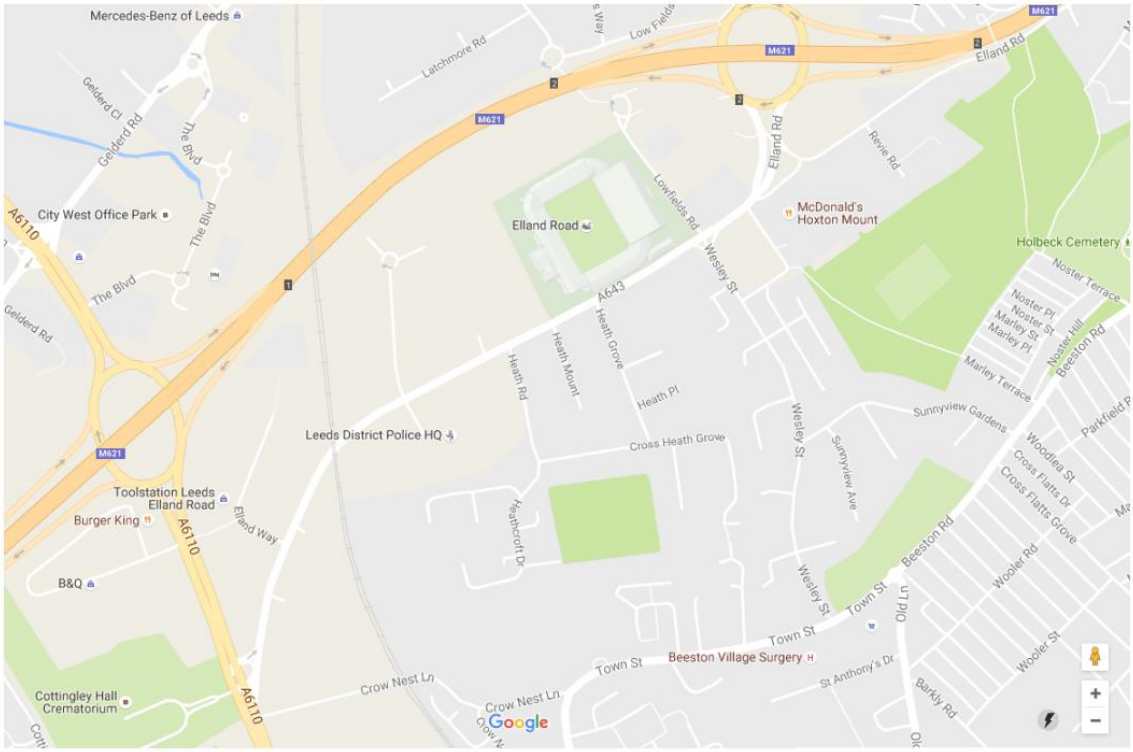
A simple junction layout with bus virtual detection points can be seen below.



7 Case Study - LUFC, Elland Road Stadium

Elland Road Stadium is a football stadium located to the South West of Leeds city centre.

The stadium holds 39,460 spectators and organises large matches approximately every 3 weeks on an irregular schedule.



7.1 Access

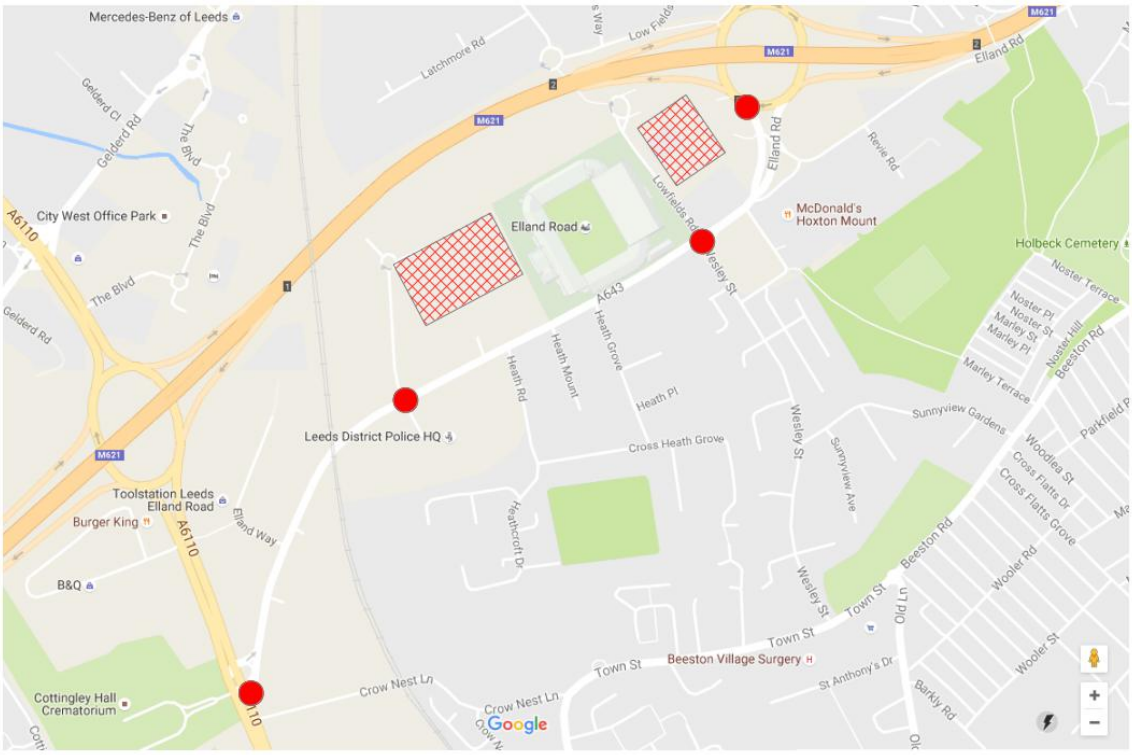
The stadium has two main access routes.

1. North to the M261 Junction 2
2. South to the A6110 Outer Ring Road (ORR)

The northbound route has a signal controlled junction where it encounters Wesley St and the main roundabout to the M621 is also signal controlled.

The southbound route has a signal controlled junction where it encounters the Leeds District Police HQ and a further signal controlled junction where joins the ORR.

Car parking is in two areas, to the West and the East of the stadium.



7.2 Current Outbound Traffic Control

Existing arrangements for emptying the stadium are in two parts.

7.2.1 Manual Control

The area to the front of the stadium is coned off to establish a pedestrian only area.

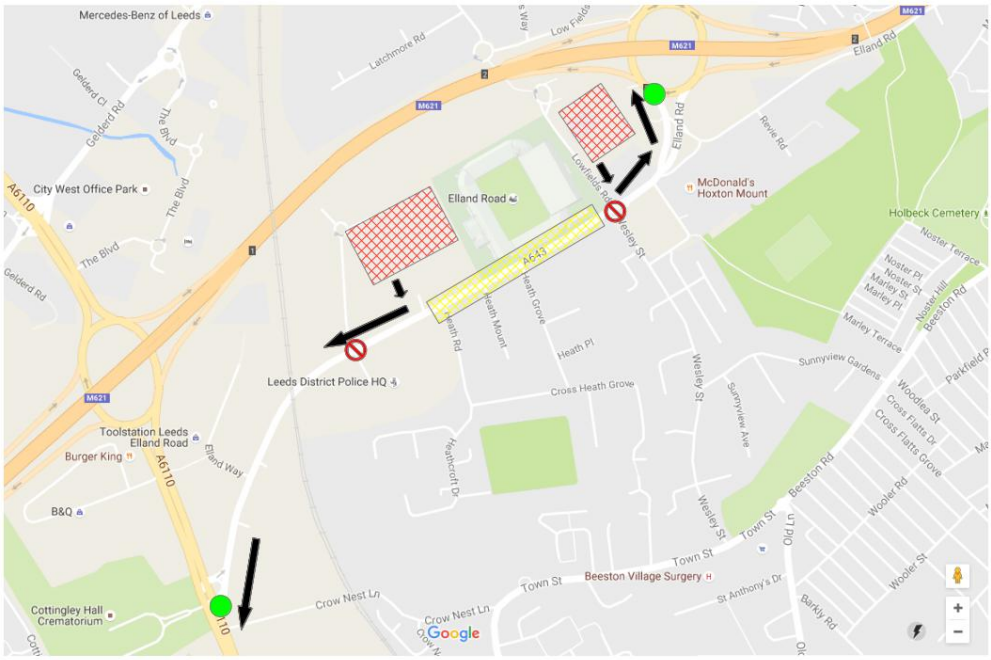
The controllers at the Wesley Rd junction and the Police HQ junction are turned off.

Traffic is directed from the West car park southbound to the ORR and from the East car park northbound towards the M621.

7.2.2 UTC Control

UTC operation for both the ORR and M621 junctions is altered to get maximum traffic flow away from the stadium. Minor compensation is also given to some other junctions at strategic points downstream of the main flow.

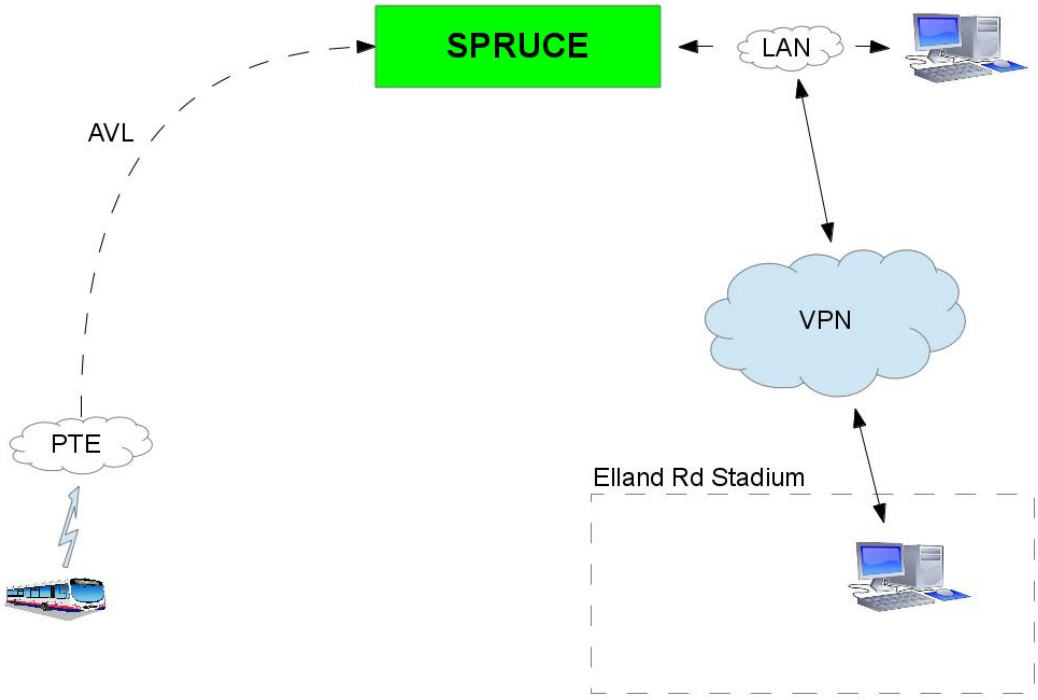
The alteration of the UTC operation is co-ordinated manually if the UCT centre is manned, should it be unmanned at the time of the fixture then the change is timetabled in and occurs at a fixed time. Due to UTC Centre manning restrictions by Leeds City Council, most of the time this is done by a pre-booked timetable change.



7.3 Proposed UTC Control Using SPRUCE

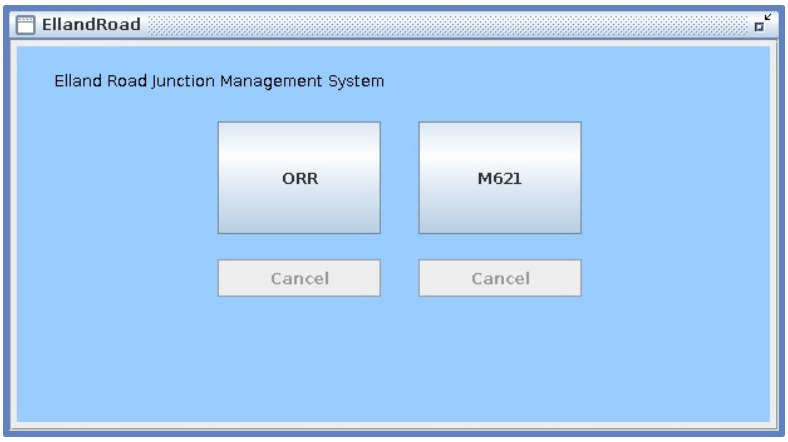
At present all control and monitoring of SPRUCE is done using GUIs in the UTC Centre. It is proposed that a GUI is remoted via secure VPN and located in the Elland Road control room.

Stadium control staff will have a different login to that of the usual UTC staff. This will enable only a particular sub-set of GUIs pertinent to the existing traffic management plan.



7.3.1 Control Method

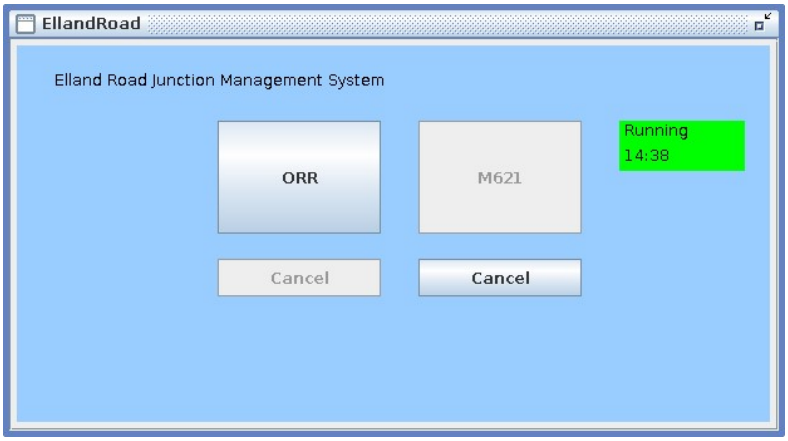
The Elland Road user will be presented with a GUI that will let them enable the Northbound (M621) route, Southbound (ORR) route or both.



On enabling the respective route, the enhancement for that route will be run for a fixed time of fifteen minutes.

A facility will also be provided to cancel the enhancement if needed.

The user will be provided with positive feedback that the enhancement has commenced and a countdown timer informing him of the time remaining.



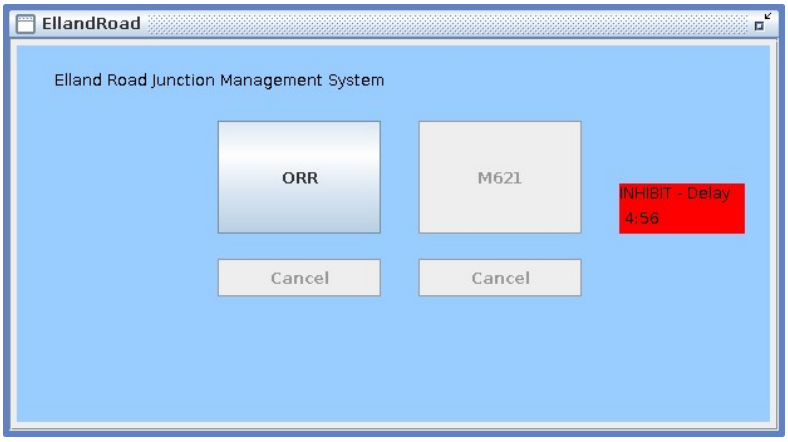
7.3.2 Constraints

To prevent possible mismanagement of the system, a series of constraints will be set.

Constraint 1 - Delay

'After running the enhancement the system shall enforce a delay of five minutes before the enhancement is able to be run again'

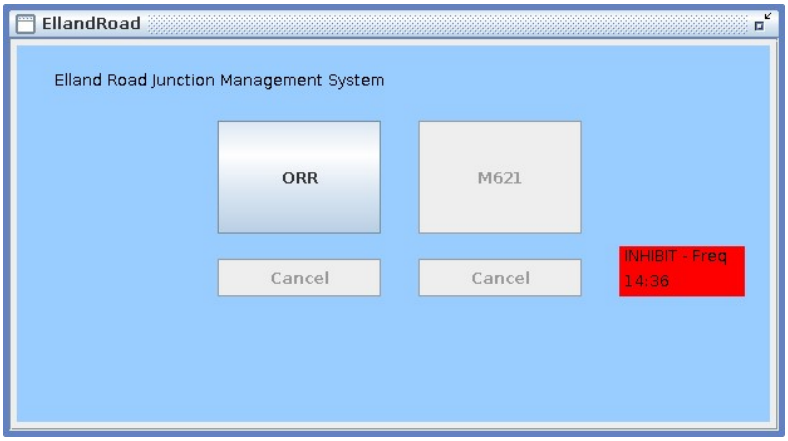
After the termination of the enhancement the user shall be presented with an indication of the inhibit and a countdown timer.



Constraint 2 - Frequency

'The enhancement will only be able to be run a maximum number of three times during any sixty minute period. A delay of fifteen minutes shall be enforced after the third running of the enhancement.'

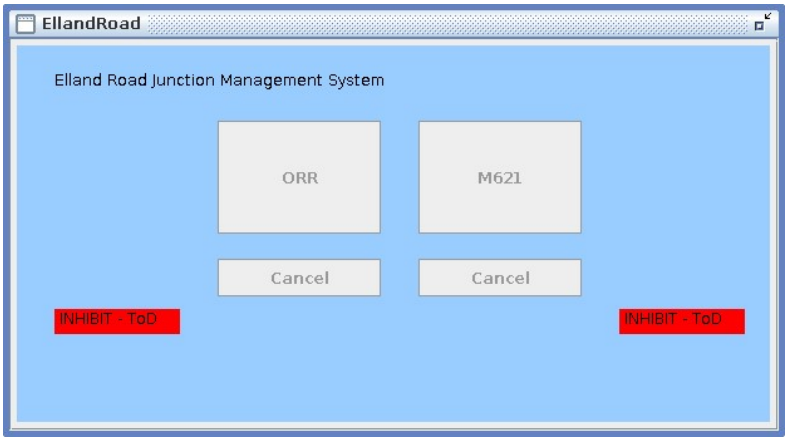
After the enhancement has been run for three times in the space of sixty minutes the user will be presented with an indication of the inhibit and a countdown timer.



Constraint 3 - Time Of Day

'The enhancement shall only be able to be run on dates and time periods specified by the UTC Centre. Outside of these dates and times the operation of the enhancement will be disabled.'

If the enhancement is not available due the the time of day the user shall be presented with an indication of this fact

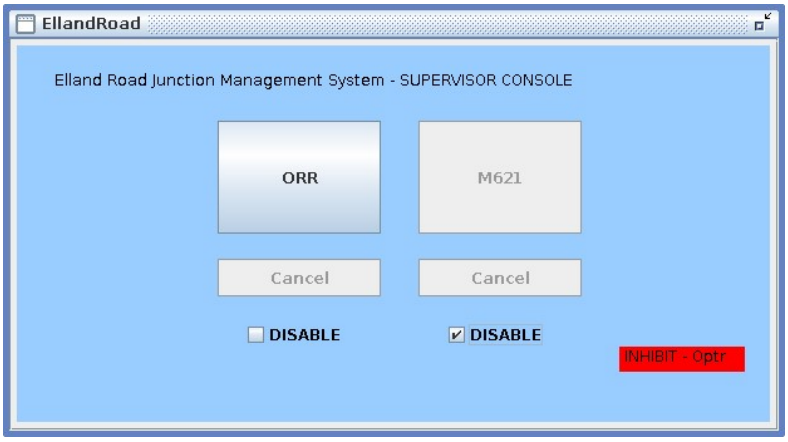


Constraint 4 - Manual Disable

'The enhancement will able to be disabled via an option in the UTC supervisor's console.'

The UTC Centre login will have an identical display to that of the stadium but will, in addition have a facility to selectively disable the activation of the enhancements.

An indication of this disablement will be displayed to both users.



8 Conclusion

The provision of local control to external agencies is uncommon and is of great concern to UTC centres where existing provisions are in place. However, it can be seen that by careful planning, management and co-operation, such control can be given in specialist cases.

Hopefully the ability to impose constraints on external control schemes will give UTC centres more confidence when considering requests from external agencies in future.

References

1. The Evolution of Urban Traffic Control: Changing Policy and Technology. (Andrew Hamilton et al) https://core.ac.uk/download/pdf/9646351.pdf
2. Leeds United Football Club website http://www.leedsunited.com/
3. Wikipedia - Elland Road Stadium. https://en.wikipedia.org/wiki/Elland_Road
4. SPRUCE ODT User Guide. http://www.underdogsoftware.co.uk/downloads/ODT User Guide.pdf
5. UTMC01 Project Report 1- Part A. (Ken Fox et al) http://www.its.leeds.ac.uk/projects/spruce/utmc1rev.pdf
6. UTMC01 Trial Area Case Studies. (Mervyn Hallworth et al) http://www.its.leeds.ac.uk/projects/spruce/sprcase6.pdf