# Minimising Traffic Congestion at signal controlled junctions using Mova

OR

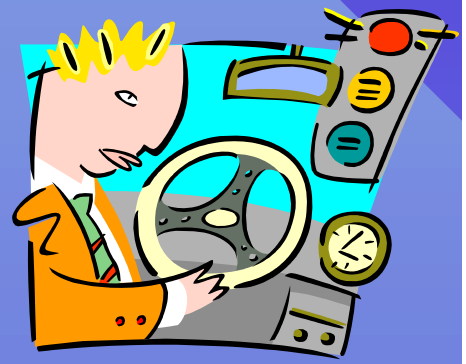
?

JSTSM Ltd

# My background and experience…

- With two UK local authorities – in a traffic manager role, highly accountable to the public, and for an Engineering Consultant, acting for local authorities and developers, designing and implementing engineering solutions to achieve technical approval for planning permissions
- Now independent, running my own rapidly growing company, JSTSM Ltd, specialising in Mova applications, the leading suppliers of advice and training on Mova, we have assisted in the implementation of about three quarters of UK Mova installations, and most of those in Ireland
- We design and working with your designers and contractors implement Mova systems

# Ever waited at a signal junction stopline?



- At quiet times, with few other vehicles around, why do you have to wait?
- In the peaks, your approach has a long queue, whilst other approaches have shorter queues (or no queue)?
- In the off peak, why does the tail of the platoon not get through the green?

# Ever considered why?

- Might it be because control relies upon a less flexible Method of Signal Control?
- Green time might vary according to time of day, but within each period, not varying according to demand?
- Or waiting for a non-existent or delayed platoon from an adjacent junction?

# What is Mova?

Developed by the UK Transport Research Laboratory in the 1980's for real time signal control of traffic signal controlled junctions

Mova, **Microprocessor Optimised Vehicle Actuation**, is control software to self-optimise the control system for traffic signals - control software, not a modelling technique!

"Using an online microprocessor, Mova maintains the optimum green stage, cycle time and control strategy to accommodate prevailing conditions to minimise queuing at traffic signal junctions…achieving significant improvement in performance" Source: TRL

# Dynamic Signal Control

A dynamic control system – works on the spot, in the “now”

Deals with traffic as it arrives

Clears traffic on the first green it receives

Each approach should clear all traffic each and every green (unless the junction is saturated) – should

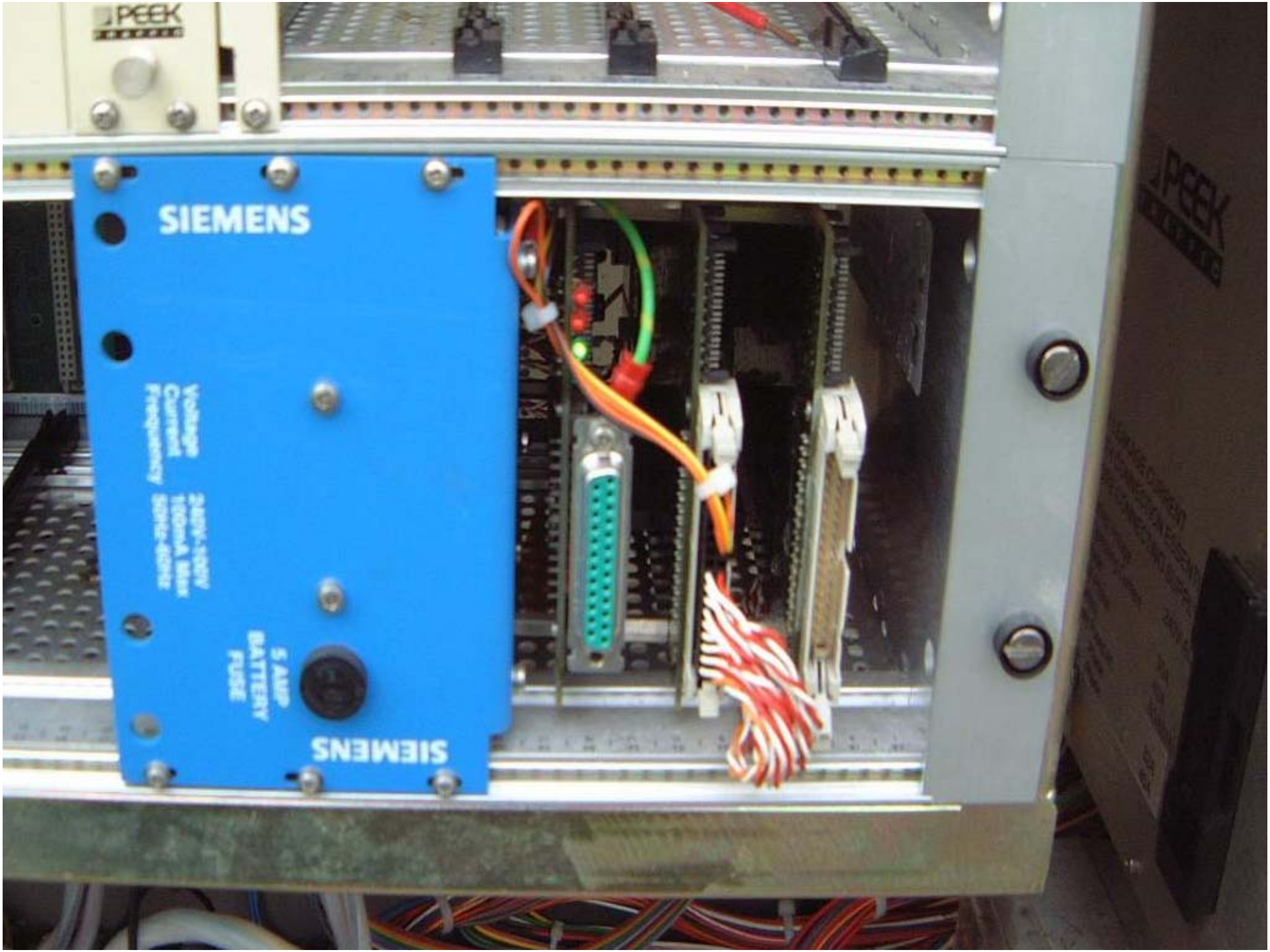
It is fully automatic – does not need “plan changes” to deal with varying conditions, it constantly changes green times to suit prevailing conditions, entirely automatically

# Hardware

Fit to any up to date Traffic Signal Controller hardware platform as an ‘add-on’ unit; increasingly manufacturers are offering it as integral software – pre-fitted in the Traffic Signal Controller

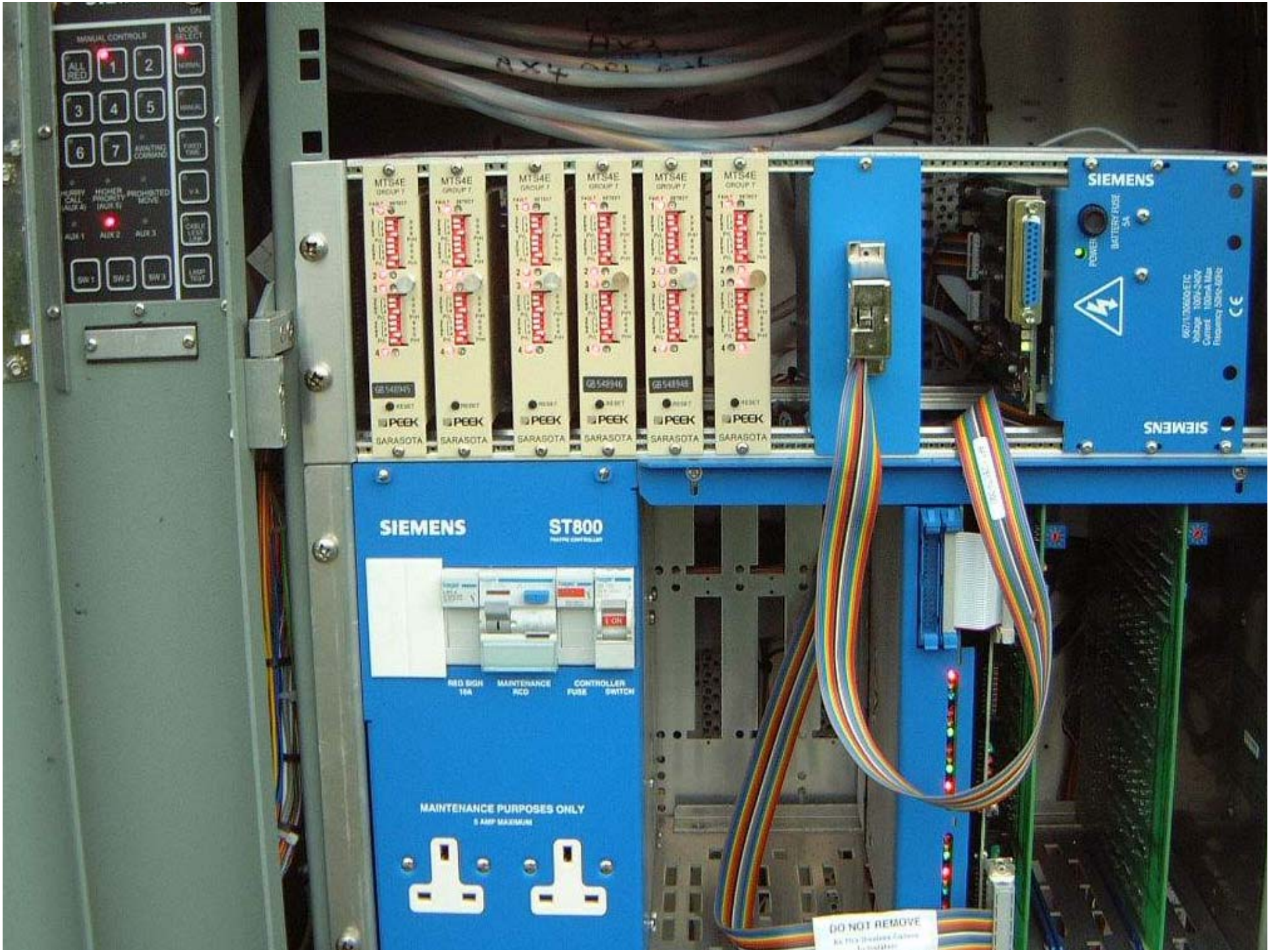
Uses vehicle detectors cut into the road surface to monitor vehicles on the immediate approaches to signal controlled junctions to determine green times in real time

Remote monitoring for lamp and detector faults is all that is needed to maintain the system, it is fully automatic – it does not need plan changes to deal with varying conditions, it constantly changes green times to suit prevailing conditions, entirely automatically


PEEK
SIEMENS
Voltage
Current
Frequency
5 AMP
BATTERY
FUSE
SIEMENS
PEEK

# Mova requires vehicle detection

- Vehicle detection using inductive loops – one or two loops per lane to count vehicle arrivals
- An ‘X’ loop, about 3.5 seconds travel time from the stopline (so usually 25m – 35m from the stopline)
- An ‘IN’ loop to give a more distant view, important in the inter- and off-peak when vehicles are free flowing (60-130m FSL)
- And on side roads, stopline loops, so vehicles leaving homes accesses or parking spaces close to the stopline will always be served


MANUAL CONTROLS
MODE SELECT
ALL RED
1
2
3
4
5
6
7
NORMAL
MANUAL
FIXED TIME
V.A.
CABLE LOSS LAMP
LAMP TEST
SW 1
SW 2
SW 3
MT54E
GROUP 7
PEEK
SARASOTA
SIEMENS
POWER
BATTERY FUSE
5A
SIEMENS
ST800
RED SIGN 10A
MAINTENANCE RCD
CONTROLLER FUSE
SWITCH
MAINTENANCE PURPOSES ONLY
5 AMP MAXIMUM
DO NOT REMOVE

# Detection issues

- So what happens if a driver “parks” on a detector?
- Mova uses the other detector in that lane to undertake the calculations – when the detector resumes normal operation, it becomes useable immediately
- Mova maintains historic data for each lane in half hour intervals so it can use previous flows if all detectors fail on an approach (rare!)

# How Does Mova Work?

For each lane in each green period,

- MOVA has a "**fixed minimum green**", the same as Controller minimum green;
- MOVA has a "**variable minimum green**" to ensure that vehicles between the X loop and stopline clear in the green.
- MOVA then looks for **end of saturation flow** on every lane
- After end of saturation flow, MOVA then **optimises competing demands.**

# How Does Mova work in congested conditions?

- Queues should not form on any approach until the junction as a whole has demand in excess of capacity
- As demand approaches saturation, the "delay minimising" algorithm changes to a "capacity maximising" algorithm
- This creates more green time for congested approaches, at the expense of those uncongested, maximising control effectiveness

# What is the effect of this?

- All approaches clear every cycle
- Mova automatically adjusts green time to accommodate demands
- No queuing occurs until the junction as a whole is saturated
- When running at or above capacity, queue management occurs automatically to ensure critical approaches are kept clear
- A high capacity, flexible and effective solution which automatically accommodates intermittent queuing, accidents and ‘events’

# The Extent of Benefit Achieved by Implementing Mova

How good is it? by comparison with VA…

"As regards performance, measured in terms of delay, the extent of improvement ranges from single percentage figures up to more than 20%, with an average of typically 13%."

Source: TRL

On roundabouts, improvement between 20% and 30%

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Mr J Spence
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14/2/96

Dear John,

**ESTIMATION OF MOVA BENEFITS BEFORE INSTALLATION**

Following your phone enquiry about the availability of method(s) for estimating the likely benefits from installing MOVA at a particular junction, I am writing to confirm the position.

There is no formal method available for calculating the level of benefit available at a particular junction, either in terms of delay saving or injury accident reduction. The best available information is given in RR 170 'MOVA: Traffic resposive, self optimising signal control for isolated intersections', and in RR 279 'MOVA: The 20 site trial'.

Both of these reports show that MOVA on average gives a 13% delay reduction, but there is no way outlined to evaluate the benefits at a particular site. However, looking at the results in RR 279 allows some interpretation of likely benefits by junction types, although these cannot be soundly supported:-

Typical major junctions on high speed roads, where the side roads are heavily loaded also - Delay reductions in the area of 20% or more.

Small to mid size but congested urban junctions, 12% - 18% delay reduction.

Reasonably loaded but not congested urban junctions 8% - 14% delay reduction.

Small quiet junctions not more than 5% delay reduction.

In addition to the delay reduction, we have studied the safety records of the 20 site trial junctions for three years prior to and since conversion to MOVA. Overall there was a slight but not significant reduction in injury accidents. However, at the 4 large, high speed junctions in the sample, there was a significant reduction of 30% in the injury accident record. This is a small sample and no further work has been done to validate this result. If this result was to be generally true at high speed sites then MOVA would be economically justified on safety benefits alone.

Further, these high speed sites become prime targets for conversion with delay benefits of 20% and injury reductions of 30%.

I hope you find this information useful.

Yours sincerely,

J R Peirce
Traffic & Transport

# Remote Monitoring

- How much ongoing effort is needed to maintain this high level of effectiveness?
- NONE!
- Once Commissioned and Validated, the only monitoring needed is inexpensive dial-back remote monitoring for maintenance – to identify and resolve hardware issues, for instance lamp fails and detection issues

# 24 / 7 / 365

- Mova is completely automatic
- Automatically varying green times, instantly responding to changes in demand, 24 / 7 / 365 – green times automatically vary to accommodate demand, all the time!
- “hands on” is not needed
- Once Commissioned and Validated, it is entirely automatic, since the Mova operational parameters (saturation flow and cruise speed) depend on approach geometry (which is fixed), and driving characteristics in each lane (which don’t change); once Validated, ongoing re-validation or plan changing isn’t needed

# Bus Priority

Mova incorporates emergency and priority vehicle (bus priority) control parameters

- Allowing normal optimised Mova control until priority is needed, when it is achieved within Mova without changing mode
- Various degrees of priority are available, including priority dependant upon current traffic conditions

# Mova at adjacent junctions

- Devised as a tool for free standing junctions, adjacent junctions can be effectively and flexibly linked,
- For instance, signalled gyratory's and roundabouts can now be controlled flexibly and effectively
- Often more than a 20% increase in performance
- One current growth area is in linear linked systems e.g. radials with a series of junctions
- And for parts of networks which when overloaded there is no point in linking

# Mova at Roundabouts

- At roundabouts, demand rises and falls on different approaches at different times, often with multiple peaks…. design must accommodate ‘normal’ peak variability, and ‘unexpected events – accidents or events
- Mova provides a far more flexible and effective solution than any other mode, because entry greens vary without loosing co-ordination on internal links - co-ordination can be achieved where and when it is needed
- Internal queues cannot be allowed to block circulatories, or motorway roundabouts to block back onto the motorway – so we use ‘backstop’ queue loops to call stage changes
- With these techniques we can set cycle time approaching the upper limit which the junction is physically capable of, rather than as fixed preconceived values

# Mova and Linked Mova Applications

- In UK, more than 1200 Mova junctions, all sizes types and flow regimes
- Of which more than 50 motorway junction roundabouts
- Including many highly strategic motorway junctions, serving for instance major Regional Shopping Centres, the NEC (National Exhibition Centre in Birmingham, next to the Airport)
- Many of these include control of “yield” approaches, and some are part time

# Applications in Ireland – around town

- Extensive experience of Mova in Fingal, more than 30 Mova junctions, Kilshane Cross adjacent to the airport was the first (2000), now bypassed by the recent N2 Motorway, N3 Snugsborough Interchange, and adjacent recently Cloncilla Rd / Coolmine Rd (a Linked Twin), others around the airport and Dublin Road Sutton (Sutton Cross Baldoyle Road and Grange Road Baldoyle), about 40 sites in Fingal
- The first Linked Mova roundabout in Ireland, Malahide Road Roundabout in Swords (Pavillions Shopping Centre), soon M1 Lissenhall Interchange – both twin stream "Linked Twins", and Ongar, three Linked
- Phoenix Park (Castleknock - White's Gate)
- In South Dublin, N4 Lucan bypass / Newcastle Road and in hand junctions in and south of Lucan Village, and N7 Naas Road / Newlands Cross
- In Dun Laoghaire, Kilmacud Road (last week)

# - Out of Town

Word is spreading about how good Mova is…

- Clare / Tipperary (Killaloe Bridge Shuttle),
- Galway (N18 Carnmore Cross, adjacent to the Airport),
- Laois (N7 Mountrath),
- Limerick (two in town, one Newcastle West),
- Meath (Navan),
- Sligo (Queen Street / Lower Quay Street),
- Wexford (New Ross Bridge)

# In Cork…

Many sites, strategic and local: N8 / N25 Dunkettle (adjacent Jack Lynch Tunnel), N25 / South City Link Road Kinsale and adjacent Sarsfield and Bandon Road Roundabouts, junctions on the N27 approach to the airport, on the approaches to the Mahon Point shopping centre, the north city ring road and elsewhere, now approaching 20 in use or in hand, many for bus priority

# UK Highways Agency Policy

- “All new trunk road installations shall incorporate MOVA as the standard mode of control”.
- This policy shall also apply … where the installation is being refurbished
- If MOVA is not to be used, then a sound case for departure from the standard must be made and approved”

Quotes from Design Manual for Roads and Bridges TD 35/06

# National Roads Authority Policy

Is there a Policy?

Should there be a Policy?

# Training Courses

- UK based Courses are open to all, which I lead
- Currently about 80 Traffic Signal Engineers a year are being trained in this way
- The intention is to offer a training course here next year
- Probably hosted by Traffic Solutions, the Dublin based nationally operating Traffic Signal installation company, and your leading suppliers of Design Build and Maintain for Traffic Signals and Mova installations
- For details contact John McCarthy or myself

# Documentation

- TRL Research Report 279 "MOVA: The 20 Site Trial“
- TRL APPLICATION GUIDE 44: The MOVA Traffic Control Manual, and TRL APPLICATION GUIDE 45: Guide to MOVA set-up and use
- Highways Agency MCH 1542 Issue C …a more practical guide to design and implementation
- TD35/06: UK Highways Agency DMRB “All Purpose Trunk Roads: MOVA System of Traffic Control at Signals”

# Thanks to…

For the loan of the Mova Unit……