Low Cost MOVA – Retrofitting MOVA to Existing SCOOT Controlled Signals for Increased Performance and at Reduced Installation Costs.

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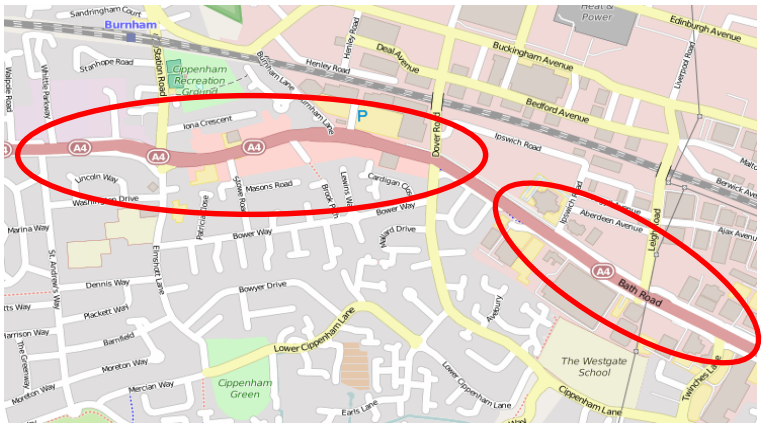
With pressures to do 'more for less' ever increasing, this paper demonstrates how some creative thinking has led to the advantages of both MOVA and SCOOT control of traffic signals being harnessed for significantly reduced installation costs and reduced disruption on street during construction. By reusing and 'repurposing' existing equipment, the volume of newly procured and installed detection and civils works is significantly reduced, greatly reducing the budgets required and minimising the level of street works required. A case study from works in Slough is discussed.

Signal control

Both SCOOT and MOVA control of signals are now widely adopted across the UK and both systems have their advantages and their limitations.

SCOOT is well proven to give good, adaptive and coordinated control of signals across a network or region and is frequently found within many urban areas. Within Slough, there are several SCOOT regions, with most of the signals along the A4 controlled by SCOOT.



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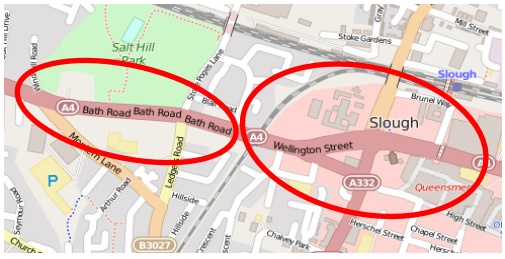
A4 SCOOT Regions in Slough



However, especially as traffic volumes drop, or the origin and destinations of vehicles begin to vary widely (as may often happen in off peak periods), SCOOT performance can begin to get 'clunky', with SCOOT being unable to react quickly to the needs of individual vehicles. This can cause drivers and pedestrians to have to wait slightly longer than ideal. And whilst the absolute level of delay to these users is typically small, the perceived level of delay can be high, causing driver or pedestrian frustration and giving the appearance of poorly performing signals.

MOVA is more typically used for its ability to react quickly to the needs and performance of groups or individual vehicles and the needs of pedestrians. Often used at isolated sites, techniques are also well developed to implement 'linked MOVA' to provide coordination across a limited signalised network, typically a signalised roundabout or two adjacent junctions. However, MOVA is generally not suitable for providing truly coordinated control of signals across a large signals network and can rely on extensive, complex special conditioning within a controller to provide coordination over a small network.

Slough

As part of a major town centre regeneration project and in readiness for the London 2012 Olympics, Slough installed seven new signalised junctions in the town centre. These junctions all operate hybrid SCOOT and MOVA control and utilise wireless magnetometer detection. They are controlled by SCOOT in the morning and evening peaks, providing signal coordination when traffic volumes are highest and general traffic patterns are relatively stable. In the off peak periods, MOVA is in operation, maximising reactiveness to the diverse needs of drivers, pedestrians and cyclists. The scheme has been very well received by both users and the council and typically users do not suffer congestion or unnecessary delays at any time of day.

Figure 1 Heart of Slough Signals

Following the success of the hybrid SCOOT and MOVA operation at the Heart of Slough and with the implementation of a bus rapid transit scheme (SMaRT – Slough Mass Rapid Transit) being planned, a desire and need to modify many of the existing SCOOT controlled signals on the A4 to hybrid SCOOT and MOVA control was identified. However, budgets were to be much more limited than those for the Heart of Slough project and wholescale upgrades would not be possible.

So the challenge became how to retro fit MOVA onto existing SCOOT controlled signals for significantly reduced costs.

The Conventional Approach

Original expectations were that a conventional MOVA design would be completed, to be installed and run side by side with the existing SCOOT system. Cruise speed surveys, ducting improvements, and a significant installation programme of new MOVA IN, X and Stop Line detector loops was anticipated. With many of the sites approaching 15 years in age and based on experiences elsewhere in Slough, the condition of the underground ducting was expected to be poor on many of the sites.

Along with the traffic management for detector installation, a reasonable amount of civils infrastructure repairs and extensions would have been expected, again with associated traffic management and its resulting disruption.

Budgetary installation costs of approximately £25,000 per site were anticipated and with 10 sites to be upgraded in the region of a £250,000 was therefore required for the installation works.

The Adopted Approach – 'Low Cost MOVA'

With a desire to reduce installation costs further and hand-in-hand to reduce the level of civils works and associated disruption and risk, a new methodology has needed to be devised and adopted.

The MOVA designs for the first 7 sites (phase one of the installation) combine a total of 50 'MOVA lanes' and the designs require approximately 150 detectors (a mixture of MOVA IN, X, stop line and sink detectors).

The engineering team came up with an approach that looked to reuse and repurpose as much existing detection equipment as possible. For instance:

- Many of the sites had speed discrimination loops or SCOOT detector loops installed approximately 80-100m in advance of the stop lines, in the approximate typical positions of MOVA IN detectors. In these cases, these detectors are to be reused as the MOVA IN detectors, with some simple controller conditioning allowing the dual purpose functionality.
- Many of the sites had VA 'system D' detection, comprising X, Y and Z loops.
    - With system D X detectors being typically installed at 39m in advance of the stop line, these have typically proved suitable for MOVA X detection also.
    - The system D Z loops are also to be used as MOVA stop line detection. Whilst they are positioned more than a single vehicle back from the stop line and could in theory leave a single vehicle 'trapped' at a red signal should they have failed to proceed on their first green signal, the detection of such situations was felt to be as good as VA operation, with which no 'trapped vehicle' detection problems has previously been identified.
- All of the sites were fortunately already installed with Siemens UG405 OTUs, providing the communications connection to the UTC instation. With the provision of a MOVA licence and some setup updates, these devices can be

made to operate hybrid UTC and MOVA control without further hardware upgrades.

Where suitable detection equipment was not available for reuse, new detectors were needed. To further minimise cost, installation disruption and risks, newer detection technologies are being used, reducing the need for civils construction works. Wireless magnetometers are already in widespread use in Slough and so form part of the new designs for new detectors, but they are also being complemented with above ground radar solutions where the wireless magnetometers are unsuitable.

Installation Savings

Overall, a reduction the quantity of new detectors is being reduced by over 75%, with only 36 new detectors being installed and 117 existing detectors being reused and repurposed. With the reduced number of new detectors, comes a reduced level of civils infrastructure repairs and extensions and the disruption associated with these works.

Installation costs are expecting to be halved compared to the original budgets, saving in the region of £125,000 when all 10 sites are completed.

Initial Trial

One site was identified that would not need any new detection and all modifications would be limited to wiring, configuration and MOVA licence updates. No civils works were therefore required. It was decided to use this site as a trial site to prove that the concept of reusing the detection for dual purposes (SCOOT and MOVA or Speed Discrimination and MOVA) was sound and that MOVA would operate well. Figure 2 shows the layout of the trial site.

With the necessary modifications completed and MOVA made operational at off peak times, no issues were identified in the MOVA operation that would have been caused by the reuse of the existing detection. Lane discrimination of vehicles was acceptable and with MOVA validated to actual vehicle speeds and actual detector positions, no consequences of slightly less than optimal detectors positions were observed. No negative consequences of using non-diamond shaped detection loops were found.

As would be conventional, it was possible to switch between MOVA and SCOOT control from the UTC instation and the SCOOT operation was not affected and was retained in its original format.

These experiences matched previous experiences of where the individual methodologies had been used at different sites, such as the use of ‘non diamond’ shaped detectors for MOVA (from wired or wireless magnetometers for instance), the positioning of detectors to match topographical features rather than MOVA cruise speeds, or the use of detectors for more than one function, such as hybrid MOVA and SCOOT.

With a successful trial, confidence has been gained to role-out the methodology to all such sites in Slough and installations are expected to start later this year.

Conclusion and Lessons Learnt

The use of hybrid SCOOT and MOVA control opens up the benefits of both systems: The coordination of SCOOT with the reactiveness and flexibility of MOVA. Through the reuse and repurposing of existing equipment, installation costs for retrofitting MOVA can be significantly reduced compared to a conventional installation, meaning the benefits of both systems can be realised for minimum spend. From experiences in Slough, the cost savings can be as much as 50%.

The technical solutions used in this methodology are, in themselves, not especially advanced.

The biggest challenges have been in breaking from the norm, identifying, understanding and accepting compromises and challenging the conventional way of doing things. With the engineering team having the clear support of the client to try something different and with the acceptance and expectation that to save money you often have to do things a different way, barriers to the innovation have fallen.

It has proven possible to introduce performance improvements and to also make significant savings compared to a traditional installation and it is thought likely that the techniques used will be appropriate to many other situations across the country.

As well as adopting a different way of thinking, some technical learning points have been identified:

- Whilst the shape of a MOVA detection ‘zone’ (from loop, radar, magnetometer etc) does not appear to be critical, lane discrimination is. There is no point in reusing a detector if it can’t reliably detect vehicles in its lane.
- Where possible, when installing new detection, whether for ‘low cost MOVA’ or any other application, install as an individual detector per lane where possible. Adjacent detectors can normally be presented to a signal controller as a single input if required, but having individual detectors gives flexibility for the future.
- Have an eye to the future and good coordination between design and maintenance teams – During the design phase of this scheme, planned resurfacing works took place on one of the sites being designed. Quickly taking the opportunity to recut a single, two lane, chevron shaped system D X detectors as two diamond detectors will give a simpler switch over to hybrid MOVA/SCOOT control and remain perfectly acceptable for VA control in the mean time.
- Be creative and understand and accept change and compromises.

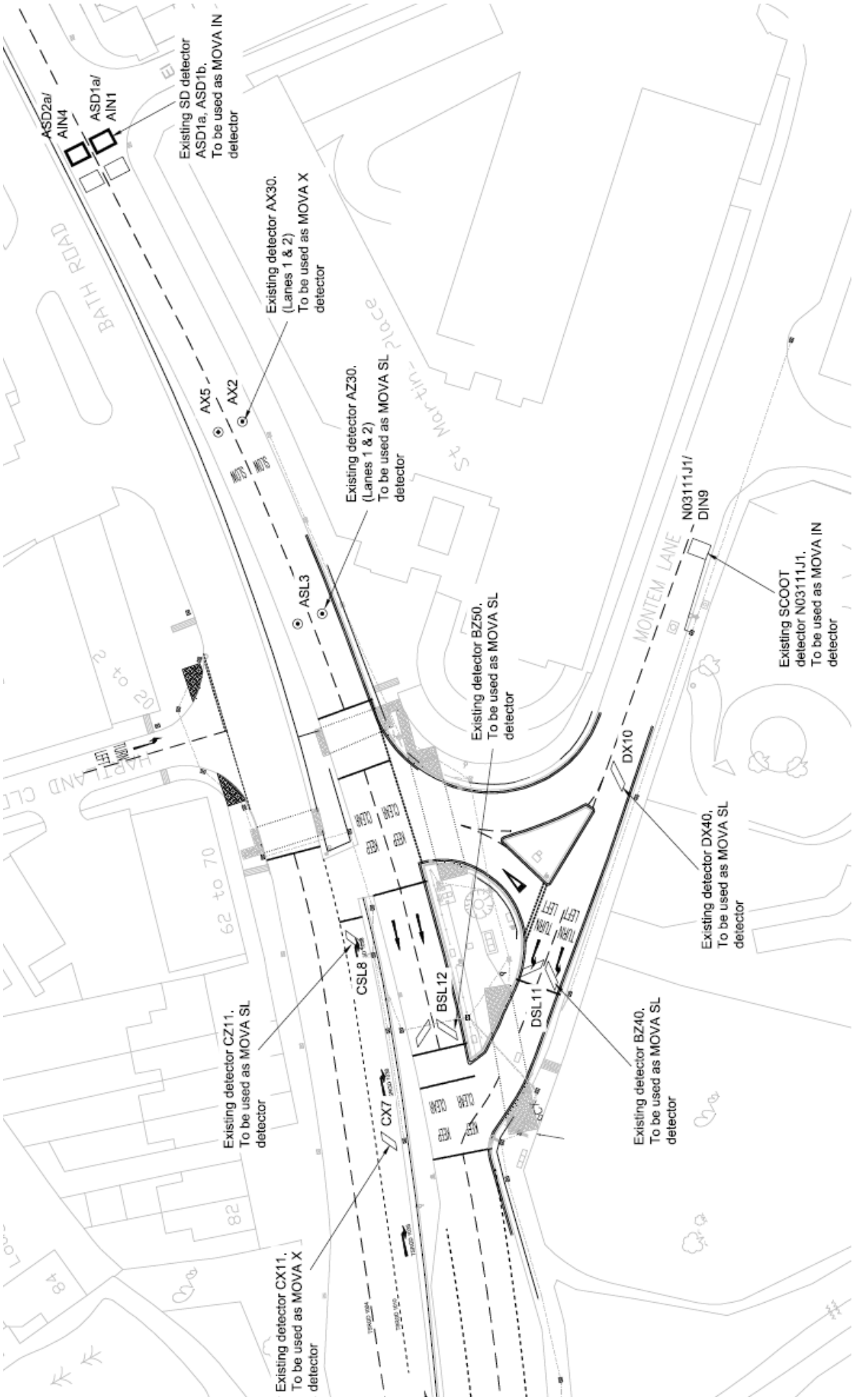


Figure 2 Low Cost MOVA Trial Site

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