INTERIM ADVICE NOTE 121/09

Advice Regarding the Application of Integrated Traffic Management

Summary
This document provides advice on identifying motorway junctions which may be suitable for the application of Integrated Traffic Management (ITM). The current techniques for the design and application of ITM are also presented.

Instructions for Use
This document is supplementary to IAN 103/08, Advice Regarding the Assessment of Sites for Ramp Metering.

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1 Introduction

Standards vs. Advice

This Interim Advice Note (IAN) provides advice upon the selection, design and installation of suitable sites for the application of Integrated Traffic Management (ITM). It draws on the experience gained from the implementation of ITM at M1 J33 and from studies at two further pilot sites at M5 J1 and M1 J40.

This document is not intended to be a standard for the selection and installation of ITM, it is intended to facilitate the application of ITM at junctions where ITM will clearly benefit the flow of traffic.

Outline

ITM in the context of this document is a means of integrating Traffic Signal (TS) and Ramp Metering (RM) technologies to reduce congestion in the locality of a motorway junction and improve efficiency through the coordinated operation of both systems. This Interim Advice Note provides advice on the benefits of ITM, the criteria for selection of an appropriate site, required infrastructure for ITM and general consideration for traffic signal control strategies.

There are a number of possible control strategies which may be adopted once the Ramp Metering Controller (RMC) and Traffic Signal Controller (TSC) systems have been linked. This document presents the basic principles by which the control strategy should be developed. It does not however attempt to prescribe an ideal solution for all junctions. It is assumed that the reader has prior understanding of RM and traffic signal control theory.

This advice is principally provided for the installation of ITM at an existing RM site, however, some of the guidance may be applicable to a new installation.

Relationship

This document should be used in conjunction with IAN 103/08 [1] and the references therein. It is recommended that the Ramp Metering Task Force (RMTF) is consulted prior to the implementation of this Interim Advice Note, via the email address or the Project Sponsor listed in Section 7 of this document.

Implementation

The main factor affecting the selection of a site for the application of ITM is the evaluation of the RM system and the traffic characteristics at the interface between the local and motorway networks. This IAN should be implemented on sites where the RMTF have been consulted and confirm that the requisite characteristics meet the selection criteria covered by this IAN.

RM operates solely on the HA network and does not strictly require consent of the adjacent Local Authority (LA) prior to installation. The HA always seeks to consult the LA to ensure that their concerns are suitably addressed. In the case of ITM, RM is linked with another system, which is often operated by the LA and therefore detailed consultation and coordination with the LA is required in order to gain their approval of the planned scheme. In the case where the LA do not own or operate the signals which the RM system is being linked to, full consent of the LA may not be required. In either circumstance, ITM requires the commitment and cooperation of both the LA and HA and both organisations should be involved at all stages in the process of developing an ITM solution. A good working relationship between all stakeholders in the ITM project is essential to its success and this IAN should form the basis of any such consultation.

2 Benefits of ITM

The fundamental purpose of ITM is to improve the flow of traffic at the boundary of the motorway and local road network. The technical approach integrates the operation of RM with the operation of the adjacent TSC to better manage the combined network. This permits dynamic modification of the junction signal timings to assist in the control of traffic intending to join the motorway from the local road network.

When functioning correctly ITM should deliver the following benefits:

Primary Benefits

- Overall improvement of junction performance during peak hours;
- Net reduction in journey times for vehicles crossing the junction on the local network and vehicles entering the motorway network from the local network;
- Reduction in journey times for vehicles travelling along the motorway through the junction;
- Improvement in the utilisation of the circulatory junction for local traffic;
- Reduction in the likelihood of queue blocking at the roundabout from vehicles trying to enter the motorway; and
- Improvement of RM operation through minimising effects of queue override and optimising queue management.

Secondary Benefits

- Improved working relationship between HA and LA;
- Improved maintenance agreements; and
- Opportunity to implement other improvements at the junction.

Details of the benefits observed from the implementation of the ITM pilot scheme located at Junction 33 of the M1, can be found in report [2] which details the evaluation of this scheme.

3 Criteria for the Selection of ITM Sites

Basic Criteria

The criteria for assessing the suitability of a site for the application of ITM relates to the technology utilised at the junction and the local traffic conditions arising from the use of that technology.

A potentially suitable ITM site will need RM already installed, and the roundabout must be partially or fully signalised typically using one of the following traffic signal control strategies:

- Cableless Linking Facility (CLF);
- Microprocessor Optimised Vehicle Actuation (MOVA); and
- Split Cycle Offset Optimised Technique (SCOOT).

If the junction is partially signalised then the arm of the junction providing highest flows to the motorway in either the AM or PM peak should be signalised. In addition, the junction should be sufficiently congested such that it will benefit from ITM.

ITM should provide benefits when the flow of traffic onto the slip road is higher than the RM system or motorway merge can efficiently cope with. When assessing the suitability of a site this situation is most easily recognised by a high number of instances when queue over ride is called by the RMC. Typically queue over ride should not be called more than 5 times during a single peak period. A higher number of instances could indicate unsuitable calibration of the RM system or flows which are in excess of what the RM system or

motorway merge can cope with. In extreme cases the traffic may queue back from the motorway onto the local roads.

IAN 103/08 suggests that RM operates efficiently below a maximum on slip flow of 900 veh/lane/hr although it can operate with flows up to 1250 veh/lane/hr depending on factors such as the length of the slip road and the percentage of HGVs. When a RM site is operating in these conditions it is possible that there will be high instances of queue override, although the RM system will probably have been calibrated to minimise those instances. Therefore, high slip road flows are a very good indication that ITM may have benefits, even if high instances of queue over ride are not observed.

If slip road flows exceed 1250 veh/lane/hr for short periods of time then ITM should also be considered as it is likely that these very high flows could be smoothed out by ITM.

The HA's RMTF should always be consulted when considering a junction with RM for ITM. The RMTF will be able to advise whether a junction is likely to be suitable for and benefit from ITM and/or recalibration. They will be looking for the following information to inform their decision:

- Flow rates on the slip road and on the main carriageway;
- Proportion of time the RM system spends in queue management mode as opposed to ALINEA operation;
- The number of times that queue over ride is called over a number of typical peak periods;
- The profile of the queue on the slip road. A queue which fluctuates from small to large regularly may indicate a need for ITM;
- The profile of the release rate from the stop line. Erratic release rates may indicate that ITM could be adopted;
- Typical sizes of platoons entering the slip road from the signalised gyratory;
- Control strategy and settings of the signals feeding traffic onto the motorway; and
- Any evidence of traffic queuing from the motorway merge onto the local road network.

Exceptional Circumstances
ITM should be considered where local traffic conditions cause irregular congestion. For example, junctions near major venues which generate localised problems causing the gyratory to 'lock' may be suitable for ITM.

The relatively low costs of an ITM solution mean that it should be considered to address even the most irregular causes of congestion.

Liaison with Local Authority
ITM only works when the scheme is able to demonstrate that it provides a mutual benefit to traffic on the HA and LA road networks; or provides a benefit to one of the networks without having a detrimental effect on the other. As such, ITM requires the commitment and involvement of both LA and the HA at all stages in the process of developing an ITM solution. A good working relationship between all stakeholders in the ITM project is essential to its success.

4 ITM Infrastructure

Traffic Signal Controller to Ramp Meter Controller Connection
ITM requires some basic infrastructure to be installed to allow communication between the RMC and TSC. The connection between the RMC and TSC can be made with either a wireless or cable link. Consideration of the durability of the link, cost of construction materials and post-installation maintenance should be taken into consideration when deciding the most suitable type of link for each site. In addition standard MCH151B, Code of Connection [3], should be followed in order to ensure that information security is not comprised through the linking of the RMC and TSC. The essential elements required for ITM operation are shown in Figure 1.

Wireless Connection
The connection between the RMC and TSC can be implemented using a wireless connection. However, local conditions need to be taken into consideration when planning the link in order to ensure that degradation of the signal does not occur as a result of objects protruding into the line-of-sight path between the RMC and TSC.

There are a number of off the shelf wireless systems available. It is recommended that the RMTF is contacted in order to obtain details of the most suitable systems.

Wired Connection
The standard linking solution would be the use of a 10 core twisted pair communications cable such as specification TR2150 [4]. Cable installations on the motorway side shall be in accordance with Design Manual for Roads and Bridges, Volume 9 [5].

It is recommended that the LA is consulted with regard to acceptable standards for cable installation in ground under their jurisdiction. The LA must also be consulted about the termination of any cables in their TSC cabinets.

The termination and testing of the cables should be carried out by a competent traffic signal engineer fully conversant with the installation of RM and Traffic Signals.

Consideration should be given to the provision of a mini-pillar or chamber at the HA/LA fence line. This may simplify demarcation points for maintenance of cables but adds complexity to the design and introduces an additional failure point.

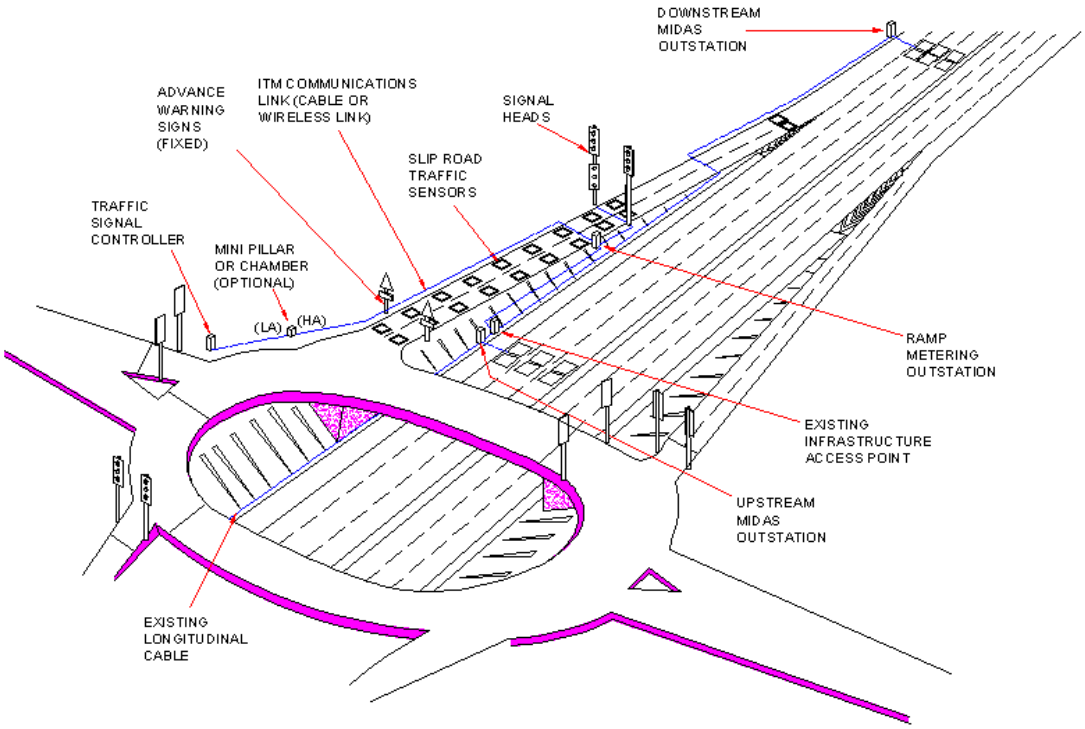

Figure 1 – Diagram of Typical ITM Site

5 ITM Traffic Signal Control Strategy

ITM control strategy is used to redistribute green time on the signalised junction to ensure the most efficient flow of traffic onto the motorway. In its most basic form, ITM will limit the number of vehicles trying to enter the motorway system by reducing green time on the approach road with the highest supply of motorway-bound traffic.

This is facilitated by the RMC transmitting messages to the TSC on system status and queue occupancy levels. The queue occupancy levels correspond to pre-determined levels up to a maximum desired queue size. The pre-determined levels should be set by a competent person via the 'Switch On-Off' algorithm on the RMC. In addition, the Cableless Linking Facility Plan, MOVA data set, or SCOOT plan will need to be modified in order to accommodate ITM on a CLF, MOVA or SCOOT system respectively.

The key to an efficient ITM solution is ensuring that the TSC uses the data from the RMC to optimise the flow of traffic onto the slip road. Achieving the optimal set-up is a skilled task for a team comprising competencies in RM calibration and traffic signal control.

6 Withdrawal Conditions

This IAN gives advice on the practice for selecting sites which are suitable for the application of ITM based on the understanding gained through the installation and operation of one pilot scheme and studies at M5 J1 and M1 J40 which are still on-going at the time of writing. Further advice will be given in future based on further developments of the ITM or experience gained in additional ITM installations. This advice will be given in an updated version of this document which will render this IAN obsolete. Please ensure you are referring to the most recent and applicable advice.

7 Contacts

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8 References

1. Advice regarding the Assessment of Sites for Ramp Metering (IAN 103/08)
2. Integrated Traffic Management at Junction 33 of the M1, Evaluation Report. TT75904
3. TTD Code of Connection MCH1514B
4. NMCS Non Armoured Copper Communications Cable TR 2150
5. Design Manual for Roads and Bridges, Volume 9. Network – Traffic Control and Communications DMRB Vol 9