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# The Network Management Duty at Junctions

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## Overview

The Network Management Duty is a key part of tackling congestion in the March 2006 second Local Transport Plans in England, and will feature in the Local Implementation Plans of London boroughs in 2007. It was introduced by the Traffic Management Act 2004, and is being implemented by all Local Traffic Authorities (LTAs) in England. The implications of this and various aspects of congestion were the subject of a key paper at the 2005 symposium (1).

The legislation has required all LTAs, including Transport for London (2), to appoint a named Traffic Manager to identify and carry out the tasks needed to fulfil the Duty. This requires all LTAs to secure the expeditious movement of traffic (i.e. road users) on their own road network, and to facilitate such movement on other LTAs' networks, as well as the national network of motorways and trunk roads. Although the Highways Agency does not share the same statutory duty, at the time of the legislation it had already been given an equivalent remit by Government to pursue similar objectives on the national road network.

The legislation requires LTAs to have regard to the statutory Network Management Duty Guidance (3), published by the Department for Transport in November 2004. In general terms, tasks which may fulfil the Duty include anything that an LTA can do to make more efficient use of the road network, or tackle congestion or disruption. A very major part of the Duty is related to institutional arrangements and actions to lessen traffic disruption and non-recurring or unpredictable congestion, typically associated with:

- works in the street by utilities, developers and the LTA itself
- parking regulation and enforcement
- responding to accidents and other unforeseen incidents
- managing the traffic arrangements for special events

Where such issues affect junctions, there will often be the most serious implications for congestion, but such matters should already be given high priority by LTAs, and are not explored in this paper. Where and when there is no such disruption, most LTA lengths of road between junctions contribute little to regular congestion, and hence offer little scope for any actions to fulfil the Duty. Moreover, where regular congestion does occur between junctions, for example on grade separated dual carriageways, there is probably little the LTA can do, assuming no road widening.

This means that the effort by LTAs and the Highways Agency (HA) to tackle everyday regular congestion, in fulfilment of the Duty or its equivalent remit, is likely to require a strong focus on the efficiency and effectiveness of junctions. From casual observations in many parts of the country, there is reason to believe that much more could be done to reduce deficiencies at both LTA and HA road junctions, and gain easy benefits in terms of congestion. This paper explores some of the issues and activities that may need to be considered in achieving effective action.

## Steps in the Process

The Network Management Duty Guidance (NMDG) in its Annex A (3) sets out good practice advice on techniques and approach. For tackling everyday congestion at junctions, a process can be readily derived as follows:

**Step 1** – Monitor vehicle journey times/speeds from junction to junction.

**Step 2** – Identify and map the junctions where regular congestion occurs.

**Step 3** – Identify other junctions where traffic growth may shortly lead to congestion

**Step 4** – Establish the reasons for congestion taking account of any junction defects

**Step 5** – Rank the identified junctions in terms of priority for attention

**Step 6** – Plan a programme of actions, remedial works and improvements

**Step 7** – Make best use of intelligent transport systems (ITSs) (e.g. UTC and MOVA)

The process outlined above has strong parallels with other LTA and HA activities. The long established, and successful methods of reducing road casualties have involved a similar process for many years. Much more recent is the not dissimilar approach to tackling bus reliability, with the requirement to conduct regular bus timing surveys and develop Punctuality Improvement Plans.

## Clarity of Purpose

Whilst few people would dispute the benefits of fewer road casualties and more reliable buses, the position regarding congestion has been less clear (4). Since the 1990s there have been concepts, policies and schemes, which have significantly influenced the LTA perception, if not the reality, of congestion at junctions, for example:

- altering the balance between safety and capacity
- bus priority by levelling down journey times by car
- physical traffic restraint to encourage more sustainable modes
- progressive reallocation of road space away from vehicles
- locking in any benefits of reduced traffic flows in urban corridors
- general hierarchies of road users with cars at the bottom of the list

Many of the above have resulted in interventions at junctions which have clearly made congestion worse. Whilst making sense in certain areas, such as town centres, there has been a tendency for LTAs to generalise their approach across whole road networks, at least to the extent of treating congestion as not really a problem, or a low priority for attention. Congestion has even been viewed as desirable in terms of sustainability and traffic trends. Prior to the Traffic Management Act 2004, there was little to discourage such thinking, and the legislation has ended a significant degree of uncertainty. The NMDG sets out how LTAs need to establish distinct priorities for the different types of roads in their networks. On overall clarity of purpose, the NMDG states the following:

*“Primarily, the network management duty is about dealing efficiently with the traffic presented on the network - both now and in the future - and the various activities that are causing or have the potential to cause congestion or disruption to the movement of traffic”*.

## Monitoring and Mapping Congested Junctions

This involves the first two steps in the above process as follows:

**Step 1** – Monitor vehicle journey times/speeds from junction to junction.

**Step 2** – Identify and map the junctions where regular congestion occurs.

The first step is probably the most difficult, because little development work has taken place to establish appropriate methods. The current lack of junction congestion data, is likely to be a major obstacle in getting the process properly underway, and the second step may be dependent on more anecdotal evidence. Without quantified information, it is difficult to rank junctions in terms of congestion severity, nor gauge the outcomes of actions taken. In the field of road safety, an equivalent difficulty would arise if casualty reduction were attempted, but without access to historic accident data.

The NMDG indicates various potential types of data, but the onus is clearly on LTAs to establish what they require. For congestion at junctions, manual surveys of queues may be relevant, but probably not as a method screening a large number locations to see whether or not congestion is a problem. There are also sampling problems with any manual method, and several days of observation can be required at each location. For these reasons, methods based on vehicle journey times or speeds would appear to offer the most potential. Because modern methods are likely to use GPS positioning to record vehicle movements, it should be possible to break the results down into individual short lengths of road so that queues at junctions can be highlighted.

The NMDG in its Annex A makes particular reference to the ITIS vehicle tracking data purchased by Government and available to LTAs at the level of road lengths between junctions in 15 minute intervals. Because this involves a very large sample of readings throughout the year, and includes relatively minor side roads at junctions, it would appear to be an obvious starting point, before considering new survey arrangements. To give an idea of how this might look, Figure 1 shows a diagram of roads to the east of Nottingham, with colours highlighting speeds between junctions. It is stressed that the speeds are not based on actual data, and have been estimated from very limited observations.

Whilst Figure 1 is able to highlight some clearly congested junctions, it is less than satisfactory as a basis for ranking the junctions by extent of congestion. However, the important feature of GPS based surveys is the breakdown of results into short road lengths. For ITIS holdings data, this has been described and illustrated for part of the urban road network in Wolverhampton (5) using the 50m road lengths for which ITIS data is understood to collected and archived. Figure 2 shows how such information might appear if aggregated into 200m road lengths, again based on estimation, and not actual data. Comparing Figures 1 and 2 shows how the more detailed breakdown in Figure 2 gives some indication of queue lengths, not only at the obviously congested junctions, but also junctions on the verge of congestion.

The type of mapping in Figure 2 could provide a robust basis for quantifying congestion at junctions, if the challenge of retrieving and processing the data could be overcome with resources available. Unless this is currently already happening, there would seem to be a strong case for a leading LTA or the HA to pilot an exercise of this sort. This could be done for a limited area with a variety of congested junctions, perhaps based on average school days throughout the year at peak times. If successful, there could be much value in the mapping being rolled out regionally or across the country as a key initiative under the Network Management Duty, or its equivalent remit on trunk roads.

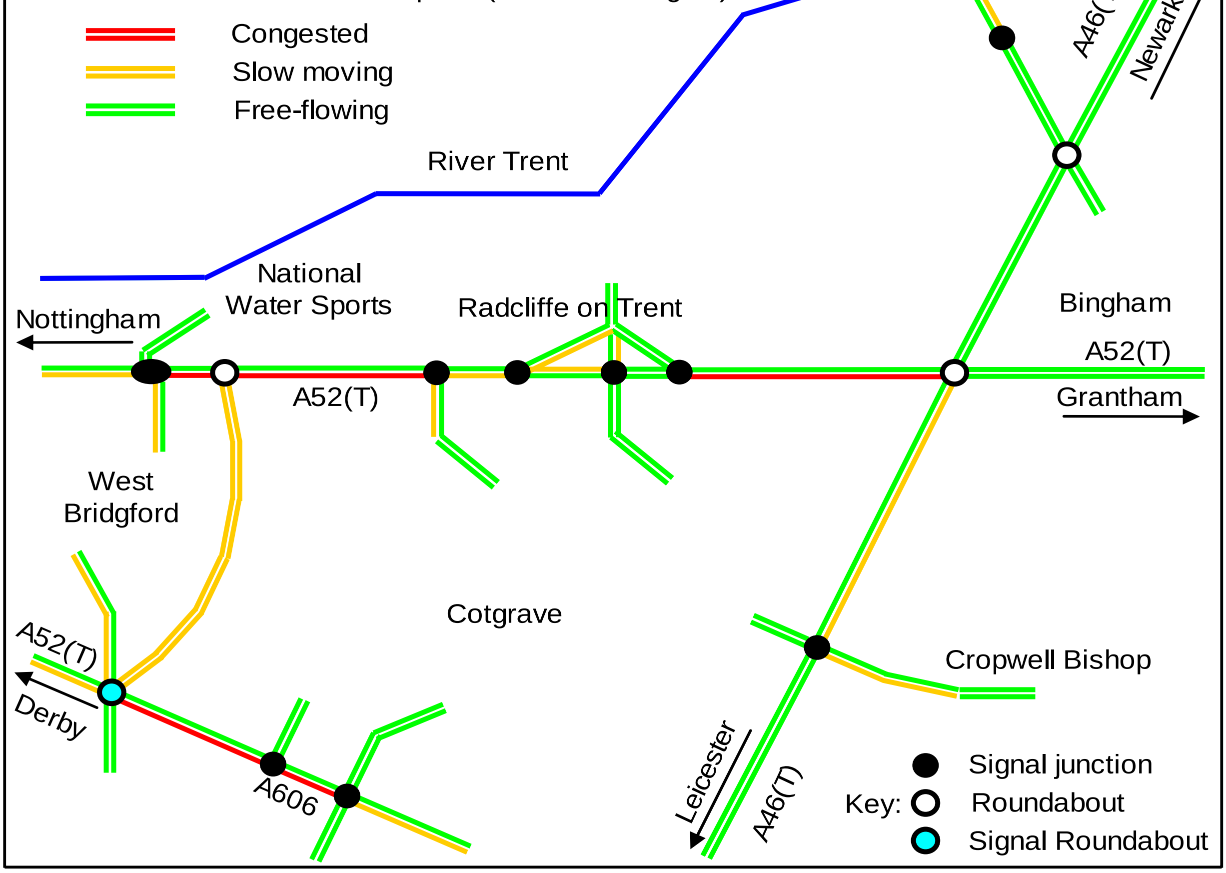


**FIGURE 1 –** Estimated AM peak (whole link lengths)

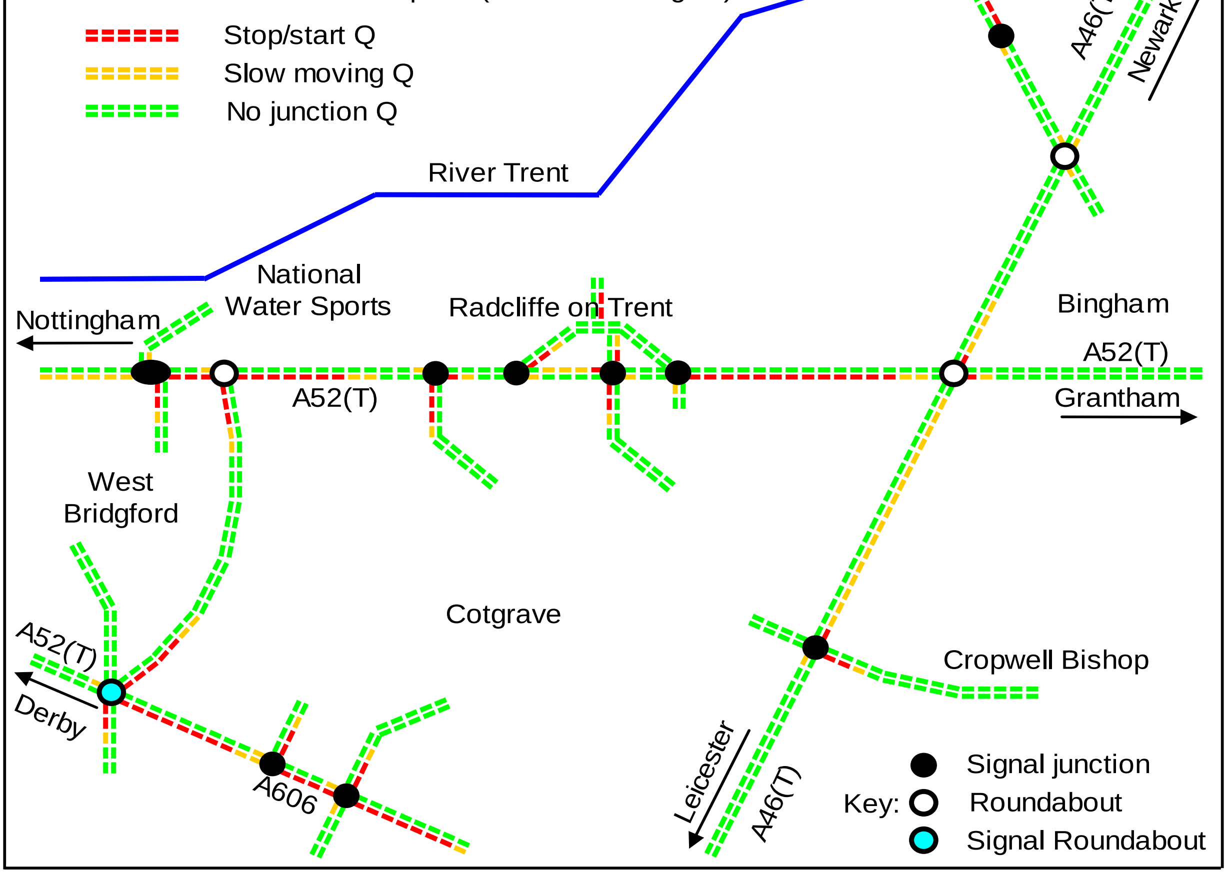


**FIGURE 2 –** Estimated AM peak (200m road lengths)

## Junction Defects and Opportunities

The first two steps in the process will have produced a map of congested junctions, and information to quantify the extent of congestion at each location. Ideally this will have identified the extent of queuing both on main roads and side roads, in a way that can be mapped as in Figure 2. Failing this, there should have been sufficient evidence to allow the degrees of congestion to be placed in categories, for example “severe”, “moderate”, “slight” or “borderline”. The process then moves on to:

**Step 3 –** Identify other junctions where traffic growth may shortly lead to congestion

**Step 4 –** Establish the reasons for congestion taking account of any junction defects

If the extents of queuing have been mapped, there should an indication of junctions on the verge of congestion. These are obvious locations where modest traffic growth can lead to definite congestion in the short term. Without the mapping, anecdotal evidence may have placed a number of junctions in the “borderline” category, and again these could be sensitive to modest traffic growth. Before such junctions are considered for particular action, it would seem reasonable to gauge the likelihood of short term traffic growth. If there are many junctions to be considered, it would seem sensible to shortlist the locations where there are identified reasons for growth, such as house building or other developments underway, or junctions where traffic will increase because of road schemes nearby, including improvements at other junctions.

From the process so far, there should now be a list of currently congested junctions with degrees of congestion, and also a list of junctions shortly to become congested. The process can now move on to Step 4, which will investigate the reasons for congestion. This will focus on various attributes of the junctions which may be regarded as potential defects, for which remedial action may be possible. Any checklist of junction attributes could benefit from the inclusion of some or all of the following:

**A** Unbalanced queuing on competing approaches or queuing on only one approach at roundabouts, signal junctions or priority junctions.

**B** Right turning queues blocking adjacent movements at priority junctions.

**C** Right turning queues at signal junctions where drivers fail to move to reasonably forward position for waiting to turn when opposed by oncoming traffic.

**D** Vehicles waiting in the middle of a signal junction to turn right, but blocking vehicles from proceeding straight on from the offside lane where intended.

**E** Any seconds when flow across congested signal junction stoplines is less than the full saturation rate, for example towards the end of green periods.

**F** Any seconds at any point in the signal cycle when little movement seems to be taking place anywhere at the junction.

**G** Junction approach or exit lanes regularly impeded by any sort of stationary vehicles, including parking, loading and frequently stopping buses.

**H** Under-used approach lanes, restricted by the road markings to relatively low flow turning movements at roundabouts or signal junctions.

**I** Under-used approach lanes, despite road markings intended to give balanced usage between two or more adjacent lanes at roundabouts or signal junctions.

**J** Lane arrows not easy to see because of worn out markings, or only one lane arrow too close to give-way or stop line and masked by first or second waiting vehicle.

**K** Any scope for extending lane markings further back from the give-way or stop line on congested approaches.

All the above attributes, if present at the junction, are indications that there may be scope for improving efficiency and tackling congestion. When typical queuing patterns have been quantified during Step 1, a single site visit during each congested peak period may be sufficient to assess the workings of the junction against a checklist of items. From the records of these site inspections, remedial action can then be pursued depending on any defects that have been identified.

## Prioritisation

From the process so far, there should be a considerable amount of information on which to base the next steps as follows:

**Step 5** – Rank the identified junctions in terms of priority for attention

**Step 6** – Plan a programme of actions, remedial works and improvements

For Step 5, The NMDG in its Annex A points towards a combined form of ranking to provide the basis for Step 6. For congested junctions, there are several criteria which might be considered for ranking, including the following:

- the seriousness of the congestion problem
- the potential for any sort of remedial action
- the extent to which such remedial action might tackle the problem

The first criterion may already have been used for initial ranking during Steps 1 and 2. This will probably have helped prioritise the investigations required for Steps 3 and 4. However, the practicalities of resolving defects may vary widely from junction to junction. Much of the work under Step 5 may therefore need to be concentrated on the criteria in the second and third bullets above. For example a seriously congested junction, but with minimal defects, would offer little potential for remedial action, nor much scope for tackling the problem. In such cases, the only prospect may be a junction improvement scheme, and this may well be considered beyond the scope of remedial action under the Network Management Duty. The ranking in Step 5 should highlight such junctions for separate consideration, and concentrate on remaining locations. A simple points system might be all that is needed to prioritise junctions for the more detailed attention in Step 6.

Step 6 is likely to require considerable resources in arriving at any realistic and costed programme of remedial works. However, not all junctions should require programmed schemes. Where the defects are due to poor operation or maintenance under existing arrangements, it ought to be possible to get matters quickly resolved, and make follow-up site visits to check the outcome. For example, congestion on only one approach to traffic signals is usually due to faulty or obsolete signal timings. The remedy should be a “quick win” in advance of drawing up the main programme. For the other junctions being considered for the programme, a further ranking is likely to be needed and could include:

- the resources needed and costs of remedial action
- how quickly the remedial action might be implemented
- the follow-up arrangements for gauging the outcome

In terms of resources, the requirements may include fresh traffic counts, lane by lane roundabout analysis, traffic signal design expertise, or other junction skills outside the scope of mainstream traffic management. Lack of resources in these areas may have a significant influence on prioritising the programme of works.

## Role of Intelligent Transport Systems (ITSs)

The NMDG in its Appendix A highlights the importance of technology based systems in network operation at relatively low cost. Such systems, including travel information and bus priority, are relevant across the range of activities under the Network Management Duty. As regards regular congestion at junctions, the scope for ITS based remedial work is limited to one or two specific applications, which may or may not be currently applied at the junction. This is the final part of the process as follows:

**Step 7** – Make best use of intelligent transport systems (ITSs)

The scope for improvement may involve introducing ITSs or reducing defects in existing ITS applications. The two main ITSs for tackling congestion at junctions are:

- Urban Traffic Control (UTC) which determines signal timings from a control centre using a real-time responsive method such as SCOOT, or fixed cycle time plans that can allow some real-time responsiveness using local detection at the junction
- Microprocessor Optimised Vehicle Actuation (MOVA) which maximises junction efficiency using additional local detection and sophisticated real time analysis to calculate timings which minimise queues and delays on a cycle by cycle basis

Apart from introducing one or other system where neither system is currently applied, work to rectify signal timing defects could involve:

- Upgrading UTC fixed cycle time plans, including best use of the local detection
- Upgrading UTC control from fixed cycle time plans to SCOOT
- Conversion of the method of control from UTC to MOVA, full time or part time

Where the current method of control is considered to be the best possible, there may well be remedial work to be done, including:

- Updating UTC fixed cycle time plans to address identified defects
- Updating SCOOT validation, and the application of time of day settings
- Rectifying or updating MOVA where imbalanced queuing has been identified

Whilst ITSs generally deliver great benefits, they can easily be let down by less than satisfactory implementation. It should therefore come as no surprise that ITSs may not be working as well as they should, and that remedial work could be of particular benefit. The previous steps in the process should have highlighted any ITS related problems, but for any congested junctions, an ITS “health check” may find room for improvement.

## Conclusions

1. In the absence of disruption, congestion on most roads is confined to junctions, and there may be significant scope to improve matters. Where lengths of road between junctions are regularly congested, for example on grade separated dual carriageways, there may be little that can be done, assuming no road widening.

2. The efforts by LTAs and the HA to tackle regular congestion, in fulfilment of the Network Management Duty or equivalent remit, will inevitably see a strong focus on the efficiency and effectiveness of road junctions.

3. From the Network Management Duty Guidance, a process can be readily derived with a series of steps towards tackling congestion at junctions. This involves problem assessment and ranking before the prioritisation of remedial actions.

4. Although policies and practices may in the past have exacerbated congestion at junctions, the Network Management Duty makes clear that congestion is definitely a problem to be tackled, subject to the needs of certain parts of the road network.

5. Many sorts of defects may be found at junctions, and a range of remedial actions and works may be possible, provided the resources and skills are available to carry out the junction investigations and devise appropriate measures.

6. Intelligent Transport Systems have an important part to play, where not applied at present, where there may be scope for upgrading, or where less than satisfactory current implementation may in itself offer scope for remedial action.

7. Lack of resources and skills may restrict the number of congested junctions that can be considered in identifying defects, devising remedial actions, drawing up prioritised programmes of work, and follow-up investigations to gauge outcomes.

8. In order to prioritise junctions for attention, ways must be found to retrieve and analyse data which can reveal patterns of congestion at junctions. ITIS vehicle tracking data for 50m road lengths may offer the greatest potential for doing this.

9. Without the ability to quantify typical patterns of congestion, using vehicle tracking data or any other means, it will be difficult for LTAs or the HA to fulfil the Network Management Duty or equivalent remit, and gauge the outcomes.

10. Unless it is already happening, there is a strong case for a leading LTA or the HA to pilot an exercise in quantifying typical junction congestion, establishing effective methods of prioritisation, and identifying remedial actions and works.

11. Whilst congested junctions can be identified, and remedial options may well exist, without a valid means of quantifying typical congestion both now, and after action has been taken, the Network Management Duty at junctions will be difficult to fulfil.

## References

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