Working paper draft 22-10-09

Predictive Navigation: the case for an initiative

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1. Traffic congestion is generally viewed as a serious and growing problem on the road network. Experience of adding capacity tends to indicate that additional traffic arises to take advantage of the extra carriageway – hence the maxim 'you can't build your way out of congestion'. Road pricing is commonly seen as the economically efficient means of allocating scare road space. But this approach seems politically difficult beyond central London and hence likely to be a long term outcome at best, despite its attractions as a source of revenue.

2. So what might be done in practice to tackle road congestion in the near term? The purpose of this note is to outline a novel approach.

What is the problem?

3. To respond to the problem of congestion, it is necessary to identify what in fact is detrimental. Standard economic analysis allows estimation of the cost of time wasted in congestion. However, surveys of motorists indicate that their main concern is the uncertainty of journey times, which bothers them more than longer journey times or stop-start driving. For instance, a recent finding from a DfT Citizens' Panel concerned with motorway driving is that 62% of respondents reported that congestion is a problem because of journey time uncertainty – the highest ranking complaint (www.dft.gov.uk/pgr/scienceresearch/social/citizenpanelmotorwaydriving.pdf) Similarly, predictability seems more important than speed for freight deliveries. Accordingly, a direct approach to dealing with the main detriment arising from congestion would be to provide drivers with good predictive information about journey times, so that they could better plan and manage their trips. This seems increasingly feasible as the relevant technologies develop.

4. Consider, for instance, the return journey from work to home where there is often flexibility as regards an individual's departure time. If good real time traffic information is available, the flexible driver would be able to avoid peak traffic conditions, so reducing both journey time itself and journey time uncertainty for the individual. And because this driver avoids the peak, traffic congestion at that time is less for those who cannot avoid it. This approach works well in the Seattle area (see www.wsdot.wa.gov/traffic/seattle/) where real-time travel time data by link allows the regular user to estimate journey times (see www.wsdot.wa.gov/traffic/seattle/traveltimes). 95% reliable travel times can also

be computed for commute trips (see www.wsdot.wa.gov/Traffic/Seattle/TravelTimes/reliability).

5. The Seattle traffic information system also allows choice of routes by the individual driver, although specific alternatives are not recommended. Route guidance to avoid congestion and incidents would in principle be attractive to drivers. However, if too many road users take the same advice, the alternative route may become as congested as the original route. There is also the concern about unsuitable routes being chosen, as happens when large goods vehicles equipped with satnav attempt to go down narrow lanes or under low bridges. It should be possible, however, to arrange to avoid the use of environmentally inappropriate routes, and it may be possible to reduce herd-like responses through sophisticated, reflexive route guidance.

6. Given the likely limited scope for alternative routes, the main emphasis in the provision of better information to tackle congestion should be sufficiently accurate journey time data, particularly in advance of the trip. This would permit better informed decisions for personal travel as regards when to start out, which destination (when there may be options, as for shopping and leisure activities), and indeed whether to take the trip at all. For road freight, good journey time data would facilitate scheduling, minimise delays due to congestion and help meet customers' requirements for delivery time.

7. It would, of course, be natural to include predictive journey time information and route guidance advice in in-vehicle satnav devices, which already provide journey time information based on historic or free-flow traffic conditions.

8. The approach described here might be termed 'Predictive Navigation'.

Technologies

9. There are four broad areas of technology relevant to prediction of journey times:
   - Digital maps – now a standard technology, although development is needed to reflect environmental concerns.
   - GPS to locate the individual vehicle – a standard technology.
   - Means for locating slow moving traffic – includes fixed roadside installations, floating vehicles, GPS and mobile phone data.
   - Computation – the need is to develop algorithms to predict future traffic, based on historic patterns, weather, incidents etc.

10. There are a number of applications of these technologies that are publicly available, the main ones of which are:

   - The Highways Agency operates the National Traffic Control Centre which gathers real-time traffic information from across the motorway network and aims to provide accurate real-time information both pre-journey and en route via the internet, mobile phones and roadside variable message signs. Most traffic forecasts are based on historic data. www.highways.gov.uk/traffic/traffic.aspx

- Transport Direct, a route planner for both car and public transport journeys, predicts journey times based on historic traffic patterns. (www.transportdirect.info/web2/)

- Google Maps is available on all mobile platforms and is integrated with traffic data from the Highways Agency.

- Trafficmaster offers a satnav route guidance system which takes advantage of real-time traffic and road incident data to provide the best available route and estimated time of arrival. www.trafficmaster.co.uk/our_solutions/smartnav-new.php)

- Tom Tom uses the traffic flow of anonymous mobile phone users on the road to provide real-time traffic information. www.tomtom.com/services/service.php?id=2&tab=4

- Inrix offers dynamic predictive traffic information in the US, based on modelling technologies developed by Microsoft Research. Flow patterns can be predicted every 15 minutes for up to a year into the future. www.inrix.com/predictive.asp

- ITIS uses floating vehicle data from cellular phone networks and GPS devices to generate accurate traffic information. www.itisholdings.com/

- The Mobile Millennium Project in Berkeley, California, is a free pilot public traffic-information system which uses anonymous speed and position information gathered by GPS-equipped cell phones, fuses it with data from static traffic sensors, and broadcasts traffic information back to the phones. http://traffic.berkeley.edu/

- Journey Dynamics offers forecasts of journey times, personalised and smarter routing, based on modelling that takes account of vehicle type, the individual's driving style, incidents and historic patterns of congestion. It is claimed that journey times can be estimated to within a few minutes. www.journeydynamics.com/index.htm

11. As well as the technologies aimed at providing information for drivers, a complementary approach arises from developments in the management of the road network, including variable speed limits, ramp metering, and swift incident management. These measures promote the smooth flow of traffic, both to optimise system efficiency (the traditional reason for introduction) but as well would improve the accuracy of traffic forecasts.

Benefits

12. A predictive navigation device which provided optimised routes and reasonably reliable journey time predictions based on real time and forecast traffic

information would allow the traveller to be advised of the best route and arrival time. There would be a variety of ways in which such information might be used, for instance to trade off a briefer commute at off-peak times against a preference for working standard office hours; to plan a trip under congested traffic conditions; to decide choice of shopping destination in the light of the expected journey time; or to achieve enhanced efficiency of a road-based logistics operation. If information about parking provision at destinations could be incorporated, this would be a further benefit.

13. An additional benefit of predictive navigation, if widely adopted, would be to help optimise the efficient use of the road network by offering alternatives to using the system at times of peak usage. In this regard the effect would be similar to the effect of road pricing in that some trips would be shifted in time and whilst others would be abandoned. With road pricing, those displaced at peak are travellers least able to afford the charge, whereas with predictive navigation those displaced are travellers who can trade off arrival time convenience against overall journey time.

14. The 2004 DfT feasibility study of road pricing used the National Transport Model and some regional models to assess the consequences of various levels of charges, these being added to the usual time and money costs of travel, assuming that the behavioural response would be as observed for fuel price increases. The outputs included the impact on traffic, congestion and carbon emissions, as well as the monetary value of welfare benefits.

15. It would be desirable for the impact of predictive navigation to be modelled in a similar way, to see how the benefits might compare with those from road pricing. However, at present empirical evidence on driver response to traffic information is very limited, and there appears to be a lack of modelling capability. The DfT Citizens'Panel mentioned above found that 50% of respondents said they would set out at a different time (earlier or later than they'd like) to avoid motorway congestion – which suggests substantial behavioural flexibility which could be enhanced with better information.

Conclusions

16. In terms of practicalities and acceptability, predictive navigation would have much to recommend it, compared with road pricing. Uptake would not be obligatory, but at the choice of the driver, who bears the cost of the in-vehicle device and the subscription to the traffic information service (although the latter might be fully- or part-funded by highway authorities in the interest of system-wide efficiency). Early adopters gain advantage from optimal routing (to the extent that such is feasible under congested conditions); as the majority become equipped the network increasingly benefits from modified travel behaviour; and all users have assurance about journey times. There is no need to standardise the in-vehicle devices, other than to agree a protocol for the interface with the traffic information stream. There are no privacy concerns, and no low income motorists penalised by the charging regime when making an unavoidable car journey to work.

17. There is quite a lot of activity in both private and public sectors aimed at providing better information to travellers. There would be an argument for a governmental initiative to foster the development of technology applications that would lead to the more efficient use of the road network. However, at present there is a gap as regards both the models which might be used to estimate economic benefits and the data in respect of behavioural response to traffic information that would be needed to calibrate such models. Accordingly, there would be a case for a research initiative designed to advance our knowledge of these matters, as well as to explore a public/private approach to deployment.

Further reading

Metz, D. (2008) National road pricing: a critique and an alternative. Proc. Inst. Civ. Eng.: Transport, 161(3), pp 167-174.

Metz, David. (2009) Predictive navigation: the remedy for congestion? Transport Times, October, p18.