Conference
'Spatial Information for Sustainable Management of Urban Areas'
Paper Title

Usage of spatial information for dynamic traffic management and traffic information in Rheinland-Pfalz

Nature of the contribution: Good/Best practice

Background

In recent years usage of Information and communication technology for traffic and transport systems (Intelligent Transport systems, abbreviated to ITS) has increased globally. Whereas traditional infrastructure like road or railway construction, airports or harbours are getting more difficult to build due to rising costs and environmental concerns, technology to improve operation of these infrastructure has become cheaper, more mature and ever widely applied.
The arrival of the internet and cheap mobile communication has given another boost to this worldwide trend.
Obviously the capacity and performance of transport networks varies considerably over time of day, week and season. Peak loads, incidents or construction sites are the main causes for congestion and underperforming networks that do, in principle, offer sufficient capacity. For road traffic a number of traffic management approaches have been developed to deal with these operational challenges. These are examples:

- Dynamic speed limits or overtaking bans can increase throughput by up to 20%
- Network wide dynamic rerouting of vehicles can help to decrease the impact of temporary bottlenecks
- Local Measures like access control, temporary use of hard shoulders or hazard warnings can improve fluidity of traffic and improve safety

Compared to actually constructing or extending road infrastructure, these systems are cheap and quick to install. Assessed by their cost-benefit ratio many applications pay back expense through drivers' savings in time or cost in as few as 1-3 years.

However traffic management is a complex task in terms of organisation and synchronization of sometimes rather different actors. In most cases different road operators manage urban networks and regional motorways (public or private), jurisdictions play a major role and, above all, drivers must be convinced and continuously reassured that traffic management is for the common good just as for their own advantage.
Therefore traffic information is a substantial part of traffic management: Only if the information conveyed to the drivers is consistent with the information used for traffic management the full potential of ITS can be realised. This is even truer as drivers prefer dynamic information to static advice: They expect to see information and recommendation take up the specific situation of the day, even in recurrent traffic patterns. Finally, like in transport infrastructure, progress in the automobile industry has lately been focusing onto information and communication technology

applications, with the navigation device as one of the most important “drivers” in car user behaviour. These navigation systems do not only replace the road map; they can give access to the whole range of information relevant for a trip, that the driver would not be able to process himself. Intricate urban networks, numerous construction sites, all kinds of events outside the personal knowledge can now be taken into account when guiding a vehicle.
Today, in Germany, in 2007 sales of navigation systems exceeded those of TV-sets and authorities have to accept that the navigation systems and similar devices will have a strong and lasting impact on how roads can and should be managed. This technology spreads quickly over the globe and may have an even higher impact where traffic rules are less strict and traffic situations more volatile than in Europe.

Multimodality has been recognised as a panacea for tackling traffic problems. Cities with inadequate public transportation systems regularly suffer more severe traffic problems, even if they boast a sophisticated road network. However, across the population mobility patterns tend to be rather fixed and open to change only over long time spans. Here too information systems have been taken up as the first option to increase awareness of mode options and to inject flexibility into the transport system as a whole. But up to now most traffic information services are restricted to specific modes and multimodal systems are the exception rather than the rule; the more so the closer they are to commercial operating environments. Without any doubt one major reason for this time-lag is the complexity that inter-modal transport chains present to the user: Miscellaneous factors like congestion trends, accidents, train delays, parking space availability and personal requirements all have to be considered at the same time. Solutions are needed that respond to this complexity yet simplify comparison between alternatives: Map-Based applications, as will be shown in this paper, fit rather well to this requirement.

Some requirements and design considerations for developing Traffic information portals

From the infrastructure operator’s point of view accurate and credible traffic information can help to improve network performance and traffic safety.
As shown above the environment of how such information will and can be put to use has changed considerably over the last decade and this process is likely to continue. The following general requirements can be concluded:

- Traffic information has to be of high quality, with sufficient resolution in space and time
- Traffic information and traffic management measures must be consistent
- Cross-border availability is important in urban environment as well as on a intra-regional scale
- All traffic information shall be available in a spatial context clearly indicating possible interferences

Traffic information in most cases has a specific position in place and time. Overwhelmingly it refers to transport networks: Primarily links (road stretches) and then nodes for the road networks, primarily nodes (stations, stops) and then links for the public transport system. In some cases information can concern areas: Weather incidents or railway-strikes are examples here.

Obviously traffic information must be referenced not only to geographical coordinates but to network elements as well. Several encoding mechanisms have been defined that allow localising information in terms of such topology. Out of these concepts the TMC table (so called location-code-list) based encoding has been a major success, recently even on a global scale. Designed for usage by conventional analogue radio TMC has found its way into most navigation devices, despite a number of disadvantages like limited resolution, no built-in cross-border compatibility or severe limitations in the content of the message transferred. TMC- encoding is also favoured by authorities: In Germany practically all police authorities and most road operators reference their information to TMC locations wherever possible.

Figure 1: Density of TMC -point locations in the city-centre of Mainz.

Surely, other methods can refer to any point on a network yet they lack the feature of being understood by millions of existing devices and being on air by hundreds of radio stations.

Guiding principles for a traffic information portal serving the Land of Rheinland-Pfalz

Rheinland-Pfalz with approximately 4 million inhabitants, 800 Kilometres of motorways and major industrial areas lacks a central conurbation. Instead the Land shares major conurbation areas at its borders areas with neighbouring Hessen (Rhein-Main-Gebiet), Baden-Württemberg (Rhein-Neckar Raum) and Nordrhein-Westfalen (Rheinland).
Accidents and road works as well as recurrent congestion are the major issues for traffic management on the motorway networks. Over the past years handling the ever growing number of trucks and their specific needs has been added.

On urban scale traffic disturbances are usually more short-lived however often linked to the motorways: As for the example of Mainz, a blockage - even lane-wise - of one of the bridges crossing the Rhine can have severe consequences on the entire urban traffic for hours. Also on an urban scale there is host of other information to consider: Parking space availability, changed traffic restrictions, guidance in case of events, status of public transport are amongst those types of information that might quickly become relevant for the citizen or for business trips and have a feedback effect for motorway traffic.
Thus cross-institutional cooperation is of crucial importance for a mobility portal in a region like Rheinland-Pfalz as far as the central task of such portal is defined:
Inform users and service providers about all events and situations that might be relevant for the safety, fluidity or comfort of mobility in any mode.

The core of this service is a Website run by the “Landesbetrieb Mobilität Rheinland-Pfalz”, the authority in charge of planning, building and operating the interurban road network.
The services includes at present:

- A comprehensive map using Web-Map-Services according to OGC-standards
- A simulator to compute the current level-of-service (congested, free-flow) out of flow data coming from approx. 1100 loop detectors over the whole motorway network
- Data from gauging rest capacity for track parking facilities
- Data links to the motorway police and the German weather service
- 50 webcams at critical points or junctions
- links to the dynamic schedule of Deutsche Bahn AG

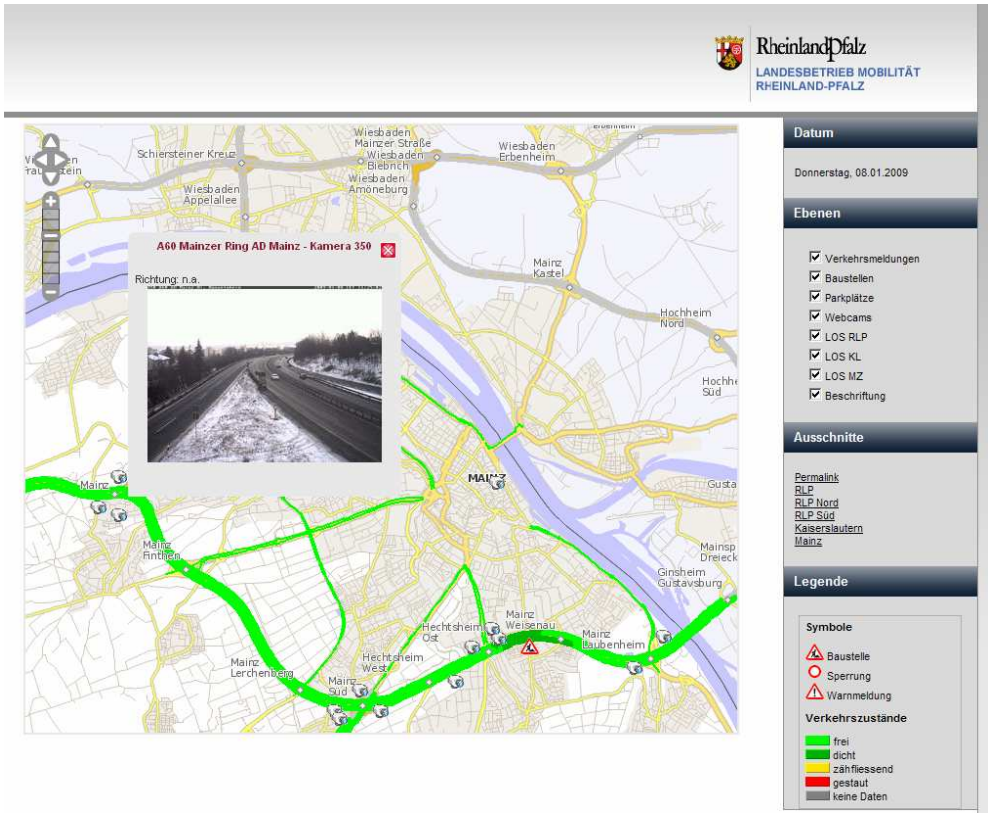

Fig. 2: Screenshots of the Service: www.verkehrslage.rlp.de with web-cam picture embedded

The service was launched in 2004 and has received high and rising interest, especially form service providers like the broadcaster SWR - South-West-German radio, which has the highest market share for radio traffic information in the region.
From the beginning, the portal was supposed to include urban information as well as regional. In 2005 the first urban area, the capital of Mainz was included with Kaiserslautern (then venue of the football world championship) following in 2006. Next cities to join the platform will probably be the cities of Ludwigshafen&Mannheim (expected for 2009) that belong to two different Bundesländer but practically form a common conurbation centre.

Urban information is displayed and presented in exactly the same way as the regional information; only the scale needs to be changed. In fact data ownership or administrative boundaries responsibilities are of little interest to the user. Cities with less than 500.00 inhabitants usually don't operate staffed traffic centres and data coming directly from traffic light control systems can be used instead. These systems are based on a variety of inductive loops or radar sensors that can be employed to provide a level-of-service overview in an approach similar to the motorway applications. Usually a limited number of sensors have to be added to deliver a complete network view, most important for the user.
In this way the regional traffic centre informs the urban systems based on the processed traffic data supplied in the opposite direction.

Links to neighbouring traffic centres (based on data feeds or WMS) open the service cross-border. Finally information on public transport services (rail and busses) can be integrated into the via a WMS service. The following figure provides an overview about the current architecture of the traffic information service.

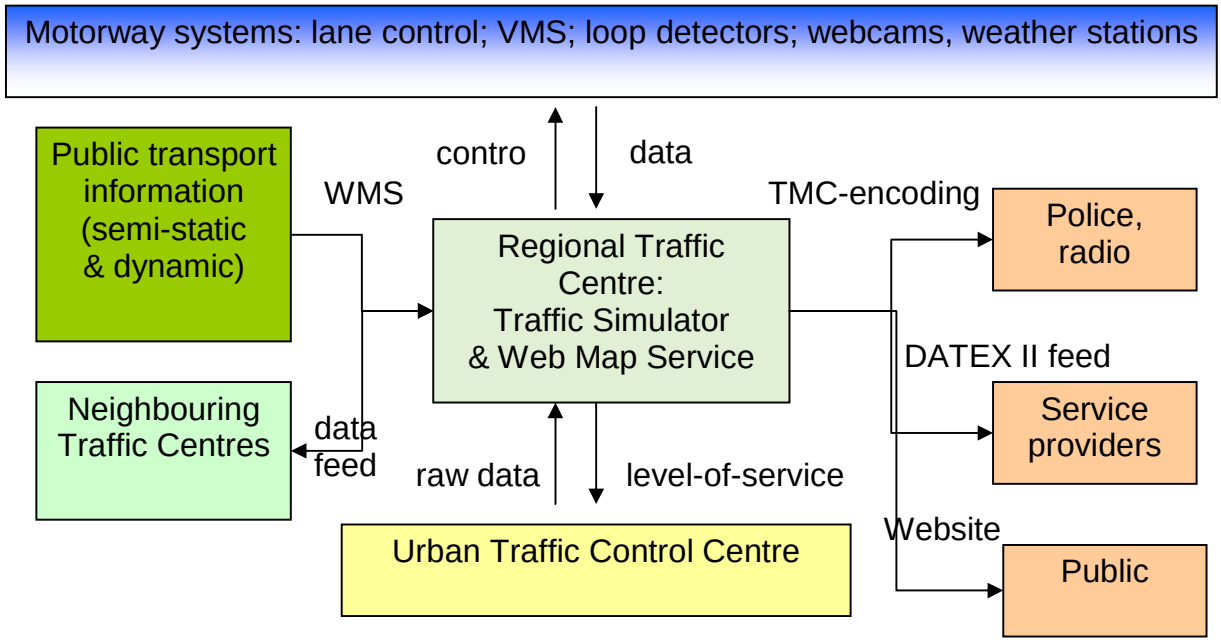

Fig. 3: Architecture of the Traffic information portal

In this way, both motorway regional and urban information can be processed into TMC messages and meet the requirement of maximum consistency and availability to service providers (free of cost). On their own, cities in Rheinland-Pfalz would probably not venture to launch an information service; moreover this would incur higher cost for service providers linking with separate information sources instead of “one-stop-shops”

Aspects of mapping traffic information in a regional context

Public administrations in Rheinland-Pfalz are supposed to set up services according to the GDI-DE guideline, which in turn reflect the INSPIRE guidelines introduced by the European Union. The traffic information has been designed along this concept.

However in order to cover all user requirements for the map services to be produced a number of issues must be regarded:

- TMC encoding is not part of the Transport Network Data maintained by the state survey and spatial data organisation

- Cross-border applications require references to several, in the case of Rheinland-Pfalz no less than 7, different data sources
- Urban maps and GIS may be based on proprietary systems and subject to licensing
- Land survey data focuses on topographical features, often less important for traffic information uses, but do not adequately reflect topological features like network connectivity
- Road Network data is subject to frequent changes at short notice; at least in the past this could not be matched by survey data

Therefore it was decided to acquire commercial map data for those purposes where survey data would be insufficient or inappropriate.
As for the design decisions user's habits and experiences have to be regarded. Users are accustomed to Websites like Google maps or Microsoft Virtual Earth and expect to resemble other sites to the look and feel of these "Trendsetters". Thanks to such mass applications internet users, even those with mobile devices, are now much more able to understand map based information and a major barrier for traffic information services has been cleared.
Also for level of service or messages there are established colour codes or icons that can be used and let users feel at home even when accessing the site the first time.

Quality aspects, future developments and conclusions

The quality of traffic information can be assessed in terms of spatial or temporal resolution, validity, availability, response time or other content-specific indicators. Yet preparation of independent data is no easy task and requires the setting up of quality control projects with own equipment. Webcams have proved very valuable here and also a close examination of user comments; in particularly those comments that come from professional users like police or radio stations.
It is the policy of the traffic information portal to display only such information that can be based on actual raw data and were experiences have shown that the resulting information is accurate. Therefore there are still a number of "grey links" that don't have sufficient detection infrastructure.

Currently are number of upgrades are in different planning or implementation stages:
- Inclusion of further urban areas (> 100.000 inhabitants)
- Increasing the data offer for public transport (real-time data)
- Improving quality and coverage for existing types of data (loops, radar detectors, webcams)
- Complete integration of all cross-border links and data exchange with all neighbours interested

In order to realise these improvements substantial investments are necessary for
- Hardware (in particular for urban systems)
- Increased detection
- Licensing map data
- Software developments and adaptation of existing systems

Also there are operating costs to cover; something that proves often much more difficult than mere investments.
Yet for total cost benefits the expense is very moderate if compared to construction cost of roads. The total cost of setting up and operating the information portal for 10 years will be less than the average costs of building 1 Kilometre of new motorway. Benefits are hard to measure but are appraised to be substantial from saved time and prevented accidents alone.
Web map service offer a high degree flexibility of contents to be included in the portal: While responsibility for map objects and in most cases attributes, remain with the content provider effort for maintenance can be kept low and organisation is substantially simplified.
As has been shown above accurate traffic information is becoming even more useful as new responding systems quickly penetrate the traffic systems. The basic task for the information portal is to make sure that this information is used effectively and delivered efficiently to the end user, i.e. the driver or user of trains and busses, directly or through service providers. If partners join forces in this common objective taxpayers money can be put to an optimal use.

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