DMOTION – AN OVERVIEW OF THE GERMAN RESEARCH PROJECT. THE PROCESS CHAIN FROM A COMPREHENSIVE DATA AND INFORMATION NETWORK TO A STRATEGY CONFORM ROUTING

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Abstract:

The German research project Dmotion is aimed at developing and implementing an integrated traffic management system for Greater Düsseldorf.

By establishing a data, information and strategy network between two public authorities and a private service provider, an enhanced traffic state analysis and a strategy management system will be provided. Road users will receive information on current traffic conditions and traffic management strategies via different media including dynamic routing advices via online navigation services.

DMOTION – INTRODUCING THE PROJECT

Dmotion is a German research project within the VM 2010 (Traffic Management 2010) research initiative funded by the German Ministry of Economy and Technology (BMWi). The aim of Dmotion is to develop and implement an integrated traffic management system for the conurbation of Düsseldorf.

This system is based on a comprehensive data, information and strategy network for regional and local authorities, as well as for private service providers. Thus, one major objective of Dmotion is to generate a consistent and comprehensive report on traffic conditions for Greater Düsseldorf. The provision of an overview on the current traffic situation is a precondition for deciding on corrective actions. Therefore, the involved authorities have to agree on certain measures to be taken in case of incidents. These traffic management measures are combined to so-called comprehensive strategies and lead to traffic streams being diverted and road users being advised to use alternative routes. The information will be provided to road users via roadside information systems (VMS), available on the internet and, additionally, provided through online navigation by private service providers (see figure 1).

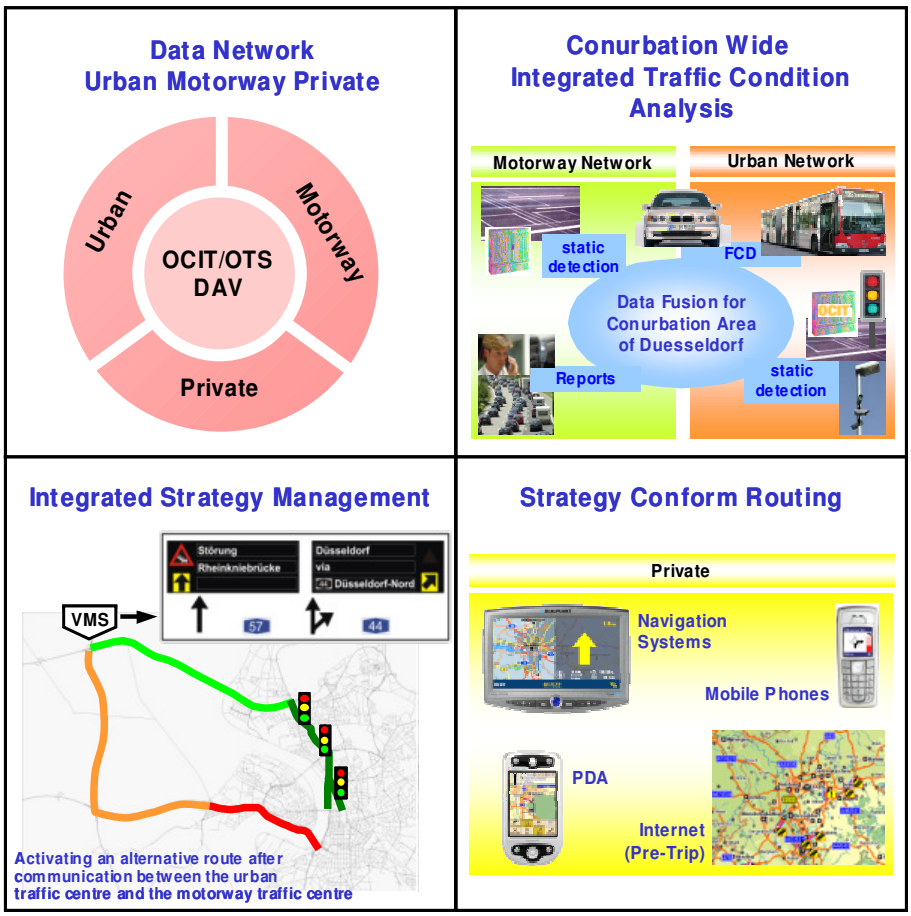

Figure 1. Columns of the Dmotion Project

Private service providers will be linked to include the agreed strategic advice of the public authorities in advanced navigation systems. Furthermore, they will contribute to generate the comprehensive report on traffic conditions by providing FCD. They will offer additional services like pre-trip routing via internet and a mobility service designed for the special user needs of local companies.

This paper introduces the Dmotion research project focussing on the three major steps in the process of traffic management

- detection and assessment of traffic situations
- selection and implementation of coherent strategies
- distribution of information to users

while being associated in a network of different sovereign road authorities and a private service provider.

INITIAL SITUATON AND REQUIREMENTS

The City of Düsseldorf (more than 580.000 inhabitants) has to cope with an extremely high level of commuter traffic. There are over 400.000 people commuting by car to the city every day, mostly for occupational reasons. In addition, drivers from the Greater Düsseldorf are attracted by numerous cultural events and excellent shopping facilities. Furthermore, Düsseldorf provides the Rhine/Ruhr conurbation area with an international airport and an international fair.

75% of the commuting people and 43% of local traffic use private vehicles. Related to the number of inhabitants, these figures show the significance of optimising the individual vehicle traffic for the conurbation area.

A motorway ring surrounds Düsseldorf comprising the motorways A57, A44, A46 and A3. The A3 and A57 are also highly frequented by supra-regional traffic. Furthermore, there are numerous radial arterial roads. For the geographical location see figure 2.

Figure 2. Geographical Location of Düsseldorf

This road network provides an excellent prerequisite for creating a comprehensive traffic management system for the city and its metropolitan area.

The federal structure of Germany leads to the fact that several public authorities are responsible for the road network of the conurbation. The motorways are operated by the Federal State of North Rhine-Westphalia with the traffic control centre situated in Leverkusen whereas the urban road network is operated by the City of Düsseldorf with its urban traffic management centre. At present, each road authority is responsible for traffic control within its sovereign territory, using different control and information systems. To guarantee an effective traffic management in the conurbation of Düsseldorf, it is necessary to integrate these actors into a coordinated strategy management.

So far, there is no knowledge by the partner on traffic conditions in the neighbouring network and therefore, these conditions are left out of consideration when taking decisions on any traffic management measures. This lack of information can be observed in nearly all conurbations in Germany. An exchange of information must be established in case of comprehensive traffic management issues. Due to the federal structure, a cooperation approach for the purpose of traffic control is only possible on the base of partners with equal rights.

Within the Dmotion project, both systems will be connected to each other to provide one comprehensive strategy management system. This comprehensive strategy management requires

- network wide traffic state analysis
- coordinated operative workflow processes between partners
- a strategy management software on both sides which is able to communicate with the/each other on a semantic base and to cover extensive workflow processes
- variable message signs as road side infrastructure for the transmission of collective information on the part of both local and regional authorities
- special programmes of traffic signals for situations of diversion on arterial roads
- standardised interfaces between traffic management centres

The increasing number of navigation systems and private service providers in the field of traffic information creates – beside collective variable message signs – an additional information medium which needs to be integrated. A private service provider is included in the association to distribute the information and strategies to the users. This is an essential need for establishing an effective strategy management system for traffic participants in the age of mobile information.

DETECTION AND ASSESSMENT OF TRAFFIC SITUATIONS

For the Düsseldorf region a real time estimation of traffic conditions has to be provided to achieve an overview on current traffic conditions on urban main roads and the surrounding

motorways. Therefore, an information network of local and regional authorities has to be established.

In the urban centre, a data fusion of traffic data collected from different sources will be performed. Data sources include static detectors (video, infra red and induction loops) as well as FCD. FCD is provided by special data suppliers such as the vehicles of Düsseldorf's taxi service, as public transport vehicles and also by private service providers that will be integrated into the process of traffic data collection. To exchange traffic data between the private service provider and traffic management centres the data are geo referenced using TMC location codes.

Based on data fusion, the real time model DINO (Dynamic Network Monitoring) will provide an estimation on current traffic conditions for the network of the City of Düsseldorf as well as a short-term prediction for the urban network. In the regional motorway management centre the traffic state estimation and the short-term prediction are performed by using the MARZ (leaflet for the design of traffic control centres for motorways) algorithms and the online model OLSIM for motorways.

The regional and the urban overview on current and predicted traffic conditions are merged and provided to the workflow based strategy management of both traffic management centres. The merged traffic condition overview forms a source for the traffic management operators as a basis for decisions for dynamic strategy management. Furthermore, traffic management operators and planners are able to monitor how the network performs, to identify weak points and to monitor and evaluate the effects of influencing and controlling measures.

While area-wide RDS-TMC location codes already exist for motorways, the main road network of Düsseldorf was covered area-wide. A total of 280 point locations were defined which span a net over the city's road network. Hence, for the conurbation of Düsseldorf a uniform medium of reference does exist. The advantage of a RDS-TMC location code list is found in the direct integration into navigation algorithms and existing navigation systems.

The merged overview on current traffic conditions is published to road users of the Düsseldorf region via internet and to the private service provider in order to provide high quality traffic information services.

SELECTION AND IMPLEMENTATION OF COHERENT STRATEGIES

Coherent strategies will be selected based on the network wide traffic state analysis. The integrated coherent strategy management is based on two columns. The first column is the coordination between public authorities for integrated strategies. The second column is the integration of private actors at the level of a strategy conform routing.

Strategy Management between Public Authorities

A workflow based strategy management will be established in the traffic management centres of the City of Düsseldorf and the Federal State of North Rhine-Westphalia. The specified strategy management provides an online adjustment of coherent strategies taking into account operational and strategic requirements of the involved partners.

A major objective for designing the system was to guarantee the sovereignty of each involved authority. Both authorities aim to evaluate the current traffic conditions for the road network of their responsibility, to decide on appropriate measures to intervene and to keep the sovereignty of actuating dynamic traffic signals, variable message signs and related roadside equipment within their own network.

Within the elaborated system both partners are able to activate workflows to implement predefined strategies allocated to certain traffic situations. In each centre workflows are activated automatically when an incident is detected in the network controlled by the particular centre (becoming the ´active` partner).

Once a workflow has been activated, the system verifies if the intended strategy can be implemented. Therefore, the system checks (for the network of its responsibility), the capacity of the alternative routes, the technical availability of actuating elements needed to implement the strategy (e.g. VMS, traffic lights) and if contradicting strategies are currently implemented.

After checking these conditions for the own network, the centre of the ´active` partner requests the strategy implementation from the centre of the ´passive` partner. The centre of the ´passive` partner checks the availability of the strategy and returns positive or negative confirmation. In case of a positive confirmation both partners start to implement the strategy.

The evaluation of traffic conditions, the selection of appropriate strategies and the adjustment of coherent strategies between the two centres are executed automatically.

Strategy Management between Public and Private Partners

The basic idea of a coordinated strategy management between private actors and traffic management centres of public authorities lies in the strategic influence of services.

Public authorities inform navigation service providers of an activated strategy of the alternative route guidance system. Through a variation of resistance, the navigation service provider ensures the routing via alternative route. This is called a ´strategy conform` routing.

To guarantee this procedure, private navigation service centres need to be provided with the strategies of the alternative route guidance system of the public authorities, too. The provision of strategies at the navigation service centre is based on RDS-TMC link lists. Additionally, for navigation applications incoming and outgoing triggers have to be defined for the strategies, so that only road users who would pass through the original route completely will be influenced in their routing.

In case of taking influence on the degree of freedom of the navigation services on the private side, the public authority needs to ensure in its own sphere of influence that there is a sufficient level of service on the alternative route. This agreement is a fundamental element of the cooperation model between the public hand and the private navigation provider. This means that within such cooperation, steering strategies will be implemented necessarily on the public side. Therefore it is required that efficient traffic signal programmes – adapted to the alternative route – will be available in the traffic computer centre.

DISTRIBUTION OF INFORMATION TO USERS

The distribution of high quality coherent traffic information to road users is a main objective of Dmotion. Therefore, an information network between private service providers and the road authorities is established. The private service provider supports the traffic state analysis by providing FCD. In return he is provided with the current network traffic state and current traffic management strategies. By integrating the strategies into the services offered, the service provider supports the implementation of the strategies.

Whenever comprehensive traffic management strategies are implemented by the urban and the regional centre, they will also be integrated into mobile navigation systems to establish a dynamic routing according to these strategies. This strategy conform routing will guarantee consistency between collective and individual information offers in order to enhance public awareness and acceptance of traffic information services among end-users. This is a consistent further development of the approaches of the finalised research project INVENT (Intelligent Traffic and User-friendly Technology).

By providing an integrated report on traffic conditions and coherent strategies, a basis for extensive traffic information services is built. Furthermore, target group-specific information will be offered by the private service provider. In collaboration with the public utility company of Düsseldorf, a traffic information service will be designed and tested referring to certain user needs of local and regional operating companies.

With the demonstrator “Firmen-Info-Dienst” distinguished traffic information and navigation services will be introduced to the public utility company of Düsseldorf which additionally offers personalised services and routing devices.

Employees of the public utility company of Düsseldorf can catch up on traffic conditions of preferred routes via intranet. These preferences need to be entered by the user once only. Furthermore, special navigation applications for service vehicles are provided. This includes dynamic routing as well as the provision of special points of interest such as gas service stations.

STANDARDISED INTERFACES

In order to guarantee the transferability of the developed aspects, the use of standardised interfaces is an essential subject. Within the project Dmotion the communication between the traffic management centres is ensured by standards which are currently developed and established in Germany.

For the motorway management centres standards are defined in the leaflet for detection units on motorways and in the initiative of the German Ministry of Transport for standardised middleware (so-called ´Datenverteiler`, DAV).

The field of traffic management in urban areas is formed by products of one system integration company only. Düsseldorf started an open way of integrating various companies with OCIT (Open Communication Interface for Road Traffic Control Systems) interfaces underlying in tender documents and set up the construction of public management centres with products/services of various companies.

In Dmotion this way is followed consistently. The OTS (Open Traffic System) initiative – led by the OCA (Open Traffic Systems City Association) cities – continues with standardisation for the urban sector. Here the project takes up with a pioneering task with its linking between the regional and the urban traffic computer centre. The interfaces between the modules which need to be developed have to be specified in a way that they serve as reference implementation for OTS. With this procedure the technical transferability of approaches developed in Düsseldorf to other conurbations is guaranteed.

CONCLUSION

Within Dmotion an integrated traffic management system will be developed by establishing a partnership of equals for a local and a regional authority and a private service provider. The design focuses on standardised interfaces, allowing the concept to be applied to other conurbations and to provide a basis for expanding the solution in order to include other authorities.

The institutional requirements and the workflows of the operational concept form an essential subject of work though the required process analyses must be understood as something specific for Germany respectively as a regional solution.

In contrast, the developed semantic and software technical approaches need to secure a maximum of flexibility and adaptability. Within the design of the strategy management tool it is taken care of these aspects. The easy provision and parameterise of workflows is a fundamental requirement. This distinguishes the worked-out approaches from other strategy management tools which follow a ´loose` linking between the regional and the urban traffic computer centre.

On the software technical aspect, the development of standardised interfaces is an essential subject of the project. It ensures the universal transferability of software components to other conurbations.

With the completion of demonstrators in autumn 2007 the valuation of efficiency of the integrated traffic management system of Düsseldorf becomes a major issue. This will be a major focus in the extensive field tests in autumn followed by a – model supported – economic valuation of the overall measurement.