Traffic Management System in the Area of Dresden
by Dr. Matthias Regler
LIST Company for Transportation and Technical Engineering Services Ltd, Rochlitz, Germany

Initial Position

Dresden is the state capital of Saxony and the biggest city in this area. It is situated near the borderline to the Czech Republic and Poland. Dresden is also one of the cities in the New Länder with a rising number of inhabitants. Around Dresden there are the motorways A4 in the north and A17 in the southwest. These motorways are part of the Pan-European Corridors III and IV. Thus, the roads in this area are used by everyday commuter and visitor traffic as well as long-distance transit traffic. Traffic volumes have increased over the past few years, in particular after the eastward enlargement of the EU. A further increase of traffic volumes in this area is expected not only for passenger cars but rather for heavy vehicle traffic.

Presently there exists the traffic management system “VAMOS” for the city of Dresden. VAMOS is a system for analysing, managing and optimising the traffic in Dresden which has gradually been realised over the past few years. It can inform drivers and influence traffic by different measures. So far, VAMOS has concentrated on managing traffic in the urban network.

The stretch of the motorway A17 in the region of Dresden includes a section with several tunnels with a length up to 2.332 m. Since a tunnel has a potential high risk of an incident with a following road closure there is a defined bypass through the city of Dresden. Activating this bypass leads to additional traffic on the urban roads. Although there are defined strategies in VAMOS to deal with this situation, congestion in the city of Dresden is likely to appear. Therefore, activating the motorway bypass through the city seems not to be acceptable.

Alternatives were proved to enhance the traffic flow in the whole region but also to provide a more agreeable bypass in case of a closure of the tunnel. It was decided to reconstruct the State Road S177 in the east of Dresden. This road connects the A4 in the North and the A17 in the south, so...
thereby a fully closed ring system of high-capacity arterial roads around Dresden will be built. It provides the opportunity to keep the through traffic completely out of the city and to dynamically manage the traffic on the road ring in case of an incident or congestion at any section of the system. The road ring is displayed in Fig. 1.

It was planned to install traffic telematics on the ring system around Dresden to inform drivers of incidents at a certain section and to direct them to free sections of the ring. Thus, it is possible to guide the long-distance traffic on the best route around Dresden and to keep the city free of through traffic from the motorways. At the same time traffic to the city of Dresden is affected by management measures on the road ring. A certain measure on the motorways could lead to a totally different traffic situation on the urban roads. This means that the management of the motorways and the management in the city should be coordinated. As a conclusion, a continuous data transfer between the management system for the motorways and the VAMOS system in the city has to be established.

**Aim of the project**

The project was aimed at analysing the feasibility of an integrated traffic management concept and its usefulness for the road users in this region. The system is expected to dynamically manage traffic streams on the motorways considering also interactions with the management system of the city.

First, factors such as infrastructure, traffic volumes and existing telematics in the region had to be analysed to find possible alternative routes in case of an incident and to identify already existing technical components that could be integrated into the planned system. Then a system of variable signposts had to be created for the chosen routes that could guide traffic from the motorways along the bypasses. The signposts should give information about incidents or congestion in the section ahead and should assist the road users in choosing alternative routes. The information given on the dynamic information boards along the roads had to consider all possible destinations of regional and long-distance traffic. Finally the usefulness of the proposed system had to be analysed by comparing costs of the system and benefits for the road users.

**Project implementation**

An analysis of the existing situation showed that the motorways in the region are in good conditions and are already equipped with several loop detectors due to existing variable message signs and safety systems in the tunnels. Although the motorways in this region have been reconstructed in the past 15 years congestion events in peak hours usually occur. Detector data showed daily traffic volumes up to 100,000 vehicles on the A4 near Dresden (three lanes per direction) in the year 2005 and volumes are expected to rise further. The last section of the newly built motorway A17 was opened for traffic in December 2006. Thus, reliable volume data have not yet been available. Prognoses expected up to 70,000 vehicles per day for the sections near Dresden (two lanes).

Traffic in the city of Dresden has slightly improved in the past few years due to the opening of the motorway A17. Nevertheless, there are road sections (especially near the bridges above the river Elbe) where the mean speed in 2005 ranged between 14 and 20 km/h which is much less than the mean value for the whole city. For the years 2006/2007 the mean speed is expected to decrease.

Analyses showed that the traffic volumes in the region have risen over the past few years and are expected to rise further. Congestions in peak hours are usual and are likely in case of an incident in the tunnel sections of the motorway. Thus, it seems necessary to install a management system at the planned road ring around Dresden that is able to inform drivers on incidents at a certain section and to reroute traffic streams to certain directions using high-capacity alternative roads.

It was proposed to create a system of dynamic traffic information boards with text information along the road system around Dresden. The layout of the signs conforms with the concept of “Dynamic Signing with Integrated Congestion Information” (dWiSta) in Germany. These signs were created after a process of technical and perception-psychological research. The analyses ended up in a technical bulletin published by the German Federal Highway Research Institute (BASt) in 2004. First signs were installed in Germany in the Rhine-Main area, in North Rhine-Westphalia and around Leipzig.

To adapt these signs to the local situation first possible incident scenarios were identified. Scenarios were created for every possibly blocked section at the road ring around Dresden. Then an appropriate rerouting for every scenario and every affected destination was defined. Mainly the long-distance destinations in the motorway network, the city centre of Dresden as well as the Czech Republic were considered for this analysis. However, it was not possible to reroute all traffic streams only on the road ring around Dresden. Certain streams are planned to reroute onto urban streets or defined bypasses
for blocked sections of motorways because otherwise the detour factor will be too large and the detour will not be accepted by the road users. To equally arrange traffic on the existing network it was also planned to split traffic with different destinations to different routes.

The necessary number and locations of the dynamic signs were derived from the analysis of scenarios and definition of bypasses. In conclusion, with a system of signs at 5 locations (cf. Fig. 1) it is possible to manage the traffic around Dresden in case of an incident. An analysis of already installed loop detectors showed that only a few detectors have to be added to collect necessary traffic data at the whole ring system.

The information given distinguishes between a full closure of the road and a congestion at a certain section. It was decided to display the additional travel time for congestion events at the signs instead of the length of the congestions because information on time losses seems to be more useful for the road users than information on congestion length. Each driver can decide himself whether he follows the proposed bypass or accepts the time loss due to the congestion. Fig. 2 shows two examples of the dynamic information boards warning of a congestion and a full closure of the A4 at the section downstream of Dresden airport. 

![Fig. 2: Examples of the proposed signs warning of a congestion (upper picture) and a full closure (lower picture) respectively and recommending a rerouting using the State road S177](image)

As there are also recommendations for drivers to the city centre of Dresden, there has to be a link between the planned management system for the motorways and the VAMOS system in the city of Dresden. Obviously, both systems cannot operate separately. There has to be a constant exchange of traffic data and information on activated strategies to ensure a coordinated traffic management in the whole area. In Germany different authorities are responsible for traffic on motorways and urban traffic. Both authorities already work together but their cooperation has to be intensified to achieve good results for all road users in the area of Dresden.

An analysis of the capabilities of VAMOS showed that the system is able to react on activated strategies on the motorways to a certain degree. The system can detect additional traffic, inform drivers via a traffic information system, adapt the control of traffic lights and avoid congestion on certain streets by activating the dynamic signpost system.

As it was planned to give information on time losses it is necessary to reliably generate those data for every section of the road ring. The motorways A4 and A17 have a sufficient number of detectors available. For the section of the State road S177 it was proposed to use a combined system of loop detectors and number plate recognition to determine the travel time. The S177 seems to be qualified for the installation of such a system because there are only a few intersections with other roads. So the probability of mistakes in determining travel times is expected to be comparatively low.
With the system described a dynamic routing of traffic in this area is feasible in principle. As an extension it was proposed to install additional dynamic sign posts to inform drivers of expected travel times to distinctive points in the road network. In Germany those signs are called “Dynamic Signing with Travel Time Information” (dIRa). They could be installed in this area at the carriageways in direction Dresden. For the determination of travel times displayed at these signs the detector data of the motorways and data from the proposed system for the S177 could be used. If necessary, an appropriate algorithm has to be applied to derive travel times from the existing data.

Finally, with a rough study of costs and benefits the efficiency of the proposed system has been analysed. This analysis based on the regulation of the appropriate German guidelines for efficiency studies (EWS; FGSV, 1997). The analysis considered one-time costs for installation and annual costs for operation and maintenance of the system. Economic benefits were expected to arise from decreasing travel times, a change in costs for operation and a decreasing number of accidents on the relevant roads. Since the whole analysis was just a feasibility study proper assumptions partly had to be made. The comparison between costs and benefits showed positive results in terms of efficiency of the proposed dynamic information system. However, it was impossible to consider all benefit components at this stage of the study. Furthermore, the relevant input parameters of the already considered components are estimated in an unfavourable way which leads to comparatively low benefit values. If the analyses of the system will be continued the benefit study could be specified considering additional data. It is expected that the benefit will be higher than determined here.

Conclusion

The feasibility of an integrated traffic management system on a road ring around Dresden and its usefulness for the road users in this region as well as the long-distance traffic has been analysed with this project. As a result, a system of dynamic traffic information boards was proposed. The realisation of this system will lead to better information of the road users about incidents or congestion in the section ahead and will suggest a rerouting for certain destinations. Thus, the system cannot only help to reduce travel times but rather contributes to an improvement of traffic safety by avoiding accidents. Benefits of the system are expected to be higher than the annual costs of the system. Since the motorways are part of the Pan-European corridors not only everyday commuters but all European travellers will benefit from this system.

It was recommended to further specify single components of the system and to consider necessary measures of the planned system during the reconstruction of the State road S177. Moreover, the planned management system on the road ring and the VAMOS system in the city of Dresden have to be linked to assure coordinated management strategies.

Sources:
