LogForum

> Electronic Scientific Journal of Logistics <

http://www.logforum.net

ISSN 1734-459X
2009
Vol. 5
Issue 4
No 1

POTENTIALS OF INTUITIVE ROUTING SUPPORTED BY ON-BOARD-TRAFFIC-INFORMATION IN METROPOLITAN AREAS - PROJECT MINERVA

Herbert Sonntag, Christine Behnke, Bertram Meimbresse

University of Applied Sciences Wildau, Wildau, Germany

ABSTRACT. The paper sums up the results of the research project MINERVA. The Minerva system contains the supply of up-to-date traffic information of the current tour area for the driver on a mobile device as a technical intention. Scientific result will be the conclusions in what quantity the routing of the driver changed by support with traffic information and of which quality the intuitive routing comparing to the dynamic routing is.

Key words: traffic, congestion, fuel consumption, GPS.

INTRODUCTION AND TASK

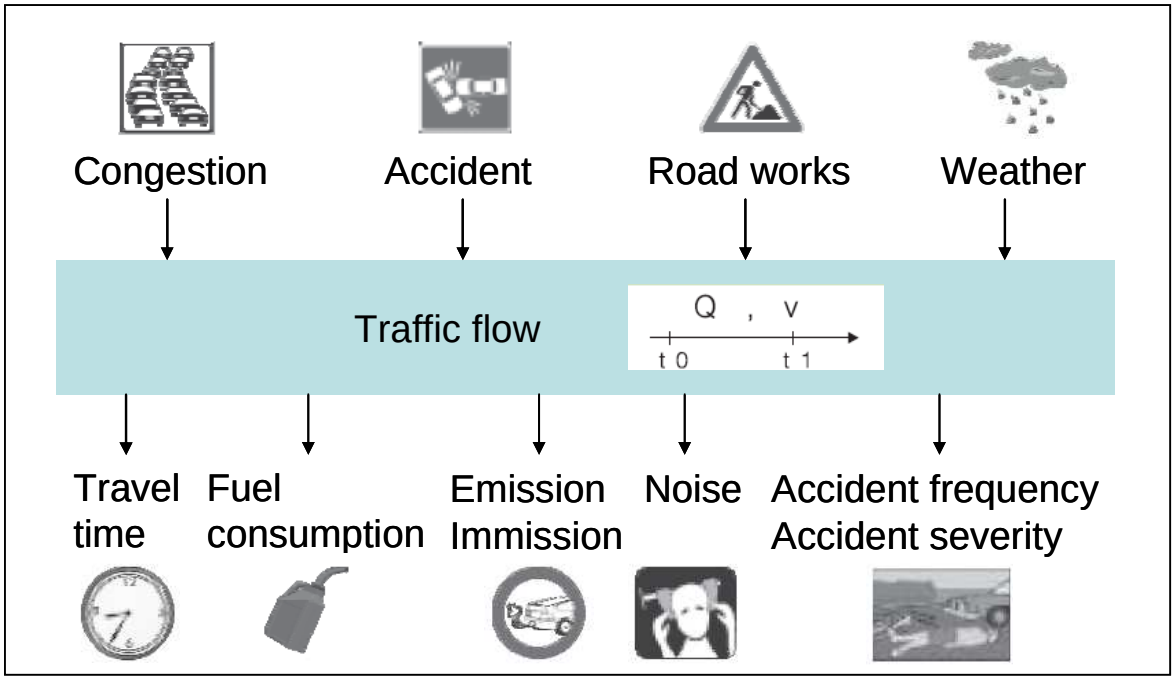
The present traffic situation in urban areas is due to ad hoc occurring and unforeseeable congestions - like accidents, rescue operations and events - hard to predict. Road hauliers suffer from the situation because drivers are mostly not informed about it. Delays are often the consequence and delivery time windows could not be met. On the one hand traffic information that is available for the drivers is often unfiltered, unsorted, incomplete, out of date and very often simply not available for the driver in time for decision making. On the other hand comprehensive traffic information based on detection systems, road work site records and prognosis algorithms is available in the traffic management offices and is partly published via Internet, information boards alongside roads and broadcasting.

Basic approaches for a reduction of the negative effects of the increasing road traffic are avoiding and relocating of road traffic as well as compliant organising and harmonising the remaining traffic. Routing support is an instrument of traffic harmonisation. Road traffic network in urban areas is because of its density of high complexity. For road users there are various alternatives to move from start point to destination. The distances of many of the alternatives differ only marginal. Travel times in contrast can vary much, because of different traffic load levels. In respect to the time axis there are the following possibilities of information as routing support:

- Pre-trip-information:
  - Information from maps and navigation approaches via Internet about routes
  - Traffic management information via broadcasting and television

Citation: Sonntag H., Behnke Ch., Meimbresse B., 2009, Potentials of Intuitive Routing supported by On-Board-Traffic-Information in Metropolitan Areas - Project MINERVA. LogForum 5, 4, 1
URL: http://www.logforum.net/vol5/issue4/no1
Accepted: 30.11.2009, on-line: 11.12.2009.

- On-trip-information:
  - Collective on-board-information: Information for all road users at a network section, e. g. dynamic information boards and TMC traffic information (TMC: Traffic Message Channel, an additional channel of the digital broadcasting transferring up-to-date information about the present traffic situation - Source: [Martens 2006]).
  - Individual on-board-information: Traffic information specified to the particular road user that are provided in the vehicle, e. g. navigation systems.



Source: BAST 2003

Fig. 1. Traffic impacts
Rys. 1. Czynniki wpływające na ruch

Route calculations are carried out on the basis of a road network and attached attributes. For the route calculation of the shortest route in road networks (graphs with nodes and links) algorithms - as for example the Dijkstra-Algorithm [Dijkstra 1959] - have been successfully implemented in numerous variants of efficiency. In static route calculations, as common in standard navigation systems, the shortest route is always the same. Congestions and other changes in the network are not considered. In dynamic route calculations the temporal component of the values (attributes have timestamp) has to be considered: dynamic route calculation is the shortest way for the present traffic situation, not in general. Attributes or values of the road network for dynamic routing continuously change. Intuitive routing particularly by an experienced driver of the region is affected by clues, e. g. traffic signs and present situation. Intuitive routing can be based on historical knowledge of the traffic situation of the driver and it can be supported by actual on-trip-information for example by traffic information systems. In table 1 the basic framework of information and routing strategy for the different routing alternatives is described.

Table 1. Routing strategies
Tabela 1. Strategie wyznaczania tras

	Criteria Routing	Input Data	Method	Actuality	Quality of the result
1	IT Static Routing	Road graph with average traffic load	Shortest Path Algorithms	Bad in changing traffic situations	Very good to very bad
2	IT Dynamic Routing	Road graph with present traffic load	Shortest Path Algorithms	Good but in time windows (15 min)	Very good to satisfactory
3	Intuitive experienced Routing	Knowledge of road network in comparable situation	Intuitive personal calculator	Bad for traffic incidences	Good to sufficient
4	Intuitive experienced Routing with information support	Knowledge of road network and up-to-date traffic information	Intuitive personal calculator	Good for professional drivers	Very good to good

APPROACH

The research project MINERVA (Minimisation of congestion effects in agglomerations through Efficient Routing support in freight Vehicles and an estimated time of Arrival notification based on present traffic situation) is funded by the German Federal Ministry of Education and Research Project Number 1750X06 and its results concerning on-board-traffic-information will be presented. The MINERVA system is tested in the urban area Berlin (DE). Due to its historical development Berlin is a polycentric urban area with a historic centre. Living, working and leisure areas are mingled.

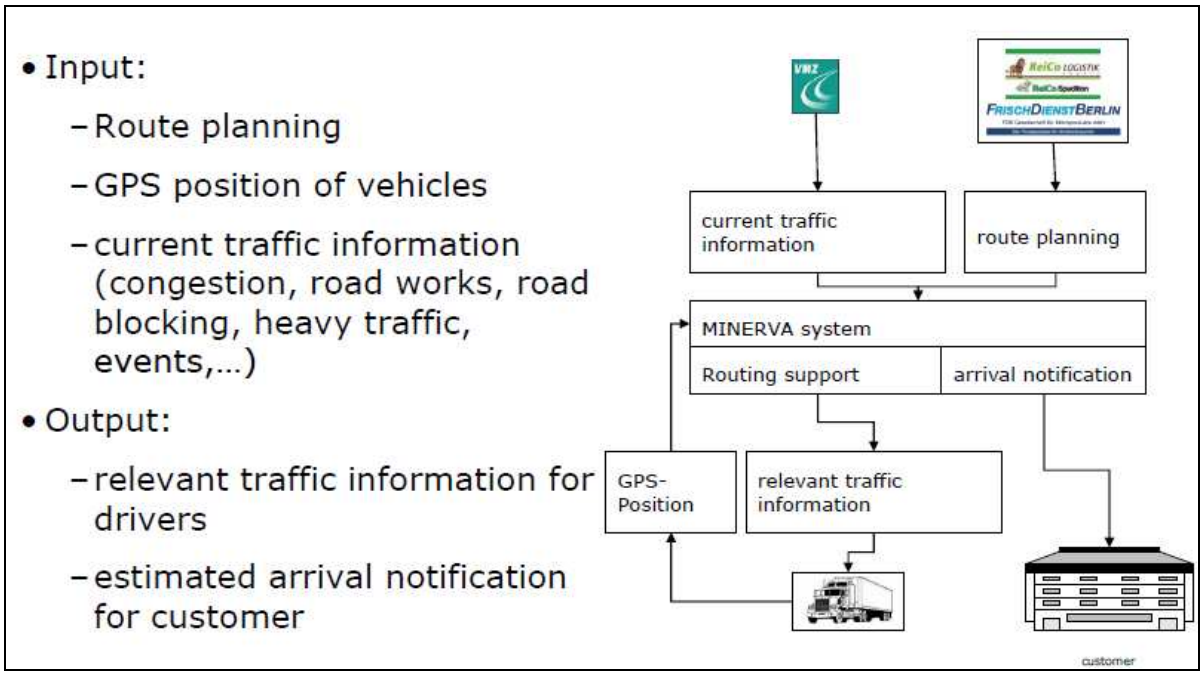


Fig. 2. Components and data flow of the MINERVA system
Rys. 2. Schemat przepływu elementów systemu MINERVA

The components of the MINERVA system are described in figure 2. The hardware components for the mobile devices are standard PDA (Personal Digital Assistant) under the operating system Windows Mobile and a standard GSM and GPRS connection and an integrated GPS module. The data flow for the mobile device is based on the GPS position and the input of the current traffic situation and a list of delivery / pick up points (route planning). An estimated time of arrival (ETA) notification is calculated by the back office system for the information of the clients.

The Minerva system contains the supply of up-to-date traffic information of the current tour area for the driver on a mobile device as a technical intention. Scientific intention of the project is the evidence that the supply of experienced drivers with relevant traffic information improves their intuitive routing, that this routing comes close to an optimal (dynamic) routing and is much better than a standard navigation device.

For the information support of the drivers in MINERVA following input data is needed: List of delivery / pick up points and the current GPS position of the vehicle. So, the relevant city area and the necessary traffic information can be defined. The information will be presented to the driver in an ellipse-like selected area between current position and next destination as shown in the figure 3 and 4. All event oriented information in the area will be displayed on the PDA and additionally the driver receives information about the present road traffic load in different colours of traffic density (Green: Normal traffic situation; Yellow: Dense traffic situation; Red: traffic congestions).

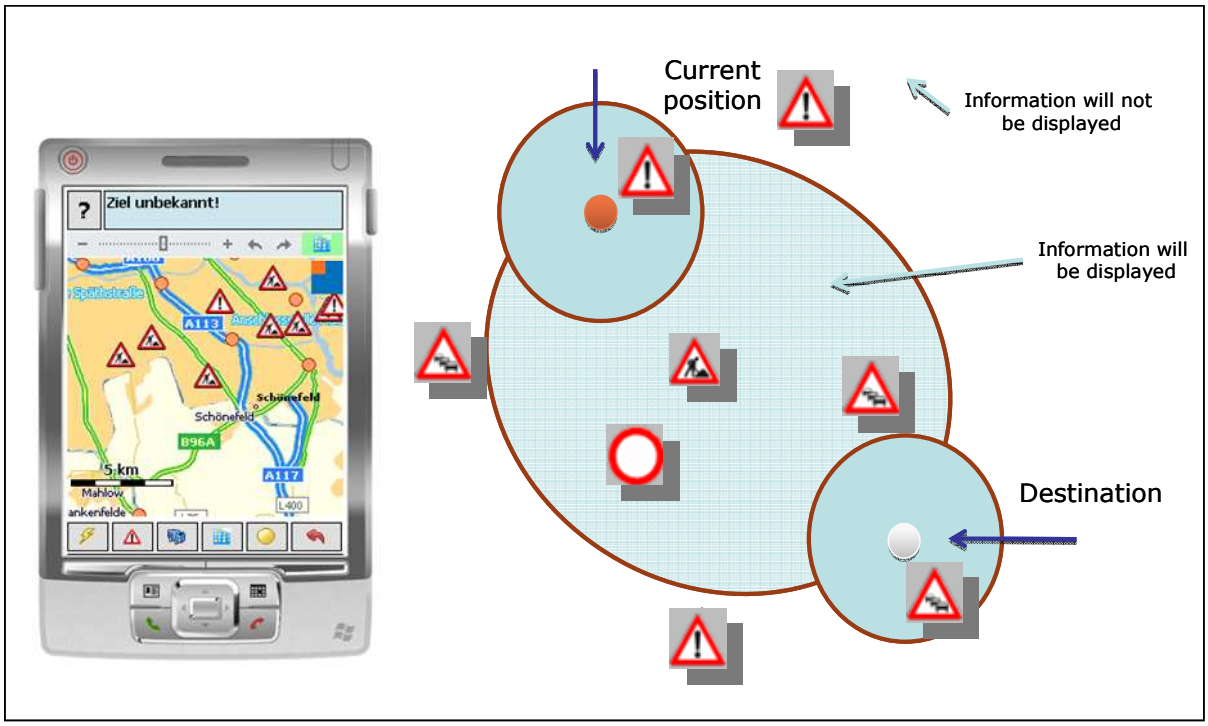


Fig. 3. Definition of the relevant city area in the MINERVA system
Rys. 3. Definicja obszarów miejskich w systemie MINERVA

For the field test preliminary the normally chosen routes of the drivers (without support) were recorded over GPS. The routing support in MINERVA is arranged as GIS traffic information. In dependence on the present position and the next destination, the driver gets on his mobile device a GIS map with the present traffic situation (roads are coloured red, yellow and green depending on congestion level) and as text. The information is updated at all two minutes.

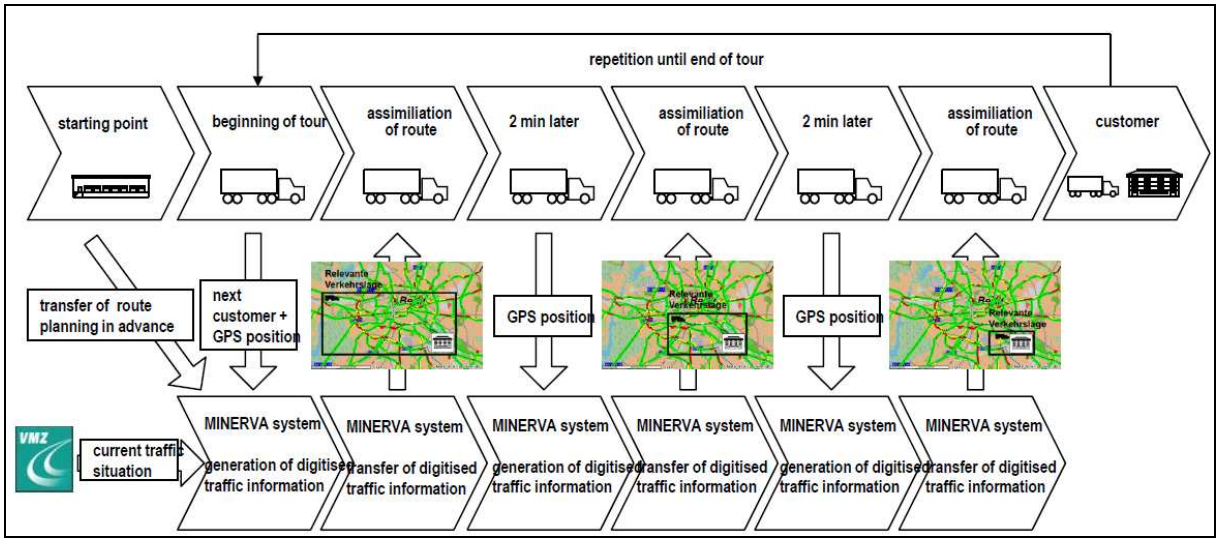


Fig. 4. Dynamic traffic information in MINERVA
Rys. 4. Dynamicznie zmieniająca się informacja nt. warunków komunikacyjnych w systemie MINERVA

An automatically generated estimated time of arrival (ETA) notification is included in MINERVA. For optimising work processes the customer could be automatically informed about the ETA of the vehicle with an e-Mail- or SMS avis. The present traffic situation is considered in the calculation. The ETA is calculated by transforming the driving time of a dynamic routing into the driving time of the intuitive driver routing. Only if the driver will most probably miss the specified time slot of delivery, the ETA notification will be transferred to the customer.

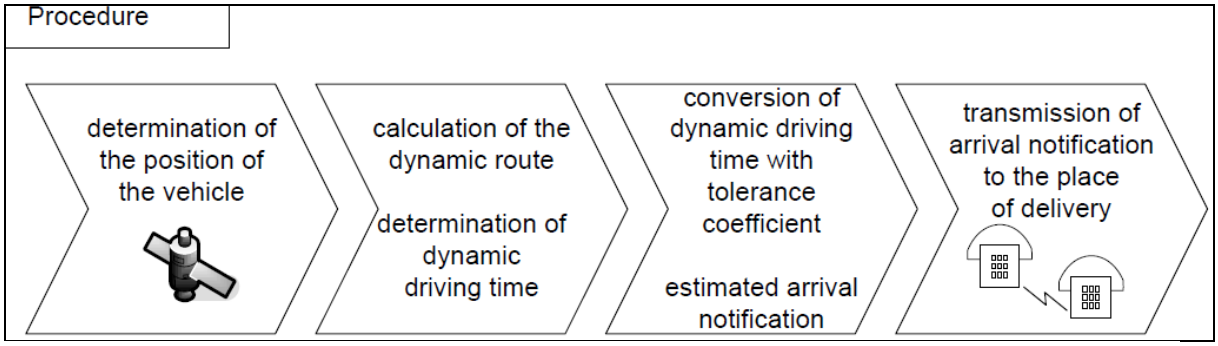


Fig. 5. Information flow of the estimated time of arrival notification
Rys. 5. Schemat przepływu informacji dotyczącej szacowanych czasów przyjazdu

RESULTS

The MINERVA system has several quantitative and qualitative advantages. Quantitative the supply of traffic information causes savings of time and fuel. The values will be examined by the comparison of different routing alternatives (static routing, dynamic routing by standard navigation system, intuitive routes chosen of the driver without information support and routes of the driver with information support). For the comparison of the different routing alternatives the traffic situation for the time of the real delivery tour has been simulated in a virtual road network of Berlin. Scientific result will be the conclusions in what quantity the routing of the driver changed by support with traffic information and of which quality the intuitive routing comparing to the dynamic routing is.

The reporting of the routes chosen of the drivers brings an information advantage for the planner - they could track the routes retrospective and present. The drivers get an information advantage by the support of adjusted traffic information. They get only the information they need for the current tour area and date and ad hoc occurring and unforeseeable congestions are included that are particular benefit for the drivers. The customer has also an information advantage by being automatically informed about delays. As further fields of application it will be analysed, to what extend the approach MINERVA is applicable to other fields of road traffic, e. g. taxi or private car.

CONCLUSIONS

Comprehensive traffic information is available in the traffic management offices and is so far only marginal used, although it holds a high information content and benefit for the user. Just the knowledge of congestions is useful for adapting processes, e. g. the planner could inform the customer about an expected delay and the customer could rearrange the working processes. When traffic information is actively used and routes are chosen due to the present traffic situation "strong factors" - like fuel - can be saved. A major problem is, that so far detailed traffic information - more than TMC - on a big scale, e. g. for a whole federal territory, are not available. For instance in Germany the separate regional traffic management offices have each their own standards building a patchwork. The topic of MINERVA is a new approach for improving the routing particularly of experienced drivers of the area while maintaining their freedom of decision. Differences in the varying routing alternatives (dynamic routing, static routing and intuitive routing with and without information support) are identified in the project. The technical implementation of the routing support into a marketable product is secured and it can be applied to other sectors and problems.

REFERENCES

BAST (2003): Jahresbericht 2002. Wirtschaftsverlag NW, Bremerhaven.

Martens, S. (2006): Nutzen dynamischer Zielführungssysteme, Vortrag FH Wedel.

Dijkstra, E. W. (1959): A note on two problems in connexion with graphs. Numeric Mathematics I, S. 269ff, 1959.

MOŻLIWOŚCI INTUICYJNEGO PLANOWANIA TRASY W AGLOMERACJACH MIEJSKICH DZIĘKI WYKORZYSTANIU INFORMACJI URZĄDZEŃ MOBILNYCH. PROJEKT MINERVA

STRESZCZENIE. W artykule przedstawiono wyniki projektu badawczego MINERVA. Komponent techniczny projektu obejmuje zagadnienie udostępnienia przez urządzenia mobilne zainstalowane w pojeździe aktualnych informacji sytuacji na drodze, występującej na danym obszarze. Naukowym celem projektu jest udokumentowanie, w jakim stopniu wybór trasy przez kierowcę zmienia się dzięki wsparciu go informacjami o sytuacji w ruchu drogowym.

Słowa kluczowe: ruch drogowy, kongestia, zużycie paliwa, GPS.

Sonntag H., Behnke Ch., Meimbresse B., 2009, Potentials of Intuitive Routing supported by On-Board-Traffic-Information in Metropolitan Areas - Project MINERVA. LogForum 5, 4, 1.
URL: http://www.logforum.net/vol5/issue4/no1

POTENTIALE EINES INTUITIVEN ROUTING MIT ON-BOARD-VERKEHRSINFORMATION IN BALLUNGSGEBIETEN - DAS PROJEKT MINERVA

ZUSAMMENFASSUNG. Der Beitrag stellt die Ergebnisse des Forschungsprojektes MINERVA dar. Der technische Teil des Vorhabens umfasst die Bereitstellung aktueller Verkehrsinformationen für das jeweilige Tourengebiet des Fahrers auf ein mobiles Endgerät. Wissenschaftliches Ergebnis ist die Feststellung, inwieweit die Routenwahl der Fahrer sich durch die Informationsunterstützung verändert.

Codewörter: Verkehr, Kongestion, Kraftstoffverbrauch, GPS.

Prof. Dr. Herbert Sonntag, TFH Wildau,
eMail: herbert.sonntag@tfh-wildau.de
Dipl. Ing. Bertram Meimbresse
e-mail: bmeimbre@igw.tfh-wildau.de
Technische Fachhochschule Wildau
FH Wildau - University of Applied Sciences Wildau
Germany