METHODS TO GENERATE INFORMATION ON WEATHER- AND ROAD CONDITION IN TERMS OF SPECIFIC ROAD SECTIONS ONLINE AS WELL AS IN THE VEHICLE FOR DRIVER AND TRAVELLER

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ABSTRACT

Road conditions in winter are a main cause for accidents and traffic jams, which apart from causing human distress also lead to high economic costs.
Apart from supplying traceable data directly from the road as a maintenance decision support on-line information and on-trip information and warnings help to enhance safety and mobility.
It is a challenge to combine and process the different sources of data supplied (e.g. stationary road weather stations, mobile spontaneously transmitted data out of moving vehicles “XFCD”, grid patterned periodical data on precipitation radar, area- or local weather forecasts, etc..) in a way, that reliable information on road weather conditions can be gained for short road sections.
Years ago BMW took the initiative to develop a service operation platform. The idea was to be able to use as much available data possible, be it from the road service or the weather service.
In a first test-run the automatically generated information messages of the service operation platform were compared with the observations made on test-drives of vehicles equipped with XFCD devices. This leads to an average compliance with the real conditions of 85% and more.
Meanwhile the methods and procedures has been developed further in numerous projects such as for the Traffic Agency Bavaria (VIB) as well as under the framework of the EU-project „eMOTION“ for applications on an European scale.
A first version of the system is already working in a commercial operation. In this case the automatically generated ALERT-C coded TMC messages, which are weather dependable, are being published via RDS/TMC-Pro Service.
The system works on basis of a so called datafusion matrix via which all data-sources are being linked to road sections (Links) in the form of geo object targets. The link-up takes place in form of expert rules and algorithms. The platform references the target data on a universal fine-link map. This way it is possible to customise the geographical reference of the information for different digital map models of the recipients (“mapping”), e.g. TMC-Locator, INTREST etc..
The input- output interfaces comply with open standards (XML, WFS etc.) and on a European scale, common traffic telematic standards like DATEX II, ISO 191xx are being supported. The platform facilitates weather dependable traffic information and forecasts. The article describes the main concepts and the architecture, as well as the range of applications and the results that have been obtained up to now.

KEYWORDS

ROAD WEATHER INFORMATION / TMC / SAFETY IN MOBILITY / MOBILE INFORMATION SERVICES / ALERT-C / SERVICE OPERATION PLATFORM / TELEMATICS / TMC / TTI

1. INTRODUCTION

Road Weather information systems became more and more indispensable and important for supporting winter maintenance decisions. Winter maintenance decision support makes the highest demands on quality and range of measurements, information and forecasts. This highly sophisticated data should also be used for traveller and traffic information. Road weather information systems are part of the road infrastructure and the telematic field.

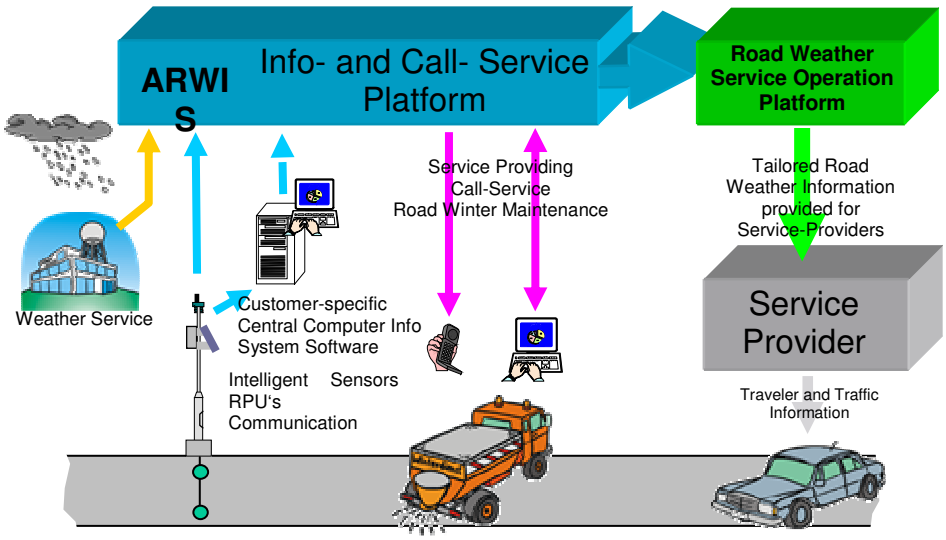


Figure 1 – Road Weather Information Policy

The field of Road Weather Information comprises the following issues: Weather Services dealing with global atmospheric weather data and forecasts, the road weather remote stations acquiring all weather related road condition data, the road weather information central computers or comprehensive information and decision support services for the road maintenance organisations and also road weather content- and service- operation platforms for traveller and traffic information purposes. In the future extended data from moving vehicles could also enhance the coverage of the road network and improve the winter maintenance services.

2. ROAD WEATHER SERVICE OPERATION PLATFORM

Weather incidents like thunderstorms and strong showers, fog, chilling humidity, and snowfall represent serious safety risks on roads. Local thunderstorms will inevitably lead to a prolongation of travel time. Appointments cannot be kept; individual stress and the risk of accidents are rising. Sleekness caused by rain, snow and ice is playing a vital role in about 30 % of all accidents within Germany and similar situations are discovered in other European countries. Finra encountered that the accident rate under snow condition is principle two times bigger than on bare, dry roads. But the risk of accidents is even 10 … 30 times higher if a critical road condition like snow or ice occurs unexpectedly [10].
This risk can be reduced by accurate, road related warnings of unfavourable weather and road conditions.
Therefore a road weather information platform was developed by micKS MSR GmbH under support and cooperation by the BMW Group FIZ and also in cooperation with the T-Traffic company ddg GmbH (→ [1]).
This service operation platform is able to process different meteorological and road weather data sources, which also can have various time and geographical references and

producing TMC coded warnings and messages referenced to short road sections based on digital map links or TMC locator. The fusion of various data sources is achieved by a knowledge base (see also figure 2).

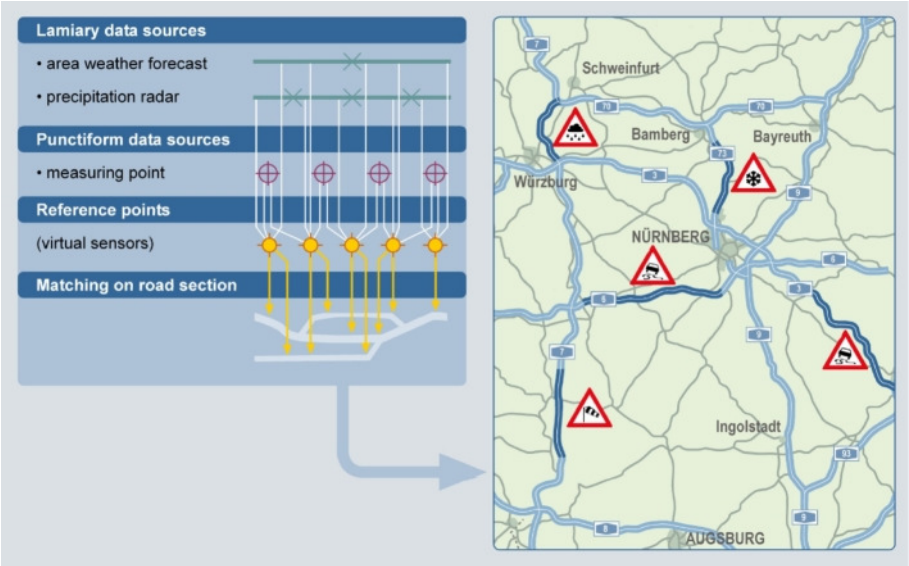


Figure 2 - different geographical referenced data sources are processed and mapped to road sections

The mobile Traffic information service provider T-Traffic and ddg now operates regularly a version of the platform under license provided by micKS company. Another application for the weather Server is the Bavarian Traffic Information Agency (VIB) established by the Bavarian Interior Ministry and by a consortium of private companies (Siemens AG, PTV AG, micKS MSR GmbH, mdv Gmbh). The system build up was finished end of 2008 and now running regularly with a contract duration of 10 Years [3].

2.1. Data sources and Data fusion

Different meteorological and road site data sources can be processed. For example

- griddled data sources (referenced to regular areas) as precipitation radar
- point location referenced data like weather stations and road weather outstations with road surface sensors
- arbitrarily structured area referenced data like forecasts for regions etc.

Also predicted data with the above mentioned geographical references can be processed in order to produce warnings and information for future time periods.
For the first step under the framework of ddg service, for BMW the following data sources are used:

- Data of all highway outstations of the German Road Weather Information System (SWIS) and environmental data station within intelligent vehicle highway systems (figure 3)
- Precipitation radar for the whole area of Germany composed from 12 radar stations (figure 4)

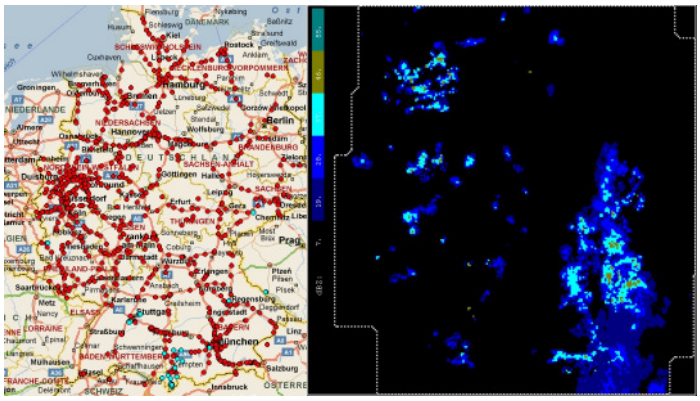


Figure 3 – datasources punctiform and lamiary reference (road weather stations and precipitation radar 2x2 km)

2.2. Extended floating car data gain coverage of road condition content

Data from the floating traffic can gain the coverage of data sources evidently. The BMW Group FIZ has started the development of extended floating car devices (XFCD) with the capability of collection all data from various sensors and systems in a vehicle in order to report critical situations during the drive. For example heavy rain from the built in wiper rain sensor, aquaplaning and slippery conditions from the behaviour of the ABS and so on. These reports are transferred by mobile communication network. The data processed by a central content Server can be also valuable for winter maintenance decision support services.

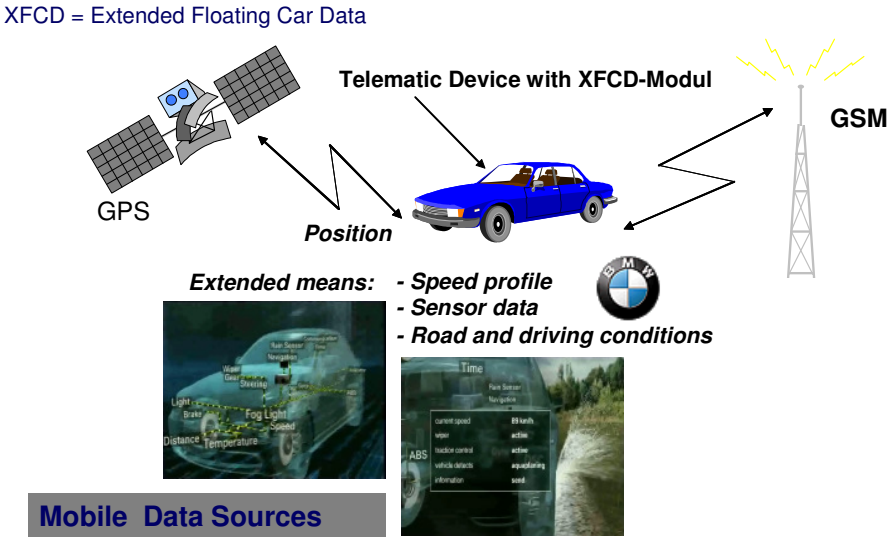


Figure 4 - XFCD Extended floating car data principle

2.3. Data fusion

Data can have different time stamps and periods of validity and also can have different local references. The different data sources were processed by means of a so called data fusion matrix which allows flexible assignment of the various source geo objects to the target geo objects.
The distance of the geographical locations from source to target is taken into account as well as the time validity of the source data. Older data have lower importance than newer

data. Also the geographical position under consideration of the topographical situation had to be included. The data fusion process uses expert rules.

3. ROAD WEATHER SERVICE OPERATION PLATFORM APPLICATION INTERFACES

A service operation platform must have the possibility to support different data models and be able to reference various digital map sources.
Because of the flexible data fusion matrix the platform was adapted to different project framework. Two examples will be introduced below.

3.1. Road weather service operation platform in europa-wide multimodal on-trip traffic information

Under the framework of the EU project eMOTION (= Europa-wide multimodal On-trip Traffic InformatiON – see also [4]) also for the weather platform europe-wide interface standards and data models were specified.
Road weather information can play its role in a Europe-wide traffic information network. As an example see figure 6.

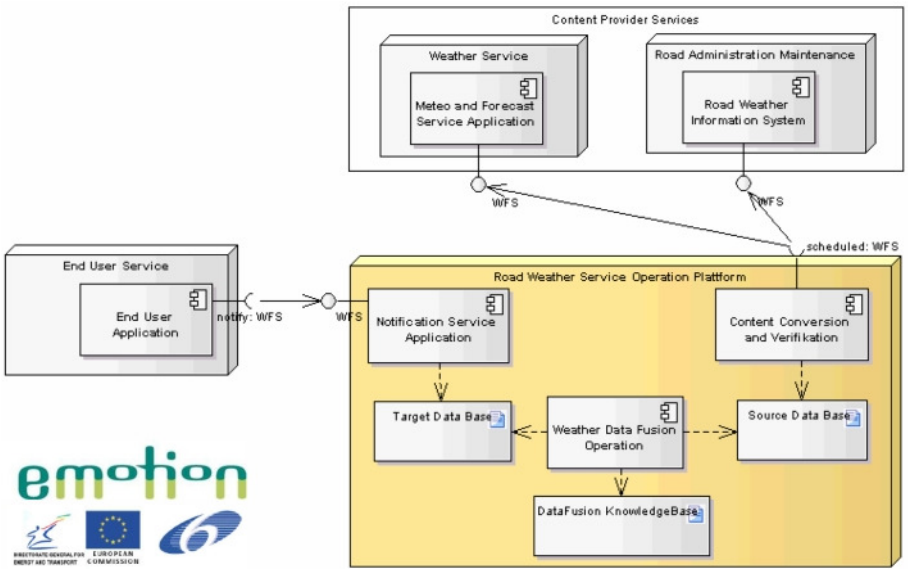


Figure 5 - UML Diagramm: Road weather service operation platform in a emotion service network

Data sources of different content providers are acquired from the weather server by means of standard emotion interfaces (like WFS = Web Feature Service) and data models following the ISO 191xx and DATEX II standards. The service operation platform delivers service data ready to use for service providers, who run end user applications. The service providers are in charge of distributing the service information to mobile end user devices and handle the business related affairs.
The emotion framework also include registry services, where interested service providers or other potential customers can ask for available content or service operation platforms. On the registry a customer can obtain all necessary meta data (see also [2]) information about the available sources as well as information about the licence conditions under which the provider is willing to sell their content. Digital rights management services are also provided by the emotion group.

3.2. VIB Bavarian Traffic Information Agency using INTREST Geo referencing

The VIB project uses a digital map model, developed under the INTREST project. The basis of INTREST are the Navteq digital map. INTREST defines an upper level of the road network of Bavaria and in addition includes country specific POI's and other location of public interest as well as public transport location.
The following figure showing the visualisation of TMC coded road weather warnings in the front end of the Information service:

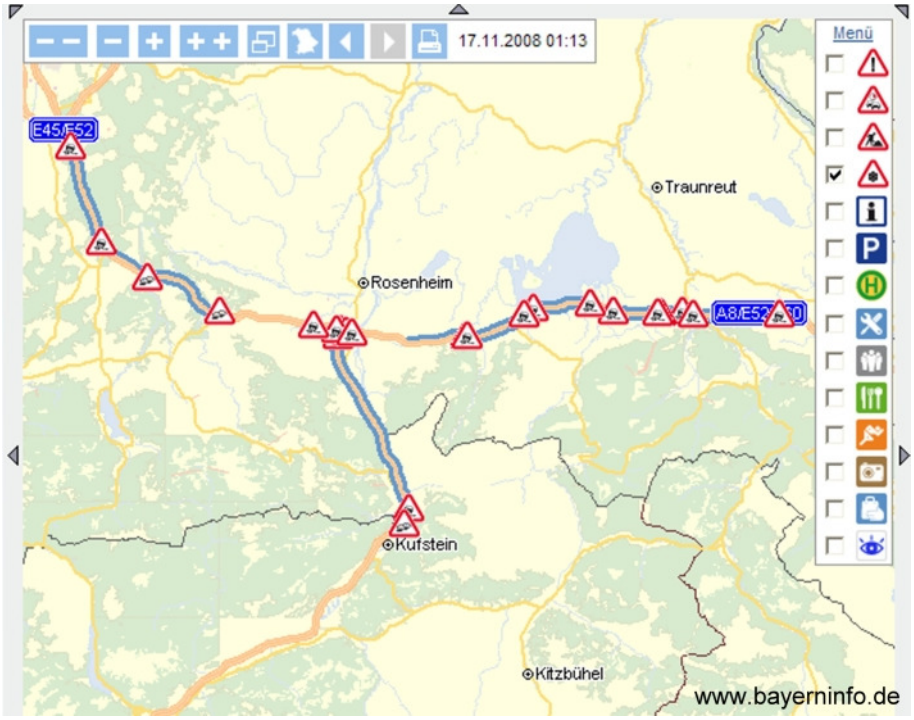


Figure 7 – Front end of "www.bayerinfo.de" showing road weather warnings

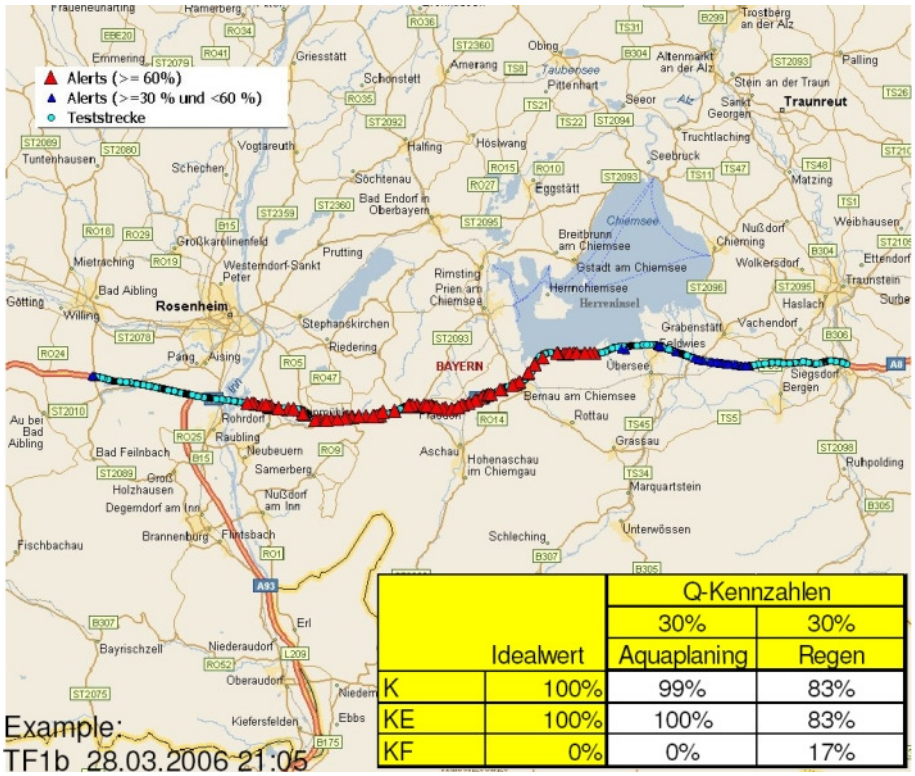
4. QUALITY MANAGEMENT

The only way to get an “over all” quality check is to collect reliably observations from experienced people and experts and compare them with the output of the information platform. On example of an observation from a driving car shows figure 6: heavy rain was detected only in a short section (ca. 2 km) on the highway near Oberpfaffenhofen, Bavaria, which was really encountered. There was also a rainy situation in whole southern Bavaria but the intensity was under the warning limits – except in this mentioned section.

Figure 8 - Example of an observation from a driving car

To meet the high requirements of a premium service, in the past BMW run several automatic quality measurement and evaluations, based on defined quality scores for message and service quality.

For that purpose, data from surveying and probe collecting tours by XFCD vehicles from BMW are summoned.



	Idealwert	Q-Kennzahlen 30% Aquaplaning	Q-Kennzahlen 30% Regen
K	100%	99%	83%
KE	100%	100%	83%
KF	0%	0%	17%

Figure 9 - visualisation of a surveying tour and some results

5. CONCLUSIONS

Weather information, especially road weather become more and more important for traffic safety. Road weather information systems are a essential part for road maintenance decision support. The immense progress in road environmental sensor devices and in forecasting of weather situations not only useful for maintenance but also for information to vehicle drivers. Future technologies such as extending floating car data and the dissemination of board computers and navigation devices can also gain new data sources for maintenance.

Future research will have their focus on automatically consideration of weather and road surface condition in traffic situation forecast in order to control the traffic and also for logistic application in the transportation industry.

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