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Implantation of a Winter-Maintenance–Management-System for an optimised intervention control

Introduction

Road winter maintenance is one of the most important tasks of road maintenance service. It shows as a permanent tightrope walk between the requirements of economy, traffic safety and environmental protection. Success in winter maintenance is dependent on rapid, target orientated and effective intervention thus generating its economic efficiency (politically as well as applied). Relevant research projects concerning winter traffic safety and economy have proven that fact.

For rapid and target orientated interventions actual information on present and forecasted weather situation, on present weather and road conditions in the network as well as on actual winter maintenance activities are of major importance.

Situation

During recent years within the Federal Republic of Germany a Road Weather Information System (named SWIS) was implanted in connection with a network of ice warning stations (GMA) thus offering an important assistance to winter maintenance and its organisation. A related problem is that this weather information is only spot orientated, related to their direct

environment, and mostly are restricted to the motorway network. Wide area covering information, especially concerning the subordinate network, is at present not available in Germany.

Ice warning systems at salient positions in the network may automatically collect and process data about road and weather conditions. These data are automatically transmitted to the central office.

But winter accident analysis have shown that exactly that spot orientated icing in the subordinate network is most dangerous and generating highest accident rates, especially because often the situation is not recognized neither by maintenance service nor by drivers. On the other hand a wide area covering permanent winter maintenance under such weather conditions or a permanent control service is unaffordable, neither financially nor from the side of personnel.

Instead of this it is much more economic and target orientated to improve the information about weather and road conditions in the subordinate network, thus enabling an improved winter maintenance coordination.

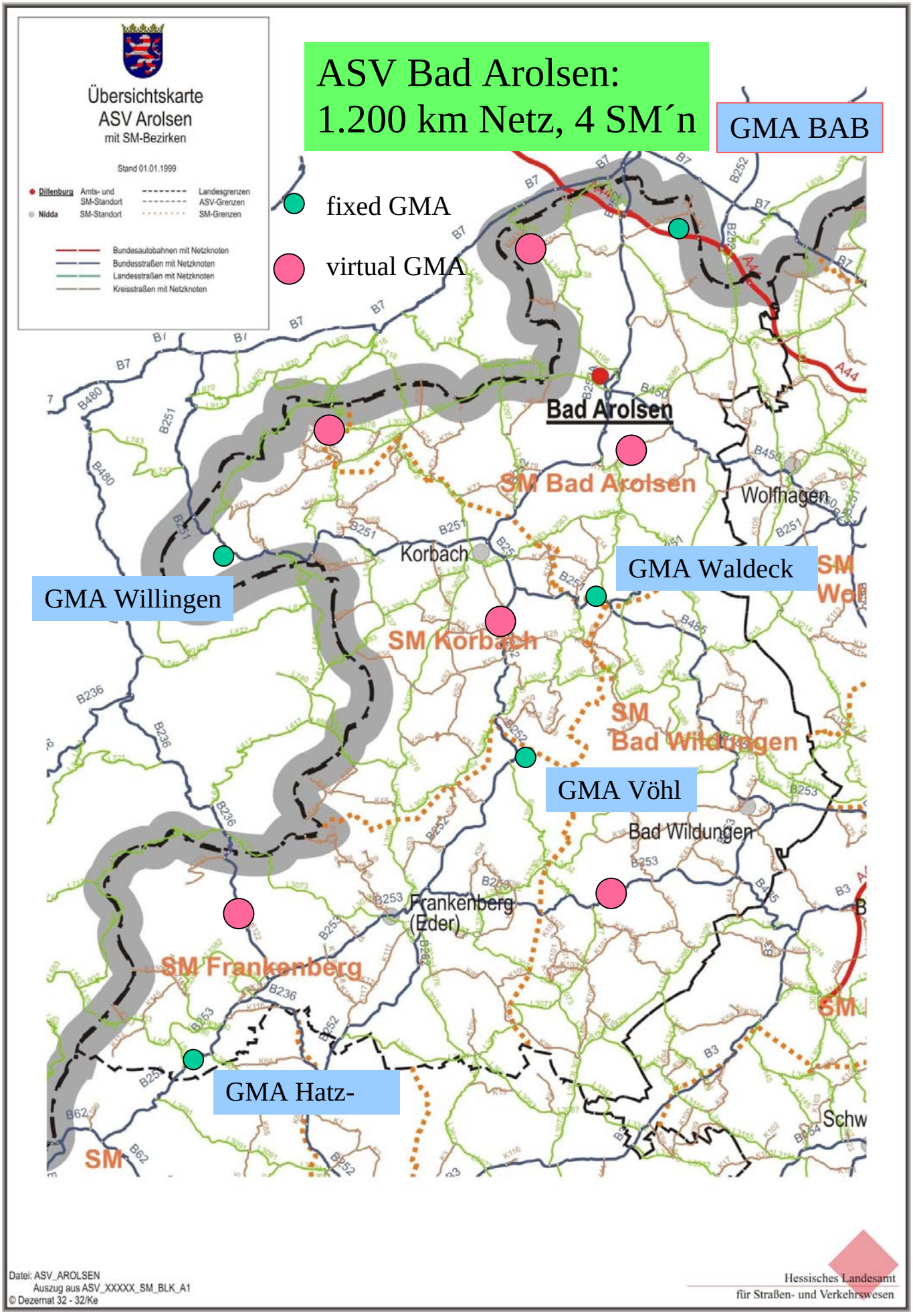
Another problem of winter maintenance organisation is poor information about winter maintenance activities. Handwritten, mostly few expressive, intervention reports are more and more replaced by board computer generated data collection, but even with this new technology the information are not available before intervention end. The actual intervention coordination is effected, if ever, by acclamation or radio. Thus an in-time and flexible operation coordination is only conditionally possible.

Such type of winter maintenance organisation is no more up-to date, respectively as technical possibilities allowing important optimisation are available.

WMS – Winter-Maintenance-Management-System Hessen

To compensate the mentioned deficiencies, the federal state of Hessen in 2002 started the project Winter-Maintenance–Management–System (WMS). It bases on the idea to use and combine all available and ingenious possibilities for winter maintenance to achieve an optimum support operation organisation.

A pilot project is performed in the district of the office for roads and traffic Bad Arolsen , which shows a pretentious network on climate and topography with a length of 1200 kilometres in Northern Hessen with four road maintenance centres. As the district is touched only by one motorway (A 44 in the north), up to now no information from GMA and SWIS were available.


Übersichtskarte
ASV Arolsen
mit SM-Bezirken
Stand 01.01.1999
Dillenburg Amts- und SM-Standort
Nidda SM-Standort
Landesgrenzen
ASV-Grenzen
SM-Grenzen
Bundesautobahnen mit Netzknoten
Bundesstraßen mit Netzknoten
Landesstraßen mit Netzknoten
Kreisstraßen mit Netzknoten
ASV Bad Arolsen:
1.200 km Netz, 4 SM´n
GMA BAB
fixed GMA
virtual GMA
Bad Arolsen
SM Bad Arolsen
Wolfhagen
Korbach
GMA Waldeck
GMA Willingen
SM Korbach
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Bad Wildungen
GMA Vöhl
Bad Wildungen
Frankenberg
(Eder)
SM Frankenberg
GMA Hatz-
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Datei: ASV_AROLSEN
Auszug aus ASV_XXXXX_SM_BLK_A1
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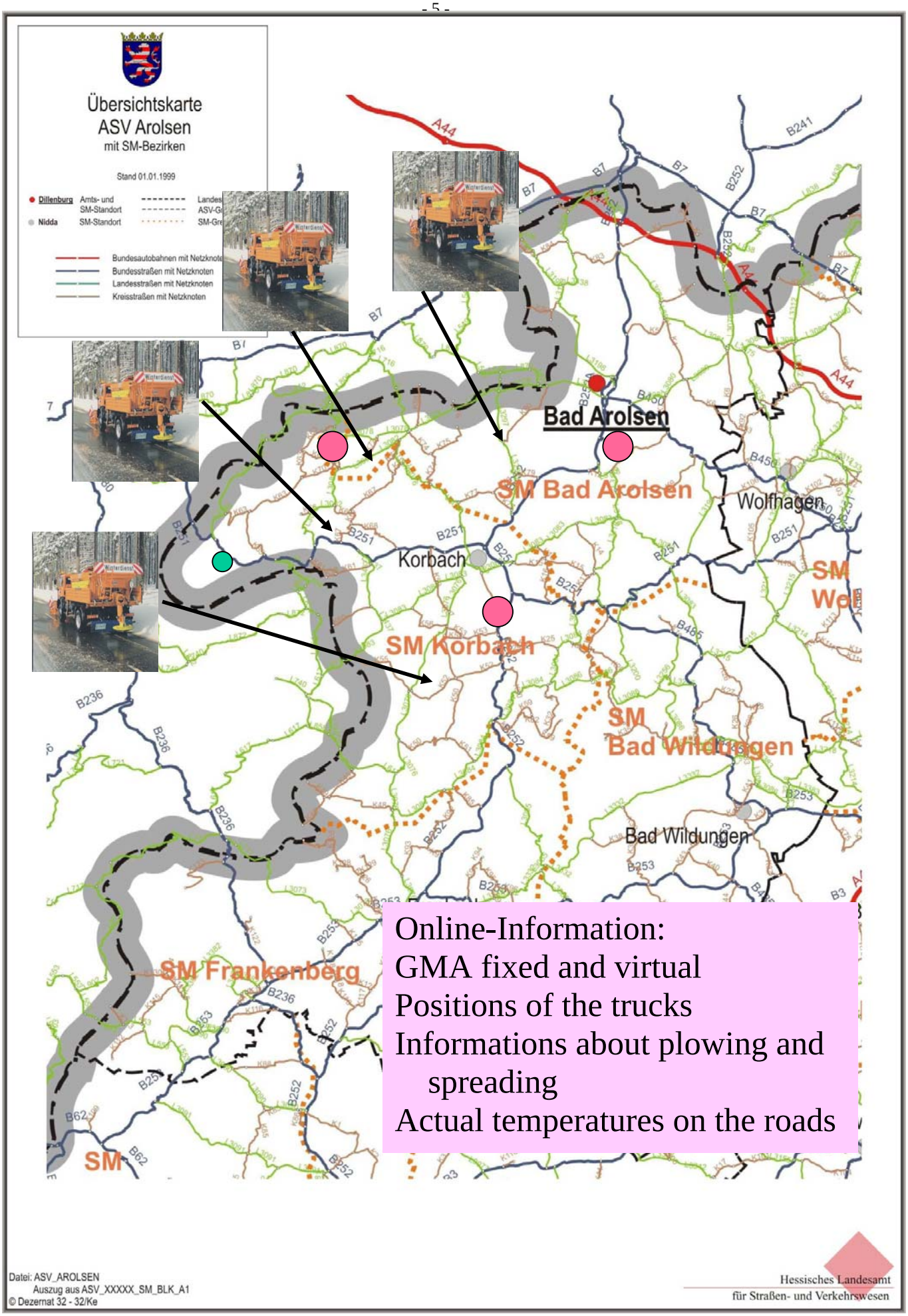
The district of ASV Bad Arolsen that way was perfectly suitable for the pilot project because this district with extremely pretentious and problematic winter maintenance showed almost no local weather, road condition or intervention data.

The test is focussing at present on two maintenance centres of the network (SM Frankenberg and SM Korbach).

The pilot project shows a system configuration as follows:

- Core of the Winter maintenance-Management-System are fixed ice warning stations. Basically 1 station per maintenance centre was planned, but experiences showed that being not satisfactorily under topographically and climatic differentiated conditions, so that at present 4 stations are installed (two per SM resp. one per 150 km of network). Concerning data transmission between Ice warning station and maintenance centre two alternatives, GSM phone and internal radio, are tested.
- These fixed stations are accomplished by so called „virtual“ stations, two of them assigned to each fixed station. Those virtual stations are not existing in reality, but their meteorological data are projected on basis of real data of the fixed stations and of defined climatic and weather profiles. The data are evaluated and calibrated by means of temporarily installed stations. Virtual stations are related to definite waypoints and are displayed at the maintenance centre as being real stations. Indication and/or calculation of salt factor and freezing point may of course not be provided. By use of virtual stations a better wide area coverage is received with low expenses. The figure shows the road network of ASV Bad Arolsen with positioning of fixed and virtual measuring stations in the areas of the maintenance centres Frankenberg and Korbach. At present there are 4 fixed and additionally 6 virtual stations installed in the areas of both maintenance centres.
- For both fixed and virtual stations in connection with SWIS data German Meteorological Service (DWD) calculates short and medium term forecasts and transmits them to the responsible operations central (affected maintenance centre) to be displayed on the monitor.
- All operational winter maintenance vehicles (state and private owned) are equipped with latest technologies concerning spreading (FS30) and machinery technology; they dispose of modern board computers with GPS positioning and spreading data collection as well as about thermographics, i.e. permanent road surface temperature measurement obtained by the rolling vehicle with automatic temperature related spreading density adjustment.
- New and particular on this pilot project is that data collected by intervention vehicles are transmitted in time to the maintenance centre (alternatively by GSM or radio) for evaluation (Floating-Car-Data). Not only intervention data (vehicle position, clearing/spreading activities) but also road surface temperatures are transmitted. Out of these data road condition and winter maintenance situation are applied to the network at the maintenance centre. The fact that with these passages an almost regular thermal mapping is taking place allows by processing these data to make an automatic computer projection concerning road weather data and forecasts for the complete network. Furthermore the passage of the vehicles at real and virtual stations allows mutual balancing of data to self test and recalibrate the complete system.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SM Bad Arolsen
Wolfhagen
Korbach
SM Korbach
SM Bad Wildungen
Bad Wildungen
SM Frankenberg
SM
Online-Information:
GMA fixed and virtual
Positions of the trucks
Informations about plowing and spreading
Actual temperatures on the roads
Datei: ASV_AROLSEN
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- Data of real and virtual stations, of vehicles and RWIS forecasts are not only stored in the maintenance centre's server but may as well at any time be actually visualised and displayed graphically in the network. This turns out as an essential aid to operations control. The figure shows an example of the principle of data availability at SM Korbach. It is essential that all available data of condition and prognosis are chained and displayed on the screen.
- Prognosis and calculations for the complete network as well as defined alarms allow the system to transfer automatic alarm information or intervention alarms to mobile telephones thus informing intervention stand-by forces. Alarmed collaborators may log into the system via portable PC from home to gain all available condition data.

The system proceeds from the assumption that now as before intervention control is obtained at each maintenance centre, i.e. no overlapping operation centres are implanted, because locally orientated responsibility is best. Of course it is as well possible to claim for the data of neighbouring districts to for a better estimation of the own winter maintenance situation. Same possibilities are allowed to the head office.

Preview

The system was partly tested in winter 2002/03 and was operative to the amount described above in winter 2003/04. At present it is undergoing an extensive feasibility test.

By improved winter maintenance information a clearly optimised winter maintenance may be expected with an improved economy, because unnecessary intervention and control rides may be omitted and interventions may be executed much more target orientated.

First experiences with the system show one hand the necessity of intensive configuration and calibration as well as some accustoming but on the other hand is well accepted by collaborators and winter maintenance superiors and some good success has already been achieved.

Last not least this is the result of engagement and interest of all participants.

Installation and calibration of virtual stations is showing quite problematic. During first test winter functioning was not satisfactory because virtual stations were climatically to different from the fixed stations. Basing on this experience the fixed station network was enlarged for this winter (2 per SM) and the virtual stations could be attached better and more definite to the fixed stations.

Based on experiences from the pilot project final installation of the system shall be accomplished in all Hessen. Experiences are to be collected particularly concerning necessary station density, methods of projection local data to the complete network, means and cycles of transmission, display and application of data.

It is important that the system permits different manufacturers and types of spreaders and spreader controls as well as different types of vehicles.

The described Winter-Maintenance-Management-System in its full implantation shall allow a future winter maintenance highly efficient and economic.

Abstract

Efficient and target orientated winter maintenance requires optimum information about present and future weather, road conditions within the network and actual winter maintenance activities. Present winter maintenance organisation does not utilise present possibilities of technology to the full extend. Road and traffic administration of Hessen started in 2002 a pilot project on a winter maintenance management system in the district of Bad Arolsen office showing in the meantime first experiences. Herein information gained from fixed ice warning stations and road weather information system SWIS are completed by virtual ice warning stations combined with actual information about road surface and weather conditions as well as about actual interventions within the complete road network. These information are directly transmitted from maintenance vehicle to operations central (maintenance centre) by radio or GSM cellular phone. At the operations central the complete network with all actual data may be graphically displayed. On such basis an essentially improved winter maintenance control may be obtained.