

Flow and presentation of road weather data and winter maintenance activities on the Internet

by
Stefan Sigurdsson
Danish Road Directorate

Abstract

The decision on whether a call-out is needed on the road network in Denmark is made at individual winter surveillance centres. To support these tasks at the surveillance centres, two computer systems have been developed. The systems are a Road Weather Information System (RWIS), and a management system for winter maintenance (VINTERMAN). The RWIS system has been operational in Denmark since 1983 and VINTERMAN has been operational since 1998.

The aim of developing these two systems was to optimize the winter maintenance activities. But all the stored data in the systems make it at the same time possible to send out very precise information to the road users about activities and road conditions. The information is given via telephone, radio, television, Text-TV and via the Internet. The development of IT technology and an increased data flow speed has made it possible to show more information on the Internet than earlier, and it's still improving.

In this paper a description is given of the data flow, - that is, from the two systems sources mentioned before, out on to the Internet.

Introduction

The Danish road network has a total length of about 72.000 paved kilometres. The administrative and economic responsibility for the road network is shared by three levels of road authorities. National roads have a length of 1.618 km and are administrated by the Road Directorate. Regional roads are covering 9.964 km for which the 13 counties in Denmark are responsible. Local roads cover 60.328 km and are administrated and maintained by the 271 municipalities. The Road Directorate administers the national roads, but daily maintenance and operation including winter maintenance are performed by the counties.

The RWIS system and the VINTERMAN system are installed in the winter surveillance centres in each county. The information from the RWIS system, together with weather forecasts and radar images, are used to determine the right time for starting the salt spreading and snow clearing operations. Once the decision is made, VINTERMAN is used as a decision support system to assist the operators in carrying out the activities. Information from the two systems is sent out on to the road users.

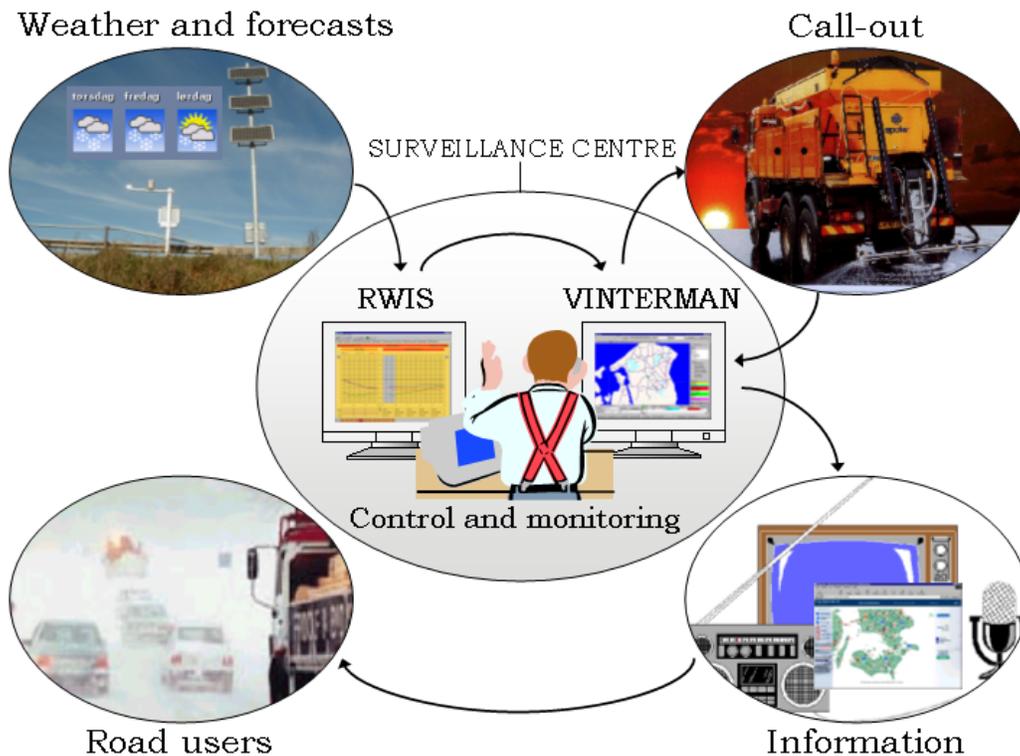


Figure: Information flow for the Road Weather Information System and VINTERMAN

To monitor the road conditions the centres have on-duty personnel from the 15th of October to the 15th of April. In a typical winter in Denmark, there are about 95 call-outs for salting due to risk of icy conditions. Salting as a result of snowfall, on the other hand, occurs only 5-10 times a year. In Denmark, we experience the particular problem of temperature fluctuations around zero, which means that during the winter the roads are slippery and dry, alternately. Therefore it is very important for the road administrations to have access to an operational RWIS system and to very short range weather forecasts. Furthermore it is very important to have as short response time as possible in the call-out situation. Due to how seldom snowfall occurs in Denmark, very few cars are equipped with studded tires. Sudden occurrence of black ice can therefore lead to major accidents, and snowfalls will always have a big negative impact on the traffic flow.

As a result of these circumstances, preventive actions are always taken to salt the roads before they get slippery. The circumstances also make it very important to give as much and accurate information as possible to the road users, to avoid eventual traffic jam and accidents. With reliable real-time information on the road conditions and activities, makes it possible for the road users to determent if they are needed to take precautions due to different road conditions, or simply to stay at home. Knowing this, before starting the journey, will make the drivers more relaxed. Now let's take a look at the data sources.

RWIS

Development of a warning-system for slippery roads in Denmark began in 1983, when the first measuring-stations were installed. Since then, the system has been continuously developed concomitantly with research on slippery-road warning. The number of stations today has now grown to 310 stations along the road network. The stations are situated all over the country and collect data every 10 minutes. The stations are measuring the following: Road temperature, conductivity of the road surface (dry, wet or salt), air temperature, humidity, wind direction, wind speed and precipitation. For each region, the Danish Meteorological Institute (DMI) computes forecasts every hour, based on observations from the measuring stations located in the region.

At appropriate times the system can send out visual and acoustic alarms. These alarms are activated e.g. when certain weather parameters exceed specified limits or are such that slippery road conditions are likely to arise.

All the data can be seen in each winter surveillance centre, but a part of the information is sent further on to the Internet. On the site www.vintertrafik.dk, road and air temperatures can be seen for all of the measuring stations. Similarly, there is a map showing the alarm status of the weather stations on DMI's website. (<http://www.dmi.dk/vejr/glatfore/glatfore.html>). The information is given for both observations and a 3-hour forecast and is shown as coloured areas on a map of Denmark. Green colour indicates that the situation is normal, yellow colour indicates that the road temperature is below zero and red indicates that slippery road conditions are likely to arise.



Figure: A 3-hour forecast showing risk of icy roads

VINTERMAN

Once the decision of making a call-out is made, VINTERMAN is assisting the operators in carrying out the activities. VINTERMAN controls the communication with the contractors and stores all appropriate information in a logbook. This provides the opportunity to monitor and control the work quality.

Based on the list of activities, VINTERMAN is also able to display all ongoing activities on a map. The activities are coloured distinctly to indicate their status on the routes. Equipment provided with on-line data collection (GPS) will be displayed on a map as a dot that indicates its position and direction. Information regarding the current position is typically used when transfer is needed and resources are moved from one route to another. Together with the list of activities the map gives the on-duty officer a good view of the situation.

Data Collection

VINTERMAN contains special features for the presentation of data obtained from data-collecting equipment. During and after the activity (with the use of on-line data collection), the facility shown on the figure will be able to display the received data from an equipment. The picture is divided into three presentation windows that are linked together. In this way, a click on either the map, graphics or list will automatically place focus correctly on the other two windows.

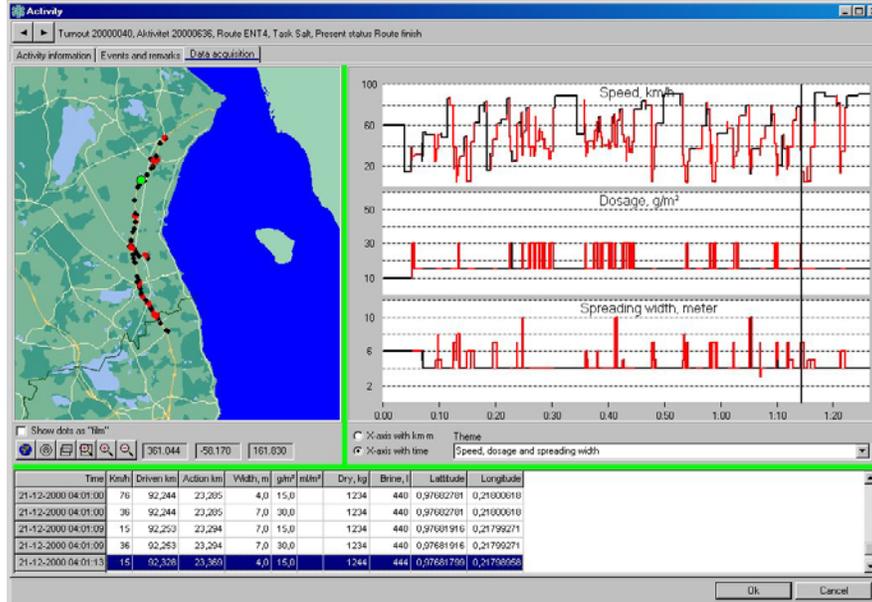


Figure: Presentation of detailed data from the salt spreaders

Data collection was initially only used on salt spreaders, but it is now available for trucks and tractors that are equipped with ploughs, and special patrol vehicles that are capable of measuring air and road surface temperature, air humidity, residual salt etc. Data from these vehicles are also presented in VINTERMAN, where the graphic is cor-

rected so the curves for items (e.g. road surface temperature) are replaced by data from a patrol vehicle.

Road Reports

VINTERMAN includes a report module in which each road officer regularly reports on the road condition. The reports describe the officer's perception of the road condition based on the Road Weather Information System, his/ her knowledge of the distance to patrols, and ongoing activities. The reports can be sent by e-mail, SMS or fax to specified groups. Reports are also published on the internet site www.vintertrafik.dk. Here, the reports are combined with observations and forecasts on air and road surface temperatures from all measuring stations in Denmark. If an observation or a forecast indicates a risk of icy roads there will be a special warning issued. A road report includes the following:

- A scheme where information on road condition and start time for activities is entered.
- A text box where messages can be written if the road condition is abnormal or in cases of extreme weather. This could be e.g., closed road, blizzard, stormy weather, tree blocking road and so on. This information will appear instantly on the site vintertrafik.dk.
- In the text box at the bottom of the scheme, the actual situation can be described from a more technical point of view. Only relevant on-duty personnel will receive this message.

The colours in the scheme are used to group the different types of information. The green line is used to report on normal road condition. The pink lines are used to give information on the winter maintenance activities on the roads. The blue lines are used to report a changed road condition and the white lines are used to give information on the weather.

Report	Overalt	M40	Nordyn	Østfyn	Vestfyn	Midfyn	Sydlyn og øer
Normal condition at this season							
Preventive salting started at							
Sailing against slippery conditions							
Snow removal started at							
Snowfall		X					
Heavy snowfall			X	X			
Snow drifting					X		X
Problematic road condition							
Only one track open						X	
Closed roads							
Spots with snow/ice							
Snow/ice on the roads							
Slippery on special places							
Black ice							
Vind							

Figure: A road report in VINTERMAN

All the information in the scheme is automatically extracted to vintertrafik.dk. On the site a map of the whole country is shown. If there is any ongoing activity or risk of slippery roads, a sign will be displayed. As a supplement to the information on activities and road condition, pictures from several web cams are available. This makes it possible for the road users to get a visual view of the situation on the roads.

To get more detailed information it's possible to get a map of each county. On the county maps the air and road surface temperatures are shown. Signs presenting the road conditions, activities and the weather situation will automatically be displayed when a report is sent via VINTERMAN. The signs have a mouse over function. If the mouse is held over a sign more detailed information will pop up. On the figure this can be seen as a yellow text box where start time of salting is given for the respective area. When a salting activity is over, the time for the last activity is shown. This information is frequently used by road users who don't want to get their vehicles exposed to salt, e.g. motorcyclists.

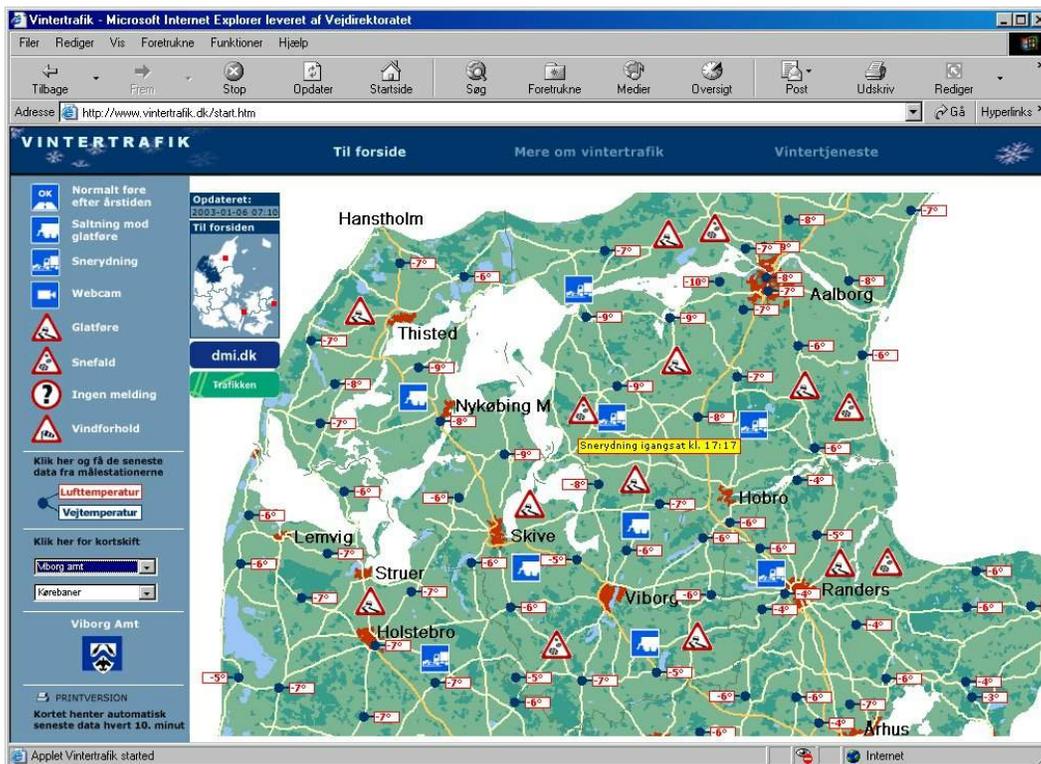


Figure: A detailed map on www.vintertrafik.dk showing road condition, activities and the weather situation

Users

Many different groups of people use the information on vintertrafik.dk. The professional users are e.g.; the personnel at the winter surveillance centres, the Traffic Information Central (TIC), municipalities, media people and local contractors.

The personnel at the different surveillance centres use the site to get a quick overview of the road and weather situation in other parts of the country. At TIC and at different radio stations, the site is used to distribute information to the road users.

Many municipalities use the site to monitor the activities on the county- and national roads, especially those municipalities that don't have access to a road weather information system. If they learn that there has been a call-out on the main road network in the area due to e.g. black ice, the on-duty personnel will inspect the municipality roads to decide whether a call-out is needed or not. Local contractors who work for private companies or private organizations use the site for the same purpose.

The professional users are almost constantly monitoring the site, and on a normal day, where nothing special is happening, the number of visitors is about 1000 – 2000 a day. On the other hand, when there is a winter situation with black ice, freezing wet road surface, freezing rain or snowfall, the number of visitors will rise up to 80.000 a day, and in these cases a main part of the visitors are the ordinary road users. The peaks are especially in relation to heavy snowfall. In these situations people want to know if there are big delays and in worst case closed roads due to snow or accidents.

Statistics

The on-line data collection from the salt spreaders and the trucks as described before make it possible to view many different types of statistics in VINTERMAN. VINTERMAN is able to provide statistics on the number of activities, consumption of salt, duration and time of call-out along with the cost of salt and payments to contractors. The statistics can also be graphically displayed. Furthermore the authorities use the information to administrate and optimize the winter maintenance.

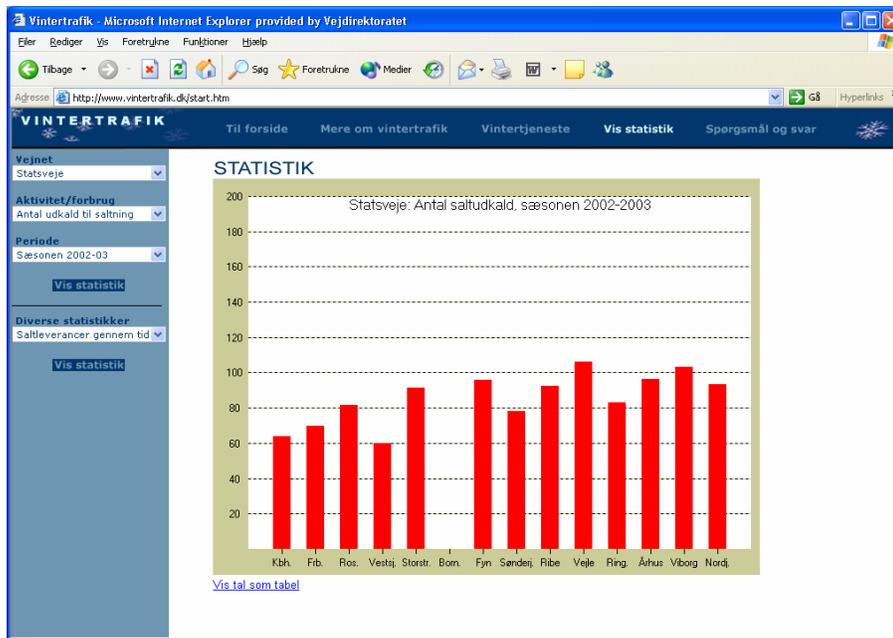


Figure: Statistics showing number of turnouts for each county on vintertrafik.dk

Information regarding activities and salt consumptions are updated in real time in VINTERMAN. Many different partners are interested in this kind of information, and having this information in the system, gave the idea of bringing it further on to the Internet. The result is that information on number of turn-outs, number of hours used to clear snow and salt consumption in tons and in kg/m² is updated daily on vintertrafik.dk. This can be seen by choosing "Vis statistik". Data is available since the winter season 2001-2002, but more historical data will be implemented in the near future.

And one might ask, - why bother to put all this statistics on the Internet? The information is already available in VINTERMAN, so the effort to transmit them further on to the Internet is not that big. It facilitates the information from the road authorities on winter related activities to different partners. For example, when a snow storm occurs it often makes big headlines in the media. How much salt was used, how much did it cost the community and so on. Having this very precise and updated information on the Internet makes it easy to give the information and at the same time easy to get hold of. Among others that ask for that type of information are other road authorities, politicians and students to mention a few.

Other information

Information such as winter service standards on each type of road and answer to many frequently asked questions is also available on the site. Questions such as; when do slippery roads occur, how often can I expect slippery roads, who maintain the roads, how much does a typical winter cost, when are the roads cleared for snow, why not to use sand instead of salt, how does salt affect the environment and so on.

Conclusion

The winter maintenance technology improves very fast, and high speed communication cables and systems make it possible to transfer a huge amount of data. With time, it also becomes less expensive. Already now it is possible to see very specific information regarding e.g. temperatures, winter maintenance activities, road conditions and salt consumption, but there is still a lot that can be improved. As mentioned before in the paper, all winter maintenance vehicles equipped with GPS and data collection can be monitored in VINTERMAN. A logical next step could be also to show on the Internet the exact position, direction and speed of each vehicle. This could provide useful information on an estimated time of end of activities. A daily update of cost of activities is also an alternative. At last it can be mentioned as an example, that in the season 2003-2004 vintertrafik.dk is being integrated with the traffic information site www.trafikken.dk to facilitate the search of road and traffic information.