Weather-Related Traffic Management in the E18 Finnish Test Area

Yrjö Pilli-Sihvola, *Finnish National Road Administration*

The test area prepared for the demonstration of weather-related traffic management telematics solutions is the E18 corridor running from Turku along the southern coast regions of Finland via Helsinki and Kotka to Vaalimaa on the Russian border. The corridor also includes maritime links from Turku to Stockholm, Sweden; from Helsinki to Stockholm, Travemunde (Germany), and Tallinn (Estonia); and from Kotka to various ports in Germany, as well as road and rail links from Vaalimaa to St. Petersburg, Russia. An overview reflecting the initial phase of the test project is presented.

The total length of the Finnish part of the E18 roadway is about 350 km. The average daily traffic on E18 varies from 2,500 vehicles near the Russian border to 35,000 vehicles near Helsinki. The average daily traffic at the border station in Vaalimaa is about 1,000 vehicles. In Turku the traffic crossing the border is about 1,300 vehicles per day and in Helsinki about 1,400 vehicles per day. The corridor runs through three Finnish National Road Administration (Finnra) districts, each of which has its own weather and road surface condition monitoring center (RWMC), which in turn exchange information among themselves and with the national traffic information center in Helsinki. The regional RWMCs in Turku, Helsinki, and Kouvola serve the entire corridor. There are nine RWMCs in Finland in all. Several variable message signs warn of the slippery road conditions along the corridor. A 14-km motorway section on the eastern part of the corridor near Kotka has 36 automatic speed-limit signs, controlled by weather and road surface conditions, and 5 automatic information signs. Road weather stations and traffic monitoring stations are placed at 3- to 30-km intervals along the corridor, and weather monitoring centers have immediate access to these stations.

Background

Finnra seeks to improve traffic flow and safety and increase driving comfort as much as possible. Environmental considerations are taken into account. Transport telematics is intended to increase the effectiveness of traffic control, traffic information, and winter maintenance.

Adverse weather conditions are a significant traffic safety problem in Finland. Almost half of winter accidents occur during bad weather or road conditions. Road users are not always aware of the road conditions and the risk of driving during wintertime. Road conditions quite often are estimated to be better than they really are. An increase in international traffic in Finland may increase the risk of accidents because foreign drivers may not be accustomed to the winter conditions on Finnish roads. Weather-related traffic management is one way to handle traffic safety problems and to improve traffic flow during adverse weather conditions.

Road transport telematic systems are becoming more common around the world and especially in Europe. In

Finland telematic solutions are used, for example, to decrease the negative effects of unexpected poor road conditions on traffic safety. The existing telematic infrastructure in Finland and especially on the E18 test area creates a firm base for new transport telematic applications. The data transmission networks are highly developed and reliable. The network of the global system for mobile communications (GSM) covers the entire 350-km-long road section. Finnish citizens are accustomed to using different types of modern telematic equipment to receive information.

The level of winter road maintenance will be improved in the Trans-European Road Network in Finland. One way to improve maintenance is preventive salting, which requires exact and real-time information on road surface conditions as well as good weather forecasts.

The need for several types of information for safe driving is increasing as is development of information processing systems. Automatic data collection and information processing will lead to automatic distribution of information to drivers. The road authorities must be ready for this development.

Vision for Weather-Related Traffic Management

The E18 test area from Turku via Helsinki to Vaalimaa will provide the following features:

- Weather and road surface conditions, road surface friction, status of maintenance activities, and traffic information will be available continuously for the entire corridor.
- Forecasts of road conditions and traffic a few hours ahead will be possible.
- All information systems concerning the E18 road section will be compatible.
- Information from Sweden, Estonia, and Russia may be received before a driver crosses the border.
- Information about unexpected traffic situations will be available to road users via information systems.
- Speed limits will be controlled according to the road surface conditions and traffic.
- Locally situated variable information signs will be used whenever needed.
- Prevailing information media will be used effectively both before and during the trip.
- Elderly drivers will be considered in the planning of telematic applications.
- Some of the information may have a direct effect on vehicles.

In the future a uniform information service will be available in understandable form to drivers of any nationality in the E18 test area.

Objectives of E18 Test Area

Telematic solutions are being tested and evaluated in the E18 test area. The goal is to improve traffic safety and flow, to improve driving comfort by means of traffic management, to supply information, and to provide more effective winter road maintenance. The project is running from 1995 to 1999. The E18 test area from Turku to Vaalimaa will be one part of the transport telematic corridor from Sweden via Finland to Russia. The main parts of the study being carried out on the E18 test area are as follows:

- Development of data collecting methods to a new level.
- Development of data handling that corresponds to the new data collecting methods.
- Development of information analysis and road-condition forecasting.
- Development of information distribution and automation of message generation to the road users' information systems.
- Evaluation of the system as a technical system and evaluation of the effects of the system on traffic.

Development of Information Systems

Current Systems

Finland has more than 200 road weather stations and about 200 traffic monitoring stations. Road weather monitoring video cameras complement the information received from road weather monitoring stations. Three weather radar serving the southern part of Finland are located in Turku and Helsinki and near Kouvola. The basic information of the road surface conditions and weather comes from the observation systems shown in Figure 1. The data are collected with the road weather information system. On the test area there are already 14 road weather and traffic monitoring stations and five video cameras.

Thermal mapping of the entire test road section was done during autumn 1995. Thermal mapping helps to situate the new monitoring stations at the right spots. Thermal mapping information also helps to widen the information of the local road weather monitoring stations to include the other sections of the road.

Planned Systems

Monitoring of weather and road conditions will be improved on the 60-km-long road section in the western part of the test area. Fifty to 60 new road surface condition

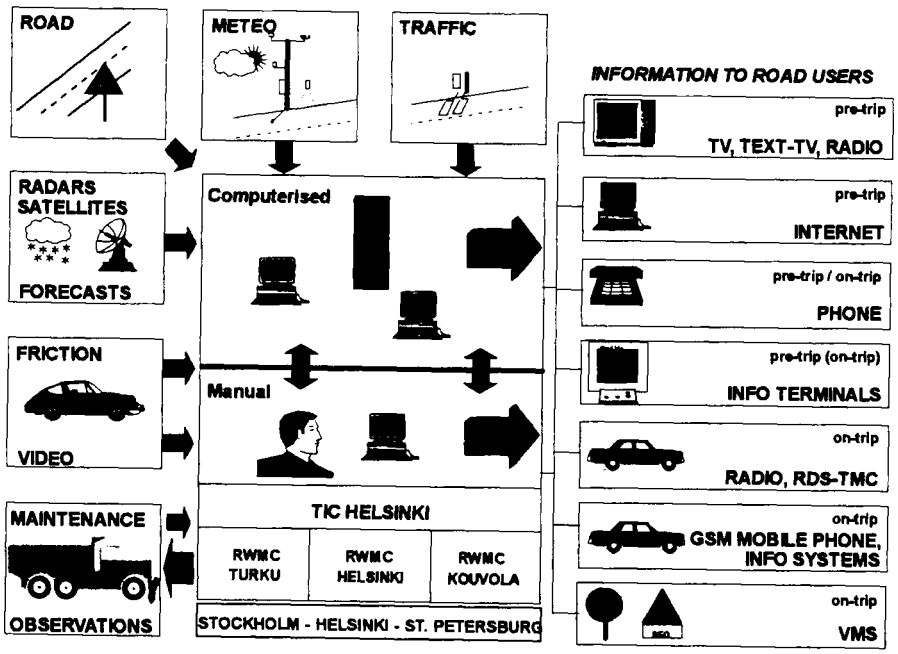

FIGURE 1 Schematic of information system.

measuring stations will be installed. Observations will be made at every kilometer on that road section. There will also be additional but fewer monitoring stations in the eastern part of the test section. The information gathered will be added to the road weather information system.

Still video pictures are transmitted from moving vehicles to the information system by the GSM-based transmitting methods. During the test, the cameras may be installed on buses driving along the test road section.

Road surface temperature and friction data will be collected by floating car sensors. The equipment that measures the friction will be installed at first on a test vehicle, but it is planned that the equipment also can be fitted to maintenance trucks and buses. Preventive salting will be made more effective with the longitudinal measurements of the road surface temperature and friction.

The maintenance activities will be stored in the new road condition information database. Every RWMC will keep the information in real time in the database so that the information may be used in all information centers whenever needed.

Data Handling Systems

Software applications of the information system will be made according to the European technical standards for telematic architecture. The information is bound to the place and to the coordinates. Data exchange among neighboring countries will be automated in part. A great deal of the information is stationary so that it may be updated by manual data transfer.

All the information (road surface condition, weather, traffic, maintenance, incidents, and so on) is recorded in the databases. The databases of each data collection system form a family of databases, and the user interface program collects all needed information from each database through the data management application. The user interface is based on the map interface called arcview. The information can be shown on the map base or in time series. Message management is used when the information must be sent quickly and directly to the road user, for example, slipperiness warnings via the radio data system–traffic message channel (RDS-TMC).

In the development of the forecasting model for road surface conditions, the prevailing methods are used in combination with new weather forecasting methods. It is important to define the responsibilities of the different road weather monitoring centers for feeding data to the systems. Within the test area are four information centers: Helsinki traffic information center, Turku RWMC, Uusimaa RWMC, and Kouvola RWMC.

Use of the Information

Road users can obtain information about prevailing road conditions, traffic, and so forth before and during their trips. Information is available via television, radio, Internet, RDS-TMC, in-vehicle information systems, telephone service, variable message signs, and infoterminals (at service stations and border stations). National

information networks like TELMO or Teletext provide access via television or modem to real-time weather data and forecasts.

The new data transfer techniques are being tested in the E18 telematics project. Data transfer from the floating cars to the road-user terminals via GSM techniques is a new way to transfer data. GSM is already a European standard and offers many possibilities for the development of different kinds of message exchange, such as short messages and cellular broadcasting.

Variable message signs are used to warn drivers about slippery road conditions, traffic congestion, incidents, maintenance activities, animals on the road, and other hazards. The automatic weather-related speed limit signs and information boards are being tested on the eastern test road section near Kotka. The posted speed limit varies automatically according to the road conditions and weather. During adverse weather conditions the speed limit is 80 km/h, and in good conditions it is 100 km/h during midwinter and 120 km/h in other seasons.

More accurate information about the road conditions is also transmitted to the road maintenance personnel to improve the maintenance work.

Conclusions

Greatly increased information on the E18 test area will be available to road maintenance personnel and road users within the next 2 years. Careful evaluations of the effects of the information will be done during the third year of the project. The main areas of the evaluation will be

- System functionality,
- Comparison of measurements from the local monitoring stations and floating cars,
- Road condition forecasting,
- Pre-trip and on-trip information to the road user,
- Effects on winter maintenance,
- Effects on traffic safety and fluency,
- Information or ergonomical aspects, and
- Economic aspects (cost-benefit analysis).

Although various road surface monitoring stations and sensors already exist, the reliability of the information must be examined and estimated. The need for more reliable information increases when the information is used to control the traffic signs, information boards, and various information delivery media.