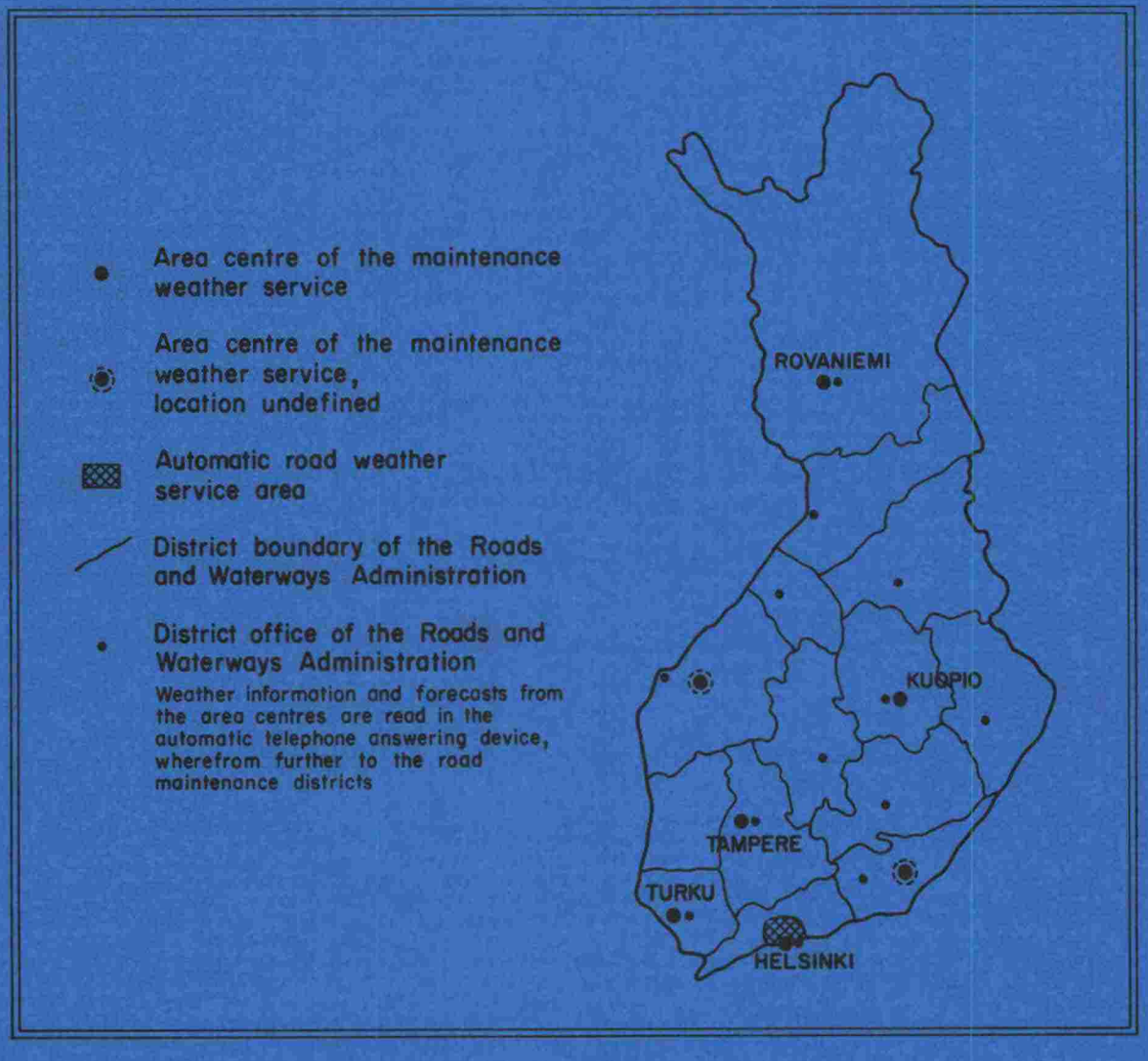
ROAD WEATHER SERVICE DEVELOPMENT

FINAL REPORT



The Steering Committee of the Road Weather Service Development

Ministry of Communications

TVH 722329 **HELSINKI 1982**

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INTRODUCTION

On 12.3.1980 the Ministry of Communications appointed a steering committee together with an ancilliary working group to investigate the development of a road weather service and its organisation in Finland.

Road weather service development in Finland constitutes a direct extension to work in conjunction with technological cooperation between European countries, i.e. COST activities. In conjunction with COST, a project entitled "COST 30: European project on electronic traffic aids on major roads" was realised over the period 1970-1980. Responsibility for its sub-project entitled "The automatic detection of bad weather conditions" was borne by Finland.

In accordance with its commission, the steering committee was charged with:

1) investigating, in the light of research results and experiences to date, the road weather service development requirement in Finland, taking into particular consideration road maintenance assistance.
2) planning and executing the necessary practical experiments in conjunction with the purpose of the area road weather service organisation in a suitable region of the country.
3) elucidating through results obtained in trials how the organisation of a road weather service on the country could be suitable realised (including operating principles, task organisation, collaborating parties and their duties).
4) assessing the costs and benefits of road weather service organisation and its feasible alternatives.

5) submitting, on the basis of its investigation, the required proposals for action, together with a schedule, for the development of a road weather service in Finland, preparing a resource and expenses assessment, and submitting a proposal for the organisation of resources (including labour) and their funding among the various parties involved.

The Ministry of Communications appointed researcher Jussi Sauna-aho to serve in the capacity of Chairman to the steering committee, Chief Inspector Olli Hintikka of the Ministry of Communications to serve as member, and invited Kirill Härkänen, Chief Engineer, Dr Asko Saarela of the Roads and Waterways Administration, Chief of Division, Jorma Riissanen, of the Finnish Meteorological Institute, Programme Planning Manager Jarmo Virmavirta of Yleisradio (the Finnish broadcasting company). Assistant Manager Markku Väinölä of the Mobile Police department and Manager of the Information Department of the central organisation for traffic safety, Esko Salovaara, to serve as members. Asko Heilala, Head of the Information Department of the central organisation for traffic safety, replaces Esko Salovaara.

Pentti Hautala, Chief Engineer from the Roads and Waterways Administration, and Researcher Martti Mäkelä from the Finnish Meteorological Institute, were appointed as Secretaries to the steering committee.

Assisting the steering committee there was a working group appointed by the Ministry of Communications. Pentti Hautala, Chief Engineer, from the Roads and Waterways Administration, was appointed as Chairman to the working group. Mikko Ojajärvi, Section Chief, from the Roads and Waterways Administration, Researcher Martti Mäkelä from the Finnish Meteorological Institute, Planning Manager Heikki Peltonen from Yleisradio, (the Finnish broadcasting company) and Assistant Manager Markku Väinölä from the Mobile Police, were invited to serve as members.

The work was originally scheduled to terminate on 30.4.1982, but the Ministry of Communications extended the date to 31.8.1982 by request of the steering committee.

The steering committee is unanimous regarding its proposals respecting the development of a road weather service.

Reports arising from this work are a final report, together with four separate appendix reports either drawn up by the working group or prepared under its direction.

After finishing its work the steering committee gives its report with enclosures to the Ministry of Communications.

Helsinki 31.8.1982

Jussi Sauna-aho

Asko Heilala	Olli Hintikka	Kirill Härkänen
Jorma Riissanen	Asko Saarela	Jarmo Virmavirta
	Markku Väinölä	
Pentti Hautala		Martti Mäkelä

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1. SUMMARY

The results and decisions derived from the investigation relating to technological cooperation between European countries, entitled "Automatic detection of bad weather", indicate that data concerning the weather and road conditions and short-term forecasts related to these are both important and beneficial to road maintenance. On this basis the research work has been expanded in Finland by investigating road weather service development and organisation.

The road weather service necessity as felt by motorists was documented through interviews and questionnaires sent out by post. In addition, opinions were sought from traffic and transportation organisations, as well as from certain town authorities.

Motorists value accurate short-term forecasts and regard road condition data as being of paramount importance.

In order to investigate various forms of services and the requirements for their realisation, practical experiments were conducted. The trial conducted in the Helsinki capital area, in 1980-1981 consisted of cataloguing experiences and establishing the starting points. In the expanded trial of the subsequent winter, 1981-1982, on operational system of real time weather and road condition information and forecasting suitable for use by authorities maintaining the roads was developed. In the Turku trial of 1980-1981 the requirements for a separate road weather service unit and influence of a taylored weather service on road maintenance, road conditions, and traffic were elucidated. A survey was made over the whole country during the winter of 1981-1982 on the issuing of special forecasts for the Roads and Waterways Administration by aviation weather services and telephone answering device.

The trials indicated that authorities maintaining the roads would benefit in the following ways:

- resource utilization improves
- the work load can be evened out
- the necessity for weather monitoring by the Roads and Waterways Administration is reduced
- winter road maintenance will be come more efficient

In the light of these results, an optimally organised road weather service is estimated to decrease road authority maintenance costs over the country as a whole by 7 million FIM/yr.

Road safety interests may be furthered through improved and precisely timed winter maintenance operations. It has only been possible to estimate accident cost savings in the capital area, where they may be 195 000 - 980 000 FIM/yr, in accordance with the degree of influence prevailing.

The annual expenses associated with the realisation and upkeep of a road weather service are estimated at 3 million FIM over the country as a whole.

In the light of investigations already made, the development of a road weather service would appear to be profitable from both the point of view of traffic and commercial and socioeconomic considerations. On these grounds it is proposed that the country be the recipient initially of an organisation serving road maintenance interests, this organisation should meet present winter maintenance requirements on a district basis. Through the development of data transmission and processing technology and of traffic control devices and procedures, the road weather service would be developed so as to satisfy the needs of motorists, too.

It is proposed to realise the road weather service as a part of the area weather service of the Finnish Meteorological Institute (FMI) by dividing the country into three areas in accordance with organisation and standards. It is proposed to organise the service over the period 1982-1989.

Responsibility for development at this stage falls to the Finnish Meteorological Institute (FMI) and the Roads and Waterways Administration (RWA).

The inception of the road weather service creates a need for information dispersal and training.

2. STARTING POINTS

2.1 THE ROAD WEATHER SERVICE AND ITS PURPOSE

In this report the term "road weather service" is taken to mean all weather and road condition data which are of use to those authorities responsible for winter road maintenance. It is possible to include weather and road condition data intended for road users as well.

The road weather service in the strict sense means the area weather service, incorporating weather and road condition information and their forecasting, to be rendered to the various parties.

The area weather service intended for road maintenance districts is termed the maintenance weather service.

The purpose of the road weather service is
- in the first place to assist those responsible for road maintenance, by supplying them with as accurate and timely weather details and forecasts as possible.
- in the second place (at least at present) to assist road users by supplying them not only with weather details and forecasts, but also with road condition data and forecasts.

Taking into account the effects of a road traffic weather service, the improvement of road maintenance and savings in resources (labour and material consumption) involved in this, and the improvement of road safety, can be set as the principal objectives of the road traffic weather service.

Through development of the system, an increase in the service supplied to the general public, chiefly through the agency of local radio, is also an objective.

2.2 COST 30 AND ITS EFFECTS

The Ministry of Communications appointed a research team in 1974 to direct and supervise the duties alloted to Finland under the COST 30 project "Electronic traffic aids on major roads" in conjunction with technological cooperation between European countries, or COST activities, and to carry out administrative duties associated with this project /1/.

Finland became responsible for the coordination of sub-project 8 (Automatic detection of bad weather) and through this duty we became the leaders in road weather research and service experiences in Europe. The objectives set for COST 30/8 were, however, of such a general European nature that the direct application of the results obtained to Finnish conditions was not possible. On the other hand, the results obtained indicated that through the correct measures road safety, the standard of traffic service and traffic costs could be influenced.

This, even during the implementation of COST 30/8, caused the research and the service to be applied more closely to Finnish circumstances to a greater extent than in the original international cooperation agreement. Hence COST 30/8 constitutes an indispensable, through insufficient, basis for the development of this system in the country. The termination of the COST 30 project resulted in further research being deemed necessary.

On this basis the steering committee of COST 30 proposed to the Ministry of Communications that a special team be appointed for the realisation of a road weather service in the country /2/.

2.3 COMMISSION

The Ministry of Communications in its letter of 12.3.1980 directed the steering committee and its ancilliary working group to investigate the development and organisation of a road weather service in Finland /3/.

Sections 3-8 of this final report will give answers to these five task categories, the directives being modified to some extent.

A working group formed a body ancilliary to the steering committee, its duties being directed by the latter. The working group was directly responsible to its steering committee.

Working group duties directed by the steering committee, together with the schedule to be followed, are listed in Appendix 1.

3. SURVEY OF NEEDS

3.1 THE NEEDS SURVEYED EARLIER

The need for a road weather service has been but poorly documented, only a few published accounts in conjunction with COST 30 activities being found in the literature from various countries.

The sub-project COST 30/5 did, in fact, cover all the information relating to traffic, but weather was given only a very perfunctory treatment /4/. Finnish material was limited to a few articles published jointly by the Roads and Waterways Administration and the Finnish Meteorological Institute, two publications from local radio of Yleisradio (the Finnish broadcasting company) and a research team report concerning runway maintenance.

3.2 THE NEEDS SURVEYED BY THE WORKING GROUP

The report on the surveillance of needs for the road weather service was prepared under the direction of Central Organisation for Traffic Safety, and the associated report appears in appendix 2 (Matti Heinonen: Tiesääpalvelun tarvekartoitus, Helsinki 1982).

Method

The opinions of motorists concerning the influence of weather on driving conditions and experiences connected with the road weather service trial of the `81-`82 winter in the Helsinki area were surveyed in four different ways. First, interviews were held with motorists in November `81, prior to the road weather service trial. Second, a questionnaire was mailed to a sample of 1500 vehicle owners located over the whole country. Third, a statement-based questionnaire was directed at certain traffic and commune collective bodies. Fourth, in April `82 a post-campaign questionnaire was sent out to the sample motorists in the Helsinki area.

Results

Of those replying to the questionnaire covering the entire country, 90 % listened to the weather forecast every day. The media through which the information was obtained were principally radio and TV. Motorists in particular hoped for accurate weather forecasts
They expressed the wish to receive weather details in the morning between 6.00 am and 8.00 am. Motorists appealed, for instance, for local weather information. Professional drivers in particular considered weather and traffic information as being of major importance.

Details concerning the road conditions constituted the most important part of traffic information. Of paramount importance was considered information telling of ice on the road. Of the persons replying, 64 % considered information regarding unusually slippery streches of road as being of major importance. Information about icy road conditions in general was held to be especially necessary by 60 % of participants. Similarly, the amount of snow and the time it was expected to fall, were details held to be highly valuable. Of importance, too, was information regarding traffic jams and road works.

A good two-thirds of motorists in the capital area were aware of the existence of the road weather trial. Of those who had heard of the trial, slightly less than one half considered the campaign beneficial.

Transport organisations strive to maintain their services irrespective of the weather, but considered a more accurate service to be beneficial. A more specific weather service would enable a more realistic timetable planning and transportation rationalisation.

Local communes strive to make use of weather information in planning the maintenance of roads and streets. The timely use and the effectiveness of equipment and machinery for preventing slippery conditions and winter road maintenance, a saving on expenses, and the fact that it could influence salt and sand utilization and alertness for snow ploughing,

were regarded as benefits accompanying a more accurate road weather service.

Conclusions

It was apparent from the investigations that from the standpoint of the general public a road weather service is mainly a supplier of information, not a creator of practical measures. This is apparent, for instance, in questions relating to alternative modes of transportation. Hence, any appreciable extension of road weather service activities in the public sector will have to be considered very carefully, especially if this could lead to extra costs. This resolves itself through the development of a area weather service, but it seems apparent that only local radio is worthy of improvement in this respect, possibly alongside a telephone weather service.

In comparison with the foregoing, a service directed at road maintenance (eg. highways, streets, property surrounds and runways) and professional traffic is appreciably more significant. These sectors can also provide the possible financing necessary for expanding activities. Through more accurate and effective informatics, communes may also be made more active in weather service matters.

On the basis of the survey of needs, the steering committee can state the following:

1) The road weather service should above all be aimed for intensification of road maintenance.

2) Enthusiasm for the matter should be aroused within the communes.

3) Professional traffic seems to require its own service channel (for example, by forced alerting over radio telephone), for route quidance, among others.

4) The public service should be intensified alongside with the development of local radio.

5) The realisation of a road weather telephone aimed at the general public should be considered only for the capital area.

The development of data transmission (Videotex, Telset, changeable signs, etc.) may easily cause more specific needs to be expressed by various users.

A more specific local planning of area weather service may on the grounds of the investigation carried out serve to make the conclusions arrived at more specific.

4. THE EXPERIMENTS

The purpose of the experiments carried out in road weather service development was to map out the different practical service forms and requirements for their use. For this purpose Finland was divided into districts (figure 1) whose models of function will be explained in the following chapters.

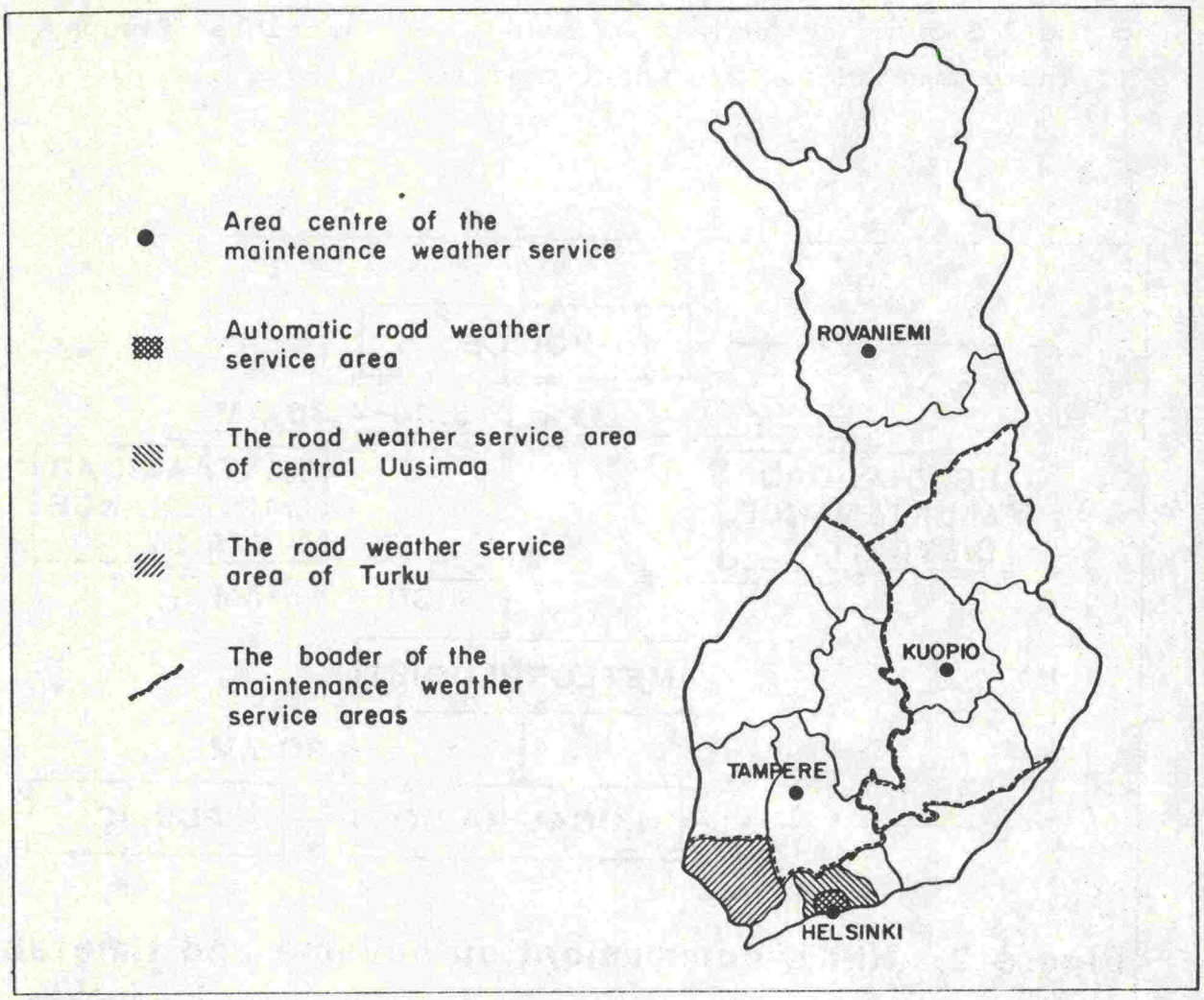


Figure 1. The road weather service systems of the road traffic in the experiments

4.1 THE ROAD WEATHER EXPERIMENT IN HELSINKI AREA, HKI I, 1980-1981

Hki I experiment was planned to be a preliminary experiment for the enhanced version of following winter. The main purpose of the experiment was defined as reporting the experiences in order to help the planning of Hki II-experiment /5/.

During the experiment the road condition observations and weather forecasts concerning the morning traffic were on weekdays reported to the local radio (YLE:n aikainen) from Espoo and Vantaa Road maintenance districts as it is shown in the following communication scheme and timetable (figure 2). The communication was mostly carried out by phone.

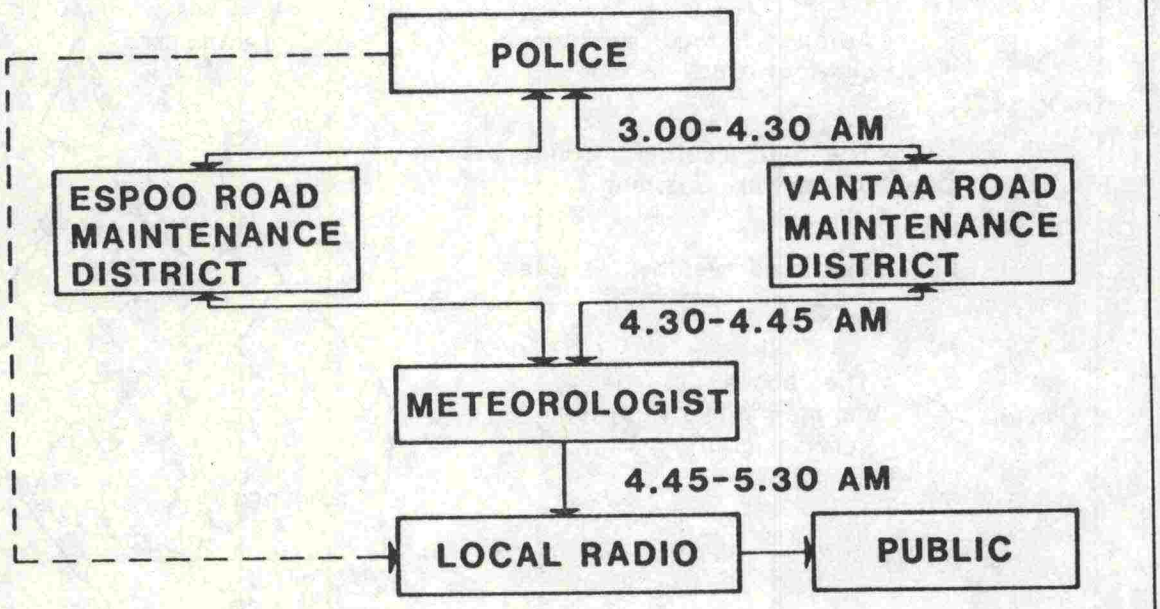


Figure 2. Hki I, communication scheme and timetable

Considered generally, the experiment worked well and in accordance with requirements. Several experiences and suggestions for improvement for Helsinki II were received, among the most important of which may be mentioned the following:

1) The parties indicated that they required training in matters relating to road conditions, road weather and observation making.

2) The accuracy of road weather forecasts improves when sufficient resources are available for forecasting work and when concentration may be focused on local road weather and road conditions.

3) Some improvement is called for in connection with the information content and impact of warnings for bad road conditions issued to the general public.

4) Problems in communications - incoherence,short-term nature, and dependence on telephone calls bound to certain times of the day - must be eradicated.

4.2 THE EXTENDED ROAD WEATHER SERVICE EXPERIMENT IN HELSINKI AREA, HKI II, 1981-1982

Originally it was intended to realise Hki II including traffic control centre and changeable signs, that is more complete than now described. Timetable and economic requirements, however, constituted limiting factors. Hence, Hki II was realised in the form of a real time weather service system of a type that is probably unique the world over.

The objective underlying the extended experiment was to develop a supply system for weather and road condition information and forecasts based on appropriate real time communications and intended for those maintaining the roads and those using them. The Finnish Meteorological Institute was responsible for service operations.

The operational scheme of the system is briefly outlined in figure 3. The road weather service of the Institute is in contact with three automatic road weather stations on various motorways, the weather radar station, the Espoo and Vantaa road masters, Mobile Police and with the local radio of Helsinki area (YLE:n aikainen). All the observations, except the radar pictures, are automatically made in real time and displayed at each terminal.

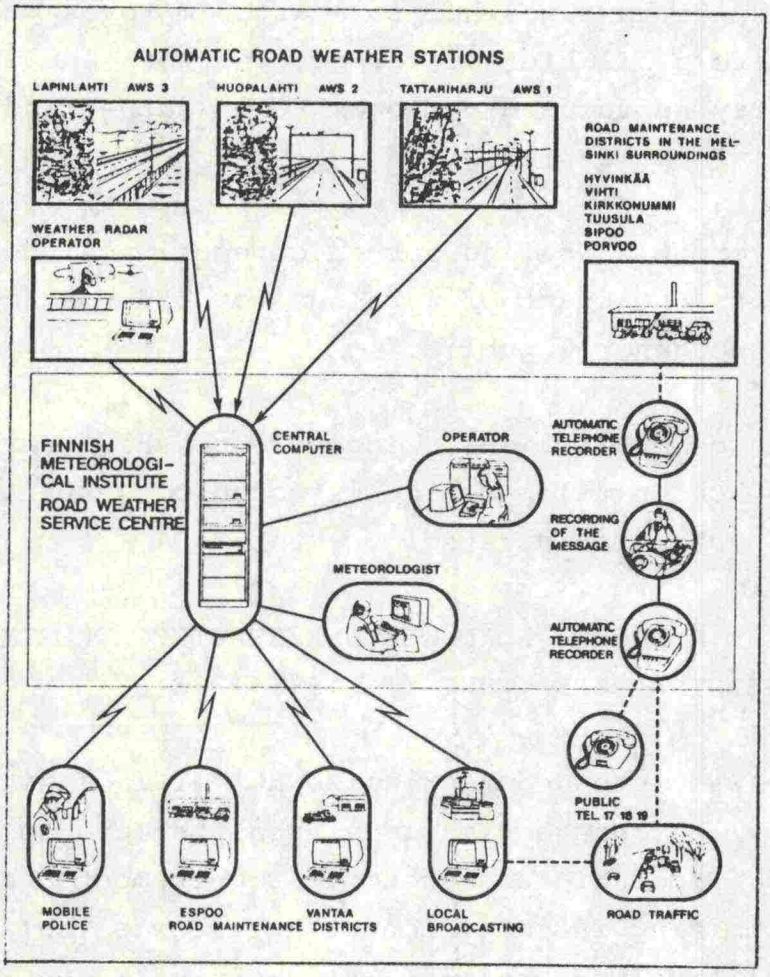


Figure 3. The operational scheme of the road weather service system

A description of the system is given in the report, Annex 3 (Auli Keskinen (Ed.): Laajennettu pääkaupunkiseudun tiesääpalvelukokeilu, Hki II 1981-1982, Helsinki 1982).

The other road maintenance districts in central-Uusimaa were serviced by a semi-automatic system and information was also issued to the general public via an automatic telephone answering device.

The system functioned, after the preliminary problems had been overcome, satisfactorily. The worst technical faults were computer breakdowns and above all the unsuitability of terminal touch buttons. However, those factors which interferred with the functioning of Hki I the most (see section 4.1) were eliminated. The system could provide the users with a greater amount of useful information than previously and furthermore in an easily understandable form (high quality graphic display).

In the cost-benefit evaluation a comparison between the Hki II type service and simplier solutions has been made (Chapter 5). The estimates indicate that a real time system is profitable only in areas with heavy traffic, where the system may if necessary be enhanced by means of traffic control (changeable signs).

Communications models contained in the area service plan of the Finnish Meteorological Institute could, however, aid the establishment of a real time system, so that extension beyond relatively heavily populated districts, or into areas with little traffic, would seem to be feasible.

4.3 THE TURKU ROAD WEATHER SERVICE EXPERIMENT OF 1980-1981

A road weather service was run in the period 1.10.1980 - 31.3.1981 in the southern region of the Turku Roads and Waterways District, the purpose of which was to investigate the operational prerequisites of a separate road weather service unit and the effects of a more taylored weather service on road maintenance, driving conditions, and traffic /6/.

Taylored road weather service was given from Tuesday to Friday. Forecasts were issued, and the service given, by a meteorologist working at Turku Airport. The principle of operations of this experiment is indicated in figure 4.

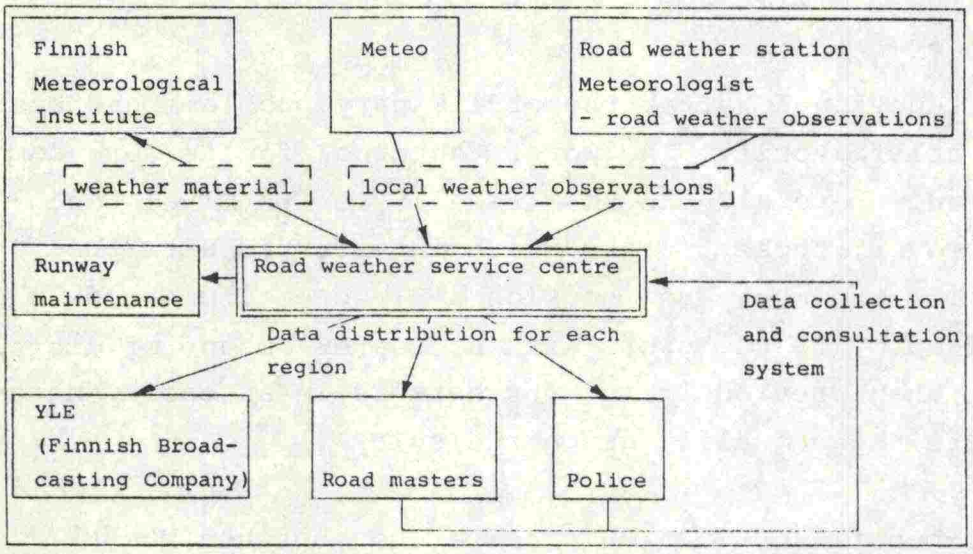


Figure 4. Principle of operations of Turku road weather service experiment.

Road masters and police could obtain forecasting service as follows:

- 9-hour forecasts were regularly issued three times a day: at 7.00 am, 1.00 pm and 9.00 pm. After this, the forecasts were available to road masters and police via an automatic telephone answering device.

  The experiment region was divided into four sub-regions, for each of which a separate forecast was given.

- In critical circumstances forecasts were issued more frequently.

- Road masters had a direct telephone contact for consultation with the meteorologist.

  Road weather forecasts were also supplied to the general public and to those responsible for runway maintenance.

- The general public received weekend road weather forecasts on Fridays in conjunction with the 5.20 pm news for Varsinais-Suomi Province, and on other days of the week warnings respecting critical weather conditions (23 weekend forecasts, 10 warnings).

- Runway maintenance staff made use of the road weather forecasts issued and sought advice from the meteorologist.

The Turku road weather service experiment functioned with the aid of simple technical equipment and rather meagre basic meteorological materials. Qualitatively, the Turku forecast service was of an appreciably higher standard than the general weather service. The term "general weather service standard" in this case means the extent to which the forecast made for this region through public communications could be considered accurate. The improvement in standards stemmed from the possibility of the meteorologist to concentrate on a single form of weather service and a regular, unvarying clientele. The Turku road weather experiment may be considered highly successful.

In the light of the success of the Turku experiment, the following considerations must be taken into account in addition to the foregoing when planning future measures:

1) Forecast monitoring and modification (weather watch), where necessary, were continuous.

2) Conditions characteristic of the region can be taken into account.

3) Collaboration between the supplier of the information and the clientele went smoothly.

4.4 COUNTRY-WIDE WEATHER SERVICE EXPERIMENT

In the winter of 1981-1982 the preparation and distribution of special forecasts from the Roads and Waterways Administration by means of a new method was tested. Forecasts were prepared twice a day by aviation meteorological services (Rovaniemi, Kuopio, Tampere), and the weather division of FMI in accordance with the regions indicated in figure 1.

At weekends forecasts were issued solely by the weather division. Communications were by means of remote control telephone answering services, the operation of which, especially during the initial stages, proved unsatisfactory. The mode of the forecasts was changed from code language to common language.

The aim of the system was to investigate the superiority rate of the area weather service over a national one, on the one hand by testing the accuracy of forecasts, and on the other, by interviewing users. By comparing, with respect to each forecast area, road weather forecast accuracy with the equivalent national forecasts, it was possible to realise the obvious superiority, and above all correctness, of the forecasts made on the spot (see Appendix 4, Yrjö Pilli-Sihvola: Teiden kunnossapidon sääpalvelu vuonna 1979-1982 kohta 3.2).

Interviews with the 11 road masters for northern Finland brought the following points to light:

1) All were of the opinion that forecasts had immensely improved.

2) The weekend service was considered to be somewhat scimpy.

3) Meteorologists are not concious of the importance of wind forecasts for the road authorities (drifting of snow).

4) The probability associated with rainfall forecasts is not a clear concept to all road masters.

5) Forecasts were often read too quickly or indistinctly.

6) Regional divisions could be reviewed

7) The forecast made before noon was only a warning for the following night.

A more precise analysis could well bring out fresh aspects, but the continuation of this system, with its weak points corrected, will provide a sound temporary solution, and from the point of view of sparsely populated parts of the country it would even appear to be the final solution.

In the winter of 1981-1982, Turku road maintenance districts received a remote-controlled weather service three times a day on weekdays. Forecasts were prepared at the Finnish Meteorological Institute by a meteorologist concentrating specifically on the road weather service. This remote-controlled system was observed to be of great benefit. However, it was not as effective from the maintenance´s point of view as the road weather service of the Turku experiment in the winter of 1980-1981 (Appendix 4, Yrjö Pilli-Sihvola: Teiden kunnossapidon sääpalvelu vuosina 1979-1982 kohta 7).

In addition to the experiments made in conjunction with the road weather service development presented in the plan of action (Appendix 1), a weather service made in conjunction with the Finnish Meteorological Institute and the Roads and Waterways Administration for road maintenance over the entire country during the winter of 1981-1982 was realised which should be put forward as one development alternative.

5. COSTS AND BENEFITS OF THE ROAD WEATHER SERVICE

5.1 GENERAL

In the investigation respecting improvement and benefits of the road weather service, with the exception of Hki II, road maintenance authority requirements and spheres of influence only were considered. From the standpoint of the road maintenance authority, benefits are obtained in conjunction with the following measures:

- the planning of resource optimisation improves
- the work demand on resources can be levelled off
- the need for specific weather monitoring by the Roads and Waterways Administration is reduced
- road winter maintenance improves.

In accordance with the evaluation associated with benefits, the optimised organisation of the above measures with the aid of the road weather service would reduce road authority expenses over the country as a whole as follows /7/:

- reduction in weather monitors	2,5 mill. FIM/yr
- correct timing and use of emergency duties	0,5 "
- proper utilization of resources and materials	3,9 - 4,4 "
Total	6,9 - 7,4 mill. FIM/yr

The above estimates are associated with a comparison between the normally forecast maintenance situation and the situation where more accurate decisions could be made through improved weather and road condition forecasting.

The savings made are available for winter maintenance operations during those critical periods when adequate resources are not otherwise forthcoming. Changes in the weather monitoring system can be reflected in the costs of certain other maintenance operations.

In addition it has been shown that through intensified winter maintenance of runways an annual savings level of around 0,5 million FIM can be achieved /8/.

The annual expenditure created by the organisation of a road weather service and the annual costs estimated on the basis of this are presented in section 7.5 on pages 47 - 51.

5.2 COSTS AND BENEFITS BASED ON EXPERIMENTS

TURKU

Assuming that the maintenance organisation on the southern part of the Turku road district would get service similar to that of the 1980-81 winter throughout the week, maintenance would benefit in the following manner:

- the road weather service could replace the weather monitors of a maintenance district almost entirely,
- advance salting in due time would reduce the amount of salt.

The financial benefit to the Turku experiment area has been estimated, on the basis of information received from the road masters, as 0,85 million FIM per winter. The annual cost of the system would be in the area of 0,5 million FIM, such that resources could in addition be utilized during the summer period for other weather service operations. It must, however, be noted that staff resources were at such a low level that no other routine service operation could be envisaged.

HELSINKI

An extensive cost-benefit analysis was made on the Helsinki II experiment (Pentti Polvinen: Pääkaupunkiseudun tiesääpalvelukokeilu 1981-1982, Liikenneturvallisuus- ja kunnossapitotutkimus, Helsinki 1982, Appendix 5).

The annual costs of the Helsinki II service extending over the winter of 1981-1982 are 375 000 FIM, of which the capital costs are 180 000 FIM (including annulments and interests) and the running costs 195 000 FIM.

Benefits felt by a maintenance organisation have been estimated on the basis of observations made in the Espoo maintenance district. Over the period 22.1.-8.4.1982 nine cases were documented in the Espoo maintenance district in which obvious benefits were obtained. Of these occurrences, it has been possible to estimate four as monetary savings in the running costs of road maintenance. In five of the cases it was not possible to quote the significance in financial terms.

When the results obtained in conjunction with the Espoo maintenance district are extrapolated to cover the Vantaa maintenance district as well, the financial benefit over the experiment winter was 180 000 FIM, in addition to which there are the benefits that cannot be directly estimated in monetary terms (reduction in stress felt in decision-making; more efficient planning and use of the working time, staff and equipment, eg. the postponing of the overtime threshold and correct timing of machinery repair).

The Espoo road master has also estimated the significance of the service maintained during the previous two winters in financial terms. It must be appreciated that the Espoo road master has been served in approximately the same fashion for three years now. When these Espoo estimates are extended to cover Vantaa as well, the following figures worthy of comparison are obtained at monthly level:

Winter 1979-1980	60 000 FIM/month
Winter 1980-1981	85 000 FIM/month
Winter 1981-1982	30 000 FIM/month

During the latter half of the winter, when evaluations were made in 1982, weather conditions were extremely "easy".

Calculated in terms of this longer period, the benefits were at least 30 000 FIM/month and at most 85 000 FIM/month, in other words 1:3. This is for direct maintenance costs assessed in financial terms. It may be concluded that the benefits to maintenance operations which could not have been estimated in immediate monetary terms would increase the maximum value to around 100 000-200 000 FIM/month/per two maintenance districts. Hence, the maximum benefit would be apporoximately four times that of the minimum benefit.

Benefits coming through the improvement of road safety were assessed as follows:

1) The daily costs of road accidents in the greater Helsinki area, were on public roads in the winter of 1980-81 42 200 FIM greater on days when the roads were covered with snow or ice than when the roads were uncovered. When the cost occasioned to the community by traffic accidents is taken into account, the difference increases by 1,6 times, in other words by 67 500 FIM.

2) Of the days when snow and ice covered the roads during the late winter, 1982, 17 % were such that information obtained via the road weather service experiment had a significant influence on the removal of this cover through maintenance measures (Espoo road master`s assessment). By applying the results of observations made in the late winter, 1982, with the 1980-81 winter, and employing the 67 500 FIM cost difference mentioned above, a maximum annual saving in accident expenses of 980 000 FIM can be concluded, assuming that the maintenance influence on difference between accidents occurring on covered and non-covered roads is 100 %.

In assuming maintenance measures carried out on the days quoted above to reduce traffic accidents by affecting the difference between accident figures on covered and non-covered roads to an extent of at least 30 %, it may be concluded that accident expenses estimated on the basis of the principle of compensation adopted by the insurance companies are reduced by almost 195 000 FIM per year. If the costs to the community of traffic accidents are taken into consideration, the same annual savings are gained by the influence level of 20 %. In observed cases, the effect of maintenance has been most pronounced during periods of heavy traffic. On this basis it may be concluded that an influence level of 20-30 % can be obtained with a fair degree of certainty.

In the light of the above, the following table may be drawn up:

Benefit	Evaluation in financial terms	
	minimum FIM	maximum FIM
In road maintenance	180 000	720 000
In accident costs	195 000	980 000
Total	375 000	1 700 000

With the total costs amounting to 375 000 FIM, it may be summarized that the costs to benefits ratio was at least 1:1 and at most 1:4.5.

In comparing benefits with costs, the following aspects must, however, be considered:

- Benefit estimates are based in part on observations made over a relatively short duration of time (23.1.-8.4.1982) in a single road maintenance district,

- If this sort of service were in the future implemented to the area service of the Finnish Meteorological Institute, total costs, and especially the costs per each road maintenance district, would be lower,

- Benefits to traffic in the form of an improvement in traffic flow and reduction in the amount of travelling time have not been taken into account (e.g. if 100 000 cars arrive at places of work half an hour late owing to bad driving conditions, the immediate calculable effect would be in the region of 3,25 million FIM).

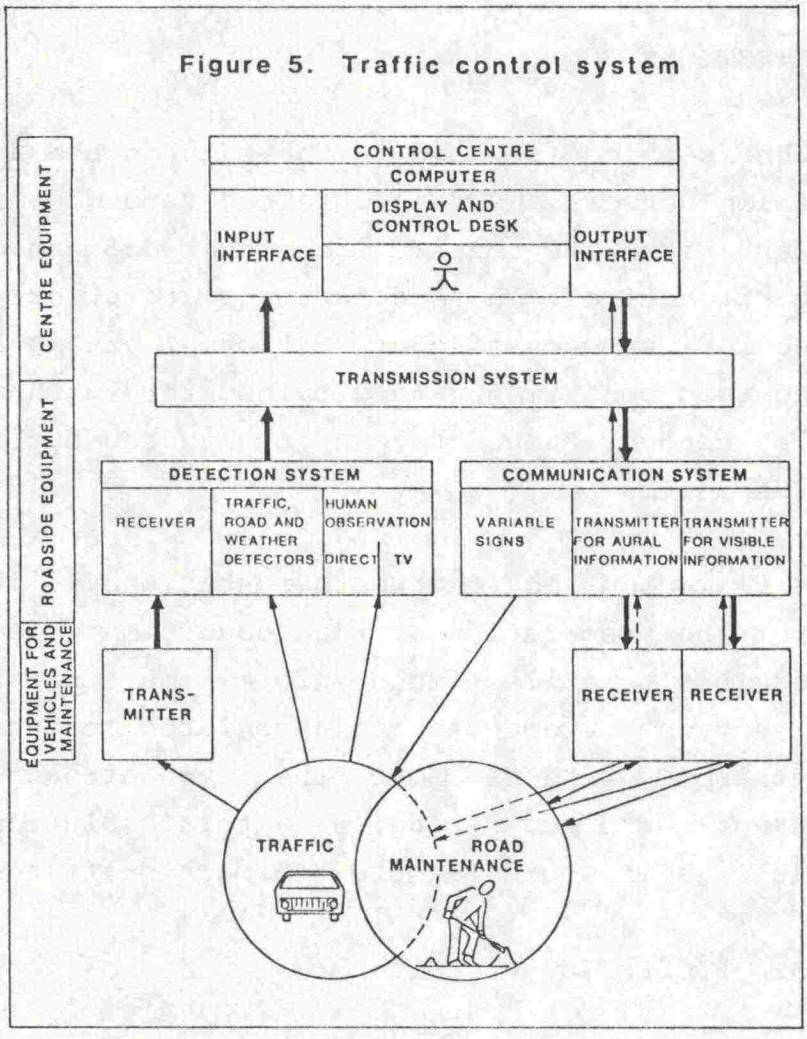
- By the service users, in the experiment only the main roads of the capital area were maintained. The maintenance authorities of streets within the towns of this area and of yards surrounding buildings could easily be incorporated in the service system. Similarly, by practically the same investment 4-5 road maintenance districts could have been served.

6. ALTERNATIVE SYSTEMS OF THE ROAD WEATHER SERVICE

6.1 GENERAL DESCRIPTION OF THE ROAD WEATHER SERVICE SYSTEM

As the road weather service is part of the traffic control system, the information flow is as depicted in figure 5.

Figure 5. Traffic control system



The figure shows both the public (traffic) and the authority maintaining the roads presented at the same level of service, which can be regarded as the future system.

From the figure the following sub-categories will be obvious:

1. Detections made on the road,
2. Data transmission from the road to the central processor, whence to the road user,
3. Data prosessing in the central unit and
4. Data reception systems.

Items 2 and 4 are so closely associated that they are treated below under the same heading.

6.2 DETECTIONS

The road weather service is based in the main on the available weather detection network and data obtained through this. In addition, observations are required from the sections of road known to be most critical. These detections are principally automatic, but for purposes of confirmation a certain amount of weather and road condition data obtained through human efforts is also needed. Such data can be gathered by the road masters and the police.

Data obtained via automatic road weather stations is the requirement for the preparation of road condition forecasts. It must be possible to collect such information automatically, so that a collection system with its associated computer is necessary in these operations. Some other type of data gathering system (manual data requesting) as a total solution would be impracticable as it would require too much staff resources.

6.3 DATA PROCESSING

Information arriving at the area service station is processed and used in three ways:

- in transmitting of basic data (road weather station observations, radar picture) to the client
- in using statistical models
- in subjective weather forecasting.

The first two categories call for automation and only the last category can be realised utilizing the equipment as it stands at present.

6.4 DATA TRANSMISSION

A fundamental component of the road weather service is the method through which the data produced is delivered to the user. A technically simple solution requires larger staff resources for the achievement of the same standard of service, and vice versa. Through trials, an attempt was made to find a solution viable under Finnish conditions. In the light of present knowledge, data transmission can be accomplished in at least four different ways.

Mistel

1. Real time, continuously available visual and graphical display, into which material separately prepared can be fed or edited (Helsinki II, Telset/Mistel system). This system makes both the inputting of automatic observational material and local forecasting possible. The standard of service is the highest of the four categories. A public service is possible.

Videotex

2. Nearly real time visual display system linked to telephone line, through which data material can be edited (editing terminal) or viewed and messages can be sent out (viewer terminal). A feature of the system is that it is not continuously "on". Observational material must be edited separately and typed in manually, and is therefore more scanty than with the above. Forecasts can be either local or areal. The standard of service is relatively high. A public service is possible.

Telephone answering service

3. Automatic telephone answering service edited regularly or based on warning needs. The observational material is limited (if at all) and forecasts are mainly local ones. In general, applicaple only to sparsely populated areas. A public service through the same channel is not possible.

4. Direct connection between user and meteorologist irregularly (only when required) established. Based on a telephone. The standard of service is low and uncertain. Would be the sole method only under exceptional circumstances, but as a supplementary system highly recommended. Contact

The features and costs associated with these systems are itemised in table 1.

It should be noted that these general framework solutions cover numerous versions of which, for instance, may be mentioned the Turku experiment and the Turku area service operated remotely over the following winter. Both of these were based on a telephone answering service principle, but the experiences were exceptional (Yrjö Pilli-Sihvola: Teiden kunnossapidon sääpalvelu vuosina 1979-1982, Appendix 4).

Furthermore, the needs of other users (local radio, commercial traffic, communes and transport organisations, the Finnish State Railways and National Board of Aviation) which cannot be satisfied by a telephone answering service system without additional staff resources being required, must be taken into consideration. Conversely, Videotex in part and Mistel as it stands satisfy these needs without necessitating any appreciable increase in staff resources.

6.5 COSTS AND BENEFITS ANTICIPATED WITH ALTERNATIVE SYSTEMS

On the basis of the alternatives given in table 1, the equipment costs associated with each system can be estimated. Staff resources, however, depend to an overwhelming extent on the standard of service desired (real time facility, 24-hour a day service, etc.). The road weather service, development will follow the area service plan of the Finnish Meteorological Institute, without the establishment of any new units, resulting in the most economical and effective alternatives, 4 or 5.

Table 1. Data transmission systems

System	Costs
1. The whole country based on the telephone answering service	The rents for the telephone answering device. Telephone costs. Meteorologist and operator resources.
2. The country partly based on the telephone answering service partly on Videotex	Approx the same as in point 1 and additionally 5 000 FIM/TV-terminal and rent for the storage space in central computer.
3. Videotex in the whole country and Mistel in Helsinki	The number of Road master districts x 5 000 FIM. Mistel-terminal costs 16 000 FIM/user. Needs approx 25 % more meteorologist and operator resources than point 2 Mistel system (~600 000 FIM) exists.
4. The country partly based on the telephone answering service,partly on Videotex, Mistel in Helsinki	The operators and meteorologists as in point 3. The costs determined by the rent for the telephone answering device and the number of TV-terminals. A few automatic stations 120 000 FIM each. Mistel exists.
5. The country partly based on the telephone answering service partly on Videotex. Mistel in Helsinki, Turku and Tampere.	As in point 4 and additionally two Mistel systems 600 000 FIM each.

These systems will correspond to the opportunities associated with advanced automation and the scope they offer for expansion and modification is considerable. The development of automation taking place in the Roads and Waterways Administration also helps to reinforce the supposition that the Videotex system, for instance, will relatively soon be within the reach of every road master. Hence, road weather service system development must lend itself easily to adaptation to other development projects under way in the Roads and Waterways Administration and the Finnish Meteorological Institute. Also, provision must be made for the expansion of the public service in the light of the increasing popularity of home videos (Telset, Text TV, Videotex).

A telephone answering service does not satisfy requirements in densely populated districts. Where as, it can be quickly established over the major part of the country as a temporary, and in places virtually permanent, solution.

The experiments which have been carried out did not provide sufficient information regarding the differences between the benefits of the various alternative services. Gathering such information would have demanded conparison material of an appreciably longer experiment period.

Helsinki II was a highly automated system which at the planning stage could realistically be considered realisable. At today´s price levels an equivalent system would not be a profitable undertaking other than in areas with heavy traffic.

It would be expedient to retain Helsinki II system and supplement it immediately with a few terminals, in other to increase its benefit and allow it to reach a larger number of users than hitherto.

7. THE PRESENT MAINTENANCE WEATHER SERVICE AND ITS DEVELOPMENT

7.1 THE LIMITS OF THE ROAD WEATHER SERVICE DEVELOPMENT

The steering committee of the road weather service development is of the opinion that the service ought to be directed in the near future primarily to the development of the maintenance weather service which means that the most realisable part of the whole system in the future would be the darkened area in figure 6.

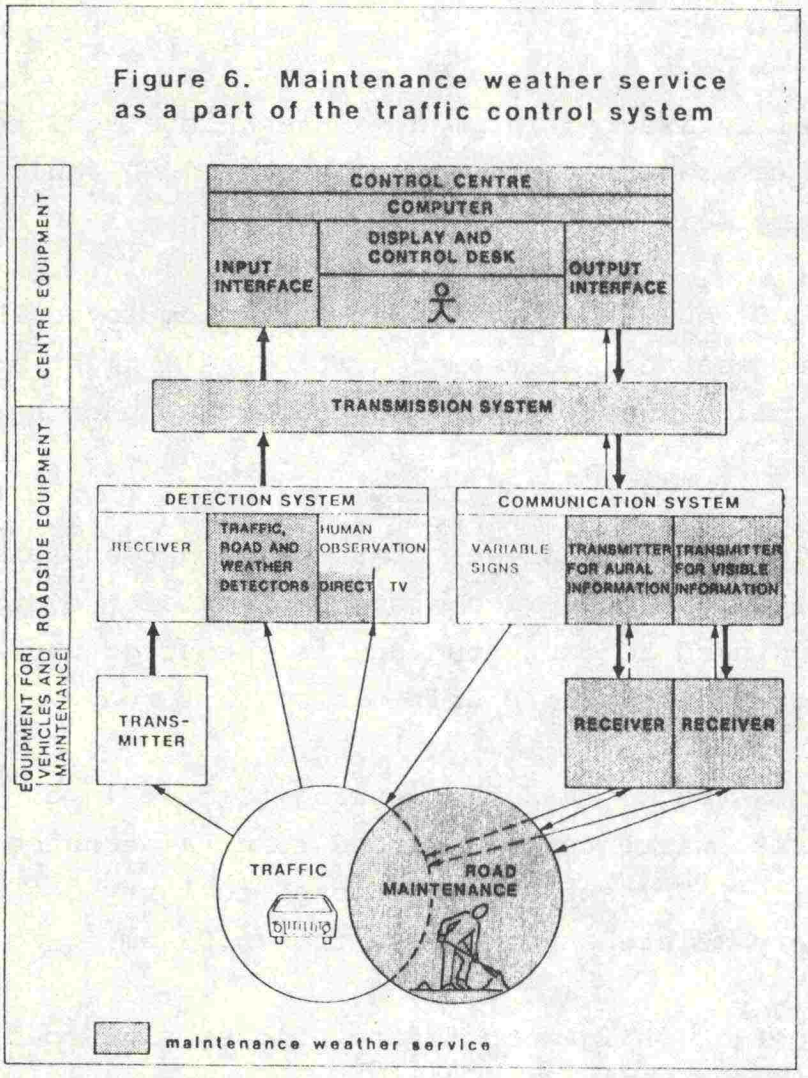


Figure 6. Maintenance weather service as a part of the traffic control system

In the detailed plans one is however prepared to introduce the system in a widened version (public service).

7.2 CURRENT WEATHER AND ROAD CONDITION MONITORING SYSTEM OF THE ROAD MAINTENANCE

Weather and road condition monitoring associated with winter maintenance is being carried out this winter (1982-1983) as follows:

A. Basic level

Each road maintenance district has during alternate weeks 1-2 weather monitors who check the situation by visiting the roads as required (generally 1-2 times per night).

B. Intensified level

The basic level is assured in road maintenance districts having heavy traffic (average daily traffic = ADT > 1000 vehicles/day) by the following means:

1. If ADT > 2000 veh/day, a night officer is employed who monitors the weather and road conditions all night and implements maintenance or warning procedures when necessary.

2. If ADT > 1000 veh/day and an important main road runs through the road maintenance district, one of the drivers is appointed to carry out duties connected with maintaining good driving conditions on this road.

3. If ADT > 1000 veh/day and the morning traffic in an urban district warrants intensified road maintenance avtivities, 1-2 drivers are instructed to carry out the necessary maintenance work as from 5.00 am.

The duty officer is obliged to inform neighbouring road maintenance districts of any fundamental changes in the weather and road conditions in order to preserve continuity and uniformity on main roads.

7.3 REGIONAL STANDARDS REQUIRED OF ROAD WEATHER SERVICE

The standard achieved by the current weather and road monitoring system may not, either from the weather or the road monitoring aspect, be lowered if winter upkeep readiness is not to suffer and compromises made respecting road conditon information acquisition. Hence, the standard of a new system should be at least equivalent to the following:

Standard/region I — Weather and road condition observation and forecasting system, real time or re-issued at least four times a day; including forecast monitoring and modification. In the capital area data is transferred in real time.

Standard/region II — Weather observation and forecasting system, issued approximately four times a day and including forecast monitoring. The most important time of day for the service is the late evening. Main roads (I class) 4 and 8, together with the environs of more heavily populated districts (the cities of Jyväskylä, Kuopio, Oulu) are required to be served as under I.

Standard/region III — Based on routine operations of the Finnish Meteorological Institute. Incorporates weather observations and forecasts. Repeated 2-3 times a day, and monitoring.

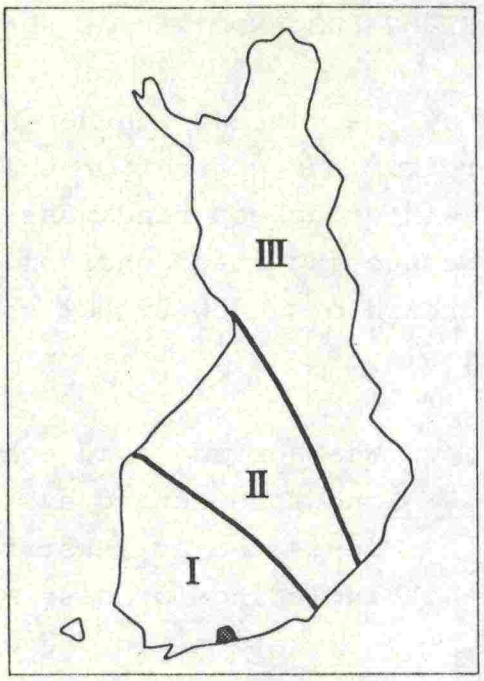


Fig. 7 Road weather service regions

In addition, road condition information should be checked in each road district in a centralized manner (1 monitor/ district) in accordance with separate instructions.

7.4 REQUIREMENTS FOR IMPLEMENTATION

The standard of service indicated would call for the following measures:

Region I

1. Establishment of a nearly 24-hour a day meteorologist-standard duty officer arrangement (area service centre) for Helsinki, Turku, Tampere and a locality in south-eastern Finland to be selected at a later juncture.
2. 10-15 automatic road weather stations to be sited on main roads.
3. Automatic observation collection, data processing and transmission systems (Mistel) to be acquired. Supposing that an automatic observation collection system would be attached to the general area service system of the Finnish Meteorological Institute, the system

mentioned could be replaced by a distribution system functioning at stated intervals (Videotex or telephone).

4. Maintaining a reduced version of the existing weather and road condition monitoring system (section 7.3) for ensuring automatic road condition observations.

Region II

1. Establishment of a nearly 24-hour a day meteorologist-standard duty officer arrangement (area service centre) (for Kuopio and Ostrobothnia localities to be determined at a later juncture).
2. 5-7 road weather stations to be sited on main roads 4 and 8.
3. An observation collection system to be organised in conjunction with the general area service system for main roads 4 and 8 together with a data transmission system functioning at stated intervals (Videotex or telephone).
4. Road condition observations on main roads 4 and 8, as per region I, section 4.

Region III

1. An approximately 16 hour-long meteorologist-standard duty officer arrangement to be established in conjunction with the Rovaniemi area service centre.
2. A weather observation and forecasting distribution system functioning at stated intervals (Videotex or telephone) to be acquired.

7.5 COST OF IMPLEMENTATION AND SCHEDULE

From the foregoing it will be apparent that it would not be expedient to establish a road weather service system of the same standard for all parts of the country.

From the standpoint of system efficacy and resource savings, it would be most sensible to establish a road weather service commensurate with the schedule for the development and assurance of the Finnish Meteorological Institute´s area service centres.

Road weather observations must be real time and should be available continuously, at specific intervals, or coinciding with changes in the weather. The observations must also be available for request at any time. A continuous real time system creates permanent rental costs, of fixed data lines,which would not appear to be justifiable outside the capital area.

In accordance with the plan of operations and econimics of the FMI, the standard required of the road weather service can be totally achieved, in the capital area, for the greatest part in the region II and for the staff resources in the entire region III. In region I the current plan allows of a meteorologist-standard duty officer arrangement between the hours of 6.00 am and 10.00 pm.

Respecting auxiliary personnel, the solution depends on the location of the area service centre (airport/other), since the utilisation of National Board of Aviation personnel would make a 24-hour a day duty officer arrangement feasible. This, however, would require that the Finnish Meteorological Institute supervise Board of Aviation staff duties discharged in this connection. The number and the utilisation of staff are dependent on the nature of the area service centre, as the relationship of the quantity of aviation weather services to other area services in the final analysis dictates the site selected.

In its plan of operations and economics for the period 1983-1986, the FMI has proposed the initiation of area service operations in the following order and according to the following schedule:

South Finland	1983
Tampere	early 1984
Turku	1985
Kuopio	1985
Rovaniemi	1986

After the planning period, centres will be established in addition in Ostrobothnia and South-east Finland. In its declaration concerning the above-mentioned plan of operations and economics, the Ministry of Finance has appealed for a certain amount of delay in the proposed timetable, but has otherwise endorsed the proposal. Since it has furthermore become apparent that the re-siting of the Tampere area centre (if it is re-located at Tampere-Pirkkala Airport) is not possible until 1984-85, it would be sensible to establish Turku before Tampere. The delay means that centres would be established at the rate of one per year.

New timetable proposal

Locality	Planning	Into service	Road weather service commences
South Finland	1982	1983	1982 autumn
Turku	1983	1984	poss. 1983 autumn (extra budget)
Tampere	1984	1985	1985
Kuopio	1985	1986	1986
Rovaniemi	1986	1987	1987
Ostrobothnia (locality determined later)	1987	1988	
South-east Finland (locality determined later)	1988	1989	

It should be noted that implementation of the above plan embodies a certain amount of continued development compared to the situation in the 1981-82 winter. In other words, the 1981-82 winter may be regarded as equivalent to the initial and minimal standard of road weather service.

So long as the schedule proposed by the Finnish Meteorological Institute is adhered to in connection with road weather service realisation, the staff resources required for the road weather service will be found from among area service staff under the FMI. In this case, additional costs would be incurred only by technical appliances for the systems, together with line rentals, maintenance fees and telephone charges.

The annual expenses of road weather service establishment at 1983 prices for the period 1983-1988 (1989) are as given in table 2. Expenses have been calculated on the basis of the standard of service described under section 7.3. Staff costs have been determined for the whole year, but since the road weather service is required principally during the winter months, 2/3rds of these expenses may be regarded as being incurred by the road weather service.

Table 2. Road weather service costs for the period 1983-1988 (1000 FIM) [1)]

Year	Staff expenses			Investments	Current expenses	Total costs of road weather service
	Number	Gross expenses	Amount for road weather service			
1983	7	510	340	150	260	750
1984	14	1020	680	840	270	1700
1985	17	1260	640	780	290	1910
1986	20	1500	1000	180	310	1400
1987	24	1800	1200	180	330	1710
1988	31	2310	1540	300	350	2100
(1989	38	2820	1880	300	370	2550)

1) Revision by the FMI area weather development planning group:
These figures have drastically been decreased in the final development plan of operations and economics of FMI for the years of 1984-1988 (issued much later than this report). There it has been calculated that 30 % of all activities of an area weather service centre are so called special services, of which 2/3rds are road weather services. Thus the actual staff costs planned for example for the year 1984 are 204 000 FIM, instead of 680 000 FIM stated here. Likewise, its is apparent that the cost/benefit ratio becomes more favourable than calculated in this report.

Videotex television sets at 5000 FIM each have not been taken into consideration in the totals quoted, as the quantity of these has to be resolved separately for each separate case. Their use also depends to some extent on the data transmission solutions arrived at by the Roads and Waterways Administration.

The annual expenses incurred by the final system, without current running costs, would be 2,6 - 2,8 million FIM, with the capital cost contribution (interests and mortgages included) being 0,7 - 0,9 million FIM and the road weather service staff cost contribution being approximately 1,9 million FIM.[1)] When estimating expenses, a 10-year amortising period for the road weather station and a 15-year amortising period for the ADP equipment have been employed, together with a 6,5 % rate of interest. Current running costs are extremely difficult to estimate, as the sites for road weather stations, for instance, have not been determined and this factor has a great influence on line rentals.

In comparing the above-mentioned sum (2,6 - 2,8 million FIM/yr) with the road maintenance savings quoted under section 5.1 (6,9 - 7,4 million FIM), it can be stated that the road weather service is a highly profitable activity and that the cost to benefit ratio follows the main trends obvious in the trials conducted (1:3).[2)]

1, 2) These figures have been revised in the final development plan of operations and econimics of FMI for the years 1984-1988. See also footnote for table 2.

7.6 EXPENCE SHARING

Regarding the expenses associated with the system, responsibility is shouldered mainly by the Roads and Waterways Administration and the Finnish Meteorological Institute. Should other paying bodies become associated with the system, the contributions mentioned above may be reduced by corresponding amounts. In connection with expense sharing, at least six different solutions exist:

1) The Finnish Meteorological Institute pays for all the resources needed for realisation of the system (staff and other running costs), as well as all equipment investments. It also charges the Roads and Waterways Administration during the initial stages in accordance with alternative a)[1)], and later solely for part of the staff resources (alternative b)[1)].

2) The Finnish Meteorological Institute provides the system with all the resouces (staff, automatic stations, etc.,), while the Roads and Waterways Administration obtains and maintains the communications channels.

3) The Finnish Meteorological Institute provides the system with the resources (staff, automatic stations, etc.,), which are compensated for by the Roads and Waterways Administration; the Roads and Waterways Administration obtains and maintains the communications channels.

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1) a) The road weather service pays for itself throughout the year, or in other words the budget for the road weather service takes into account staff salaries in summer as well.
   b) The road weather service forms part of the area service, so that part of the winter and almost all of the summer are taken care of by area service financing.

4) The previous alternative modified such that the Roads and Waterways Administration obtains the automatic stations, maintains them, and the Finnish Meteorological Institute charges only for the service and running costs.

5) As thus far in conjunction with the experiments which were conducted: the Roads and Waterways Administration obtains the equipment and the Finnish Meteorological Institute makes no charges whatsoever.

6) The Finnish Meteorological Institute budgets everything to itself and does not collect any charges whatsoever from other parties.

In accordance with Road Act, equipment belonging to the road constitutes typical entities to be obtained and maintained by the road keeper. The road weather service falls into the sphere of operations of the Finnish Meteorological Institute, and in accordance with Act of Basis for Payment an authority must charge for the services it renders.

In the light of the foregoing, the steering committee considers that alternative 4 would fulfil most satisfactorily the requirements quoted previously.

8. PROCEDURE PROPOSALS

On the basis of the investigation made, the steering committee for the road weather service development declares that road weather service development in Finland would be profitable from the point of view of both commercial and socioeconomic considerations.
The Committee proposes the following:

8.1 ROAD WEATHER SERVICE SYSTEM

Establishment of a road weather service

1. In Finland a road weather service should be established as defined in greater detail below.

Standard of the road weather service and users of the service

2. The road weather service should be organised such that its standard in each area meets the current requirements approved for winter road maintenance; see 7.3 and chapter 6.
   At the same time, provision should be made for flexibility in order to accommodate future requirements as may be forthcoming.

3. The road weather service in Finland should initially be developed principally as a maintenance weather service.

4. Taking into consideration, for instance, data processing and transmission technology, traffic control devices and method developments and economics, the road weather service should also be developed in accordance with the requirements of road users, especially in areas with heavy traffic.

5. The road weather service should be organised such that within the same framework in the future a weather service for winter runway and railway maintenance could be realised.

   For collaboration arrangements among different parties, a separate plan can be made if needed.

The road weather service as part of the area weather service, regional districts and area service centres

6. The road weather service in Finland should be treated as a part of the area weather service of the Finnish Meteorological Institute.

7. From the standpoint of the road weather service, the country should be divided into the following sub-regions which are based on differences in service organisation and service standard requirements (see Figure 7):
   - South and South-west Finland
   - Central Finland
   - East and North Finland

8. From the standpoint of the road weather service, there should be seven area service centres to be established where the Finnish Meteorological Institute will realise area weather service. The centres should be situated in the regions as follows:
   - South and South-west Finland; Helsinki, Tampere and Turku.
   - "Central Finland": Kuopio, together with two locations to be designated later, one in Ostrobothnia and the other in South-east Finland.
   - East and North Finland: Rovaniemi

8.2 SCHEDULE

9. The road weather service development should be linked to the area weather service development schedule of the Finnish Meteorological Institute.
   Certain aspects of this timetable should be reviewed (see section 7.5).
   In addition, the development timetable for local radio must be taken into consideration.

10. The road weather service given by the area service centres of the Finnish Meteorological Institute and the initiation of the service at these places should be scheduled as follows:

Helsinki	begins in the autumn, 1982
Turku:	1984
Tampere:	1985
Kuopio:	1986
Rovaniemi:	1987

Centres would be sited in Ostrobothnia and South-east Finland in 1988 and 1989.

8.3 ORGANISATION AND COOPERATION BETWEEN PARTICIPANTS

11. Responsibility for the road weather service development - taking into consideration that initially the service would incorporate for the most part road maintenance - should be borne by the Finnish Meteorological Institute, as the provider of the service, and the Roads and Waterways Administration, as the user of the service.

12. In order to achieve flexible initiation and management of the road weather service, the Finnish Meteorological Institute and the Roads and Waterways Administration should organise a suitable standard form of cooperation at both district and central office levels.

13. When the amount and type of users of the road weather service increases, sufficient cooperative activities should be arranged among users, providers and agencies (Post and Telecommunications Office, The Finnish Broadcasting Corporation, etc.,) associated with the service.

8.4 TRAINING AND INFORMATION SERVICE

14. The Finnish Meteorological Institute and the Roads and Waterways Administration should organise appropriate training for users and providers of the road weather service. This would ensure the road weather service to be maximally efficient and useful.

15. Training should be given for:
    - road maintenance staff (executive staff, weather monitors), respecting interpretation of weather and road condition information and forecasts and their application
    - meteorologists, respecting the important weather factors influencing road maintenance and their significance
    - other participants (including mobile police, radio and the general public), respecting road weather service activities or activities of the parties in making use of weather details which have proved to be significant

16. Representatives of the labour force (organisations, cooperating bodies) should be appraised of the initiation of the road weather service and its influence on current weather and road condition monitoring practice.

17. With the road weather service later linked to automatic traffic control, information and training for the general public and motorists should be organised in conjunction with utilisation of the system.

8.5 FINANCING

18. Financing of the road weather service for the time being should be organised in conjunction with the budgets the Finnish Meteorological Institute and the Roads and Waterways Administration in the manner described below.

19. With reference to Road Act, the Roads and Waterways Administration should acquire, install and maintain the automatic road weather stations, and also meet the expenses incurred by these. The Roads and Waterways Administration shall also acquire the equipment required for the inception of the road weather service.

20. The Finnish Meteorological Institute should meet the staff, equipment and other expenses created by the road weather service organisation and then charge these expenses to the Roads and Waterways Administration in compliance with Act of Basis for Payment and the Acts associated with this.

21. The Finnish Meteorological Institute and the Roads and Waterways Administration should investigate throughly, and agree on, payment principles for the road weather service (weather service staff, equipment and other resources and their use for the road weather service).

22. With an increase in the number of user categories, the financing and meeting of the costs incurred should be separately agreed on by the participating bodies.

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