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VIA BALTICA
ROAD WEATHER INFORMATION SYSTEM

FINAL REPORT

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LT CONSULTANTS

Preface

This report has been prepared in the sub-project "Study on the development of Road Weather Information System in Estonia, Latvia, Lithuania and Poland" under the project "Three Feasibility Studies of the Via Baltica Road Project Phare Services contract 95-0943.00".

The main consultant of the project was LT-Consultants Ltd. (Project Manager Mr. Björn Silfverberg) and the sub-consultant for this report was the Finnish National Road Administration whose team consisted of three experts Mr. Hannu Lehtikankare (Team Leader), Mr. Teuvo Frändilä (Road Maintenance Expert) and Mr. Kimmo Toivonen (RWIS System Specialist).

Helsinki, January 1996

Executive Summary

General

The objective of this work has been to prepare a master plan on the establishment of a Road Weather Information System, RWIS, in the three Baltic countries and Poland by taking especially into consideration the Via Baltica route.

This report includes recommendations for the locations of the Road Weather Stations, technical specifications, organization of the system and its use, the plan for the needed training and a cost estimate.

The Baltic countries, Estonia, Latvia and Lithuania as well as Poland have a great interest in establishing an automatic Road Weather Information System, RWIS, which would improve their road maintenance level in winter time.

Via Baltica

It has been regarded well justified to establish the information systems under the umbrella of the Via Baltica project. This strategy would promote winter maintenance, improve road safety, serve users of the road and also attract more international traffic to this route. Via Baltica is one important highway among others in each Via Baltica country. The international role of the road as a link between Scandinavia or St.Petersburg area in Russia and the regions of Southern and Central Europe has increased the value of the road.

The development stage of RWIS in different countries varies. Estonia and Poland have already started the establishment of RWIS. It is recommended to establish the Road Weather Information System also in Latvia and Lithuania. The systems in Poland and Estonia should be expanded from the point of view of Via Baltica.

RWIS

RWIS consists of Road Weather Stations and the computer system to analyze and present the data. Also tele- or datacommunication system is needed for transferring the data. In a developed system there may be road weather camera as well as weather radar and satellite picture displays also attached to the system. Thermal mapping may be used as one part of the system.

Cooperation between a Road Administration and a Meteorological Institute is very important for the good utilization of RWIS. Meteorologists are best experts what it comes to weather forecasts and climatical conditions. The Meteorological Institutes will also benefit from the new, automatic Road Weather Stations.

The main function of the RWIS is to be an instrument for the road maintenance staff. The goal is to promote smooth and safe winter road traffic with reasonable road maintenance staffing and machinery as well as with a limited amount of road salt.

Type and organization of RWIS along Via Baltica

Road Weather Information System can be best utilized when Road Weather Duty Centers (RWDC) are established. RWDC is the place where personnel of the road administration is on duty and follows the weather and road conditions with the assistance of RWIS. Thus, the duty system of the winter road maintenance can be

Centers (RWDC) are established. RWDC is the place where personnel of the road administration is on duty and follows the weather and road conditions with the assistance of RWIS. Thus, the duty system of the winter road maintenance can be reduced, and additionally the duty personnel in RWDC has the best expertise in utilization of RWIS. Naturally, the expertise of the road maintenance supervisors is also utilized in weather monitoring.

It is recommended in this report that in the near future the RWIS along Via Baltica would consist of 29-30 Road Weather Stations, 40 Workstations and 5 Road Weather Duty Centers with Central Computers (Table 1, Figure 1).

All the road administrations along Via Baltica are willing to cooperate within the RWIS. Practically this would mean at least that the RWDCs in each country would exchange their weather and road condition information around the clock.

If the road administrations along Via Baltica could follow the weather situation in their neighbouring countries, they would be able to make their road maintenance actions better in time. The road users would benefit and thus the road safety would improve, if the quality level of road maintenance was similar and road maintenance actions right-timed.

Table 1. Proposed RWIS in Via Baltica.

	Road Weather Stations	Workstations	Road Weather Duty Centers & Central Computers
Estonia 1995-96	2 (1995) 3 (1996)	1 in Head office 3 in RRAs 1 in Meteorological I. later in MWZs	1 in Head office
Latvia 1996-97	4 Via Baltica 3 in vicinity	1 in Head office 3 in RRAs 1 in Meteorological I. later in MWZs	1 in Head office
Lithuania 1996-97	5 Via Baltica 3 in vicinity	1 in Head office 3 in RRAs 1 in Meteorological I. later in MWZs	1 in Head office
Poland 1995-96	4 (1995) Warsaw r. 5-6 (1996) Bialystok r.	(1 in Head office) 2 in RRAs 2 in Meteorological I. About 10 in ZDs along Via Baltica	1 in Warsaw RRA 1 in Bialystok RRA

Information to the road users

It is recommended that the road users will be informed with the assistance of the RWIS. The Road Administrations should agree with local radio stations that road

weather information is given to the road users in the radio broadcasts. Later the road users could be informed also through Internet or information terminals at service stations and in addition with variable weather-controlled traffic signs.

It is recommended that through special radio programs the drivers could get to know the weather and road conditions along the whole Via Baltica and in many languages (local, English, Russia). The road users could also be informed of the road and weather conditions along the whole international route. Thus, a driver in Tallinn could already know what to expect in Latvia, Lithuania and Poland and vice versa. This would orientate the drivers to a right expectation of the road conditions and time consumption. So, the risks in the traffic could also be decreased.

Cost estimate

The cost estimate for RWIS of four Road Weather Stations, four Workstations and one Central Computer with the needed software as well as needed technical assistance in installation and training varies from USD 125.000 to 351.000.

International funding

It is recommended that Via Baltica would get a priority in introduction of RWIS. This could be supported by international funding arrangements like EBRD. The international funding could support the establishment of the RWIS in order to create a continuous system along Via Baltica. In the beginning this could happen by supporting the investment of a couple of Road Weather Stations and the needed software as well as the needed technical assistance for installations and training.

The countries along Via Baltica are in different stages in the establishment of the RWIS. However, if the further development of RWIS along Via Baltica is supported by international funding, certain benefits could be achieved with common procurements of equipment and training. Also the schedule of the establishment of the continuous RWIS along Via Baltica could be shortened..

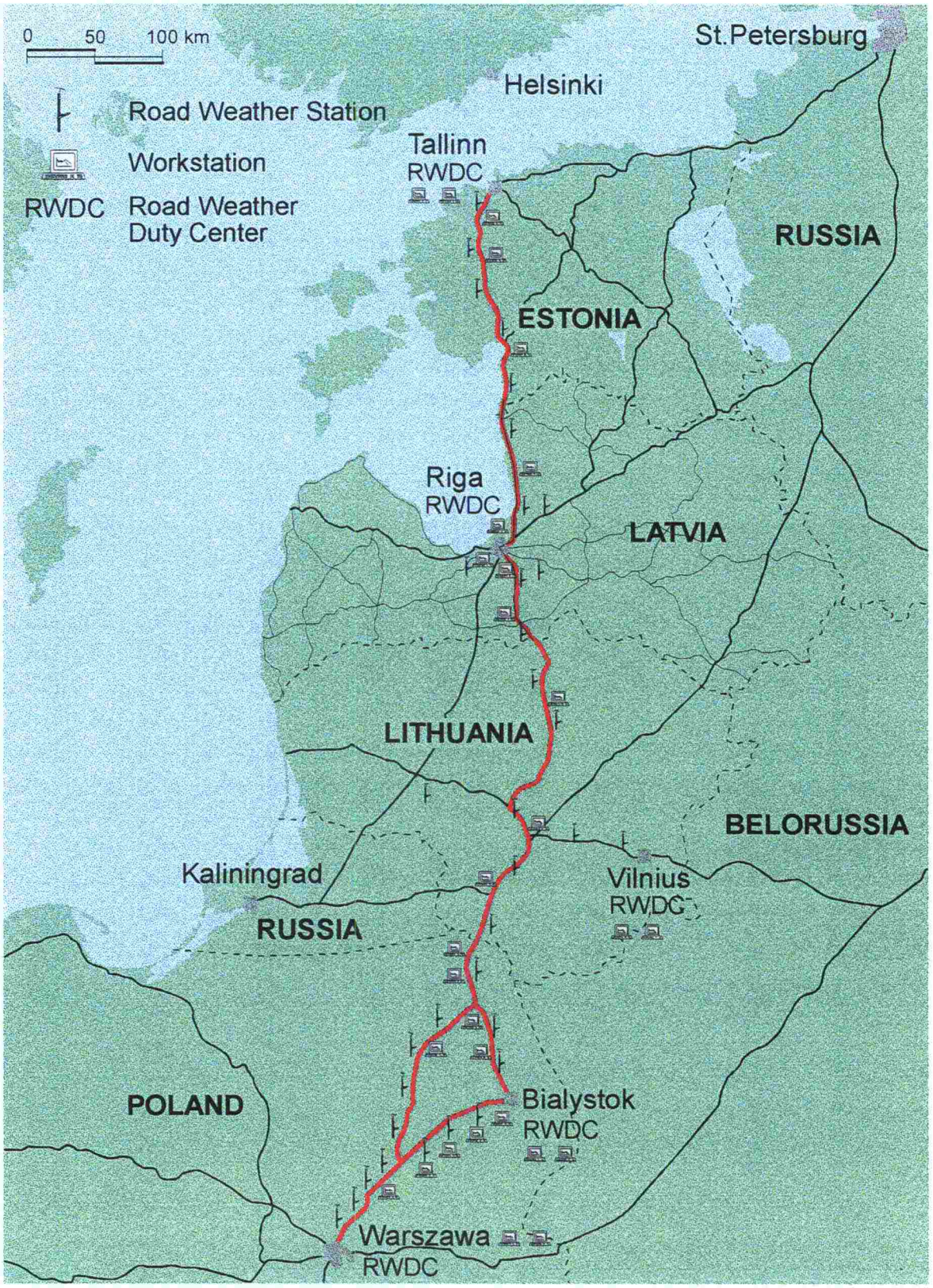

Figure 1. Proposed RWIS along Via Baltica

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Abbreviations and Explanations

DODP	Regional Road Administration in Poland
EBRD	European Bank for Reconstruction and Development
ERA	Estonian Road Administration
GDDP	General Directorate of Public Roads in Poland
GSM	Digital Mobile Phone system
INFORMIX	data base application
LAN	Local area network
LaRA	Latvian Road Administration
LiRA	Lithuanian Road Administration
MS-DOS	Microsoft - Disk Operating System
MWZ	Maintenance Work Zone
OD	Maintenance Work Zone in Poland
on duty	the situation when personnel is working outside the normal working hours; e.g. in the evening and night and during the weekends
ORACLE	data base software
OS/2	Disk operating system
RRA	Regional Road Administration
RWIS	Road Weather Information System
RWS	Road Weather Station
stand-by	the situation when personnel is available (usually at home) and ready to come to work immediately when alarmed.
TCP-IP	Data transmission protocol
UNIX	Disk Operating System in powerful computers
Windows	Computer user interface
Windows NT	An improved computer user interface
ZD	Subregional Road Management Unit in Poland
X.25	data transmission protocol and network

1 Introduction

1.1 Objectives

The Baltic countries, Estonia, Latvia and Lithuania as well as Poland have a great interest in establishing an automatic Road Weather Information System RWIS which would improve their road maintenance level in winter time.

It has been regarded well justified to establish the information systems under the umbrella of the Via Baltica project. This strategy would promote winter maintenance, improve road safety, serve users of the road and also attract more international traffic to this route.

The objective of this work is to prepare a master plan on the establishment of a Road Weather Information System in the three Baltic countries and Poland.

This report includes recommendations for the locations of the Road Weather Stations, technical specifications, organization of the system and its use, the plan for the needed training and a cost estimate.

During the study it has become clear that the development stage of RWIS in different countries varies. The present stage has been taken into account when this plan was made.

1.2 Persons and organizations met during the mission

A fact finding mission was made to each of the countries along Via Baltica during October and November. During the missions different local parties were met. All the three members of the team (Mr Hannu Lehtikankare, Mr Teuvo Frändilä, Mr Kimmo Toivonen from the Finnish National Road Administration) participated in the missions, which lasted a couple of days in each of the recipient countries.

The main organizations to negotiate with were the national road administrations in each country. They have the main responsibility in the development of the RWIS.

The fact finding missions took place as follows:

Latvia	October 23-25, 1995
Lithuania	October 25-27, 1995
Estonia	October 31 - November 1, 1995
Poland	November 7-10, 1995

Traffic-based examination

The most important and busiest roads are discovered and the stations are placed mainly along these roads, usually main roads. In the beginning of the system establishment this is a good method. This way with only a limited number of stations a road, which exceeds borders of road maintenance areas, can be managed.

Needs of winter maintenance

A local road maintenance supervisor knows best which are the needs for maintenance. He has experience in weather conditions in his own area and he knows the most difficult places for winter maintenance. As the road maintenance supervisor is also responsible for the every day condition of the road network his views on the locations of the stations are of great importance. This helps the weather station network to develop naturally into a feasible wideness. In an early phase the number of stations can be estimated only roughly. The wideness of the network can be defined more closely when the road administrations have more experience in using the information of the stations. A national strategy is needed in order to locate the stations for the whole country in the best possible way.

Organizational framework

Organizational framework is one issue to be considered when choosing the locations of the stations. If e.g. the costs of the stations are shared between different organizations, parties have to compromise in placing of the stations. Compromising is not necessarily inconvenient : e.g. the Meteorological Institute is a natural partner when developing the weather station network. The Meteorological Institute can use the information received from the stations for its own purposes but also make road weather and road condition forecasts for the road administration.

Development plans of a duty organization will also affect the placing of the stations. Centralizing the duty system (Road Weather Duty Centre) has usually an effect in placing the stations.

Other factors

In addition to the above mentioned reasons, availability of electricity and data links (telephone) as well as possible actions against vandalism can affect the placing of the stations. It is not always possible to build the stations in the functionally best places because the costs would rise excessively high.

If a wrong location for a weather station was chosen, the station can later on be moved to another place with quite reasonable costs.

2 Background

2.1 Road, Traffic and Accidents

Most of the data on the road, traffic and accidents is based on the Feasibility Study of Via Baltica [*Via Baltica Feasibility Study,*1993]. It is known that in many sections the traffic has increased considerably - perhaps even 50% in some parts of Poland. The

The following key persons in different organizations were met during the missions:

Estonia

Estonian Road Administration

Mr Koit Tsefels	Maintenance Director	Headquarters, Tallinn
Mr Märt Puust	RWIS-Coordinator	Headquarters, Tallinn
Mr Uno Kask	Production and Maintenance Director	Pärnu Regional Road Administration
Mr Uring Tõnis	Superviser of a Road Maintenance Work Zone	Pärnu-Jaagopi

Meteorological Institute

Ms Helve Kotli	Director	Headquarters, Tallinn

Estonian Telephone Company Ltd

Mr Andres Käärik	Department Manager	Tallinn

Latvia

Latvian Road Administration

Mr Valdis Laukšteins	Technical Director (Coordinator of the Study)	Headquarters, Riga
Mr Andris Lapsinš	Chief of a Project Implementation Unit	Headquarters, Riga
Mr Gints Alberinš	Deputy Manager of a Project Implementation Unit	Headquarters, Riga
Mr Vilnis Urbanovichs	Director	Riga Regional Road Administration
Mr Janis Lacis	Manager, (Client representative)	Riga Regional Road Administration

Latvian Hydrometeorological Agency

Ms Marta Treiliba	Head of Department of Meteorology and Climate	Headquarters, Riga
Ms Rasma Kleinberga	Meteorologist	Headquarters, Riga

Lattelekom

Mr Talis Galdinš	Network Operations Director	Headquarters, Riga

Lithuania

Lithuanian Road Administration

Mr Gintaras Asadauskas	Technical Director	Headquarters, Vilnius
Mr Algimantas Janušauskas	Head of Foreign Investment Division (Coordinator of the Study)	Headquarters, Vilnius
Mr Henrikas Jurkuvenas	Deputy Chief of Division	Headquarters, Vilnius
Mr Vytautas Timukas	Head of Foreign Relations and Information Division	Headquarters, Vilnius
Mr Violmantas Lirauskas	Director	Kaunas Regional Road Administration
Mr Vydmantas Gendvilas	Technical Director	Panevežys Regional Road Administration
Mr Stasys Stravinskas	Vice-director	Panevežys Regional Road Administration

Lithuanian Board for Hydrometeorology

Mr Petras Korkutis	Head of the Board	Headquarters, Vilnius

Ministry of Communications

Mr Jonas Bitinas	Head of Division of Communication Technology Strategy	Vilnius

Energy Agency of Lithuania

Mr Vytautas Rainys	Deputy Director of the National network	Vilnius

Poland

Polish Road Administration

Mr Marek Rolla	Adviser of the Director General (Coordinator of the Study)	General Directorate of Public Roads, Warsaw

Mr Adam Supernak	Chief Engineer	Bialystok Regional Road Administration (DODP)
Mr Zbigniew Ziemian	Deputy Managing Director	Bialystok Regional Road Administration (DODP)
Mr Wladyslaw Poleszczuk	Maintenance Director	Bialystok Regional Road Administration (DODP)
Mr Jerzy Wojtan	Manager of a Sub-Regional Road Management Unit (ZD)	Bialystok Region Bialystok
Mr Gospodarczyk	Maintenance Director	Warsaw Regional Road Administration (DODP)
Mr Ptawski	Expert	Warsaw Regional Road Administration (DODP)
Mr Stefan Osiecki	Manager of a Sub-Regional Road Management Unit (ZD)	Warsaw Region Płonsku
Mr Andrej Mirosz	Superviser of a Road Maintenance Work Zone (OD)	Warsaw Region Poczernin
Representatives	Sub-Regional Road Management Unit (ZD)	Bialystok Region Łomza
Road and Bridge Research Institute		
Mr Jerzy Szymoński	RWIS-Expert	Warsaw
Meteorological Institute		
Mr Czeslaw Rosa	Director	Bialystok Regional Meteorological Institute

1.3 Description of a Road Weather Information System (RWIS)

The Road Weather Information System (RWIS) consists of Road Weather Stations and the computer system to analyze and present the data. Also tele- or datacommunication system is needed for transferring the data. In a developed system there may be road weather camera as well as weather radar and satellite picture displays also attached to the system. Thermal mapping may be used as one part of the system. A description of RWIS is presented in Figure 2.

The main function of the RWIS is to be an instrument for the road maintenance staff. The goal is to promote smooth and safe winter road traffic.

The RWIS is utilized mainly in the every day operations in Regional Road Administrations (RRA) and Maintenance Work Zones (MWZ). The purpose is that the road maintenance staff knows weather and road conditions as well as possible. They know the situation in real time and, what even better, already beforehand.

The road maintenance staff follows the weather and road conditions on their personal computers, called the Workstations. The Meteorological Institute can make better forecasts for the road administration when information from the Road Weather Stations is available. The Road Weather Stations can also give certain ice-warnings automatically, but these warnings are only for a short period, not as long as the forecasts by the Meteorological Institutes.

The duty organization around day and night can be kept smaller because only few persons are needed to observe a large area in a Road Weather Duty Centre (RWDC). If weather changes require, the duty officials will alarm the Maintenance Work Zone personnel to check the situation on road and start the operations if needed. This reduces personnel costs and also unpleasant and hard night-time work.

The information produced by the RWIS makes it easier to execute winter maintenance operations on right time and with right equipment. Thus, the time when road is slippery is reduced. The use of salt can be reduced which improves the condition of the environment.

By means of the system vehicle operating costs can also be reduced. Time is saved, as due to system the traffic is flowing more smoothly. On better road conditions cars do not wear out so much, they consume less fuel and damages caused by the road salt will lessen. Savings in accident costs are most substantial. Road safety is improved when the time of slippery and bad road conditions can be reduced. According to a study of the Finnish National Road Administration the cost-benefit ratio concerning the vehicle operating costs may be about 1:5 *[Pilli-Sihvola et al..1994].*

Weather and road condition information can also be transmitted directly to road users by different kinds of public service methods such as radio stations, telephone, text-TV, information terminals at service stations, Internet etc.

Location of the road weather monitoring stations

A wide enough and well functioning network of Road Weather Stations, where locations of the stations are well selected, is the most important factor when setting up the Road Weather Information System. The wideness of the network and locations for the stations depend on the local circumstances. Climatic areas, traffic considerations, needs of road maintenance and organizational framework have to be taken into account when planning the network.

Climatic examination

This angle of view aims at covering large areas with only a limited number of stations. The idea is that wide areas that have similar climatic conditions, e.g. temperature zones, can be covered with information given by one station. This method requires cooperation with local meteorological institutes which have the knowledge of different climatic zones.

number of accidents is quite high in every country along Via Baltica.

Estonia

In Estonia the length of Via Baltica is 193 km. The Average Daily Traffic (ADT) varies between 1.500 and 9.000. The accidents in Via Baltica have been as follows:

	1994	1995
Accidents with injuries to persons	45	38
Injured persons	63	48
Killed persons	15	14

Latvia

In Latvia the length of Via Baltica is 204 km. The Average Daily Traffic (ADT) varies between 1.200 and 12.100. There are almost 300 accidents annually in which over 20 are killed and 100 injured.

Lithuania

In Lithuania the length of Via Baltica is 272 km. The Average Daily Traffic (ADT) varies between 970 and 13.200. There are about 250 accidents annually in which over 20 are killed and 160 injured.

Poland

In Poland the length of Via Baltica is either 300 or 340 km depending on the selected route. The Average Daily Traffic (ADT) varies between 700 and 12.900. There are about 250 accidents annually in which about 60 are killed and 240 injured.

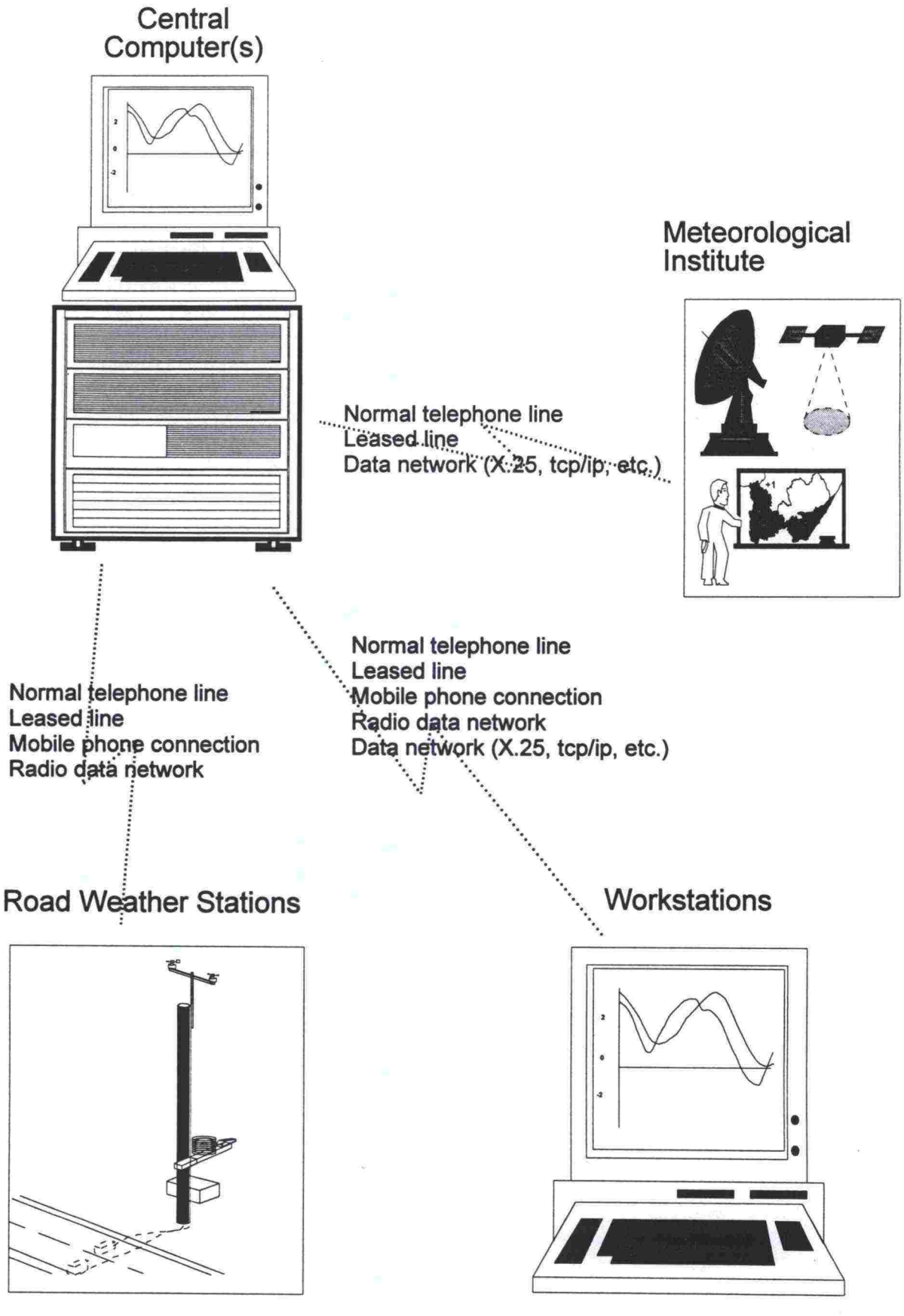


Figure 2. Description of the Road Weather Information System, RWIS

2.2 Road Maintenance Organizations

Estonia

The Estonian Road Administration (ERA) is organized under the Ministry of Transport and Communications. The Director General and the Directorate of the ERA are situated in Tallinn, where there also is the meeting place of the Board of the Road Administration and the facilities of the Technical Centre.

The field organization consists of 15 Regional Road Administrations (RRA) and under them of 63 Maintenance Work Zones (MWZ). So there are three to five MWZs in every RRA. Regional Road Administration borders follow in general the borders of the 15 provinces. In an average there are 970 kilometres of public roads in a RRA and accordingly 230 kilometres in a MWZ.

Via Baltica is located in the territory of three RRAs: Harju, Rapla and Pärnu.

The total personnel in ERA was in 1994 about 2600. The trend of the number of people is decreasing.

ERA is financed by the state and most of the road maintenance and construction is done by the staff and the equipment of the RRAs. The use of private contractors was in 1994 17% of the road management (maintenance and construction) costs.

Latvia

The Latvian Road Administration (LaRA) is responsible for the public roads in Latvia. It consists of the Road Department directly in the Ministry of Transportation and the Road Directorate as a separate administration.

There are 26 Regional Road Administrations (RRA), that are responsible for the local road administration in their areas. The RRAs are further divided into three or four Maintenance Work Zones. There are in an average 790 kilometres of public roads in a RRA. In Latvia there is a will to change the organization into larger RRAs.

The RRAs themselves take care of the administrative matters and the maintenance of the roads. In road construction and repair works they act only as clients. Also part of the maintenance work will be contracted out in 1996.

The LaRA has implemented a client-producer organization. In every RRA there are one or two inspectors permanently working from the Road Directorate. Their task is to inspect the work that has been ordered by the Road Directorate.

Via Baltica goes through three RRAs: Limbazi, Riga and Bauska.

Lithuania

The Lithuanian Road Administration is responsible for the public roads in Lithuania. The administration is divided into 10 Regional Road Administrations (RRA), that are responsible for the public road network in their area. There are 2000-3000 kilometres of

public roads in each region. The road construction is done mainly by private companies.

Every RRA consists of three to five Maintenance Work Zones.

There is a separate organization (company) which takes care of all 4- lane highways and motorways in Lithuania. The main motorway is the east-west connection, the motorway Vilnius - Kaunas - Klaipeda.

Via Baltica is crossing three RRAs namely Panevezys, Kaunas and Marijampole.

Poland

The national road network belongs to the Ministry of Transport and Maritime Economy. Under this administrative body there is the Polish Road Administration, which consists of General Directorate of Public Roads and 17 Regional Road Administrations (RRA) (the Regional Directorates of Public Roads). There are 1000 -2000 kilometres of national roads in each RRA. There are 49 administrative areas (provinces or voievodships) in Poland.

The RRAs are divided into Subregional Road Management Units (in Polish ZD). In Poland there are about 170 ZDs of which in Bialystok region 14 ZDs.

The ZDs consist of two or three Maintenance Work Zones (in Polish OD) each. In an OD there are about 100 kilometres of national roads.

The regional *(voievodship)* roads are managed by the Regional Directorate of Public Roads.

In general, heavy road maintenance machinery is owned by private companies, but the auxiliary equipment (salt spreaders, snow plows) attached to it is owned by the road administration.

Via Baltica is in the area of two RRAs, namely Warsaw DODP and Bialystok DODP.

3. The present situation of the Road Weather Information Systems

Estonia

The Estonian Road Administration has already started in 1995 to establish the RWIS. ERA has purchased four Road Weather Stations (from a Finnish company Vaisala) in the autumn 1995. There are plans for 12 new stations in the year 1996. The RWIS is planned to be completed in the year 1999 with 47 Road Weather Stations.

The RWIS itself is micro computer based and it will be in test use for one year. Two of those purchased four stations are along Via Baltica. In the years 1996 and 1997 there will be three stations more along Via Baltica. Thus, altogether there will be five stations along Via Baltica in the future, which is a reasonable number of the stations. The spots for the stations are chosen by considering the climate, traffic and security.

According to their plan, RWIS will use normal telephone lines but also local radio data networks for communication. There will be regional "central" computers which gather data from the regional Road Weather Stations and one bigger main Central Computer with the information from the whole country. The Workstations are connected to one of these regional "central" computers. There are plans for 15 regional "central" computers, one in every Regional Road Administration. The purchasing of the main Central Computer has been planned for years 1996-97.

Latvia

There is no Road Weather Information System in Latvia at present. However, there are some plans for establishing the RWIS. For example some spots for first locations of the Road Weather Stations have already been planned. In the first phase two to four stations would locate along the Via Baltica. The Latvian Road Administration has considered the station spots by means of climate, traffic and security. Via Baltica is one of the important roads of Latvia. The surroundings of Riga is the most important area concerning the traffic and so also preferable for the RWIS.

Lithuania

There is no Road Weather Information System in Lithuania at present. Specific plans or decisions of the RWIS have not been made. Some thoughts about the locations of the Road Weather Stations, however, exist. There should be four to five stations along Via Baltica. Via Baltica is one of the important roads concerning the traffic and the RWIS in Lithuania. On the Vilnius-Kaunas-Klaipeda motorway traffic is the busiest route in Lithuania, and therefore it is an important link to Via Baltica. West from Kaunas Via Baltica is part of that motorway.

Poland

The Polish Road Administration has the RWIS already in use. The establishing of the system started two years ago. At present, the system is working only in Warsaw Region of the Road Administration. There are 20 Road Weather Stations (from a Polish company Trax) in Warsaw Region. There is also one test system with one station in Krakov area of a model by Vaisala-company.

The Road Administration is expanding the system. There will be four stations along Via Baltica in the near future (in Warsaw Region). Totally, 60 stations will cover the Warsaw Region in the future. After Warsaw Region the system will be expanded to other parts of Poland. According to the Polish plans, the remaining part of Via Baltica will not be covered first by the Road Weather Information System.

The locations of the stations are chosen by considering the climate, traffic and security. The system has a Central Computer and a few Workstations. The Central Computer and the Workstations are OS/2 micro computers with a graphical user interface. The data communications are done with telephone lines and modems. An automatic forecast model for the road surface temperature is under development.

All the data from Polish meteorological stations are seen in a separate system. This system works also in OS/2 micro computers. The total number of the meteorological stations is 64. The data is regenerated once in an hour. The data transferring to the

micro computers is done by radio broadcasts. The micros have connections to the radios through which the broadcasts are received. The data can be seen in various ways on the computer screen. The system is in use at the Road Administration head office and in some Regional Road Administration offices.

4. Organizational and Technical Readiness

4.1 Readiness in computer expertise

Estonia

There are MS-DOS based micro computers in the head office and also in the regional offices of the Road Administration. So, the Road Administration has computer expertise in MS-DOS and MS-DOS based software. The Road Administration has planned to train at least one person to computing, especially to UNIX environment. The lack of the computer experts is a problem in the whole Estonia.

Latvia

UNIX- and WINDOWS NT -environments will be installed at the end of this year 1995 to the head office of the Road Administration in Riga. At present there are a few MS-DOS based micro computers in use. The ORACLE data base server is already in an installing phase at the head office. The server will work in WINDOWS NT environment. The database will be used by micro computer based Workstations which are connected through local area network. So the LAN will be installed also at the end of the year 1995 to the head office. The Regional Road Administrations have some MS-DOS based micro computers mainly with 286 and 386 -processors. So the Latvian Road Administration has reasonable computer expertise in MS-DOS and also some expertise in WINDOWS NT, UNIX and ORACLE database at the end of the year 1995.

Lithuania

There is a local area network in the Road Administration head office in Vilnius. The network is used to combine the MS-DOS based micro computers in the office. In the next year 1996 Transport and Road Research Institute in Kaunas and a couple of Regional Road Administration offices will have local area networks which are connected to the head office. UNIX and WINDOWS NT environments will be installed in the near future to the head office. INFORMIX data base will be tested soon. The Regional Road Administrations have some MS-DOS based micro computers mainly with 286- and 386-processors. Therefore, the Lithuanian Road Administration has already computer expertise in MS-DOS and networks. They will have very soon expertise in UNIX, WINDOWS NT and INFORMIX database too. Mostly the computer expertise is in the head office. The regional offices have mainly expertise in using MS-DOS based software.

Poland

There are MS-DOS and OS/2 based micro computers in the head office and also in the regional offices of the Road Administration. The Road Administration has, therefore,

computer expertise in MS-DOS and OS/2 environments. Especially, the head office has good knowledge of those systems. Regional offices have mainly expertise in using software in those environments. In addition, UNIX and INFORMIX systems are being tested in the Regional Road Administration in Bialystok now.

4.2 Operational Process of the Road Maintenance

Estonia

The Estonian Road Administration (ERA) has been active in finding facts about the Road Weather Information System for three years. The first two years have been on a general level in collecting information. The year 1995 has been the year for implementing the system on a pilot level. ERA has started the system with purchasing four Road Weather Stations. Two of the stations have been installed on Via Baltica. Almost every station will be located in a different RRA. There are plans to extend the system so that next year ten more RRAs will be taken within the system.

Because of the tight budget, road maintenance machinery is old and the replacement of it with new equipment has been difficult. Winter maintenance is anyway guaranteed on all public roads. There are four maintenance classes, the use of which depend on the importance of the road.

The Maintenance Work Zones (MWZ) use their own machinery for deicing as well as for snow and ice removal. Via Baltica belongs to the best maintenance class called class 1. In class 1 the fixed action time for snow and ice removal is four hours and the road has a bare pavement policy (no ice or snow on the pavement). The fixed action time is valid all the day round.

For deicing purposes mainly a mixture of salt (NaCl) and sand is used. Gradually the MWZs will start using more and more pure salt in deicing activities.

The duty system in the maintenance is covering the whole country almost all around the clock in winter time. There is a person in every RRA on duty during the day time and in MWZs there is the supervisor or his assistant on stand-by or on duty even at night time during the winter months. That means 60-70 persons on duty in the whole country. The Meteorological Institute sends a forecast to the RRAs two times a day. ERA is paying for the extra work in the meteorologists' salaries. A group of machine operators is on stand-by during the weekdays and the weekends.

The organization is familiar with stand-by and duty tasks. The maintenance machinery is partly old and ineffective and the same goes for the auxiliary equipment. The lack of budgetary funds is the main reason for not renewing the machine fleet. Estonia uses truck mounted plate spreaders to apply mixed sand or salt. Liquid salt is not used, but the maintenance experts know about the system and are considering to use it in the future. The high price of the system is known and forms a hindrance to implement it. To fully utilize the benefits of the RWIS, the use of liquid salt would be a prerequisite.

Latvia

In Latvia where Via Baltica follows the coastal area for long distances deicing actions are carried out about 75 times per season and plowings about 50 times per season. Via Baltica belongs to the highest maintenance class. The fixed action time is two hours. A first class road is not allowed to be slippery or snowy. A snow path is allowed in low

freezing temperatures.

For deicing a mixture of sand and salt is used (one part sand and one part salt) or pure salt. The winter maintenance is based on old and ineffective maintenance machinery owned by the Latvian Road Administration (LaRA). Separate machines are used for each method. The machines are light and ineffective. The capacity of the work is rather low due to the inefficiency of the equipment. New technology is coming into winter maintenance so that some liquid salt will be used in 1996. Due to lack of funds RRAs can execute a limited amount of work only, e.g. ten times of salt spreading in a month.

One person is on duty in RRA office during working hours and the weekends. The Meteorological Institute gives general forecasts every day and specific forecasts for the main roads. Additional information in winter time is sent to Road Directorate when necessary and they distribute it further. The supervisors in MWZs are responsible after 4 pm until 8 am. They are at work during that time if necessary and decide on the measures. The operators do not form any stand-by groups, but they can be called to work when necessary. The machine operators come to work at 4 am and are ready to start the actions at 5 am. The aim is that the main roads are cleared at 7 am.

Tendering for private maintenance procedures will start in 1996. LaRA will also start in Riga area the construction works of three salt storage buildings in connection with liquid salt equipment installations.

The opinion in LaRA is that the establishment of the RWIS - system is necessary. The operational readiness is getting better when new technology will be introduced. Suggestions of a new winter maintenance technology has been made by a Finnish expert group in 1993 to cover the Riga region.

LaRA has received a loan from EBRD for the winter maintenance equipment. Most probably LaRA will use part of the loan for the first investments of RWIS.

Lithuania

A mixture of sand and salt or pure salt is used for the prevention of slipperiness on roads in Lithuania. Prewetted salt is going to be used on Via Baltica in 1996. The aim is that the main roads are salted in two hours.

The maintenance equipment is ineffective and combination methods are not used (e.g. removing slush and salting at the same time). There is lack of budgetary funds to replace the old equipment.

The duty system or stand-by operations are active the day around in winter time. The supervisors in MWZs are all the time either at work or reachable by phone at home. General weather forecasts can be received through fax, radio or phone three times per day, but more precise forecasts would be needed. The maintenance machine operators come to work at 4 am for the maintenance of the main highways. If it is not necessary to start to work, the men will be sent back home. The operators do only the driving. They work about 15 days per month. There are other men for the routine maintenance. Every morning the information about the road condition is sent via RRAs to the headquarters of the Lithuanian Road Administration (LiRA). The roads must be very slippery if the drivers are called to work outside the working time. The working time on trunk roads is from 4am to 10 pm.

In each RRA there is one person on duty 24 hours a day. He is in charge of the

maintenance procedures at night. He collects information from MWZs and sends it to LiRA Hq, where there is a person on duty between 7 am and 8 pm. The information from RRAs is summed up and prepared to be sent further to the radio. The information contains such as information of road condition, snow cover, limitations to the traffic and what has been done up to 7 am. The radio gives information also later on during the day.

LiRA is ready to modernize its winter maintenance and information system. The information is not precise enough and goes through many persons. The ineffective winter maintenance equipment and limited funds to the maintenance are the main problem areas.

Poland

In Poland the old maintenance equipment has through the privatization process been moved into the hands of state owned enterprises. There are also many private companies with a light organization. The maintenance organizations do not own any heavy maintenance machinery, only auxiliary equipment to the machinery. When the winter maintenance tasks are contracted out, the small companies usually win in the bidding process.

Poland has started to establish a RWIS of their own in Warsaw RRA. A part of Via Baltica is included in that area. Via Baltica belongs to the roads where maintenance standard class 2 is used in practise (there are some sections in standard class 3, in theory). In class 2 salt is used on the full width and length of the road. After snowing loose snow is permitted for four hours and slush for six hours. These fixed action times are valid 24 hours a day. The road surface should be deiced within three hours.

On ZD (Subregional Road Management Unit) level there is a person on duty 24 hours a day. In case of alarm he will notify the supervisor in Maintenance Work Zone (in Polish OD). The supervisor then alerts the contractors to go with the equipment on the roads. When hazardous conditions are threatening the contractors are in readiness in the premises of the maintenance base. The men work in three shifts when needed. There are about 120 starts (times to act) to salt in one winter season.

A mixture of sand and salt is used for the prevention of slipperiness (50%/50%).

TV weather broadcasting at 11 pm and regional radio forecasts are utilized in decision making of maintenance practices. Forecasts for the RRAs are made twice a day by the regional Meteorological Institute, and they are sent by fax to the road officials. At the moment, the Meteorological Institute does not get the information of the existing road weather stations.

Via Baltica is one highway among the others. The RWIS- system is probably going to spread in Poland during the coming years. There is readiness to introduce the new system which would raise the service level of the roads.

4.3 Telecommunications, electricity

Estonia

The digital telephone network is developing quickly. There are 420000 telephone

subscriptions in Estonia today. 100000 of them are digital ones. The operator company of the telephone network is Estonia Telephone Company Ltd (Eesti Telefon). All the new subscriptions are digital if achievable. It is possible to get digital connections to the head office of the Road Administration. Technically there are no obstacles to build reliable telephone connections. The trunk call costs are ten times higher than local calls. Data networks are operated by a separate company called Estpak Data. TCP/IP and X.25 based networks are available in the biggest centres. Electric lines are not a problem along Via Baltica.

Latvia

Availability of electric and telephone lines is not a problem to the Road Weather Stations along Via Baltica. Both networks are dense along the road. However the reliability and functionality of the lines may be a problem in some areas. Fortunately, the digital telephone network is growing fast and reliable connection can be built at least with bigger costs. The digital telephone network will cover the whole country in two years. Between the biggest cities there are also TCP/IP and X.25 based networks available. NMT and GSM mobile phone networks are in use and available along the biggest roads and centres. One available communication method is the radio data network.

Lithuania

The reliability of the telephone lines is not good according to the Road Administration. The mobile telephones are working better. A country wide optic fibre network is under construction. Alongside with it, the digital telephone network and data networks are developing rapidly. The biggest centres are already covered. The new digital telephone subscriptions are very reliable but accordingly only available in biggest cities nowadays. A problem may be an expensive service line from the nearest telephone exchange. There are two GSM-operators in Lithuania. The GSM networks cover the biggest roads and cities at present. Electric lines are not a problem along Via Baltica. The alongside of Via Baltica is densely inhabited and the needed service lines to the stations will not be long.

Poland

The existing Road Weather Stations are connected to the gathering computer with normal telephone lines. In some areas there are some problems with the reliability of the lines. Generally, the lines are working well enough. The mobile phone networks are also available but the operating costs are very high. Electric lines are not a problem along Via Baltica.

4.4 Security and protection

In the Road Weather Information System, only the Road Weather Stations have to be protected against vandalism. Central Computers and Workstations are usually located in the offices of RRAs or MWZs where security problems are part of usual office security.

The devices of a Road Weather Station can be placed inside a building (maintenance bases, service stations). Only the sensors have to be outside. All the other sensors,

besides the road surface sensor, can be close to the location of the device (for example fixed in a mast fitted on the roof of a building). The cables of the road surface sensors can be some hundreds of meters in length. This length is long enough in most of the cases in order to place the sensors in right places on the road.

If the stations are built by the side of the road, where there is no building available, robust boxes or other solutions can be built.

5. Climatical Conditions

5.1 Climatical zones

Estonia

Via Baltica goes from Tallinn to Pärnu and further to the border of Latvia. Tallinn and Pärnu are on the coast as well as the section between Pärnu and the Latvian border. The section between Tallinn and Pärnu goes in inland where in the middle the climate is different.

Latvia

Via Baltica goes from the Estonian border to Riga on the coastal area. From Riga to the Lithuanian border the conditions change towards inland climate.

Lithuania

In Lithuania the climatical zone is quite the same along Via Baltica. Only from Kaunas towards the Polish border the topography changes to be more hilly, and the climatical zone changes to another.

Poland

Near the Lithuanian border Via Baltica goes through Suwalki hilly area and Augustow lake area where there are different climatic conditions as well as around Bialystok. From Bialystok towards Warsaw the climatical conditions change to slightly warmer.

The climatical zones can be seen in the map of each country in Appendix 2.

5.2 Difficult places in the sense of slippery conditions of the road

In the climatical zones there are usually different micro-climates which cause that some spots are more slippery or freeze earlier than others. As well the snowing may be different. Based on their experience the local road maintenance supervisors usually know very well the circumstances on their roads. Also it is wise to ask for expertise of meteorologists in the exact placing of the Road Weather Stations.

6. Configuration of the Computer and Analysis Equipment and Software

The modern RWIS has normally three basic parts:

- Road Weather Stations
- Central Computer/Computers
- Workstations

6.1 The Road Weather Station

The Road Weather Station is an equipment which monitors the weather and the road conditions on the road. The station is situated by the side of the road. The station spot must be in a place where the station can give a reliable idea of the surrounding weather and road conditions. Also traffic (volume, speed etc.) and security of the station must be considered. The accuracy demands are targets of a very good station based on generally accepted requirements [*Perry et al., Highway Meteorology, 1991],[COST-309 Project, EU, 1992*]. Probably, there is no such equipment on the market which meet all the requirements. Therefore, these requirements should be considered as a target. The Road Weather Station should be able to make at least the following measurements.

- Temperature of the road surface, absolute accuracy +- 0.2 °C, resolution 0.1 °C
- Temperature of the road subsurface (5-20 cm below surface), +-0.2°C and 0.1 °C
- Current road condition (dry, moist, wet, icy, snowy etc.)
- Temperature of the air, +- 0.2 °C and 0.1 °C
- Humidity of the air, +- 2% and 1%
- Precipitation; intensity, amount and form
- Wind; direction +- 5° and 1°, speed +- 0.2 m/s and 0.1 m/s
- Estimation of the salt amount on the road (g/m^2)
- Freezing point of the road surface (°C)

The reliability of the data from the stations must be very high, because the station data is the basics of the RWIS. There must be alternative means for connection to the station; including telephone line, leased line and serial line (RS-232). Also wireless connections should be supported, like radio data network and GSM mobile telephone network.

There should be a possibility to expand the stations with various optional sensors. Optional sensors are recommended for:

- Visibility
- Air pressure
- Ground frost
- Traffic monitoring (volumes, speeds, vehicle classes etc.)
- Still and/or moving video picture (road condition, traffic)

etc.

6.2 The Central Computer

The Central Computer (hardware and software) gathers information from the Road Weather Stations and distributes information to the Workstations. The Central

Computer has normally also connections to other systems like to the system of the Meteorological Institute.

The Central Computer must have adequately capacity to handle all stations and to store all the data. Some kind of archive method is needed for the old road weather data.

The Central Computer must have proper connection methods for information gathering and distribution and to the other systems (for example modems + telephone lines, data network connection). A good data network makes it possible to communicate efficiently with other Central Computers and systems, for example TCP/IP based fast network.

The Central Computer has normally its own database for configuration and road weather data, but also databases in the network should be made possible to utilize. The database system must be reliable and the recovering abilities good. The software and hardware environment of the Central Computer must be chosen so that expansion of the system is easy and economical (more road weather stations and Workstations to handle).

There may be several Central Computers in one country, if for example the operating costs of the communication are otherwise much higher. The trunk call costs may be considerably higher than local call costs. In that case the Central Computers must, of course, communicate and change data with each other. The road weather situation in the whole country should always be seen in every Workstation in the system. It is recommended that the RWISs in the different Via Baltica countries would communicate to each other.

The status of the system should be able to be monitored on the Central Computer (how everything is working). It should be possible to configure automatic alarm functions on the Central Computer. It must be possible to send the Road Weather Station data to the other users, especially to the Meteorological Institute.

The connection to the Meteorological Institute is recommended to exist, because the road weather forecasts and also the radar and satellite images are very important part of a modern RWIS. The Meteorological Institute can work directly on the Central Computer or the Central Computer can communicate with the computer system of the Meteorological Institute.

The type of the Central Computer depends on the type of the RWIS. The RWIS-equipment suppliers set their specifications for the computer needed. In minimum, it probably has to have 486 level processor, 8 Mbytes RAM memory and 500 Mbytes hard disk. The operating system may be different like DOS, OS/2 or UNIX.

6.3 The Workstation

The Workstation is the computer from which the users of the RWIS follow the information from the system. The Workstation (hardware and software) receives information from the Central Computer. The displays are generated at the Workstation, only the observational data is transferred. The Workstation displays present road weather information, and possibly road weather forecasts and radar and satellite images in an easy-to-understand form.

Map, graph, table and image displays are in use. Weather images should be possible to be watched as an animation in order to see the movement of the rains and clouds.

Of course, the use of the Workstation software must be easy.

It must be possible to make connection to the Central Computer with various communication means. At least, the telephone line with modems, straight RS-232 connection and data network connection must be supported. Also some other networks should be supported, for example mobile phone networks, radio data networks and X.25 networks. Local and wide area networks are becoming more common, and therefore, connection to the Central Computer through them is important. If the Central Computer can act as a Workstation too, it will be useful especially in the beginning of the RWIS.

The type of the Workstation computer depends on the type of the RWIS. The RWIS-equipment suppliers set their specifications for the computer needed. In minimum, it probably has to have a 386-level processor, 4 Mbytes RAM memory and 100 Mbytes hard disk. The operating system may be different like DOS, OS/2 or UNIX.

Estonia

The establishment of the RWIS has already started in Estonia. The Workstations are now MS-DOS-based microcomputers and they are now in test for one year. The Workstation itself can gather the data from the Road Weather Stations. The Estonian Road Administration has planned to implement a UNIX-based Central Computer but the installation will not be before 1996-97. They have also planned to install some local Central Computers. The connection to the Meteorological Institute will be made through the main Central Computer. The local area networks will be probably used in the future.

Latvia

UNIX and WINDOWS NT environments will be in implementation phase soon in the Road Administration of Latvia. ORACLE database and local area network are under installation. MS-DOS based microcomputers are in use. Part of the regional offices will probably be connected only by ordinary telephone lines. It seems obvious that the RWIS should work in these environments. This will help the system operators, because they already know the operational environment of the RWIS. The connection to the Meteorological Institute must be also planned, especially the transfer of the weather forecasts and the weather images.

Lithuania

UNIX and WINDOWS NT environments will be in implementation soon also in the Lithuanian Road Administration. The head office has already local area network (LAN) and more networks will come next year. Also the connections between the LANs have been planned. Part of the regional offices will be connected only by ordinary telephone lines. MD-DOS based microcomputers are in use. The RWIS should utilize the environments in question. INFORMIX database is coming to test and after that perhaps also into practical use. The connection to the Meteorological Institute must be also planned in Lithuania, especially the transfer of the weather forecasts and the weather images.

Poland

In Poland the RWIS already exists but only in Warsaw region. The RWIS environment is OS/2. Both the Central Computer and the Workstations are working in the same environment. Poland has planned to develop a computer based forecast model for the road surface temperature. This model will need connections to the Meteorological Institute. In future, it would be good to utilize the data networks.

7. Location of the Road Weather Stations

A wide enough and well functioning network of Road Weather Stations, where locations of the stations are well selected, is the most important factor when setting up the Road Weather Information System. The wideness of the network and locations for the stations depend on the local circumstances. Climatic areas, traffic considerations, needs of road maintenance and organizational framework have to be taken into account when planning the network. It is difficult to give an exact recommendation for the distance between the Road Weather Stations because it varies from place to place. When the road conditions of Via Baltica can be controlled by the means of the system, the distances are reasonable. For example in southern Finland the distance between the Stations is 60 km in average.

In the following, the proposed number and locations of the Road Weather Stations along Via Baltica are presented. The proposed locations of the Road Weather Stations are presented in the map in Appendix 2.

Estonia

Considering the RWIS in Estonia, there should be five Road Weather Stations along Via Baltica.

According to the plan of the Estonian Road Administration (ERA) five Road Weather Stations will be situated along Via Baltica: Harju RRA/Kanama (1995), Rapla RRA/Märjamaa (1995), Rapla RRA/Jädivere (1997), Pärnu RRA/Nurme(1997) and Pärnu RRA/Häädemeeste (1996). That plan is reasonable in the point of view of Via Baltica. The system along Via Baltica is one link in the larger RWIS- system in Estonia. ERA will implement a net of 47 Road Weather Stations in the country in 1995-99; 12 Stations by the end of 1996 and the rest until the year 1999.

It is recommended that, in addition to the two stations already installed, all the rest three stations on Via Baltica would be installed during 1996, and not later as it is in the present plan of ERA.

Latvia

Considering the RWIS in Latvia, there should be at least four Road Weather Stations along Via Baltica.

In their present plan the Latvian Road Administration has planned to install seven road weather stations into Riga area and its surroundings. On Via Baltica there would be four stations: Limbazi, Saulkrasti, southern Riga area and Bauska. LaRA has considered some stations outside the Via Baltica also. The information from those stations would support the information gathered from the stations along Via Baltica, as

approaching weather fronts could be indicated in the east and west. Thus, all these seven weather stations would be beneficial for Via Baltica.

Lithuania

Considering the RWIS in Lithuania, there should be four to five Road Weather Stations along Via Baltica.

In Lithuania it has not been decided into what exact locations the Road Weather Stations would be installed. It is suggested that roughly the stations would locate on Via Baltica as follows: Raudonys north from Pasvalys, Silagalis south from Panevezys, Cinkiskis north from Kaunas and one near the Polish border south from Marijampole, one additional could locate south from Kaunas. In addition to that, it would be reasonable to locate two stations along the motorway Vilnius-Kaunas and one in the motorway closer to Klaipeda. The information from those stations would also support the information gathered from the stations along Via Baltica, as approaching weather fronts could be indicated in the east-west direction, and also the motorway is an important link to Via Baltica.

Poland

Considering Via Baltica and the RWIS in Poland, the system should be expanded to the whole Via Baltica road, and altogether there should be 9-10 Road Weather Stations along Via Baltica.

Four Road Weather Stations are going to be installed along Via Baltica in the Warsaw region already in the year 1995. Plans for other RRAs outside the Warsaw RRA do not exist.

The suggestion is that new stations to Via Baltica should be installed as follows: three stations between Ostrow Maz and Bialystok, two stations between Bialystok and Augustow and one station near Suwalki. If the norther alignment of Via Baltica is regarded three to four stations are recommended between Ostrow Maz and Augustow This network would cover the different climatic areas in Bialystok, in Augustow lake area and in Suwalki hilly area. Also the distances between the stations would be suitable.

8. User Organization

8.1 Road Maintenance, Road Weather Duty Centres

General

Via Baltica is one important highway among others in each Via Baltica country. The international role of the road as a link between Scandinavia or St.Petersburg area in Russia and the regions of Southern and Central Europe has increased the value of the road.

Road Weather Information System can be best utilized when Road Weather Duty Centers (RWDC) are established. RWDC is the place where personnel of the road administration is on duty and follows the weather and road conditions with the

assistance of RWIS. Thus, the duty system of the winter road maintenance can be reduced, and additionally the duty personnel in RWDC has the best expertise in utilization of RWIS. Naturally, the expertise which the road maintenance supervisors have is also utilized in weather monitoring.

It is recommended that the road users will be informed with the assistance of the RWIS. The Road Administrations should agree with local radio stations that road weather information is given to the road users in the radio broadcasts. The RWDCs should regularly (3-4 times per day) send road weather information to the radio stations. In the beginning this is easiest by telefax, but later straight data network transfers will be possible. It is possible also that a radio station has a Workstation of the RWIS. Later the road users could be informed also through Internet or information terminals at service stations and in addition with variable weather-controlled traffic signs.

It is recommended that through special radio programs the road users could get to know the weather and road conditions along the whole Via Baltica and in many languages (local, English, Russia). Thus, a driver in Tallinn could already know what to expect in Latvia, Lithuania and Poland and vice versa. This would orientate the drivers to right expectations of the driving and time consumption. So, the risks in the traffic could also be decreased.

There have been discussions on the possible combination of an emergency alarm center and RWDC. In the first phase, it may be difficult to join these centers because they are operating under different ministries. In any case, different people would be needed to these different tasks although they would be located in the same premises. However, active distribution of weather information to the emergency alarm center is recommended; e.g. one Workstation could be situated in the alarm center where the road condition could be followed in real-time.

Estonia

In the first phase there will not be any Road Weather Duty Centre and only the duty officials in the RRAs will have a Workstation and access to the displays of the Road Weather Stations.

In a later phase the RWDC is suggested to be located in Tallinn to serve the Via Baltica area and the western part of the country. In addition, there could be another RWDC to serve the eastern part of the country. The Workstations should be located in RRA offices and preferably also in MWZ offices.

The existing duty system in the winter road maintenance could be reduced so that the supervisors could be taken out of the duty arrangements. They could be replaced by a weather observer in the RRA level. The system would function so that the duty official in Tallinn RWDC would alert the weather observer in an RRA in case of risk for slippery conditions. The weather observer could stay at home and he would be woken up by the duty official in Tallinn RWDC. When the weather observer has found out that there are concrete slippery prevention tasks to do, so he/she would wake up the supervisor in a MWZ. By taking these arrangements the number of duty personnel at a time could be reduced from 60-70 to 16-17 in the whole country.

Latvia

Four Workstations are proposed: the LaRA Headquarters, Riga RRA, Limbazi RRA and

Bauska RRA. The Road Weather Duty Centre should be located in LaRA Hq in Riga. Workstations are proposed to be situated later also in MWZ offices.

The duty system in the winter road maintenance is suggested to be reduced. A weather observer in RRA (on stand-by at home) could be woken up by the duty official in Riga Hq RWDC in case of risk for slippery conditions. After checking the road surface condition the weather observer in turn would wake up the road supervisor in a MWZ. The supervisor would be the decision maker on calling the crew to work. The number of people on duty at the same time could be reduced to a third from the existing figure.

Lithuania

The Road Weather Duty Centre (RWDC) should be located in Vilnius in the facilities of the LiRA Headquarters. The Workstations would be in the first phase in Vilnius Hq, in Panevezys RRA, in Kaunas RRA and in Marijampole RRA. Workstations are proposed to be situated later also in MWZ offices.

With the introduction of the RWIS the number of people on duty could be reduced. The duty officials in RRAs could be changed to stand-by terms. The LiRA Hq would be the only place where there were an official 24 hours on duty all the winter time. The duty official in Vilnius RWDC would alert the weather observer in a RRA in case of risk for slippery conditions. The weather observer could stay at home and he/she would be woken up by the duty official in Vilnius RWDC. When the weather observer has found out that there are concrete slippery prevention tasks to do, so he/she would wake up the supervisor in a MWZ.

Also the weather information would be more exact and trustworthy. By locating the RWDC in the headquarters it could maintain the role of information centre, that it has today.

Poland

Today when the winter road maintenance organization is working without the RWIS there is duty personnel in the ZD- offices at least in Bialystok area. It is recommended that in the RWIS-system the Road Weather Duty Centre would be located in RRA offices. In case of Bialystok area the centre should be located in the head office in Bialystok; in Warsaw area probably in Warsaw. The Workstations should be in the RRA head offices and in every ZD office. Workstations are proposed to be situated later also in OD-offices.

In that case the duty officials in ZD offices could be changed to stand-by terms and they would work as weather observers during hazardous road conditions. The RRA head office would be the only place where there were an official 24 hours on duty all the winter time. The duty official in Bialystok or Warsaw RWDC would alert the weather observer in a ZD in case of risk for slippery conditions. The weather observer could stay at home and he/she would be woken up by the duty official in the RWDC. When the weather observer has found out that there are concrete slippery prevention tasks to do, so he/she would wake up the supervisor in a MWZ (OD). Thus, from the ZD level down to the MWZ (OD) level the system could work as it is now.

The final proposition for Via Baltica RWIS is that the Bialystok region should have a priority in the RWIS plans that the Polish Road Administration makes for the future. That way it could be sooner linked with the RWIS in the Warsaw end of Via Baltica.

8.2 Personnel with the RWIS

The duty officials could be chosen from different personnel groups. The potential groups are:

- technical personnel
- office workers
- maintenance machine operators

People from all these groups have been used as duty officials e.g. in Finland. It has been found, though, that experience in the field of winter road maintenance is a good asset. The use of young, computer minded truck and grader operators has given good results. They have practical experience about the effects of the ice and snow prevention measures. That experience is apt to make the alarms from RWDC to weather observers more sensible.
When the RWDC is functioning 24 hours a day and in three shifts (two persons in a shift) it ties six people permanently and about ten people are needed in the system altogether considering sick leaves, other leaves and vacations.

The RWDC should have a foreman preferably on a full time basis, but also a part time job comes into the question. The later alternative would work better when the RWDC has been fully established and has been functioning some years.

Table 1. Proposed RWIS in Via Baltica.

	Road Weather Stations	Workstations	Road Weather Duty Centers & Central Computers
Estonia 1995-96	2 (1995) 3 (1996)	1 in Head office 3 in RRAs 1 in Meteorological I. later in MWZs	1 in Head office
Latvia 1996-97	4 Via Baltica 3 in vicinity	1 in Head office 3 in RRAs 1 in Meteorological I. later in MWZs	1 in Head office
Lithuania 1996-97	5 Via Baltica 3 in vicinity	1 in Head office 3 in RRAs 1 in Meteorological I. later in MWZs	1 in Head office
Poland 1995-96	4 (1995) Warsaw r. 5-6 (1996) Bialystok r.	(1 in Head office) 2 in RRAs 2 in Meteorological I. About 10 in ZDs along Via Baltica	1 in Warsaw RRA 1 in Bialystok RRA

There has to be at least one person in each country for the RWIS upkeeping in the beginning. His/her job is to run the operating systems, the RWIS software and computer hardware (backups, archive, error detection, etc.). He/she has to do also the software and hardware installations. When the system expands, more persons are probably needed. These persons do not have to work full time for the RWIS, they can also work with other systems. During the installation and implementation phase the job is probably full time.

The maintainer of the Road Weather Stations is a very important person. His job is to install road weather stations, take care of them by changing components, install sensors in the pavement and reinstall them after paving works etc.. That person should have the education of an electrical technician. This person can also do other activities besides. It might be possible to combine these two jobs but then the person has to know both fields of expertise.

8.3 Cooperation with meteorological institutes and between road authorities along Via Baltica

General

The cooperation between the user organization of RWIS (Road administrations) and the Meteorological Institute is very important for the proper utilization of the system. Participation of the Meteorological Institute in the road weather forecasts makes the system much more useful and reliable. The experts in local meteorological institutes have told how climatic zones exist in their countries. This information on climatic zones combined with the local small-scale weather experience of the road maintenance authorities are of importance when defining the exact places for the Road Weather Stations.

The Meteorological Institutes have manual weather observation stations around the countries. At the moment, they do not have automatic stations of their own. It is recommended that they will get access to the RWIS of the Road Administrations. Through a Workstation meteorologists can get the data from the Road Weather Stations which are more accurate for the road conditions than conventional weather stations. Via the computer system they could also send their written forecasts straight to the RWIS-users. Later when radar or satellite pictures can be attached to the RWIS, the picture data will be transferred from the Meteorological Institute to the RWIS within the data network.

The Meteorological Institutes get information from each others too. Therefore, they can forecast the approaching weather fronts.

It would be useful to get the special road weather forecasts three to four times per day during severe weather conditions.

The data from the modern Road Weather Stations is also useful to the Meteorological Institute for their other purposes. Therefore, it should be taken into account when determining the costs for the services by the Meteorological Institute to the Road Administration. Thus, one reasonable solution may be that the parties do not charge each others.

Estonia

The Meteorological Institute and the Road Administration are going to start their regular cooperation already during the winter period 1995-96. Every Regional Road Administration will get by telefax a weather forecast twice a day from the Meteorological Institute. ERA is paying for the extra work of the meteorologists. Anyway, meteorologist and computer support personnel are working 24-hours per day at the Meteorological Institute.

The Meteorological Institute is willing to increase the cooperation with the Road Administration.

There are plans to acquire two old military weather radars from Sweden in 1-2 years. These radars are yet technically new enough in order to meet the requirements of the Meteorological Institute. At the moment there is an old radar near Tallinn, but it is not technically satisfactory any more. When the Meteorological Institute gets the new radars, it is recommended that it will provide the RWIS with the real-time weather radar pictures.

The Meteorological Institute can follow weather satellite pictures on their computers. The costs of the satellite pictures are supported inter alia by Nordic countries, and according to the agreement, the Meteorological Institute can not distribute the pictures further. The same situation is in Latvia and Lithuania.

Latvia

The Meteorological Institute and the Road Administration have already today regular cooperation. The Meteorological Institute gives general forecasts every day and specific forecasts for the main roads. Additional information in winter time is sent to the Road Directorate when necessary and they distribute it further to the Regional Road Administrations. Road weather warnings are given in general radio broadcastings when necessary. Anyway, meteorologist and computer support personnel are working 24-hours per day at the Meteorological Institute.

The Meteorological Institute is willing to increase the cooperation with the Road Administration.

The Meteorological Institute can follow weather satellite pictures on their computers like in Estonia. There are also plans to acquire a new weather radar, possibly also an old military model from Sweden like in Estonia.

Lithuania

The Meteorological Institute and the Road Administration have already today regular cooperation. General weather forecasts can be received through fax, radio or phone three times per day, but more precise forecasts would be needed. Road weather warnings are given in general radio broadcastings when necessary.

The Meteorological Institute is willing to increase the cooperation with the Road Administration.

The Meteorological Institute can follow weather satellite pictures on their computers like in Estonia. It receives also weather radar pictures from Sweden, but they cover the

Lithuanian area only partly. There are also plans to acquire a new weather radar, possibly also an old military model from Sweden like in Estonia. When the Meteorological Institute gets the new radars, it is recommended that it will provide the RWIS with the real-time weather radar pictures.

Poland

The Meteorological Institute and the Road Administration have already today regular cooperation. Regional weather forecasts for the RRAs are made twice a day by the Regional Meteorological Office, and they are sent by fax to the road officials. At the moment, the Meteorological Institute does not get the information of the existing Road Weather Stations. Road weather warnings are given in general radio and Text-TV broadcastings when necessary.

The Road Administration receives data from Polish meteorological observation stations in a separate computer system . The total number of the meteorological observation stations is 64. The data is regenerated once in an hour. The system is in use at the Road Administration head office and in some Regional Road Administration offices.

There is a weather radar near Warsaw which covers a long section of Via Baltica. The radar picture will be seen in a computer of the Bialystok Regional Meteorological Office next year. It is recommended that the radar picture will be transferred to the proposed Road Weather Duty Centres.

It is recommended that the Meteorological Institute including the Regional Offices will get the data from Road Weather Stations. Thus, meteorologists could make more precise forecasts for the roads. It is reasonable that the road weather forecasts for Via Baltica are made by the Meteorological Institute in Warsaw and in Bialystok.

Cooperation between road authorities along Via Baltica

All the road administrations along Via Baltica are willing to cooperate within the RWIS. Practically this would mean at least that the RWDCs in each country would exchange their weather and road condition information around the clock. If there are similar systems in the countries, it will be very easy to follow the road and weather conditions in the neighbouring countries straight by a computer. If the systems are different, it will be difficult to make contacts between the computers. However, to exchange the information with telefax is in any case possible.

If the road authorities along Via Baltica could follow the weather situation in their neighbouring countries, they would be able to make their road maintenance actions better in time. The road users would benefit and thus the road safety would improve, if the quality level of road maintenance was similar and actions right-timed.
In the establishment of the RWIS the countries are in different stages. However, if the further development of RWIS along Via Baltica is supported by international funding, certain benefits could be achieved with common procurements of equipment or training.

9. Training

The user organization include

- the system specialist
- the maintainer of the Road Weather Stations
- the person in charge of the duty centre
- the duty officials
- the weather observers and maintenance supervisors

If we think of the necessary training in the establishment of a RWIS the following training is needed.

System specialist, 5-8 days + 2 days
The system specialists should already have basic expertise in computers and computer science. They have to have or get training about the environment in which the RWIS works. They need also training for the RWIS itself concerning the Central Computer and the Workstation. This RWIS training can take five to eight days. The training can be given by the RWIS- equipment supplier or by an experienced user organization (a foreign road maintenance organization). Later when the system has worked for a few months, it is practical to get some further training for example for two days. The specialist can be used as a trainer in training programs for other staff concerning the use of software..

Maintainer of the RWS, 3 days + additional days later
The maintainer of the RWS has to have basic expertise in electrical engineering. The training for the Road Weather Station maintenance can be given by the RWIS-equipment suppliers or by an experienced user organization (a foreign road maintenance organization). The training takes about three days. It is practical to get some further training later.

Foreman of the duty centre, maintainer of the RWIS- devices, duty officials and maintenance supervisors, 5 days + additional days later
At the beginning a training of 5 days durance should be given to this group of people. The program should consist of the following items

- introduction to meteorology (the basics)
- forecasts adjusted to the road circumstances
- maintenance policy in the country in question
- maintenance methods used in the country
- training for the use of the applications (data transfer)
- PCs
- Road Weather Stations
- communication skills
- cooperation between the duty officials and the maintenance work zone personnel

The officials should have basic professional skills preferably within the winter road maintenance. The trainers can come from experienced user organizations (a foreign road maintenance organization), Meteorological Institute (meteorology) and outside consultants (road weather meteorology, duty responsibilities, etc.). Also professionals of the Road Administrations themselves can train their staff in some areas (winter maintenance, communication). On-the-job training will be a very important part of the further training.

It is important that the persons who participate in the training can train more people in

the future. The training should be also training of trainers. In the coming years the training should continue, as the RWIS system probably will be extended and the techniques improved, new devices will be introduced (radars, road cameras etc.) The training is suggested to continue as a two days/year basis.

10. Establishment

The proposal for the measures to start the project can be found in the following:

1) Cooperation is agreed between the Road Administration and the Meteorological Institute if not done earlier.

2) Exact location of the stations is decided based on the following facts:
   -representative place according to climate, traffic and organization
   -reliable data on weather
   -electricity and telephone lines are near
   -security will not become a problem

3) Equipment is specified, tenders are asked and equipment ordered
   -Road Weather Stations
   -computers and modems if needed
   -computer software

4) Training is planned and specified, tenders asked and training arranged

5) The system specialists are appointed and trained.

6) The places for road weather observation stations are prepared.
   -constructional works (possible cabin, poles)
   -electricity
   -telephone line

7) The Road Weather Stations, computers and software are installed.

8) User organization is further trained to use the Road Weather System.

9) Duty arrangements in winter maintenance are slowly changed to be smaller and more effective. Probably, this is reasonable only after the first year of using experience of RWIS.

When the first phase has been performed, it is easy to expand the system by additional Road Weather Stations and Workstations. It means also that the area covered by the stations and the personnel using the system will increase. The general data communications will certainly also develop.

It is difficult to predict the final number of the Road Weather Stations. According to experience of the Finnish National Road Administration the final wideness of the station network will become clear when setting up the network. When the road conditions of the main roads can be controlled by the means of the system, the network is near to its final wideness.

11. Cost Estimation

Prices of equipment and software which are in the market vary a lot. Naturally, there are also differences in the suitability and quality of the systems. The systems are manufactured in many countries. Recommended requirements for the RWIS are described in a previous chapter of this report.

Cost estimate for the RWIS in an example of four Road Weather Stations and Workstations
(in **USD**):

1. Hardware and software

- One Central Computer (UNIX)		20.000-25.000
RWIS software		1.000-25.000
Database		5.000-6.000
Four modems		1.000
-Four Road Weather Stations	á 5.500-45.000	22.000 - 180.000
-Four Workstations	á 2000	8.000
RWIS software	á 500-10.000	2.000-40.000
Four modems		1.000
Sub-total Hardware and software		**60.000 -286.000**

2. Installation

The installation costs of the Road Weather Stations themselves are dependent on the costs of the labour and materials in each country. Also installation costs of the data and electric lines have to be considered. The costs may be about 2500 per station. Technical assistance needed in the installation will be about two man-day per station and in addition the installation of the computers and their software. The costs of the technical assistance in the installation of a RWIS with four Weather Stations and Workstations may be about 10.000.

Sub-total Installation of four stations	**20.000**

3) Training

Costs for training fees of international consultants (excluding travel, accommodation, per diem etc. costs):

- Training of system specialist (8 days)	20.000
- Training of station maintenance person (3 days)	10.000
- Training of duty officials (5 days)	15.000
Sub-total Training	**45.000**

TOTAL

The cost estimate for the investment costs of a RWIS with

-4 Road Weather Stations
-4 Workstations
-one Central Computer
-software
-the needed technical assistance in the beginning

Total **125.000 - 351.000**

Operation costs

Communication costs are dependent on the chosen communication means and the operation costs of those in the country. If we regard that the four Road Weather Stations are gathered three times per hour and the data is distributed also three times per hour to the four Workstations. It makes totally 24 calls per hour and 576 calls per day. In one month there are 17280 calls of 10-15 seconds in duration. The communication costs might be a couple of thousands of dollars per month.

The prices of the road weather forecasts and weather images from the Meteorological Institute are very dependent on the deal between the Road Administration and the Meteorological Institute. It is recommended that the Road Administration and the Meteorological Institute regard the benefits which occur to both of them. The Road Administration will get valuable expertise from the Meteorological Institute, but also the Meteorological Institute will get valuable information from the expensive devices owned by the Road Administration. Thus, a reasonable solution may be that the parties do not charge each others.

12. Schedule

Already in the winter period 1995-96 Road Weather Stations are being installed along Via Baltica in Estonia and Poland. However, these first stations are not enough even in those countries, but the number of stations and organizations using the system should be increased. It is proposed Via Baltica gets a priority in the countries when expanding the system. Thus, in Poland and in Estonia it would be possible to cover Via Baltica sections with RWIS already in the winter period 1996-97 latest in autumn 1997..

Latvian and Lithuanian Road Administrations have not yet started the establishment of the RWIS. It is recommended that they would start to construct the system in 1996, perhaps with a limited number of Road Weather Stations and Workstations.

It can be estimated that it is possible to start the operation of RWIS 5-6 months after the issue of tenders. Therefore, the tendering procedure should be started in spring in order to get the weather stations installed before winter.

It is recommended that Via Baltica could get a priority in introduction of RWIS. This could be supported by international funding arrangements like EBRD. The international funding could support the establishment of the RWIS in order to create a continuous system along Via Baltica. In the beginning this could happen by supporting the investment of a couple of Road Weather Stations and the needed software as well as the needed technical assistance for installations and training.

APPENDIXES

1. List of earlier reports and documents

2. Maps of the countries along Via Baltica

Estonia

1) Proposed locations of Road Weather Stations, Workstations and Road Weather Duty Center in Estonia
   Borders of Regional Road Administrations along Via Baltica *[ERA]*
   Temperature curves in winter in Estonia (absolute minimums) *[Meteorological Institute]*
2) Planned locations of all Road Weather Stations in Estonia *[ERA]*
3) Planned locations and schedule of all Road Weather Stations in Estonia *[ERA]*

Latvia

1) Proposed locations of Road Weather Stations, Workstations and Road Weather Duty Center in Latvia
   Borders of Regional Road Administrations along Via Baltica *[LaRA]*
   Climatical zones in Latvia (marked with ruling and borders) *[Meteorological Institute]*

Lithuania

1) Proposed locations of Road Weather Stations, Workstations and Road Weather Duty Center in Lithuania
   Borders of Regional Road Administrations along Via Baltica*[LiRA]*
   Climatical zones in Lithuania (marked with ruling and borders) *[Meteorological Institute]*
2) Trunk lines of digital telephone network today or in the near future *[Ministry of Communications]*
3) Coverage of GSM-network of Omnitel-Company *[Ministry of Communications]*

Poland

1) Proposed number and rough locations of Road Weather Stations and Workstations, proposed locations of Road Weather Duty Centers in Poland
   Borders of Regional Road Administrations along Via Baltica *[GDDP]*
   Climatical zones along Via Baltica in Poland (marked with ruling and borders) *[Meteorological Institute]*

Sources in italic letters

3. Manufacturers/ dealers of equipment and software for Road Weather Information System

APPENDIX 1

List of earlier reports and documents

COST 309-Project, Road Weather Conditions, Commission of the European Union, Office for official publications of the European Communities, Luxembourg 1992.

Perry A.H., Simons L.J., highway Meteorology, E & FN Spon, Chapman & Hall, London 1991.

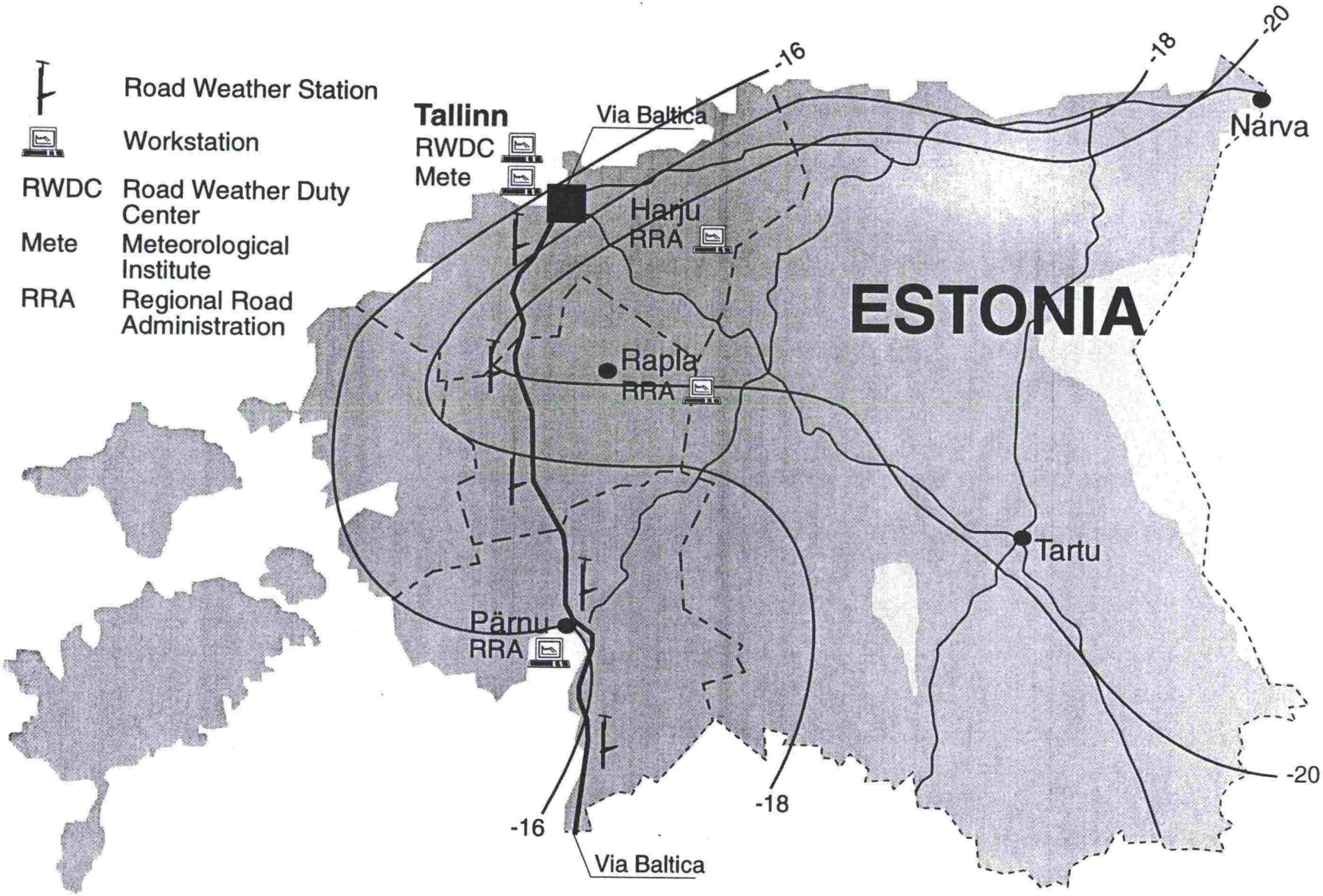
Pilli-Sihvola Y., Toivonen K., Kantonen J., Road Weather Service System in Finland and Savings in Driving Costs, Transportation Research Board, USA, 1994.

Traffic Monitoring and Road Weather Information Systems in the Baltic countries Estonia, Latvia and Lithuania, Fact finding report and proposal for the continuation (Prefeasibility study), Finnish National Road Administration, 1994.

Via Baltica Feasibility Study, Nordic Project Fund/ Nordic Investment Bank/ European Bank (EBRD)/ Ministry of Transport & Communications of Finland, Viatek/ Sweroad, August 1993.

APPENDIX 2

ESTONIA



1) Proposed locations of Road Weather Stations, Workstations and Road Weather Duty Center in Estonia
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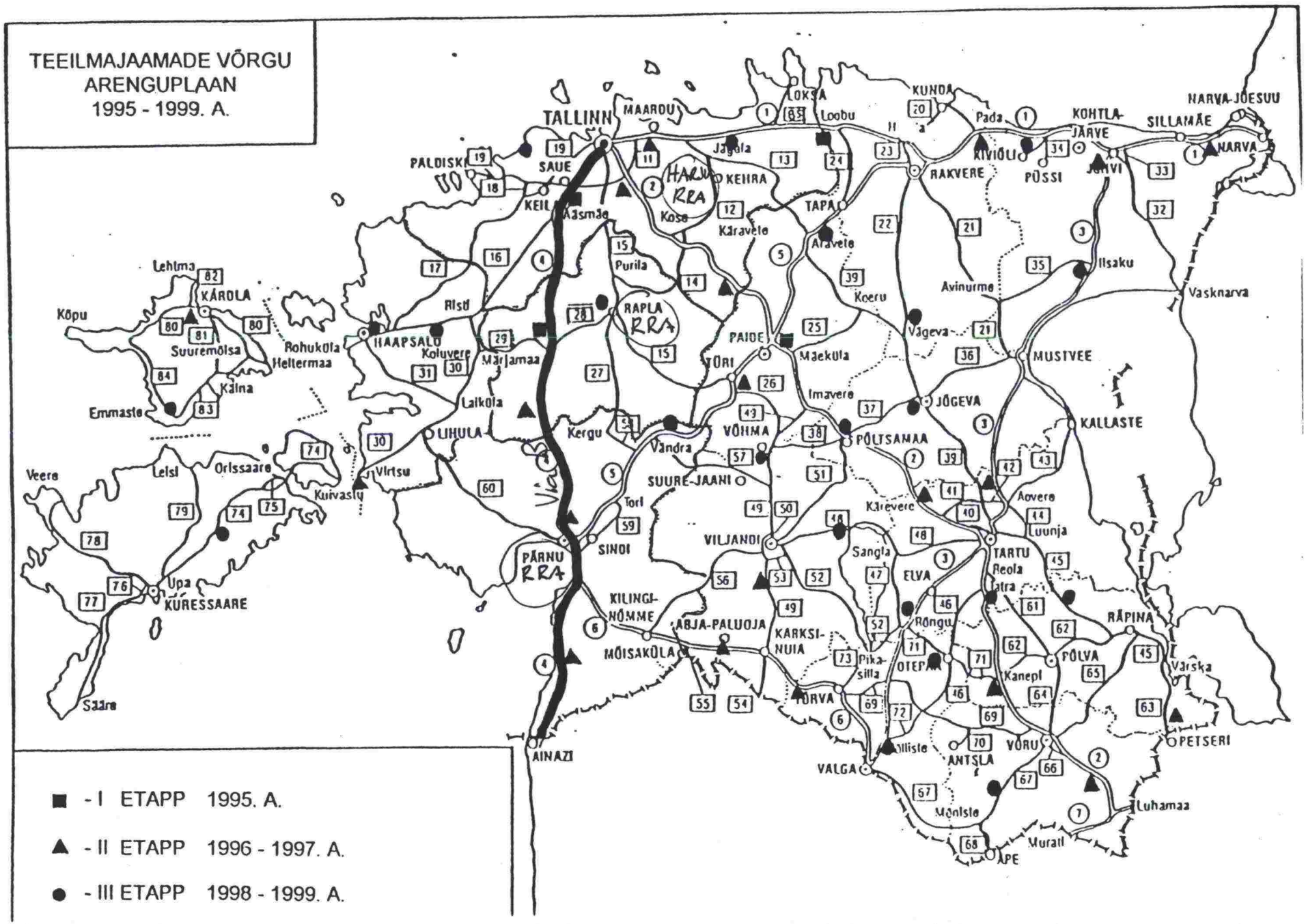
Temperature curves in winter in Estonia (absolute minimums) *[Meteorological Institute]*

2) Planned locations of all Road Weather Stations in Estonia *[ERA]*

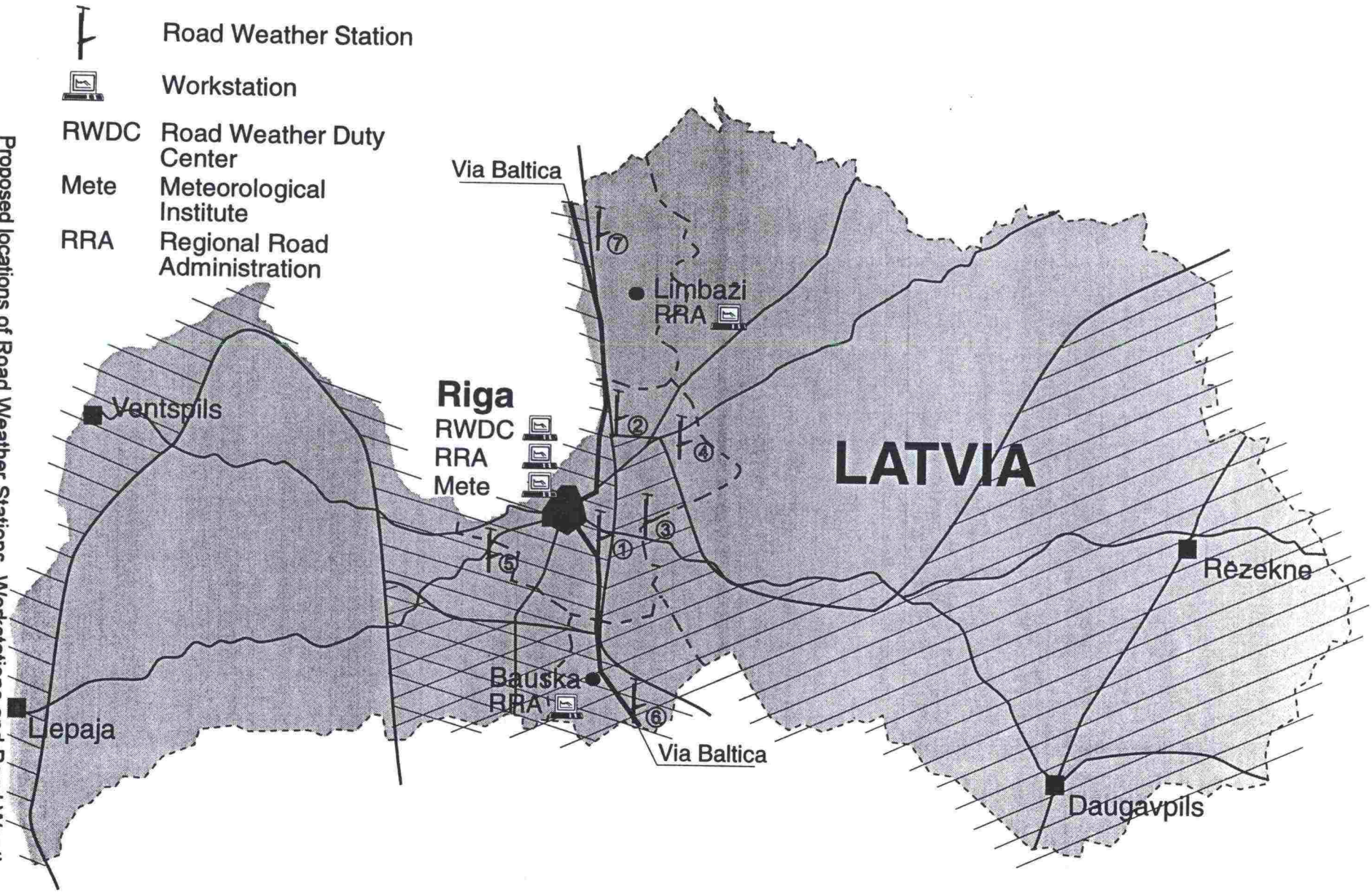


3) Planned locations and schedule of all Road Weather Stations in Estonia *[ERA]*

Teeilmajaamade arenguplaan aastate lõikes 1995 - 1999.a.

TV	1995	1996	1997	1998	1999	KOKKU
HARJU	Kanama	Jüri	Maardu	Muraste	Kuusalu	5
HIIU	-	Kärdla	-	Haldi	-	2
I-VIRU	-	Jõhvi	Vaivara	Purtse	Iisaku	4
JÕGEVA	-	Mustvee	Põltsamaa	-	Õuna	3
JÄRVA	Mäo	Türi	Ussisoo	Ambla	-	4
L-VIRU	Viitna	-	Viru-Nigula	Simuna	-	3
LÄÄNE	-	Virtsu	-	Palivere	Haapsalu	3
PÕLVA	-	Kanepi	Koidula	-	Ahja	3
PÄRNU	-	Häädemeeste	Nurme	Vändra	-	3
RAPLA	Märjamaa	-	Jädivere	-	Rapla	3
SAARE	-	-	Valjala	-	-	1
TARTU	-	Laeva	Kobratu	Rõngu	Kambja	4
VALGA	-	Ala	-	Tõlliste	Otepää	3
VILJANDI	-	Loodi	Abja	Võhma	Oiu	4
VÕRU	-	Vastseliina	-	Kanksti	-	2
kokku :	4	12	11	11	9	47

LATVIA



Proposed locations of Road Weather Stations, Workstations and Road Weather Duty Center in Latvia
Borders of Regional Road Administrations along Via Baltica *[LaRA]*
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LITHUANIA

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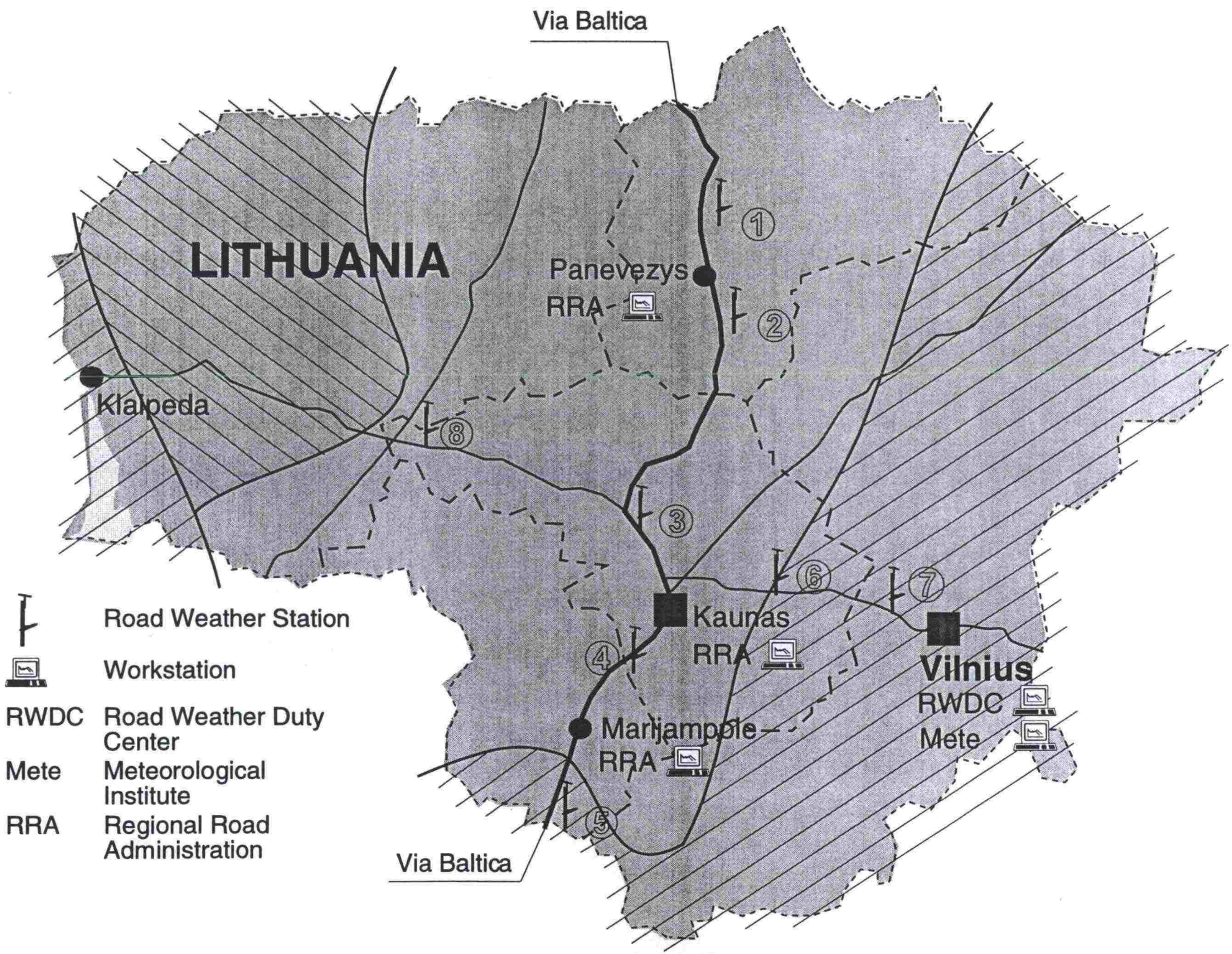
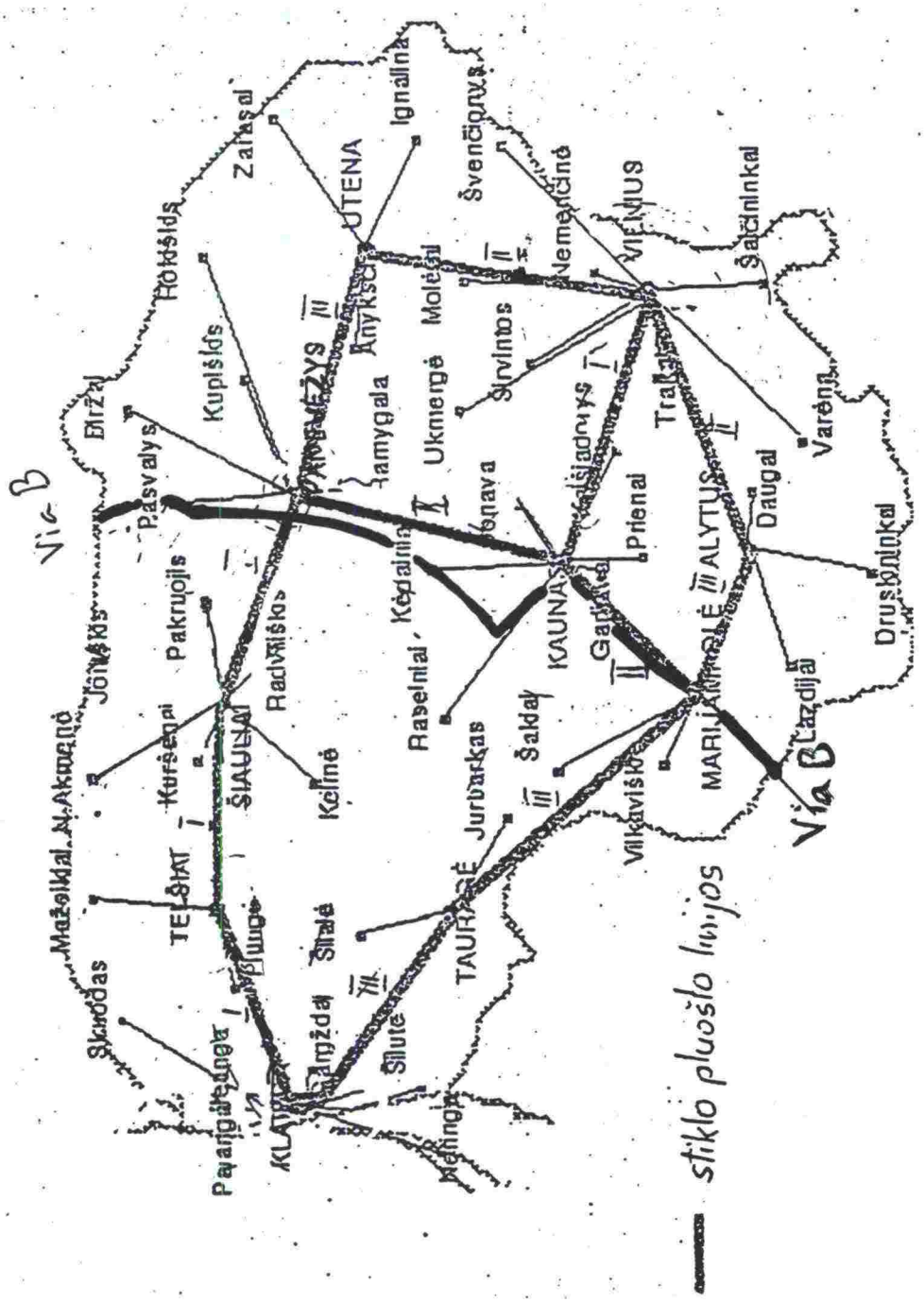




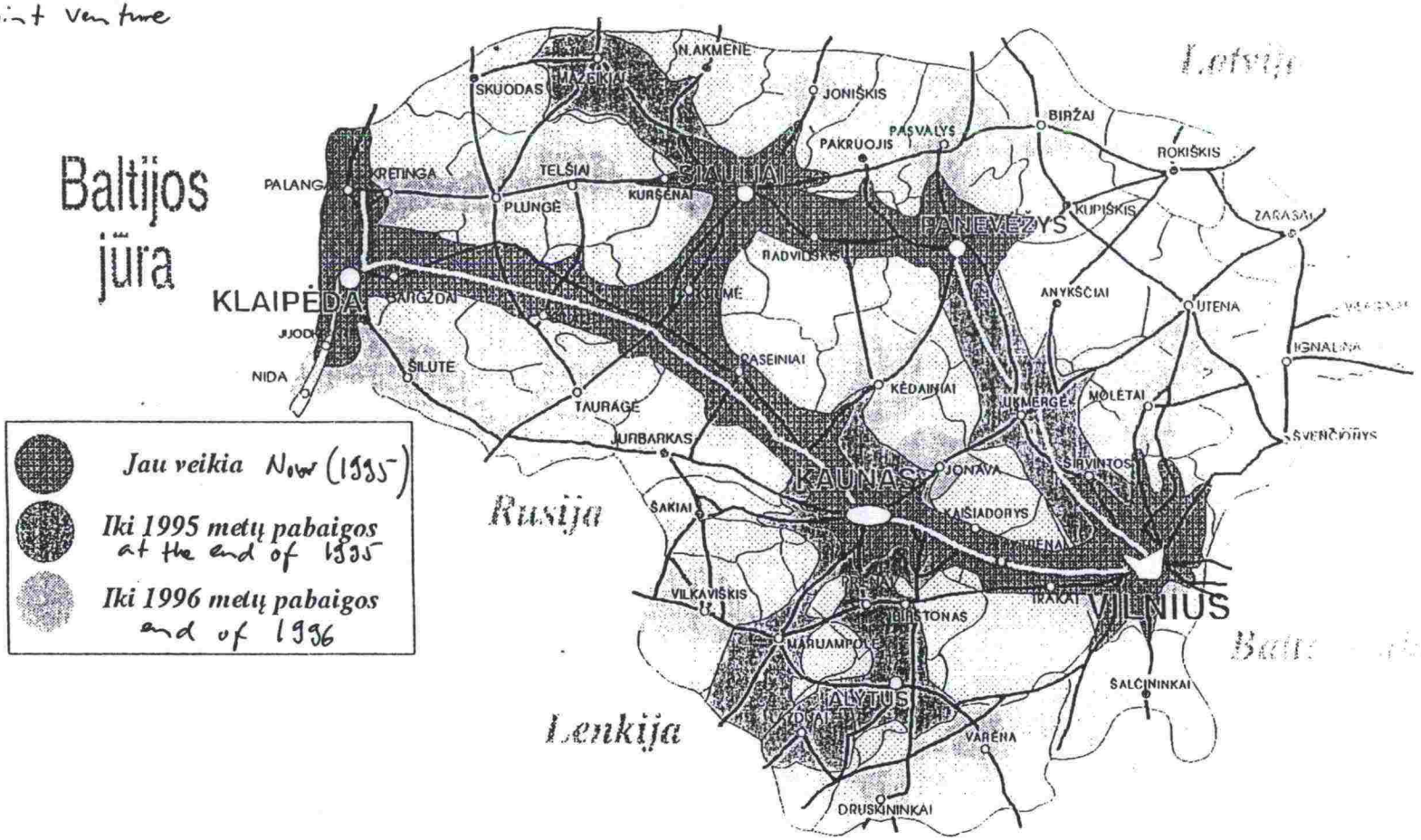
2) Trunk lines of digital telephone network today or in the near future *[Ministry of Communications]*

3) Coverage of GSM-network of Omnitel-Company *[Ministry of Communications]*

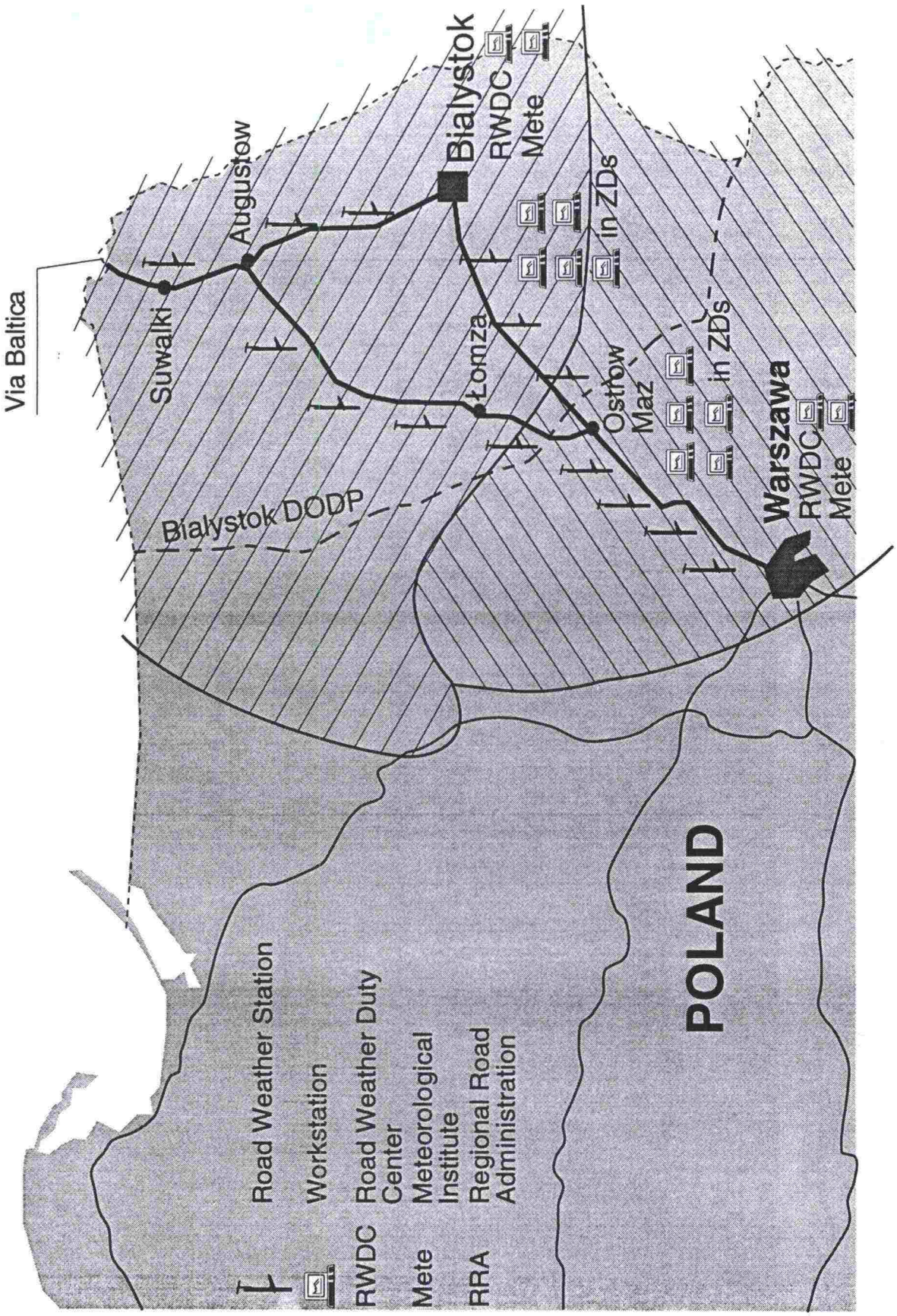
OMNITEL
Telekomunikaciniai tinklai

USA-Lithuanian
Joint venture

OMNITEL GSM *tinklo*
aprėptis Lietuvos Respublikoje 1995 - 1996 metais



POLAND



Proposed number and rough locations of Road Weather Stations and Workstations, proposed locations of Road Weather Duty Centers in Poland
Borders of Regional Road Administrations along Via Baltica *[GDDP]*
Climatical zones along Via Baltica in Poland (marked with ruling and borders) *[Meteorological Institute]*

APPENDIX 3

MANUFACTURERS/ DEALERS OF RWIS-EQUIPMENT AND SOFTWARE

Bocshung Mecatronic AG
CH-3185 Schmitten/ FR
SWITZERLAND
telefax: +41-37-36 20 71

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Hauptstrasse 10
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