TELEMEDICINE APPLICATIONS IN FINLAND 1996

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Preface

The emergence of a new technology prompts the pioneers to investigate, experiment with and discover applications. In making their decisions, they have to trust their vision of how effective the technology will be. Drawing on the experience of the pioneers and the evaluation of their projects, others can then plan their own action strategies and programmes.

The physical prerequisites for telemedicine, especially the telematic services including software and hardware, have taken great strides forward in Finland in the past few years. Since the cost of telemedicine has simultaneously fallen, the technical-economic obstacles to its applications have been noticeably reduced. This report by Docent Mårten Kvist proves that telemedicine applications are already being widely tested and used in Finland. The use of modern telematics in health care is no longer the domain of a few front-line pioneers, since telemedicine has already become a reality throughout the country and at all levels of health care. Many of the applications have, furthermore, been devised as innovative solutions to basic health care needs. Telemedicine is in the near future expected to influence the diagnosis and treatment practices of radiology, pathology and dermatology, for example, in both primary and secondary health care.

The aim of FinOHTA, the Finnish Office for Health Care Technology Assessment, in carrying out this investigation has been to survey the position of telemedicine and the extent to which it is used in Finland today. The investigation is the first step in a process that will ultimately determine the benefits and costs of telemedicine applications. So far no reports on the subject satisfying the criteria for scientific research have been published either in Finland or abroad, even though the need for information clearly exists. Judging from the number of inquiries and evaluation initiatives addressed to FinOHTa alone, many of the Finnish health care organisations are, however, in need of clear quantitative knowledge about the effectiveness of telemedicine, the costs and other potential consequences. Against this background, it would appear that the time is ripe for evaluations of telemedicine applications.

FinOHTA hopes that the present report will be of assistance to Finland's health care on issues related to telemedicine. We also hope that readers will contact us and tell us of any ideas or proposals in the field of evaluation inspired by either this report or by any other telemedicine issue.

The proposals for further measures listed at the end are those of Docent Kvist.

Helsinki, 24 April 1996

Pekka Karp, Research Professor
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The National Research and Development Centre for Welfare and Health, Stakes

Foreword

This report is a brief survey of telemedicine applications and was commissioned by the Finnish Office for Health Care Technology Assessment (FinOHTA) of the National Research and Development Centre for Welfare and Health (Stakes). The substance of the report is based on telephone interviews conducted in late 1995 and early 1996. The interviews were primarily directed at the chief physicians or chief radiologists of central hospitals, after which the findings were supplemented by interviews with other key persons mentioned in the course of the interviews. The undersigned was assisted with the interviews by Dr. Raili Laiho-Rekola and medical student Irina Pasanen. In some cases the interviewees later sent us written material that was used in writing the report. The interviewees were later given an opportunity to comment on the text drafted on the basis of the interviews.

In defining telemedicine applications we have primarily tried to describe the data transfer between health care organisations, to the exclusion of telephone, telefax and electronic mail communications.

The report seeks to give a depth account not of telemedicine technology but of the telemedicine applications in use either now or in the near future (during 1996).

The criterion for classifying applications has been chronology, i.e. the report first deals with applications that may already have passed into history. It then proceeds to applications in use at the present moment and finally takes a look at health care units' plans for the next two years (1996-1997).

I do hope that the report will prove useful to anyone wishing to learn more about certain applications. The presentations are accompanied by details of the persons who provided the original information.

Turku, March 1996

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Abstract

The current state of telemedicine applications was evaluated by means of telephone interviews directed at the chief physicians of all the hospital districts in Finland and at other key persons recommended by them. The data were supplemented by interviews directed at the private sector. All in all, 44 interviews were made between November 1995 and January 1996.

In this report 40 health care units were found to be engaging in telemedicine, while 11 health care colleges and three technical research institutes have the potential for using telemedicine applications. Most of the connections were established in 1995 or will become operative in 1996. The oldest forms of telemedicine still in use were established in 1985. The emphasis is on radiology, but pathology, dermatology, psychiatry, clinical chemistry and neurophysiology, general practice and nursing science are also represented. Norway has approximately the same number of telemedicine applications in use (n=40) as Finland, but Sweden more than twice as many (n=90).

Rapid data transfer connections (ATM) for telemedicine have been built in most of the university cities (Helsinki, Oulu, Tampere and Turku). The university hospitals are not connected, with the exception of Oulu-Helsinki. Applications using rapid data networks have been built between regional hospitals and the university hospitals in Turku, Kuopio and Oulu, to be followed by Lappeenranta-Helsinki in 1996. ISDN connections have been used for video conferencing in dermatology, psychiatry and pathology. Some hospitals still transfer X-ray images by ordinary telephone lines.

Reports from abroad indicate that the high initial investments in telemedicine equipment have been an obstacle to the development of the system. The biggest advantage of telemedicine is that it reduces the patient's travelling time and costs. The quality of care improves as expert opinions are available immediately. This likewise means savings in health care since subsequent visits are no longer necessary simply to receive expert advice. Telemedicine will increase the competition between health service providers and has great potential in health personnel training.

Very little is known at the moment of the effects and effectiveness of telemedicine applications, and the evaluation of methods and technology is urgently needed in this field. Aspects of confidentiality in telemedicine also need to be evaluated. The exchange of experts between Finland and other pioneering telemedicine countries should be encouraged, as should the construction of telemedicine applications with the nearby regions.

Contents

1. Introduction

Telemedicine has taken great steps forward in the past few years. This has been made possible by the rapid technical advances in telecommunications, which have in turn led to telemedicine applications. Although Finnish scientists have been carrying out experiments on a greater or lesser scale for years, chiefly in the field of radiology, it is really only in the past two or three years that there has been any wider interest in exploiting the potential of the new data transfer technology in health care. By global standards, Finland has been a pioneer in telecommunications and has a reputation for being a country of extensive modern data networks, wireless technology and mobile telephones, i.e. as a land of high-tech know-how.

Data network services are available in Finland at a reasonable price (ISDN, ATM, wireless networks), thanks to the competition between telecommunications operators. Establishing connections both nationally and internationally is thus no longer a problem. The prices of telemedicine equipment have fallen rapidly, and the trend continues. The software is not yet quite so advanced, however. There are also a number of standardisation and confidentiality questions to be solved if telemedicine is to develop without any constraints and its potential be exploited to the full in the structural change now taking place in health care.

Data transfer in health care has so far been mainly experimental, but some units are already putting the results into practice, i.e. they are using data transfer in their daily clinical work. This report covers 40 health care units engaging in telemedicine. Eleven institutes of health care education and three technical research institutes have the potential for using telemedicine applications. Forty-six instances of telemedicine practices between two units were recorded. Connections may of course be established between countless units as a result of networking, and not just between two units, as has tended to be the case so far.

Various definitions of telemedicine have been put forward. Van Goor & Christensen (1992) define it as ´the investigation, monitoring and management of patients, and the education of patients and staff using systems which allow ready access to expert advice, no matter where the patient is located´. Although in the broad sense telemedicine means medical interaction via the telemedia (and the ordinary medical telephone contact can be counted as part of telemedicine), the cornerstone of telemedicine has nevertheless become combinations of networks, computers and TV/video technology.

Telemedicine is a common term for a number of applications named after the field in which the development or use occurs, such as teleradiology, telepathology, teledermatology, telepsychiatry, teleendoscopy, telesurgery, etc.

A symposium on telemedicine held in Turku in October 1995 put forward the following arguments in favour of telemedicine, based on experiences in Sweden. It permits:

- easier access to specialists
- consultations with specialists without long, time-consuming journeys for the patient
- easier referral for treatment
- improved quality and efficiency of care
- greater potential for personnel to take part in continuing education
- improvements in the working environment
- improvements in the organisation of health care
- improved continuity of care
- more efficient emergency duty functions
- controllable costs.

Little is known of the effects and effectiveness of telemedicine applications, and there is an urgent need for an evaluation of the methods and technology in this field.

No study has previously been made in Finland of the use of telecommunications in health care; it is therefore obvious that more detailed information on the connections that already exist between health care units and the plans for developing them in the near future is needed as a basis for further planning.

2. Telemedicine abroad

Telemedicine has its roots in the United States, where radiological images were first transferred via the telephone network in the 1950s. The technology improved in the 1960s and 1970s and also began to be applied in other countries, such as Canada and Australia, where the long distances made the rapid implementation of the new technology imperative. Satellite data transfer has also been used for the purpose in Canada, but naturally this has been considered an expensive medium.

The most advanced telemedicine countries in Europe are Norway, Sweden and France. Although Finland was the first Nordic country to apply telemedicine, in 1969, it was followed by Sweden in 1970 and Norway in 1983. Norway has set up a telemedicine centre at Tromsö that has helped to develop telemedicine connections in the remote regions. The system has been operating for a good ten years. First a rapid data network (2 Mbit/s) was built between centres. Now that ISDN connections are available, it is estimated that operations using them would function equally well. The Norwegians first concentrated on teleradiology but have since 1990 also turned to telepathology. At the beginning of 1996 Norway had 40 organisations using telemedicine applications.

In Sweden telemedicine is highly advanced. The SPRI published an extensive report of the distribution of telemedicine applications in 1993. Sweden at present has 90 units using telemedicine applications. It would appear that Sweden is rapidly establishing telemedicine networks covering all the county councils (health districts). According to one recent investigation, 20 radiological units in Sweden were using teleradiology at the end of October 1995 (Jarlman et al.).

A book on telemedicine applications was published in Sweden in 1995 (Utbult). This was chosen as the text book for the optional course in telemedicine beginning at the University of Turku in autumn 1995.

Denmark first used telemedicine in 1988 and at present has applications in use in the cities of Ålborg, Viborg and Århus.

Iceland began applying telemedicine in health care in 1992.

France and Italy have been active in developing global first-aid telecommunications for seamen. Three satellites in orbit (Inmarsat) are capable of establishing links with any ship fitted with receivers wherever it may be in the world, even if the caller does not know the ship's location. This has been part of an European Union (EU) project and has been based on EU directive 92/29. According to this directive, each country should appoint a telemedicine centre capable of issuing first aid advice to seamen. The centres should also be in contact with each other if necessary and provide expert advice in the seamen's own language. The plan for this project was announced at the world telemedicine congress in Toulouse at the end of November 1995.

The French telemedicine centre is located in Toulouse. Dozens of hospitals are connected to the data network and can communicate with one another in most of the specialist fields of medicine.

Britain also has years of experience in the development of telemedicine. The telemedicine centre at the University of Belfast provides regular continuing education, for example, to six institutions.

The telematic services in primary health care within EU member states were surveyed and reported in a book published last year (De Maeseneer & Beolchi, 1995).

Under the EU "Telematics in Health Care" programme a survey has been made of various telematic applications in Europe (such as the monitoring of pregnant women in home conditions (DFM), the computer-aided health promotion of growing youngsters (E ZOOT), support for the acquisition of data on disabled persons (HANDYNET), the technology initiative for disabled and elderly people (TIDE), the increase of social support (RACE), and the stimulating of public debate between urban populations (ETM)). The findings are reported in a book published last year (Gott, 1995).

The EU funded telemedicine development projects in Finland in 1995, at least the joint project involving the City of Turku health care and Turku University Central Hospital (ISAR-T), and the TERVE project in the North Karelia Hospital District. The EU has also awarded funds for a joint project taking in the island province of Åland, the Stockholm archipelago, and the islands of Gotland and Bornholm (the Ö Project).

There are a number of journals on the subject, such as the *Journal of Telemedicine and Telecare*, the *Telemedicine Journal*, *Telemedicine Today*, the *Healthcare Telecom Report*,

and *E-medNews*. The number of scientific articles on the subject has rocketed in a few years. In 1993, only 22 articles were found under the search word "telemedicine" in the Medline database, as against a total of 134 already in 1994 and 1995.

3. Telemedicine applications

3.1. Applications by Hospital District

3.1.1. Uusimaa Hospital District

The District experimented with the transfer of X-ray images in 1990 but later abandoned it because of the primitive technology. The District does not at present have any applications in use or planned (ADP Manager Matti Aarnio 27.11.95).

3.1.2. Helsinki University Central Hospital and Helsinki Hospital District

Helsinki University Central Hospital (HUCH) has had a 155 Mbit/s ATM local network in use since autumn 1994, to which the MRI, CT and SPET imaging devices, biomagnetic devices, dose planning systems for radiotherapy of a number of workstations in the Meilahti area and the Töölö hospital have been connected. The majority of the ATM connections for the imaging devices are, however, by means of 10 Mbit/s Ethernet lines, because ATM network cards were not available for the computers of the older equipment. The service is used almost daily and its use has been growing steadily. Patients at Töölö Hospital have been examined by the MRI equipment at Meilahti Hospital and the data transferred electronically to Töölö Hospital, where they have been printed out as images and reports have been issued by radiologists. Image transfer has also been utilised in the diagnosis of certain brain tumour, cerebral haemorrhage and abdominal injury cases where patients suffering from these have been examined at Meilahti Hospital. The link has also been used to send images from Töölö Hospital to the Department of Oncology so that the radiotherapy doses can be planned for the treatment of brain tumours (Carl-Gustaf Standertskjöld-Nordenstam 23.11.1995 and Sören Bondestam 25.1.1996, Pekka Karp 31.1.1996).

MRI and CT images have been transferred chiefly by way of experiment to and from Oulu University Hospital (OUH) and HUCH since 1.10.1995 by means of a Datanet ATM network. CT images have also been transmitted from HUCH to OUH for rapid prototyping. The project is to be evaluated six months after the construction of the line connection.

A line connection based on a Datanet ATM network construction is to be established in January 1996 between HUCH and the South Karelia Central Hospital (Lappeenranta). This is a pilot project in which CT images taken on Siemens equipment will be sent to Helsinki for consultation.

Since 1995 there has also been a link between the HUCH image network via the Datanet ATM network to the Helsinki University of Technology at Otaniemi, Espoo. This will be used primarily for the study of biomagnetic phenomena and medical imaging by the BioMag Laboratory and the University's Laboratory of Biomedical Engineering (Pekka Karp 31.1.1996).

The Eye, Ear, Nose and Throat Hospital and the Children's Hospital will in the course of 1996 possibly be installing technology permitting image transfer. Ethernet connections already exist at both clinics, but the clinics still lack the necessary hardware and software. The questions of compatibility and processing programs have been raised.

In pathology HUCH has used network links for communication between four pathology departments, and between the departments and the Pathology Department at the University of Helsinki. The PATI program has been used to issue PAD reports, which the computer has automatically coded and transferred to a common database. So far there has not been any image transfer proper (Kaarle Franssila 23.11.1995).

An Ethernet local network will be constructed at the Helsinki University Pathology Department in spring 1996. The department is taking part in the European Europath telepathology experiment probably beginning in April 1996. The department is investigating the type of equipment best suited to telepathology, considering that all the other computers in the department are MacIntosh. (Stig Nordling 1.3.1996).

Helsinki Hospital District began an experiment in December 1995, in the first stage of which ordinary telephone lines will be used for CT consultation between Malmi and Maria Hospitals. The aim is to upgrade the link to ISDN standard in May 1996 when Maria Hospital acquires an MRI unit. Helsinki Hospital District will later be developing telemedicine connections with HUCH and Uusimaa Hospital District (Timo Leiviskä 31.1.1996).

3.1.3. Varsinais-Suomi Hospital District

Planning of the first X-ray image transfer project began in 1990 and the first images were transferred between Paimio Hospital and Turku University Central Hospital (TUCH) in 1991. The experiment began with a 64 kbit/s line connection, but the transmission rate was too slow and the pilot project never went into production (Martti Kormano 23.11.1995).

In autumn 1995 experiments began with an ATM-based link between Paimio Hospital and TUCH (10 Mbit/s). This link is to be used to transmit images produced on a digital X-ray unit (IMIX®) to TUCH. The link is, of course, a two-way one. The experiment is due to end on 31.3.1996, when the results will be evaluated.

TUCH has a rapid ATM link (155 Mbit/s) between the X-ray units at its A and U hospitals.

One ISDN link (128 kbit/s) has been used in radiology between the X-ray departments of the Satakunta Central Hospital (Pori) and TUCH, chiefly for transmitting diagnostic neuroradiological material. The findings have been interpreted at TUCH, after which decisions have been made on the need for and urgency of surgical treatment.

Twice during 1995 TUCH gave specialist consultations (in radiology, internal medicine, paediatrics and dermatology) by way of experiment at the request of Utsjoki Health Centre in Northern Lapland. 1-2 ISDN lines were used.

In pathology, TUCH has since the beginning of 1996 been equipped to give telepathological consultation assistance in the form of ISDN-based video conferencing. This facility has mainly been used to give reports on tissue samples taken in Åland and in personnel training in the study of cytological smears.

In January 1996 the Varsinais-Suomi Hospital District commissioned a 2 Mbit/s Datanet network linking up all its regional hospitals (Loimaa, Raisio, Salo, Turunmaa and Uusikaupunki). So far most of the data transmitted has been for administrative use, but in 1996 the network will also be used for telemedicine applications. Salo Regional Hospital is planning to purchase a CT unit in 1996, after which the interpretation of CT images may be concentrated on TUCH (Kalevi Lauslahti 29.1.1996).

In March-April a rapid connection for the transfer of X-ray images will be built between the Department of Dentistry at the University of Turku and TUCH. A network is also being built between the dental unit at the City of Turku Health Centre and the Turku University Dental Clinic so that the health centre unit can utilise the expert services of the Clinic's X-ray department. A regional training event in teleodontology was held in Turku in January 1996 (Erkki Tammisalo 29.2.1996).

Other major teleradiology projects at TUCH have included the start-up of a digital archive on 1.10.1995. An image compression program was installed at the very end of 1995 that will permit the storage of millions of X-ray images at the archive. Since 1.9.1995 TUCH has also had a video matrix by means of which ultrasound scans, for example, can be followed at several points in the hospital using other machines connected to the video network.

3.1.4 Satakunta Hospital District

An EDI-based laboratory test request and result transmission system has been established between the Satakunta Central Hospital and Satalinna Hospital using fixed connections (2 Mbit/s).

The Satakunta Central Hospital has since summer 1995 had connections (128 kbit/s) with the TUCH X-ray unit (Toshiba Express) for image transfer.

The system for transferring patient records from one hospital to another uses fixed links (Satalinna, Harjavalta and Rauma 2 Mbit/s; Kankaanpää, Huittinen, Pori Youth Psychiatry Outpatients' Clinic and Psychiatric Outpatients' Department 256 kbit/s) and modem links.

In autumn 1995 a broad band connection (155 Mbit/s) was installed between the Satakunta Central Hospital and the Pori unit of the Tampere University of Technology for transferring a digital EEG signal in real time (C-Medicom project). The system also permits interactive and simultaneous data viewing and video conferencing. The link went into use at the Department of Clinical Neurophysiology at Tampere University Hospital (TUH) in January. The connection is at present being evaluated in clinical routines.

The clinical neurophysiological unit at the Satakunta Central Hospital also transferred an EEG signal using an ISDN line to a municipal seminar held in Helsinki in September 1995 by way of demonstration.

An ISDN connection has also been in use to Rauma Hospital (pathology) since the beginning of 1996. Video conferencing units are also in experimental use at the Satakunta Central Hospital (Pentti Rantanen 23.11.1995).

The Regional Council of Satakunta has launched a programme for the development of a Satakunta data network, one of the main items being the development of a Satakunta telemedicine network (C-Medi). Under the project a permanent ISDN-based connection will be created between the health centres in Northwest Satakunta (Noormarkku), Harjavalta and Kankaanpää and the Satakunta Central Hospital for the transfer, reporting and archiving of radiological images. Ultrasound signals are also to be transferred from Harjavalta Health Centre. The system should be in use on 1.9.1996, after which its use will be evaluated (Pekka Loula 1.3.1996).

3.1.5. Kanta-Häme Hospital District

The transfer of laboratory reports between health care units is being developed. No images have been transferred (Veikko Mäkelä 23.11.1995).

3.1.6. Pirkanmaa Hospital District

In 1988 Tampere University Hospital (TUH) and Kangasala Health Centre embarked on a joint image transfer project during which 372 radiology images were forwarded for report at the Central Hospital in the space of four months. A 64 kbit/s connection was used. As a result, it was concluded that the system was sufficiently good for interpreting most of the common X-ray images using a 512x512 pixel matrix, though a 1024x1024 matrix would be preferable (Paakkala et al., 1991).

A link has been in use since 1991 between TUH and Pikonlinna Hospital aiming to test technical applications in the transfer of CT images. In this pilot project SECTRA image processing software has, among others, been edited to suit a Finnish environment. The hospitals' Ethernet networks have been linked by a 2 mb/s data line since the beginning of 1993. The experiment has concentrated more on technical innovation than on production proper.

CT images have since 1994 been transferred from the Päijät-Häme Central Hospital (Lahti) for report by TUH. The connection has operated at a speed of 64 kbit/s and has been used mainly for neuroradiological diagnostics. This application is in weekly use.

Pathology images have been transferred between the Mikkeli Central Hospital and TUH since December 1994 using one ISDN line (128 kbit/s). The facility has been used for weekly consultation over problem cases and for quality assurance. The unit is equipped with a microscope, a video camera and a PC workstation with a video card. The image has been of a good quality. Usually 4-5 pictures are sent at a time for assessment, after which their interpretation has been discussed over the telephone (Markku Helle 6.2.1996).

21.1.1996 saw the start of an experiment in X-ray image transfer and radiology consultations between Parkano Health Centre and TUH. X-ray images taken in Parkano are digitalised with a scanner (Pinja®) and transferred via an ISDN line (128 kbits/s) to Tampere for report. There is a pc workstation at both ends. The benefit of this teleradiology will be evaluated in six months' time.

3.1.7. Päijät-Häme Hospital District

CT images have been transferred from Päijät-Häme Hospital District to the Tampere and Kuopio University Hospitals for report since 1994 by means of a rapid 64 kbit/s link and Photophone® hardware. This connection has been used mainly for neuroradiology diagnostics. The most crucial images have been selected for transfer at a rate of about 30 a year. The reply has been given by telephone. This facility has been used weekly, but the problem has been the slow speed (10-15 minutes per image).

There are plans for installing a new digital MRI workstation in spring 1996. The lines have not yet been installed (Martti Soiva 23.11.1995).

3.1.8. Kymenlaakso Hospital District

There are no concrete plans for using telemedicine applications (Jukka Savolainen 23.11.1995).

3.1.9. Etelä-Karjala Hospital District

A 2 mb/s data line will go into use in March 1996 between Helsinki University Hospital (HUCH) and the Etelä-Karjala Central Hospital. The aim is to transfer CT images for report. The hardware exists and the data link is being built. The image processing and transfer software have still not been decided (Matti Hannuksela 23.11.1995).

3.1.10 Etelä-Savo Hospital District

Neuro X-ray images and images produced on CT units have been transferred for interpretation to Kuopio University Hospital (KYS) since 1993. The image is digitalised on a Videoviewer® unit and sent by modem and an ordinary telephone line to Kuopio. The discussion on the interpretation of the image continues on another telephone line. About three cases a week have been handled in this way (Paula Lahti 27.11.1995).

In the field of pathology, images have since December 1994 been exchanged by the Mikkeli Central Hospital and Tampere University Hospital (TUH) using one ISDN line (128 kbits/s). The facility has been used weekly for consultation on problem cases and for quality assurance. The unit is equipped with a microscope, a video camera and a PC workstation with a video card. The image has been of a good quality. Usually 4-5 pictures are sent at a time for assessment, after which their interpretation has been discussed over the telephone (Markku Helle 6.2.1996).

At the beginning of 1995 a telemedicine image transfer connection was established between the Mikkeli Central Hospital and Mäntyharju Health Centre using one ISDN line (128 kbits/s). Experiments have been made with transferring individual X-ray images from Mäntyharju to Mikkeli. The activity has been purely experimental. More consultations have been held with dermatology specialists. A PictureTel Venue 2000 unit was used. The experiment showed that the transfer was satisfactory. This line speed did not permit sufficiently fast updating of the still picture but this could be achieved with 3 ISDN lines (384 kbit/s). Various camera options have been tested during the project and the configuration has been adapted for consultation use. The still picture is shown on an ordinary 486 computer monitor without halting the rest of the program. Work is in progress on developing a new camera suspension/light source combination that will improve the usability of the auto-focus zoom camera.

A link between the Mikkeli Central Hospital and Kuopio University Hospital KUH and teledermatological consultation using three ISDN lines began in late 1995/early 1996.

An experiment in dermatological consultation over single digital frames has also begun using the Internet as part of the project (Raimo Suhonen 27.2.1996).

3.1.11. Itä-Savo Hospital District

The Hospital District has had Photophone® hardware in use since 1990 for transferring CT images taken in Savonlinna to KUH for report. The report has then been given by telephone. The data transfer has mostly been unidirectional, from Savonlinna to Kuopio. The main branches of medicine where the need has been felt have been neurosurgery and neurology. The facility has been in weekly use and the estimated volume is about 70 cases a year (Risto Karasto 23.11.1995).

United Laboratories Ltd and Medix Ltd have been transferring their laboratory reports to the Savonlinna Central Hospital electronically for years. The hospital laboratory referrals have also been sent to these laboratories in electronic form (Risto Karasto 23.11.1995).

3.1.12. Pohjois-Karjala Hospital District

The Pohjois-Karjala Central Hospital has four years been sending emergency CT-images to the KUH neurosurgeons for consultation, chiefly asking for the need of operative treatment. The images have been scanned at the emergency department and transferred by telephone line. Less than 100 cases are handled a year in this way. A certain number of angiographic images have also been sent to the KUH neurosurgeons. (Kai Kurki 28.2.1996)

In 1995 a regional TERVE (meaning 'healthy') project was launched in the Pohjois-Karjala Hospital District, the aim being to create a uniform, flexible care chain and thus to achieve operative control of the patient's care chain in primary and secondary care and on the border between these. At the first stage there are plans for starting a pilot project during 1996 aimed at developing the referral practices (the 'smart' referral). The project involves five health centres and a few specialist branches from the Central Hospital (internal diseases, surgery, gynaecology and first aid).

The project will continue with work on the electronic patient record and care feedback, scheduled for 1997.

One sub-project is the transfer of plain X-ray images between Lieksa Health Centre and the Pohjois-Karjala Central Hospital. These films are scanned at the Health Centre and sent to the Central Hospital via a 2 Mbit/s data network. A report is then sent by fax.

The pilot project will last for six months, after which it will, depending on the results, go into routine use. Lieksa annually makes about 4,000 investigations, some of which will be forwarded to the Central Hospital for consultation.

The Central Hospital's internal network is being developed so that digitised images can be transferred within the hospital from the radiology department to the different units. In the course of modernising two of the operative wards information technology capabilities will, furthermore, be installed so that the wards can have video links with the operating rooms, the ambulatory surgery unit and, if necessary, the health centres to meet the demands of e.g. various endoscopic and other activities.

Potential telediagnostics projects are telepathology applications by means of image transfers and consultations with the KUH pathologist. Teleneurophysiology will also be introduced as an experiment by means of EEG interpretation in the course of 1996. (Kai Kurki 23.11.1995)

3.1.13. Pohjois-Savo Hospital District

In 1974-1976 KUH and the University of Kuopio jointly devised a regional computer-based system for ECG analysis. The ECG signal and anamnestic information were sent in digital form via selected telephone lines to the University's computer centre for analysis. In problem cases the analysis was validated by a physician specialised in electrocardiology. The results were sent as a data transfer to the sender. They were also stored in a data file for further use in monitoring the patient's progress (Yrjö Jokinen 28.2.1996).

The system was in use until the early 1990s and some 200,000 ECGs were analysed in all. The analysis service has been used even since then in epidemiological research projects. The bulk of the material came from KUH, but the service was also used by the City of Kuopio and Health Centers in Siilinjärvi, Leppävirta, Nilsiä and Nurmes.

The Kone Ltd Instrument Division manufactured two generations of small series of ECG recording and data transfer equipment for the system. The analysis service was discontinued when no suitable new recording devices could be obtained for the system.

Since 1989 X-ray images - mostly neurosurgical cases - have been transferred from the Keski-Suomi Central Hospital in Jyväskylä to KUH for consultation with the KUH neuroradiologist and neurosurgeon, and from other central hospitals (Pohjois-Karjala, Mikkeli and Päijät-Häme) from 1990-1994 (Seppo Soimakallio 28.2.1996).

A pilot Data-Medic project has been running since 1994 designed to transfer digital readings from the ambulance transporting a patient to the duty doctor at the KUH emergency department (e.g. ECG, oxygen saturation, blood pressure and pulse rate, the paramedics´ estimates of the patient's vital signs so called Glasgow Coma Scales). The data are transferred by mobile phone. 1995 saw the introduction of a program called SAKARI devised for this purpose. The project has been developed in collaboration with the Technical Research Centre of Finland. So far the data transfer has been tested in the City of Kuopio. The second stage of the project, during which the data will be transferred straight to the KUH patient database (the data were previously printed out as a telefax only) is scheduled for spring 1966 (Aapo Immonen 28.1.1995).

In January 1996 Iisalmi Regional Hospital began transferring X-ray images to KUH. There are Siemens® workstations at both ends and the Ethernet networks of both units are connected by a 512 kbit/s line (Seppo Soimakallio 28.1.1996).

Image transfer from Varkaus Regional Hospital to KUH is scheduled to begin in February 1996. Both units have Siemens® workstations and the connection is the same as that between Iisalmi and KUH (Seppo Soimakallio 28.1.1996).

There are plans in the Pohjois-Savo Hospital District for developing the local data network to take in the Kuopio University Hospital and regional hospitals in Varkaus and Iisalmi and all the health centres in the area. So far no time schedule has been drawn up for the network expansion (Juhani Kärjä 27.11.1995).

3.1.14. Keski-Suomi Hospital District

The Photophone® system has been in use since April 1989; the X-ray images are scanned with a video camera, the video signal is processed on a PC and forwarded by telephone

modem to the KUH radiology department. Almost only CT images of the head have been sent via this system. They are images required by the hospital's neurologists, who wish to consult the KUH neurosurgeons. The advice is then given over the telephone on receipt of the images (Jarkko Nyrhinen 14.3.1996).

A digital image transfer facility has been available between the Keski-Suomi Central Hospital in Jyväskylä and KUH since May 1995. This is a Lanlink connection between the magnetic resonance imaging unit workstation and the corresponding unit at KUH. KUH has been consulted on magnetic resonance imaging cases only once or twice a month, mainly for head images. The feedback has been received by phone. This Lanlink connection has also been used in the opposite direction, when postoperative control images taken on the KUH imaging equipment have been sent to the Keski-Suomi Central Hospital. KUH has been able to make film copies of the images sent by the Keski-Suomi Central Hospital in digital form, for storage in its own archives (Jussi-Pekka Usenius 29.2.1996).

The CT equipment will be renewed in 1996, when a connection similar to that already established for magnetic resonance imaging will be installed.

The Keski-Suomi Central Hospital has plans for concentrating its telemedicine consultations with specialists on one outpatients' department (a 'teleclinic') (Ilkka Kunnamo 14.11.1995).

3.1.15. Etelä-Pohjanmaa Hospital District

Requests for laboratory tests and the resulting reports have been sent between health centres and Central Hospital laboratories since 1993; by 1995 the system included all the health centres in the region. The health centres have a display unit connected to the computer system of the Central Hospital laboratory (Jaakko Rajala 23.11.1995).

At the end of 1995 Kauhajoki Health Centre built a Datanet connection. This will be used mainly for consultation with the Central Hospital specialists. Seinäjoki Hospital is connected to the Lanlink network, which also gives access to the Datanet network (Jaakko Rajala 23.11.1995).

There are plans for beginning the transfer of X-ray images and MRI images to and from Tampere and Vaasa within the next two years (Aarno Särmö 23.11.1995).

An EDI connection is also planned between the laboratory computer systems of Kurikka Health Centre and Seinäjoki Hospital so that the systems can communicate test referrals and reports in machine language. Since the volume of data is small, modem connections have been considered the best solution (Jaakko Rajala 29.2.1996).

3.1.16. Vaasa Hospital District

There is not yet any image transfer facility in the Vaasa Hospital District. Laboratory reports have, however, been transmitted to the health centres in the region for years (Leo Keski-Nisula 25.1.1996).

By 1997 at the latest, the Vaasa Central Hospital will have a magnetic resonance imaging unit; the need will then arise for neuroradiological consultations by means of image transfer (Leo Keski-Nisula 25.1.1996).

3.1.17. Keski-Pohjanmaa Hospital District

Reports of laboratory tests are sent by modem to Himanka and Toholampi Health Centres and the Tunkkari unit of the Perhonjokilaakso health unit (Heikki Aurekoski 28.2.1996).

In 1992 CT images taken at the duty clinic were sent from Kokkola to Oulu using a digital telephone line (Diginet) at a speed of 64 kbit/s (Jarmo Reponen 1.3.1996).

The CT equipment is to be renewed in 1996.

A data network connection (2 Mbit/s) will be built in 1996 between Kokkola and Oulu. This will mainly serve the needs of radiology.

3.1.18. Pohjois-Pohjanmaa Hospital District

In 1969 X-ray images were transferred by television from Oulu to Helsinki. This was the first such experiment in Scandinavia, and its aim was to examine the technical prerequisites for image transfer and for the successful interpretation of images.
The leading persons in this project were Pekka Soila, Pekka Vuoria and Erkki Laasonen (*Tekniikan Maailma* 14/1970: 82-85; Jarmo Reponen 30.11.1995).

In 1990 there was a rapid data link (2 Mbit/s) between Oulu University Hospital (OUH) and Oulaskangas Hospital. This was used chiefly in radiology and in the interpretation of gastroscopy findings. Several dozen patients were examined. Responsible for the project were radiologist Seppo Lähde and gastroenterologist Juhani Lehtola. A report was issued of the experiment (*Sairaala-lehti* 11/1990: 47-49).

Radiological images (ordinary health centre plain films) have been transferred from Kuusamo Health Centre to OUH since 1991. A digital telephone line (Diginet, 64 kbit/s) was used to begin with. This was disconnected 1993-1994. Images have once again been transferred since 1995, initially with an ISDN connection (128 kbit/s), now with a fixed line of the same speed.

In 1991-1992 an extensive teleradiology experiment was carried out in which X-ray images were transferred via a digital telephone line (Diginet, 64 kbit/s). Involved in the experiment were OUH, the Keski-Pohjanmaa Central Hospital in Kokkola, the Lappi Central Hospital in Rovaniemi, Raahe Regional Hospital and Kuusamo Health Centre. A report was issued of the results (*Sairaala-lehti* 6-7/1992: 16-18, *European Journal of Radiology* 1995: 19: 226-231) (Jarmo Reponen 1.3.1996).

A link between Raahe Regional Hospital and OUH was established in 1992 and updated in 1993 to form a 2 Mbit/s Lanlink. This is used for consultations over CT images with Oulu and logging into the image network of the radiology clinic. A few clinical consultations are held each month and the image network is used daily for investigation. If necessary, other hospitals can be contacted via the Raahe Hospital network using Lanlink/Datanet services (Jarmo Reponen 1.3.1996).

In 1993 CT images were transferred via the Internet from Oulu to Tromsö Hospital and also to the Reykjavik Central Hospital. The connections were used in the interpretation of both technical and patient examination series. Test contacts have occasionally been made since then, but the connections have never been in productive use (Jarmo Reponen 1.3.1996).

In summer 1994 an ISDN connection was built between the psychiatry clinic at OUH and Kuusamo Health Centre. It has been in weekly use for psychiatric consultation and guidance. The link has also permitted health centre personnel to participate in meetings at the psychiatric clinic (Jarmo Reponen 30.11.1995).

As part of a telepsychiatry project, test connections were made in 1995 from OUH to Raahe and Oulainen Health Centres using an ISDN video conferencing link (384 kbit/s). In 1995 Oulu Institute for Health Care Education began distance teaching at Päivärinne Hospital and Oulaskangas Institute for Health Care Education using video conferencing equipment and three ISDN lines (384 kbit/s) (Jarmo Reponen 30.11.1995).

In autumn 1995 OUH had some test connections with the Kainuu Central Hospital, using the frame relay technique to transfer digitalised images to Kajaani (Jarmo Reponen 30.11.1995).

MRI and CT images have been transferred between OUH and HUCH since 1.10.1995 using the Datanet ATM network from Oulu to Helsinki. This experiment is to last six months. CT images have also been transferred from HUCH to Oulu for rapid prototyping. The project will be evaluated at the end.

An ATM-based ´Koillismaa data network´ is at present being built to connect the municipalities of Kuusamo, Taivalkoski and Pudasjärvi to the national data network.

The Pohjois-Pohjanmaa Hospital District has since 1995 had a ´Telemedicine and data transfer strategy´ devised by a team of chief physicians aiming to link the hospitals in the district and later all the health centres, too (Jarmo Reponen 1.3.1996).

Telemedicine applications in the field of pathology and obstetrics are also planned for 1996.

3.1.19. Kainuu Hospital District

Laboratory reports are transferred via an ordinary telephone line to Vuolijoki Health Centre. Vuolijoki Health Centre can see on its own terminals the reports on tests carried out on its own patients at the Kainuu Central Hospital; the other health centres can see only the reports on samples which they have themselves submitted (Seppo Kemilä 23.11.1995).

Images for radiological examination have been transferred by way of experiment since October 1995 between OUH and the Kainuu Central Hospital using the Lanlink (2 Mbit/s) (Jarmo Reponen 30.11.1995).

A direct connection with Oulu will be established at the beginning of 1996 and the MRI unit to be purchased for the Central Hospital will be connected to it (Jarmo Reponen 30.11.1995). The aim is to obtain consultations from OUH. The type of line has not yet been decided. It seems at the moment that the line will not be operative before 1997 at the earliest (Seppo Kemilä 23.11.1995).

There are also plans for transferring X-ray images from Kajaani Town Hospital to the Central Hospital's radiology department, but no date has yet been fixed (Seppo Kemilä 23.11.1995).

3.1.20. Länsi-Pohja Hospital District

There are no plans for introducing telemedicine applications. The need does, however, exist (Olavi Heikkilä 23.11.1995).

3.1.21. Lappi Hospital District

In 1992 the Lappi Central Hospital took part in a teleradiology experiment. When the new MRI unit is purchased in 1996, data transfer connections will be established with Oulu (Jarmo Reponen 1.3.1996).

There are plans for commissioning an ATM-standard connection in 1996 to permit data transfer between the Lappi Central Hospital, OUH, and the Kainuu and Keski-Pohjanmaa Central Hospitals. The most useful application would be the capability for receiving reports on MRI images taken elsewhere. No decisions have, however, yet been made on the hardware investments (Mikko Koivisto 23.11.1995).

Twice during 1995 TUCH gave by way of experiment specialist consultations at the request of Utsjoki Health Centre (in radiology, internal medicine, paediatrics and dermatology). One or two ISDN lines were used.

Utsjoki Health Centre has in 1995 used telemedicine for consultations with a dermatologist or surgeon at the Mehiläinen Hospital in Helsinki (2 ISDN lines) (Pauliina Kytölä 26.1.1996).

Utsjoki has also been in contact with the Lapland Institute of Social Welfare and Health Care Education. Members of staff have been able to follow training events in Rovaniemi by means of video conferencing (Aino Snellman 28.1.1996).

Utsjoki will have a third ISDN line (384 kbit/s) in 1996 (Pauliina Kytölä 26.1.1996).

The Lappi Central Hospital, Muonio, Enontekiö, Inari and Utsjoki Health Centres are together planning to start a pilot project in 1996. The aim of this project is to investigate the potential for collaboration in specialist medical care and the health centres in the remote regions for consultations with specialists, guidance and continuing education using video conferencing equipment. No decision has yet been made on funding (Aino Snellman 28.1.1996).

3.2. Applications in Åland and private sector

3.2.1. Åland

Autumn 1994 saw the start of a development project known as the "Ö Project" in the Åland archipelago, along with representatives of Gotland in Sweden and Bornholm in Denmark. The project led to a couple of joint video conferences in 1995. The aim is to achieve flexible cooperation between secondary and primary health care. Among the main target areas will be the treatment of diabetes, the treatment of back pains, and first aid. The Ö Project has been granted EU funds (Anders Fagerlund 27.11.1995).

A second project in the area is the Archipelago Project involving the island areas of Stockholm, Turku and Åland. The aim is to draw up a joint project plan for the use of telemedicine in the archipelago. Planning of the project began in December 1995.

Specialist consultations with neurologists have been possible between the Åland Central Hospital and Uppsala University Hospital since 1.1.1995. There is also a need to develop consultation in psychiatry and neurophysiology between the two hospitals.

In October 1995 the Åland Central Hospital acquired a 3 ISDN-line connection. This has been used for consultations with Stockholm and Turku. Microscopic sections, chiefly in the field of pathology, have been sent to Turku for examination, as have certain haematological smears and bone narrow aspirates. The video conferencing equipment has been used in providing further training for the laboratory staff.

The potential for consultation over CT images is to be developed in 1996, probably by digitising the images with a scanner of Pinja® type and then transferring them on-line to TUCH. The need is greatest in cases where neurosurgery is a serious treatment option.

Links are also being planned between the hospital and various libraries. One topical issue is the need for the local patient associations to establish contacts with Mariehamn Town Library and for doctors to gain access to the SPRI databases in Sweden (Anders Fagerlund 27.11.1995).

3.2.2. Private Health Care Sector

In the private sector, MRI images have since 1.3.1995 been transferred from Magneetti-Botnia in Oulu to Tesla-Vagus in Turku (1 ISDN line). The feedback is been given over the telephone (Martti Kormano 23.11.1995).

A 2 Mbit/s link has been built between Kaarina Health Centre and Vagus in Turku as part of a product development project. A multimedia-based solution will be aimed at in data transfer. The development of the image processing software in particular has been the primary objective (Martti Kormano 23.11.1995).

Saimaan Magneetti in Lappeenranta has been transferring MRI images to Tesla-Vagus in Turku since 1.1.1995 (Martti Kormano 23.11.1995).

Magneettimehiläinen has since 1.9.1995 been transferring MRI images to Tesla-Vagus. The feedback has been given over the telephone. This facility has been in daily use (1-3 cases per day) (Martti Kormano 23.11.1995).

An image transfer system is planned for implementation in 1996 between Åland and Vagus, by which ordinary X-ray images taken in Åland are converted to digital form on a Pinja® digitiser and sent to Turku for report.

Keski-Pohjanmaan Magneetti Ltd (Kokkola) has been transferring MRI images to Magneetti-Pulssi (Turku) for report (by telefax) since 1994. Regular use has been made of the service (several cases a week) (Kalevi Katevuo 28.2.1996).

The FinnMed research centre in Tampere has since August 1995 been running a research project called Ortocon using a pilot ATM connection (10 Mbit/s) with the Orton Hospital

in Helsinki. The experiment proper is due to begin in February 1996 and will last six months, after which the facility will be evaluated. During the project, orthopaedic photos of endoprosthesis patients will be transferred to an orthopaedic reference database. There will be Pinja® digitisers and PC workstations at both ends. An ISDN-based video conferencing facility (384 kbit/s) has also been used alongside the ATM-based image transfer for consultation on the interpretation of the images (Juha Nevalainen 6.2.1996).

4. Proposals for further measures

1.

Research projects should be initiated to evaluate the effects and effectiveness of telemedicine applications compared with cases treated by conventional methods. The benefit derived by the patient in the savings on travelling time and costs must be allowed for in estimating the costs. Examples of areas where such evaluations could be carried out are the Satakunta region, the Lapland Health Centre Project, the Åland archipelago and North Karelia.

2.

In order to develop the technology, funds should be made available for research projects investigating the best way to ensure successful data transfer between different health care units, allowing for the needs of both the patient and the care personnel. The recent reports issued in Sweden on data transfer security (e.g. electronic signatures, and the verification of subsequent amendments to files and of the original text) should be exploited in planning research projects. There is a particular need for a pilot project using a smart card system in which the smart card is the patient's sickness insurance card and the identification cards of the health care personnel. Used together, they would grant access to all the health care information systems outside the organisation treating the patient at that moment.

3.

Projects should be promoted that enhance the international exchange of knowledge in the field of telemedicine. The primary task should be to provide expert assistance on the use of telemedicine applications in the neighbouring countries (Sweden, Norway, Estonia and Russia). The universities of Tromsö, Umeå, Turku and Tartu have, among others, expressed their interest in multi-country cooperation. By installing video conferencing units and ISDN lines the partners could be in daily contact and could use the facility in, particularly, personnel training.

4.

Expert exchange should be promoted between Finland and other telemedicine pioneers (such as the USA, Canada, France, the UK and the other Nordic countries). The Finns could thus ensure that their expertise is constantly updated in this rapidly developing field.

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Appendix

6.1. Persons interviewed

ADP Manager Matti Aarnio, Jorvi Hospital
Medical Director Pekka Karma, Helsinki University Central Hospital
Professor Carl-Gustaf Standertskjöld-Nordenstam, Helsinki University Central Hospital, Department of Radiology
Chief Specialist Kaarle Franssila, Helsinki University Central Hospital, Department of Oncology
Docent Stig Nordling, University of Helsinki, Department of Pathology
Chief Physician Krister Höckerstedt, Helsinki University Central Hospital, Department of Surgery
Administrative Physician Jorma Lauharanta, Helsinki University Central Hospital
Specialist Sören Bondestam, Helsinki University Central Hospital, Department of Radiology
Research Professor Pekka Karp, STAKES, FinOHTA
Clinical Physicist Veli-Pekka Poutanen, Helsinki University Central Hospital
Chief Physician Timo Leiviskä, Helsinki City Hospital
Professor Martti Kormano, Turku University Central Hospital, Department of Radiology
Medical Director Kalevi Lauslahti, Varsinais-Suomi Hospital District
Professor Erkki Tammisalo, University of Turku, Department of Dentistry
Medical Director Pentti Rantanen, Satakunta Central Hospital
Docent Pekka Loula, Tampere University of Technology, Pori Unit
Medical Director Veikko Mäkelä, Kanta-Häme Central Hospital
Chief Physician Timo Paakkala, Tampere University Hospital
Specialist Juha Nevalainen, Tampere University Hospital
Project Manager Rauno Veneranta, Finnet Group
Hospital Engineer Juha Aalto, Tampere University Hospital
Chief Physician Martti Soiva, Päijät-Häme Central Hospital, Department of Radiology
Medical Director Jukka Savolainen, Kymenlaakso Central Hospital
Medical Director Matti Hannuksela, Lappeenranta Central Hospital
Chief Physician Raimo Suhonen, Mikkeli Central Hospital, Department of Dermatology
Chief Physician Markku Helle, Mikkeli Central Hospital, Department of Pathology
Chief Physician Paula Lahti, Mikkeli Central Hospital, Department of Radiology
Chief Physician Risto Karasto, Savonlinna Central Hospital, Department of Radiology
Medical Director, Project Manager Kai Kurki, Pohjois-Karjala Central Hospital
Medical Director Juhani Kärjä, Kuopio University Hospital
ADP Manager Yrjö Jokinen, University of Kuopio
Managing Director Aapo Immonen, Emervest Ltd
Head of Department Matti Mattila, Kuopio University Hospital
Professor Seppo Soimakallio, Kuopio University Hospital, Department of Radiology
Chief Physician Jaakko Nyrhinen, Keski-Suomi Central Hospital, Department of Radiology
Senior Physician Jussi-Pekka Usenius, Keski-Suomi Central Hospital, Department of Radiology
M.D. Ilkka Kunnamo, Saarijärvi-Karstula Health Centre
Medical Director Aarno Särmö, Etelä-Pohjanmaa Central Hospital
ADP Manager Jaakko Rajala, Etelä-Pohjanmaa Central Hospital
Chief Physician Leo Keski-Nisula, Vaasa Central Hospital
Medical Director Heikki Aurekoski, Keski-Pohjanmaa Central Hospital
Deputy Chief Physician Jarmo Reponen, Raahe Regional Hospital and Oulu University Central Hospital, Department of Radiology
Medical Director Seppo Kemilä, Kainuu Central Hospital

Medical Director Olavi Heikkilä, Länsi-Pohja Central Hospital
Chief Physician Mikko Koivisto, Lappi Central Hospital
Medical Director Pauliina Kytölä, Utsjoki Health Centre
Provincial Medical Officer Aino Snellman, Provincial Government of Lapland
Medical Director Anders Fagerlund, Åland Central Hospital
Docent Kalevi Katevuo, Magneetti-Pulssi Ltd

6.2. Telemedicine connections in Finland (January 1, 1996)

Connections	Speciality	Beginning year
Helsinki (Malmi) - Helsinki (Maria)	radiology	1995
Helsinki - Oulu	radiology	1995
Helsinki (Orton) - Tampere	orthopedy	1995
Helsinki - Turku (priv.)	radiology	1995
Helsinki (priv.) - Utsjoki	general practice	1995
Joensuu - Lieksa		1996
Kaarina - Turku (priv.)	radiology	1995
Kajaani - Oulu	radiology	1995
Kangasala (Pikonlinna) - Tampere	radiology	1991
Kauhajoki - Seinäjoki	general practice	1995
Kokkola - Turku (priv.)	radiology	1994
Kuopio - Joensuu	radiology	1991
Kuopio - Jyväskylä	radiology	1985
Kuopio - Mikkeli	radiology	1993
Kuopio - Savonlinna	radiology	1990
Kuusamo - Oulu	psychiatry	1994
	radiology	1991
Lahti - Tampere	radiology	1994
Lappeenranta - Turku	radiology	
Loimaa - Turku		1995
Mariehamn - Bornholm		1995
Mariehamn - Gotland		1995
Mariehamn - Stockholm		1995
Mariehamn - Turku	dermatology	1996
Mariehamn - Turku	pathology	1996
Mariehamn - Uppsala		1995
Meilahti Hospital - Töölö Hospital	radiology	1994
Mikkeli - Mäntyharju	dermatology	1995
Mikkeli - Tampere	pathology	1994
Oulaskangas Hospital - Oulu	radiology	1995
Oulu Institute for Health Care Education - Päivärinne Hospital	nursing science	
Oulu - Raahe	radiology	1992
Oulu - Turku (priv.)	radiology	1995
Paimio - Turku	radiology	1991
Parkano - Tampere	radiology	1996
Pori - Rauma	pathology	1996
Pori - Tampere	clinical neurophysiology	1995
Pori - Turku	radiology	1995
Pori - Turku	nursing science	1995
Raisio - Turku		1995
Utsjoki - Rovaniemi	nursing science	1995
Salo - Turku		1995
Turku - Utsjoki	general practice	1995
Turku - Utsjoki	teledermatology	1995

Turku - Utsjoki	radiology	1995
Turku - Utsjoki	paediatrics	1995
Turku - Utsjoki	internal medicine	1995
Turku - Uusikaupunki		1996

6.3. Telemedical centres in Finland (January 1, 1996)

Place	Organisation
a) Health care units	
Helsinki	Helsinki University Central Hospital, Töölö Hospital
Helsinki	Helsinki University Central Hospital, Meilahti Hospital
Helsinki	Magneettimehiläinen
Helsinki	Helsinki City, Maria Hospital
Helsinki	Helsinki City, Malmi Hospital
Helsinki	Orton Hospital
Joensuu	Pohjois-Karjala Central Hospital
Jyväskylä	Keski-Suomi Central Hospital
Kaarina	Kaarina Health Centre
Kajaani	Kainuu Central Hospital
Kangasala	Pikonlinna Hospital
Kauhajoki	Kauhajoki Health Centre
Kokkola	Kokkolan Magneetti
Kuopio	Kuopio University Hospital
Kuusamo	Kuusamo Health Centre
Lahti	Päijät-Häme Central Hospital
Lappeenranta	Etelä-Karjala Central Hospital
Lappeenranta	Saimaan Magneetti
Lieksa	Lieksa Health Centre
Mariehamn	Åland Central Hospital
Mikkeli	Mikkeli Central Hospital
Muhos	Päivärinne Hospital
Mäntyharju	Mäntyharju Health Centre
Oulainen	Oulaskangas Hospital
Oulu	Oulu University Central Hospital
Oulu	Magneetti-Botnia
Paimio	Paimio Hospital
Parkano	Parkano Health Centre
Pori	Satakunta Central Hospital
Raahe	Raahe Regional Hospital
Raisio	Raisio Regional Hospital
Rauma	Rauma Regional Hospital
Salo	Salo Regional Hospital
Savonlinna	Savonlinna Central Hospital
Tampere	Tampere University Hospital
Turku	Tesla-Vagus
Turku	Magneetti-Pulssi
Turku	Turku University Central Hospital
Utsjoki	Utsjoki Health Centre
Uusikaupunki	Vakka-Suomi Hospital

b) Educational units

Helsinki	Helsinki Institute of Nursing
Helsinki	Helsinki City, Maternity Hospital
Helsinki	Helsinki IV College for Health Care Professionals
Kajaani	Kajaani Institute for Health Care Education
Kemi	Kemi Institute for Health Care Education
Kokkola	Kokkola Institute for Health Care Education
Kotka	Kotka Institute for Health Care Education
Lappeenranta	Lappeenranta Institute for Health Care Education
Oulu	Oulu Institute for Health Care Education
Pori	Pori Institute for Health Care Education
Rovaniemi	Lappi Institute for Health Care Education

c) Others

Espoo	University of Technology
Pori	University of Technology
Tampere	FinnMedi

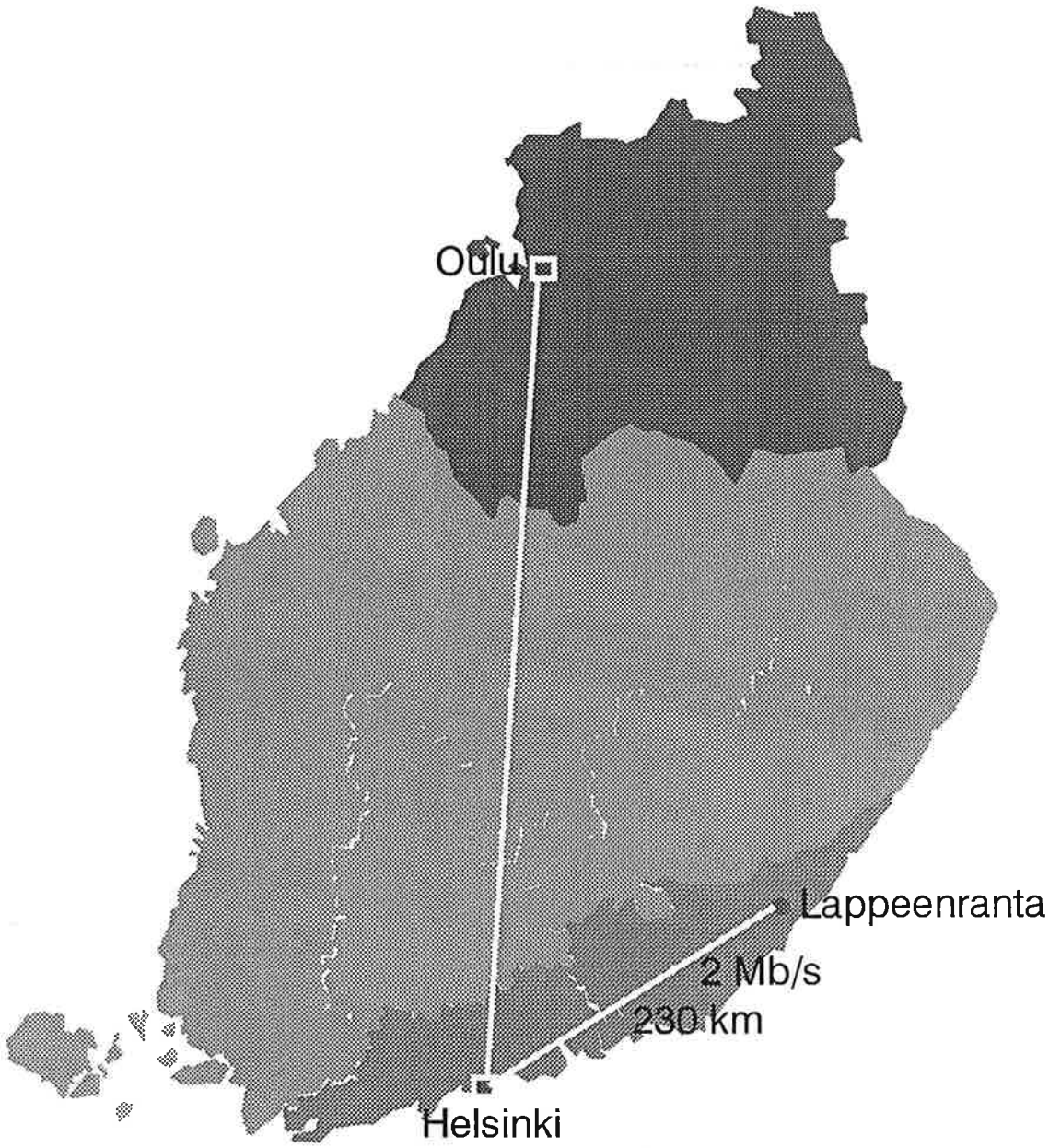

Figure 1. Telemedicine connections of Helsinki University Central Hospital

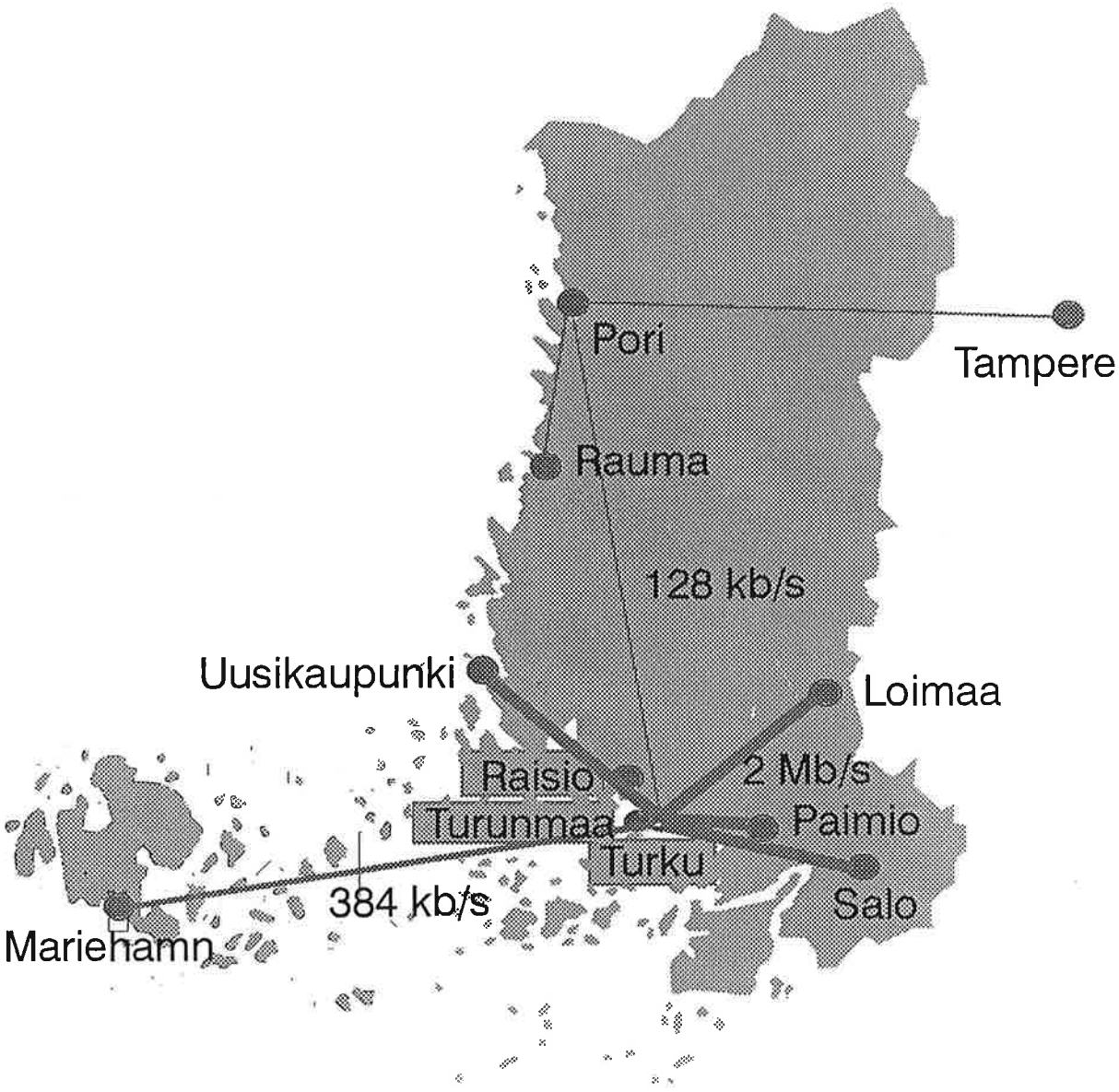

Figure 2. Telemedicine connections of Varsinais-Suomi Hospital District

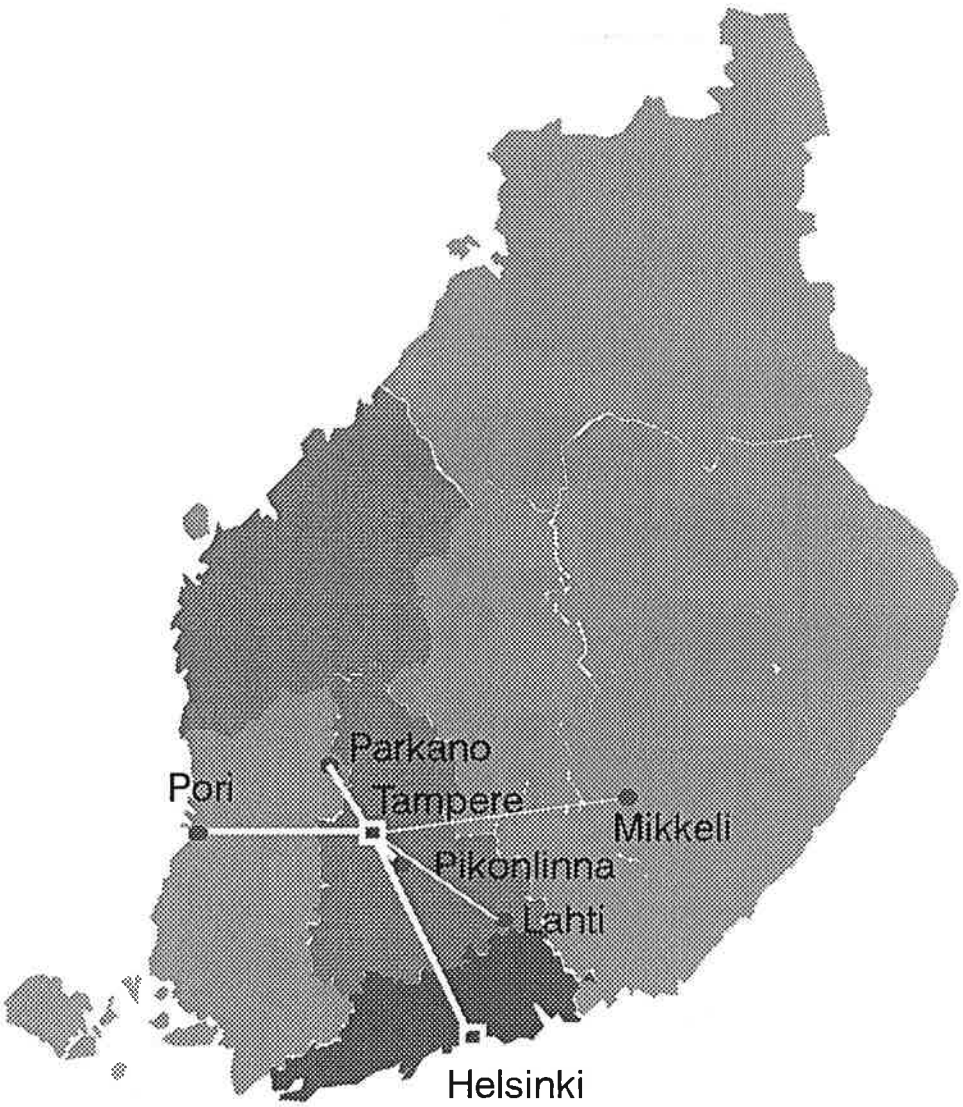

Figure 3. Telemedicine connections of Pirkanmaa Hospital District

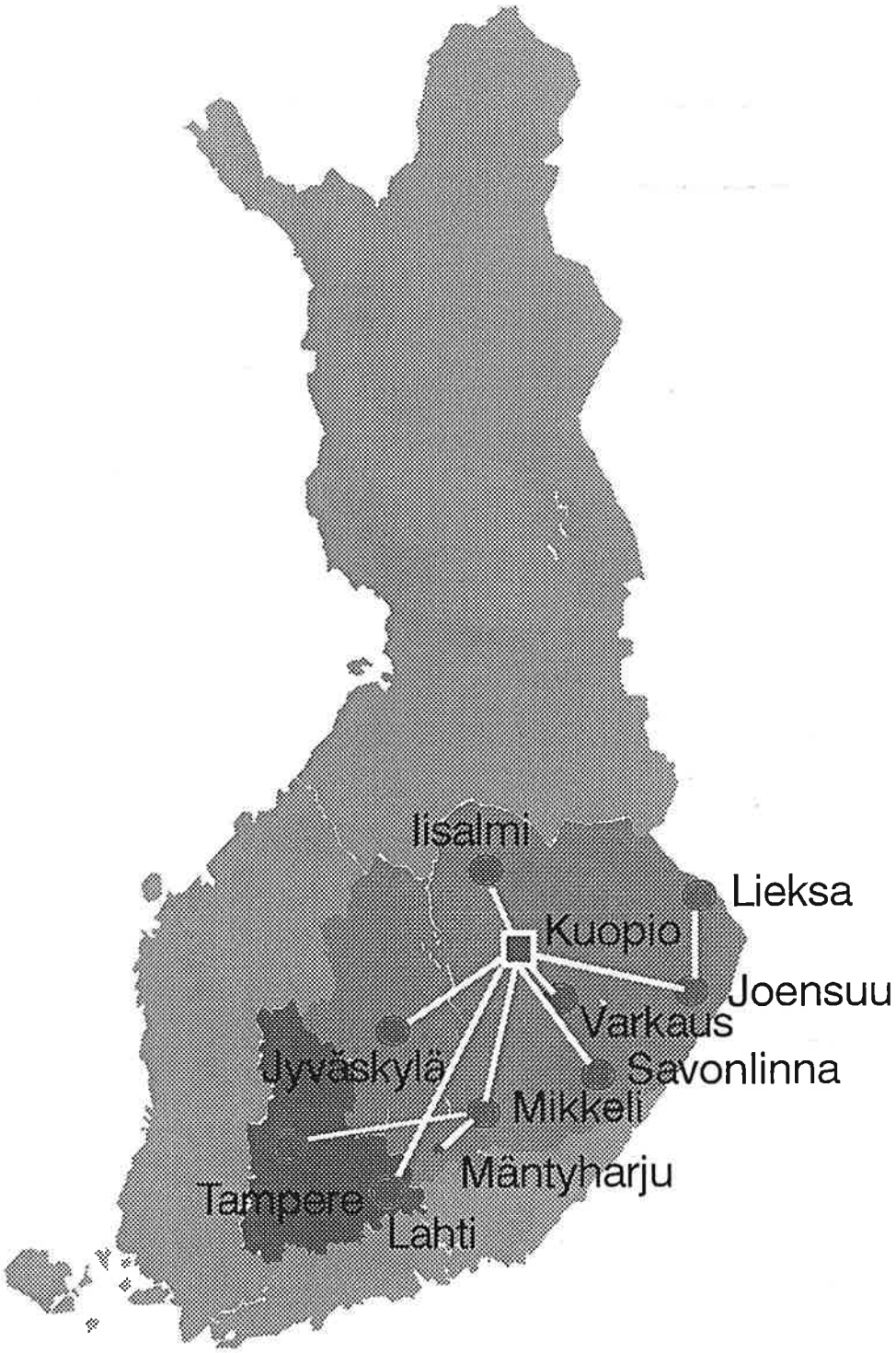

Figure 4. Telemedicine connections of Pohjois-Savo Hospital District

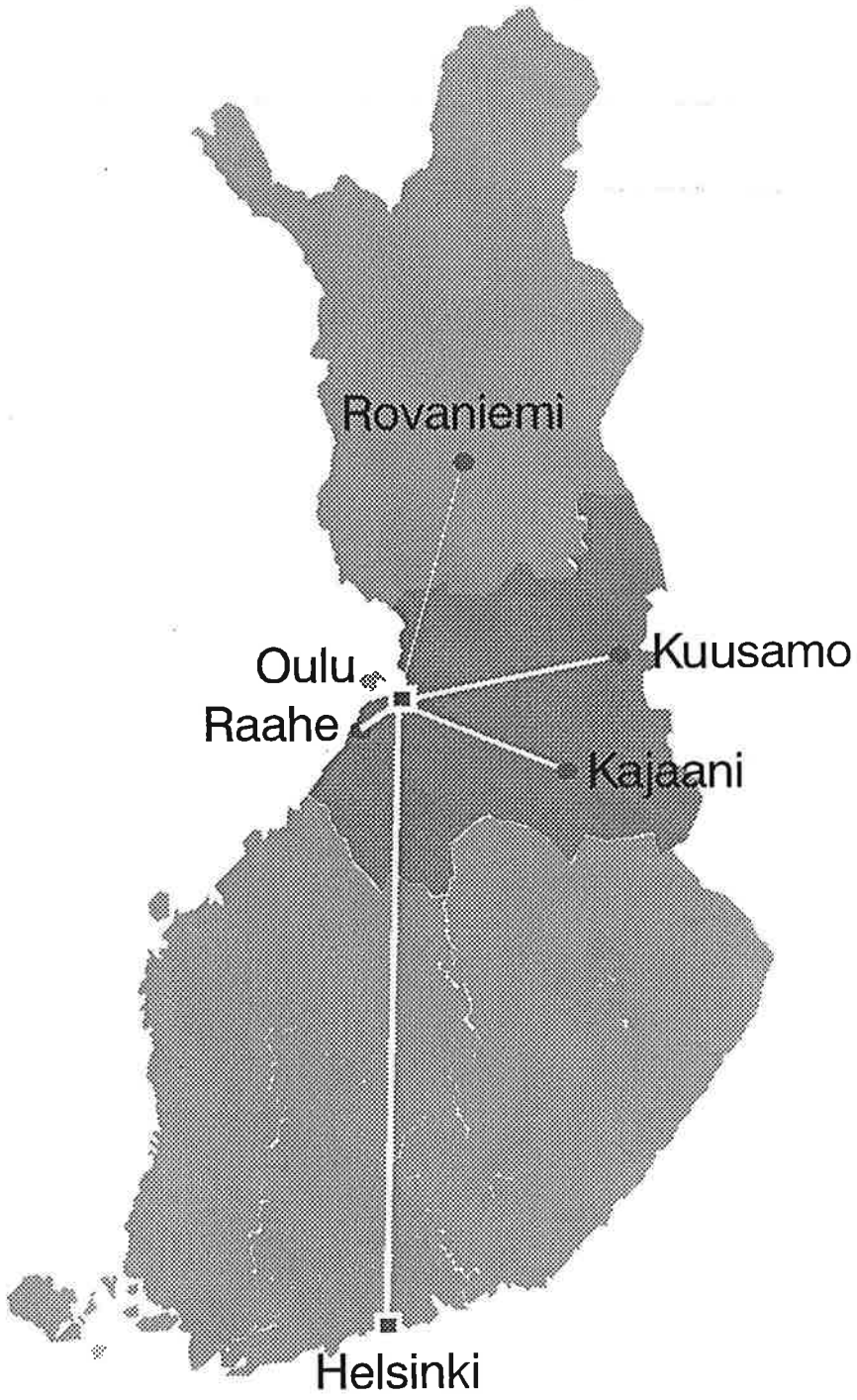

Figure 5. Telemedicine connections of Pohjois-Pohjanmaa Hospital District

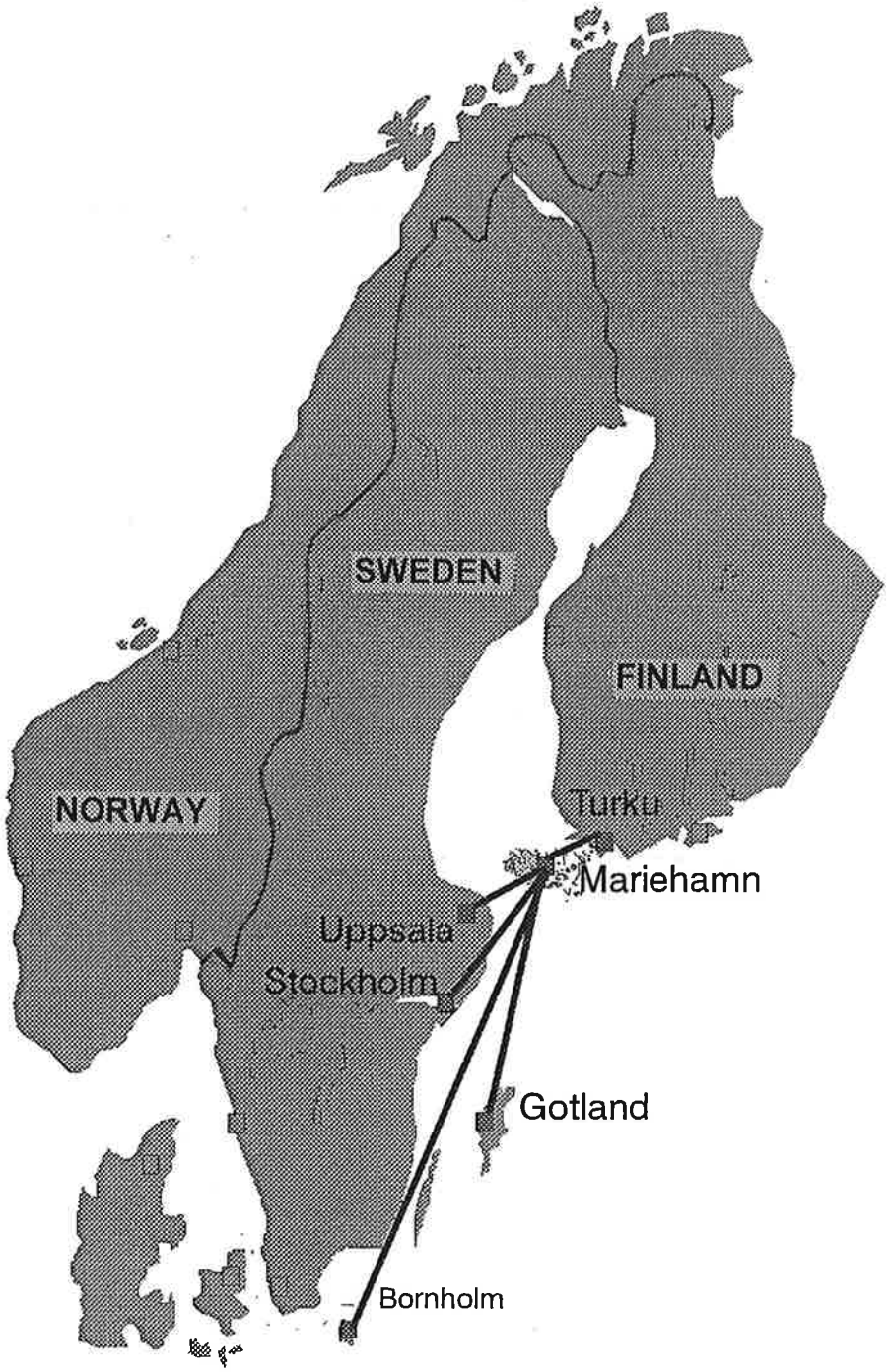

Figure 6. Telemedicine connections of Åland

Terveydenhuollon menetelmien
arviointiyksikkö

Finnish **O**ffice for **H**ealth Care **T**echnology **A**ssessment

The goal:
To promote effectiveness and efficacy in Finnish health care.

The modes of operation:
* To collect, analyse and synthesise
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* To promote national assessment studies both in quantity and quality.

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