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Title of the Deliverable:

Evaluation of the Lithuania demonstrator

Work-Package contributing to the Deliverable:	WP09 – Setup and development of Lithuania demonstrator
Nature of Deliverable ** :	Report (RE)
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Abstract:

The description and illustration of the telemedicine services implemented in Lithuania at four validation sites for medical applications in echocardiography and angiography are presented. The material consists of the three main parts:

1) a description of the state at the validation sites before the SAMTA project was started;
2) the goals of the validation sites for implementing the SAMTA results,
3) the evaluation of the SAMTA project application software at the validation sites, emphasising its telemedical possibilities on narrow-band networks, which are typical for rural hospitals.

Keyword List: Telemedicine, narrowband, implementation, echocardiography, angiography

* Type: PU - public, LI - limited, RP - restricted

** Nature: PR - Prototype, RE - Report, SP - Specification, TO - Tool, OT - Other

EXECUTIVE SUMMARY

The state of four Lithuanian validation sites, which implemented telemedicine services developed by the SAMTA project, is analysed. Medical applications of the SAMTA project were carried out in the field of echocardiography and angiography. The scaleability of the application software for the networks of different bandwidths was demonstrated. The narrow-band dial-up networking is the most “uncomfortable” mode for telemedical trials. However, it is the most frequent case in rural hospitals nowadays. All Lithuanian validation sites have carried out Telemedical trials in narrow-band networks.

Image compression techniques play considerable role when transmitting information through the narrow-band channels. Some wavelet classes were investigated and suggested for medical image compression (Deliverable D04.1). It was proved that wavelet transform considerable outperforms JPEG standard. For some wavelet classes the compression ratio for medical images is twice better than it can be achieved by the JPEG technique for the same compression quality. The results of medical image compression quality were approved by physicians in clinical environment (Deliverable D10.1).

CONTENTS

1. INTRODUCTION

During the SAMTA project the validation sites had undergone a lot of organisational changes (separated and merged again, changed the titles, etc.). Due to restructurisation and other re-arrangements of Lithuanian health care system it is rather difficult to trace all the changes. On the other hand, the key persons and their activities remained the same. Therefore, below we will refer to:

- Kaunas validation site (instead of writing the Kaunas Cardiology Institute and Cardiology Clinic
- Vilnius validation site (as abbreviation of Vilnius University Emergency Hospital),
- Elektrenai validation site (to prevent a misunderstanding, as the former Elektrenai Rehabilitation hospital was renamed to Abromiskes sanatorium. The latter is near the village Abromiskes of the Elektrenai region),
- Palanga validation site (to shorten the long name of Palanga Institute of Psycho-Physiology & Rehabilitation – PIPPR).

1.1 Motivation

It was foreseen according to the plan of the SAMTA project to present the results of the WP09 (Setup and validation of Lithuania demonstrator) in this deliverable. The scaleable application software developed by our project consortium may be used over the wide range of network technologies (from narrow-band dial-up modem connection up to broad-band networks). These possibilities were tested and demonstrated for representatives of the validation sites. However, the narrow-band communication channels are typical for majority of rural health care institutions in Lithuania (and in all the European countries, perhaps). Such channels invoke many problems trying to implement telemedical services there. Therefore, a special attention was paid to trials performed in narrow-band networks. Results of such trials are summarized in this deliverable (chapter 4.3).

Information transmission speed highly depends on its compression. The results of investigation of image compression techniques, which were used and evaluated by the Lithuanian validation sites, are presented in the Deliverable D04.1. Then the methods of mathematical statistics were applied to evaluate the compression ratio acceptable by physicians for medical image quality. It was based on the experiment in the Lithuanian validation sites when the angiologists valuated compressed image quality straightforward and the echocardiologists carried out some measurements on the compressed images. The results on an estimation of acceptable compression ratio by the Lithuanian validation sites are presented in the Deliverable D10.1.

All deliverables are interrelated. Therefore, we will present here the progress of demonstrators of the Lithuanian validation sites from the technical and medical point of view. Four medical institutions (mentioned above) validated the results of the work packages of the SAMTA project in a clinical environment. Wide area connections were based on dial-up telephone lines with modems and narrow band Internet channels. The trials between Kaunas, Vilnius, Elektrenai, and Palanga had been carried out.

1.2 Glossary

The following terms and abbreviations are listed and described in order to facilitate the reading of this document:

AS-ERH	Abromiskes Sanatorium (the former Elektrenai Rehabilitation Hospital) - one of the validation sites of the SAMTA project. Short nickname - **Elektrenai validation site**.
CAD	Coronary Artery Disease
DICOM	Digital Imaging and Communication in Medicine - a standard [8] for medical imaging.
DUN	Dial-up networking
ECG	electrocardiogram
KIC-KCC	Kaunas Institute of Cardiology and Cardiology Clinic - the main validation site of the SAMTA project. Short nickname - **Kaunas validation site**
KMU	Kaunas Medical University
KTU	Kaunas University of Technology
LAN	**Local Area (computer) Network**
LITNET	Lithuanian Academical and Research Network. The LITNET Network Operating Centre (NOC) is run by and located in the Kaunas University of Technology.
MMLAB	Image Processing and Multimedia Research Laboratory at the Kaunas University of Technology - the SAMTA project partner
PIPPR	Palanga Institute of Psycho-Physiology & Rehabilitation - one of the validation sites of the SAMTA project. Short nickname - **Palanga validation site**.
pts	patients
VUEH	Vilnius University Emergency Hospital - one of validation sites of the SAMTA project. Short nickname - **Vilnius validation site**.
WAN	Wide area (computer) network

2. SITUATION BEFORE SAMTA

After regaining independence in 1990 the Lithuanian health care system has been changing for the more and more optimal model of health care delivery for patients. The health care institutions involved in the SAMTA project as validation sites have been subjected to structural and organisational changes. In this chapter the previous state of the Lithuanian validation sites (i. e before the SAMTA project) is presented.

2.1 Introduction of the validation sites

2.1.1 Kaunas validation site: organisational structure, medical resources

The Kaunas Institute of Cardiology (KIC) together with the Kaunas Cardiology Clinics (KCC) has been the main validation site of the SAMTA project in Lithuania. MD habilitatis A. Lazaravicius (the Lithuanian well known specialist in the field of echocardiography) suggested to include the KCC as the main validation site in 1996, when the proposal for SAMTA project had been started to prepare. His doctoral student R.Jurkevicius (now he is a MD) worked at the KIC until the year 2000. Then recently he joined the KCC and has a position of a researcher at the KIC as well.

Prof. R.Navickas (the main specialist of interventional radiology in Lithuania) has his position at the Radiology Clinic and at the KIC too. His activities are related to angiography / coronography, i.e. the field of interest of the KIC and KCC corresponding departments.

The KIC has been the largest Lithuanian research and education institution in the cardiology domain, and the health care services provider with cardiology and cardiac surgery clinics. Patients after treatment and short follow-up from there have been transferred for rehabilitation. Two rehabilitation centres (see chapters 2.1.3. and 2.1.4. bellow) have been the validation sites of the SAMTA project as well.

The Institute of Cardiology has been a governmental institution, where the research and treatment are carried out. The Institute of Cardiology was established in 1969. In 1997 there were 225 employees, among them 127 researchers (27 professors and 50 MD). Among them there are physicians, chemists, biophysicists, mathematicians and programmists.

The main goals of the Institute of Cardiology have been:

- to develop research in fundamental, preventional, clinical and invasive cardiology;
- to train specialists and to promote researchers;
- to help with research publications, course- books, manuals and by organising conferences, symposiums and other events;
- to help implementation of the newest research and treatment techniques in the Lithuanian health care institutions.

The Cardiology Clinics at the Kaunas University Clinics was established in 1990. In 1997 it had 7558 patients, among them 600 patients with sudden heart attacks. The average stay in the department has been 10.3 days per patient.

The Cardiology Clinics has had close contacts with the following departments of Institute of Cardiology: experimental cardiology; preventive cardiology; clinical cardiology; invasive cardiology; rehabilitation; X-ray and Biochemical laboratory; Treatment automation laboratory.

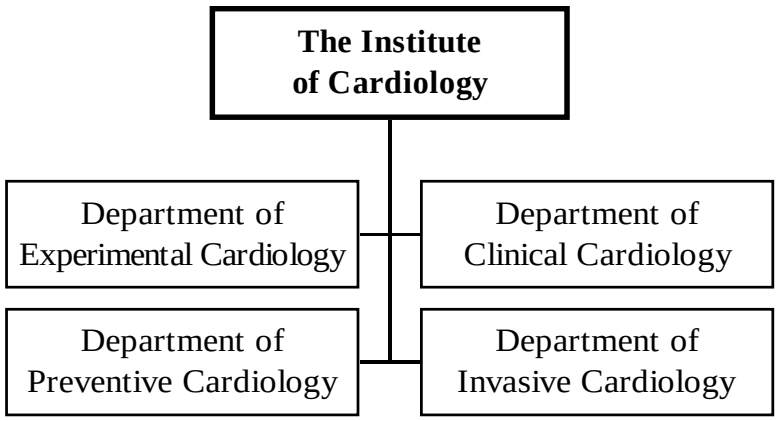

Figure 2.1-1 The structure of the Institute of Cardiology

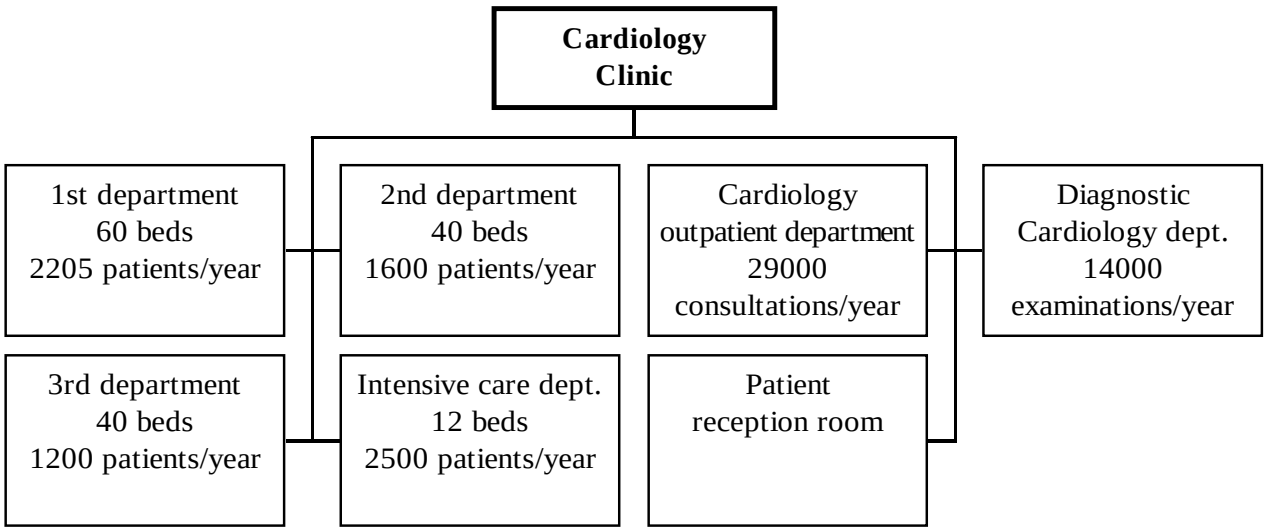

Figure 2.1-2 The structure of the Cardiology Clinics and its medical resources

The **department of diagnostic cardiology** has been carrying out analysis of ECG, echocardiograms and other information from diagnostic equipment. Five physicians belonged to this department (one professor and one MD). There were two up-to-date echocargiographs.

During a year different echocardiographic examinations have been carried out there:

- 150 transesopfageal echocardiographic examinations;
- 30 intraoperative echocardiograms;
- 100 stress echocardiography.

The department has been functioning round the clock.

The department of diagnostic cardiology has been used as a teaching bases for students and for upgrading physicians.

The research field of the department has included the investigation and evaluation of:

- the left ventricular function;
- the mitral annulus motion;
- myocardial viability;
- mitral regurgitation before the surgical plastic.

2.1.1.1 Technical resources of the KIC and KCC

The KIC-KMU was equipped with two out-of-date ultrasound scanners (Kontron and Toshiba without DICOM output. Therefore, movie capture PC plug-in board was planned to be used for acquisition of echocardiographic images sequences.

The internal computer network was based on 10Base2 backbone and was used mostly for research. IC-KMU was connected to LITNET (InterNet) by 2 Mbps radiolink (before the SAMTA).

2.1.1.2 Local and external co-operation/ exchange

There was no electronic data interchange implemented for diagnostic images at the Kaunas Institute of Cardiology and Cardiology Clinic before the SAMTA project started. However, MD habilitatis A.Lazaravicius supported the idea of electronic data interchange for echocardiography needs in 1996.

2.1.2 Vilnius validation site

Vilnius University Emergency Hospital (VUEH) was established in 1991. It has served as umbrella for different departments of Vilnius University Faculty of Medicine. The VUEH has been a tertiary level health care services provider.

2.1.2.1 Structure of the VUEH and medical resources

There has been several clinics and departments in VUEH:

1) Anaesthesiology and Reanimatology Clinic;
2) Clinic of General Surgery (consists from Abdominal Surgery, Urology and Gynaecology Departments);
3) Neuroangiosurgery Clinic (consists from Neurosurgery, Neurology and Vascular Surgery Departments);
4) Toxicology Department;
5) Traumatology, Orthopaedics and Microsurgery Clinic;
6) Radiology and Radiosurgery Departments;
7) Diagnostic Department (sonography, endoscopy, electrocardiography, electroencephalography, functional investigations of cardiopulmonary system);
8) Clinical, biochemical, immunological and microbiological laboratories.

The Clinic of General Surgery was founded in 1990. At the same time the new Vilnius University Emergency Hospital was founded. In 3 September 1990 according to the order of Vilnius University Rector the previous Surgery Department of Vilnius University Faculty of Medicine was divided into three new clinics: 1) Clinic of Traumatology- Orthopedics; 2) Clinic of Surgical diseases; 3) Clinic of General Surgery.

The Clinic of General Surgery belonged to the Vilnius University Emergency Hospital. Recently 35 physicians of various specialities have been working in this clinic: general surgeons, gynaecologists, urologists, and internists. The main fields of clinical activity included diagnosing and treatment of surgical diseases, teaching of medical students and residents, scientific work, training of pre-certificated and certificated physicians, the development of modern scientific medicine and it's applicability into the general practice, the assurance of highly qualified and specialised health care service to the Lithuanian people.

There have been 158 places for urgent abdominal surgery, gynaecology and urology patients. The main goal was to provide a proper urgent medical help for citizens of Vilnius. Every year more than 7000 patients are admitted to the clinic, more than 5000 operations are performed, 70% of them are urgent abdominal surgery, gynaecological and urological operations. Operating activity is 67-68 %. Every year the mean duration of hospitalisation time has been slowly decreasing (1996 - 8,2 days, 1997 – 7,5 days, 1998 – 6,8 days).

The Clinic of General Surgery takes a leading place in developing the minimal invasive surgery:

Laparoscopic cholecystectomy, laparoscopic hernia's repair, appendectomy, fundoplication, adhesiolysis, diagnostic endoscopy and laparoscopy, gynaecological laparoscopy, percutaneous nephrolithotripsy and so on. The Lithuanian Society of Minimal Invasive Surgery, that was founded due to the great activity of the Clinic physicians, have organised many national and also international seminars and conferences. Minimal invasive surgery makes 70 % of all operations for treatment of patients with gynaecological and urological diseases.

Educational work in the Clinic has been carried too: the third year students of general medicine and also students of paediatric, stomatological specialities study the course of introduction to the surgery, fourth year students study the course of urgent surgery. The Clinic of General Surgery has been the main clinic of surgical residency, especially training in urgent surgery. Annually two weeks courses of urgent surgery and minimal invasive surgery have been organised.

The main scientific research interests have included the minimal invasive surgery and the surgery of urgent abdominal diseases. In eight years 2 books, more than 155 scientific articles and references in various Lithuanian and foreign journals have been published.

The clinical physicians have been the active members of various Lithuanian and foreign scientific Societies.

The Clinic of General Surgery has been maintaining good friendly relationships with Surgery Clinic of Kristianstadt Hospital (Sweeden), Urological Clinic of Diusseldorf University Hospital (Germany), Clinic of General Surgery Bergen University Hospital (Norway).

The SAMTA project partner physician Aleksandras Uzkalnis has been working in the department of the Vilnius University Emergency Hospital. Aleksandras Uzkalnis is the high skilled surgeon, and he is fluent using echoscopic, endoscopic diagnostic equipment as well as computers in his work. This was the reason to invite him as the main partner from the validation site of the Vilnius University Emergency Hospital.

2.1.2.2 Technical resources

There were about 70 PCs, connected in local computer network with direct on-line Internet possibility at the Vilnius validation site (there are about 100 PCs now). The main hospital data base was made on the Clarion DOS version basis and enabled to collect patients passport data, investigations results and surgery protocols. The archives of medical images could not be formed within this database .

Its LAN has been based on 10Base2 backbone. The old "home-made" hospital information system (HIS) has Clarion – based and it is still running, but its support is not available anymore.

The Vilnius validation site was equipped with out-of-date ultrasound scanners by Toshiba without DICOM output. An endoscopy system has been used there. It had no output to store endoscopy movies on a PC Therefore movie capture PC plug-in boards were planned to be used to acquire echocardiographic and endoscopic image sequences.

2.1.2.3 Local and external co-operation/ exchange

There was no electronic data interchange implemented for diagnostic images before the SAMTA project at the Vilnius validation site.

2.1.3 Elektrenai validation site : organisational structure, medical resources

The Abromiskes Sanatorium (the former Elektrenai Rehabilitation Hospital) is located in the midway between Vilnius and Kaunas (approximately 50 km from both sides.) in the rural region. The cardiological patients after treatment or surgery are directed there.

Rehabilitation centre in Abromiskes is the oldest one in the Lithuania. It was established in 1980 as a Clinic for the Institute of Heart and Vascular pathology.

After its reorganisation in 1998, the rehabilitation centre has 380 beds.

The centre consists of :

- department of cardiology,
- first department of neurology,
- second department of neurology,
- section of Traumatology and artrology.,
- department for children with diseases:
- neurologics, traumatologics and ophthalmotologics.

The attitude to rehabilitation has been changing. The physicians have to keep up with the newest medical technologies and the information of medical databases. There has been a joint team in the rehabilitation centre. The team includes physicians of different specialities. An original treatment scheme has been constructed for every patient according to his/her disease. A rather original scheme of treatment was constructed for patients with Parkinson disease.

The rehabilitation centre has licensed clinical laboratory. Heart ultrasound investigations have been carried out for every patient with heart disease. These data form background for developing original heart attack prediction system.

A patient has been treated according to the newest technologies and has been looked after attentively in any department of the rehabilitation centre.

2.1.3.1 Technical resources

The out-of-date ultrasound scanner without DICOM output has been used. There was simple Novell LAN connecting several PCs at the Elektrenai validation site.

2.1.3.2 Local and external co-operation/ exchange

There was no electronic data interchange implemented for diagnostic images before the SAMTA project at the Elektrenai validation site. However, due to influence of MD. A.Lazaravicius in 1996, the patient examination data exchange (together with images/ movies) were foreseen there.

2.1.4 Palanga validation site : organisational structure, medical resources

The Palanga validation site is located in the west part of Lithuania, at the Baltic seashore. The distance from Kaunas and Vilnius to Palanga is 250 km and 350 km accordingly.

The institute was established in 1992 on the Basis of Palanga Department of Institute for Cardiovascular Research of the Kaunas Medical Academy. The first steps in scientific research were started in 1969 when institution was formed as the department for rehabilitation of patients suffering from cerebrovascular disorders.

There are 124 co-workers at the Institute: among them there are 34 scientific researchers ,4 Dr. habilitatis , 7 Dr.

The main directions of scientific research have included :

1) At the area of psychophysiology:

a) Autonomic heart rate control and hemodynamics in healthy subjects and ischemic heart disease patients:
   i) Autonomic heart rate control and hemodynamics during individual sleep stages;
   ii) Autonomic heart rate control and hemodynamics during exercise tests;
   iii) Central nervous system control of heart rate and hemodynamics using informational test and relaxation;

b) Computerisation of cardiovascular testing

c) Biometeorology and human health:
   i) An experimental model of medical meteorological forecasting system;
   ii) An impact from biometeorological factors on cardiovascular system (mortality and morbidity from stroke in relation to biometeorology), possible mechanisms
   iii) involved - investigation of changes in cardiovascular function by means of functional testing.

2) At the area of rehabilitation:

a) Elaboration and implementation of Long-term Cardiac Rehabilitation Programme.

b) Elaboration and implementation of Stroke Prevention and Control Programme.

The field of interest of the project "Elaboration and implementation of long-term cardiac rehabilitation programme" has had some relations to the SAMTA project (from the medical point of view).

The goal of the Long-term Cardiac Rehabilitation Programme was elaboration of cardiac rehabilitation model for coronary artery disease patients (CAD pts), evaluation of its efficiency, preparation of recommendations for long-term secondary prevention programmes, including education of patient, his family and medical staff working at primary care level.

The structure of the Institute and medical resources

There have been three main departments at the institute:

1) Clinic of Cardiovascular Rehabilitation;
2) Laboratories:
   a) Cardiology,
   b) Clinical Physiology,
   c) Neurophysiology;
3) Department of Scientific Informatics.

The Clinic of Cardiovascular Rehabilitation was established in 1990. Cardiological patients after treatment or surgery are directed there. The patient examination data together with images/movies are prepared there.

Long-term programme for 272 CAD pts have been introduced mostly after acute myocardial infarction (157 pts) or coronary bypass surgery (30 pts). Individual rehabilitation programmes for everybody was prepared after identification of the main tasks and risk stratification based on the results of clinical investigation and cardiovascular testing. The programme involved symptom control, physical training, psychological support, secondary prevention, medication and educational curricula for patients and doctors from primary care level. Follow-up after 3, 6, 12 months period: 60.0% of pts carried out the programme fully, 37.3% - partially. Participation in the programme 85% of pts estimated it as positive. Improvement in functional status, symptom release, better control of hypertension and congestive heart failure, reduction of depression and anxiety, restoration of fitness and working ability have been established. Endpoints were as follows: 4 pts died, 3 pts had reinfarction. Return to work was in 76.3% of pts. Improvement of life quality was in 72.2% of pts. Quite strong correlation among changes of patients cardiovascular, physical and psychological state, and life quality self-estimation was demonstrated.

In-patient clinic (30 beds) has been for ischemic heart disease patients, especially after acute myocardial infarction complicated by heart failure and disorders of cerebral blood flow and peripheral vessels as well as cardiac patients after bypass surgery. Functional testing (active orthostatic test, bicycle ergometry, monitoring, etc.) for assessment of physical training level and cardiovascular functional reserve has been performed. Complex of physical, drug, and psychological treatment have been optimised for an individual patient. The efficiency of rehabilitation has been evaluated.

Patients have been undergoing gymnastic and callisthenics at the sport hall and/or at the sea beach, walks in botanical park and/or at the sea beach, massage, psychological relaxation procedures, rational diet etc.

2.1.4.1 Technical resources

A simple Novell LAN connected several PCs at the Palanga validation site before the SAMTA project started. . Switched (dial-up) modem lines were connected to LITNET (InterNet). The out-of-date ultrasound scanner without DICOM output was used .

2.1.4.2 Local and external co-operation/ exchange

There was no electronic data interchange implemented for diagnostic images at the Palanga validation site before the SAMTA project started. There was need for receiving echocardiographic images from a hospital, which sent a patient for rehabilitation.

3. PLAN, TARGETS

3.1 Organisational / medical / technical aspects

Digital data processing has been in use for several years in many Lithuanian hospitals. However, it typically has been performed locally without communication between hospitals, and even without communication between separate departments at the same hospital. This situation is slowly changing now because the need for inter-hospital communication and co-operation increases:

- the increasing costs of the health care sector enforce the necessity to share expensive equipment among hospitals in the same region or city and to avoid unnecessary patient transportation.
- the specialisation level of the physicians reached today requires permanent education and training as well as the possibility to consult experts for difficult cases.

Today the efficient wide area networks and the necessary infrastructure for them are available in Lithuania. Telemedicine is an application offering real solutions for existing problems:

- in case a patient is referred to another hospital for examination with expensive special equipment, the physicians can discuss the results and images via teleconferencing, avoiding unnecessary travel.
- the necessity of patient transportation to a specialised hospital in emergency cases can be discussed with the remote hospital in advance, avoiding unnecessary patient transports.
- physicians may consult experts in difficult cases (e.g. for a second opinion), thus increasing treatment quality.
- tele-consultation on a regular basis (e.g. mutual presentation of interesting cases) results in permanent training and education of the participating physicians.

It should be noted that the advantages mentioned above depend on the applying of telemedical services by the physicians in everyday life, which in turn depends on the ease of use, availability, reliability and functionality of any telemedical application. Therefore it was planed to validate the developed application software in clinical environment. Due to the fact that Lithuanian Heath Care institutions suffer from lack of funding, and that only inexpensive narrow-band communication channels are available for every physician, it was planed to start validation of the SAMTA application software using the latter channels. It should be noted that a similar state is in rural regions of the Western European countries.

The KTU team had experience using narrow band network for teleradiology in Lithuania. They have developed a computerised (PC based) workstation for diagnostic radiology. The workstation might be connected to any ultrasound scanner or to an X-ray system with standard video output (up to 625 lines of TV frame). Seven prototypes of the workstation were implemented at the main hospitals of Vilnius, Kaunas, Panevezys, Siauliai and Klaipeda. Telemedicine environment (with medical image transmission) over the dial-up (telephone line) network was implemented. The whole process of teleconsultation was divided into 3 stages: data packet preparation (data from the database (DB) along with digital images), data transmission through the communication channel, and data distribution within the radiological database management system. The system allowed to transmit up to 7 compressed images per minute (through a modem with 9600bps average speed). JPEG compression standard with compression ratio of 16 was proved to be acceptable for physicians when transmitting ultrasound images for diagnostic radiology.

The KTU MMLAB partner together with MD habilitatis A.Lazaravicius suggested to develop the next step of telemedicine applications towards the diagnostic cardiology in Lithuania. Inexpensive technique for grabbing cardiological ultrasound images in any stage of the heart cycle had been developed. It was based on synchronisation of the frame grabber from ECG signal. It allowed to grab and transmit a minimal amount of cardiological images, which represent sufficient diagnostic information about a patient. It was planned to transmit three types of a heart sections: everyone in systolic and diastolic states (in total: six images per patient). Such amount of images can be transmitted through narrow band channels. However, during the lifetime of the SAMTA project a lot of up-to-date video capture boards appeared in the market. Consequently, one of them (the MiroVideo DC-30) was chosen as a basic hardware plug-in board for the medical workstations on the PCs.

Mostly heart operations are performed at the Vilnius University hospital in Santariskes, at the Kaunas Medical University Clinics and at the Sailors' hospital in Klaipeda. After the operation the patients of Vilnius and Kaunas undergo treatment at the Abromiskes sanatorium (the former Elektrenai rehabilitation hospital in country side). The patients from Klaipeda undergo treatment at the Rehabilitation Centre of the Sailors' hospital and at the Institute of Physiology and Rehabilitation of the Palanga health resort. Patients being sent for rehabilitation have no images with them (neither before nor after the operation). There is demand for digital images with a report in digital form transmitted through any channel. Before the SAMTA started the rehabilitation centres had only dial-up telephone lines. Now Palanga validation site have in addition 2MB radio link for Internet communication, and Abromiskes sanatorium has Internet, connected through leased line to a local Internet provider.

One of the goals of the SAMTA project was the development of a prototype application, which would be integrated into a clinical environment at two „validation countries" (Hungary and Lithuania: four validation sites per each country). The validation sites would allow to test, evaluate and assess the project developments in „real" hospital environments.

One of the main targets was a **better health care delivery in areas without broadband access** (rural areas, CEC/NIS).
The SAMTA project aimed to improve the quality of health care delivery by integrating other disciplines: information technology, communications technology and medicine. The possibility to transmit patient related images and data quickly and efficiently over networks is available today. The „connectivity" to systems on more advanced networks allows to perform consultation of remote specialists in difficult cases and therefore might increase the „level of expertise" available to a patient at a remote hospital (e.g. in a rural area). For the physicians, evaluation of the diagnosis of disease just in time (due to teleconsultation) improves their efficiency of treatment. It helps to prolong patients' working capacity. On the long term, the integration of medicine and information technologies would have to stimulate further processes related to economics and education:

- production of means for telecommunications and computing
- creating working places for related services
- organising courses of studies for physicians

Planed Clinical Benefits
The demonstrator would cover much of the intensive data traffic related to patients with open heart surgery in the country. Images and patient related data would be quickly and easily available to rehabilitation centres via WAN connections. Patients with open heart surgery consume the most expensive resources in Lithuanian hospitals. Cardiovascular diseases are the most frequent reason for death in the country. A standardised exchange of discharge reports, findings and

images would improve the quality of the physicians' work. Having the required data available in time can save life and resources (e.g. duplication of tests can be decreased).

These benefits are important not only for Lithuania or Hungary. Heart surgery is a very resource consuming medical domain in other CEC/NIS and the EU countries as well. The opportunity to save resources by improving efficiency of treatment is acute for physicians all over Europe.

The connections to specialists for specific cases all over Europe (remote consultation) are of great demand. A scaleable telemedicine architecture could be the foundation of a European network of clinical competence. Current personal meetings and discussion at professional conferences could be vastly extended through the use of communication networks. Communications and Competence networks immediately benefit from the health care delivery.

According to the WP09 "Setup and validation of Lithuania demonstrator" it was planed to test the SAMTA project result in a clinical environment. Wide area connections would be based on narrow band channels. The four validation sites mentioned above were foreseen: in Kaunas, Vilnius, Elektrenai and Palanga.

Sequences of images representing a beating heart have been sent through narrowband channel in off-line mode. Two strategies for sending these images were foreseen:

1. during the day if the bandwidth between two medical institutions is 64kbps or greater ;
2. during the night if two medical institutions are connected using dial-up phone lines and modems.

The distance between Cardiological Clinics of Kaunas Medical University and Vilnius University Emergency Hospital is approximately 100 km. These institutions are connected to the LitNet (i.e. Internet subset) through channels with 64 kbps of bandwidth. The first strategy for sending medical motion pictures was planned to be used. After getting information at the receiver end, two physicians (one in Kaunas, another in Vilnius) would have the possibility to analyse the heart movements and to discuss pathology by phone.

The distance between Kaunas and Elektrenai is 50 km, and the distance between Kaunas and Palanga is 240 km approximately. Rehabilitation hospital of Elektrenai and Rehabilitation Centre at Palanga health resort have not been connected to Internet before the SAMTA project started. They are connected at the moment already there. There is a simple Novell LAN connecting several PCs at the Elektrenai validation site. Switched (dial-up) modem lines are used to connect to LITNET (InterNet).

Compressed ultrasound images of a heart motion were planned to be sent from Kaunas to Elektrenai and to Palanga via dial-up telephone lines with modems. Using a narrowband channel (less then 64 kbps) the images (corresponding to only one cycle of heart beatings) would be stored and compressed. A heart cycle lasts approximately one second. This compressed sequence of ultrasound images (a cine-loop) would be transmitted at night. Physicians at the receiver and the sender ends would have the possibility to watch cine-loops and to discuss pathology by phone next day or later on.

A minimal amount of cardiological images which represent sufficient diagnostic information about a patient's state should be used in trials through narrow-band channels. Three or four types of a heart sections (in systolic and diastolic states) would be sufficient to be transmitted through a dial-up telephone line. This forms six or eight images per patient.

3.2 Summary of the needs for local co-operation / exchange

3.2.1 The Kaunas validation site

There are needs for **local** communication for information exchange among the sections of the Cardiology Clinics and the departments of the Institute of Cardiology , and additional to them with the Cardiosurgery Clinics, which is headed by the MD. R.Benetis.

External communication for information exchange should be carried out :

- when a patient is sent to the rehabilitation centre at Abromiskes;
- when other health care institutions (for example University Emergency hospital in Vilnius) need teleconsultation;
- in emergency case for teleconsultation with other health care institutions in Lithuania (Vilnius, Klaipeda, Siauliai, Panevezys), when cardio and/or angio information has to be distributed among participants;
- the international teleconsultation is required:
    - at first with the Hungarian validation sites (for both echocardiography and angiography medical fields);
    - with Latvian physicians in angiography (Prof. Uldis Kalnins, director of the Riga Cardiology Institute (Latvia) expressed his interest to use the SAMTA application software: this information was received by Prof. R.Navickas);
    - with the Swedish, German medical centres.

3.2.2 The Vilnius validation site

There are needs for local communication for information exchange among the hospital departments.

Close external co-operation and information exchange is going to be carried out with:

- the Kaunas Institute of Cardiology and the Cardiology Clinics;
- Vilnius University Hospital in Santariskes;
- rehabilitation centre in Abromiskes;
- rehabilitation centre in Palanga;
- Surgery Clinics of Kristianstadt Hospital (Sweden);
- Urological Clinics of Diusseldorf (Germany);
- Clinics of general Surgery of the Bergen University hospital (Norway).

3.2.3 The Elektrenai validation site

The patient examination data exchange (together with images/ movies) was appreciated there.

There are needs for **local** communication for information exchange among the sections of the Abromiskes sanatorium.

External communication for information exchange should be carried out :

- with the Kaunas validation site (when a patient arrived from there);

The physicians would appreciate if some angiographic images were delivered to them following a patient from Kaunas or from Vilnius (there is no Angio diagnostic equipment at the Elektrenai validation site);

- with the Vilnius validation site and Vilnius University Clinic in Santariskes (when a patient arrived from there);
- with Palanga validation site (co-operation, information exchange);
- the international teleconsultation is required:
    - with the Hungarian sanatorium near Balaton (for echocardiography);

3.2.4 The Palanga validation site

There are needs for local communication for information exchange amongst the hospital laboratories and Rehabilitation Clinics.

Close external co-operation and information exchange is going to be carried out with:

- the Kaunas Institute of Cardiology and the Cardiology Clinics;
- the Seamen Hospital of Klaipeda (for echo stress test results);
- the Klaipeda City hospital and its departments: Stroke Prevention and Rehabilitation, Cardiac rehabilitation;
- the University of Klaipeda and its departments : Psychology and Informatics;
- the Clinical Physiology Institute of the Pisa University (Italy);
- the Newcastle General Hospital of the Newcastle University upon Tyne (UK).

4. SAMTA RESULTS

4.1 Organisational / medical / technical

The main results are presented in this chapter. It is worth to draw attention that the SAMTA project influenced the organisational, medical and technical state of the validation sites. A lot of experiments were performed during trials for sending medical images/ movies between validation sites.

The SAMTA trials and results **improved** an understanding of the telemedicine benefits at the validation sites. This is perhaps one of the most important achievements.

Some presentations were made during the SAMTA project partners meeting in Lithuania (15-17 June, 2000). The demonstrations of the SAMTA project results and applications were carried out during the International Conference/ workshop , which was held during the SAMTA meeting in Lithuania:

http://www.mmlab.ktu.lt/mmlab/SAMTA/

The same information is presented on Annex of this deliverable.

The following main presentations were made during the meeting:

- at the Vilnius University Emergency Hospital

- Angio system with analog output, using AVI to DICOM conversion from SAMTA application.
- CT system (Toshiba) with direct DICOM output.
- Demonstrated Endoscopy (Visible Light): video output grabbed with Miro Video DC30, and S3 graphics adapter of physician's notebook (image acquisition and DICOM'isation using SAMTA application).
- US machine (Siemens SONOLINE Prima).
- a hospital/department network (which started from ARCNET 10 years ago and now is Ethernet based).
- Sending image (657 KByte) to Kaunas (permanent connect through LitNet).
-

- at the Abromiskes Sanatorium

- US machine (Hewlett Packard), images stored on S-VHS tape, TV card used as frame grabber.
- Image received from Kaunas (incl. report).
- narrow-band connection to LitNet (typically only around 4.800-9.600 kBit/s; that time it was much better: 16.800 bps using the connection to local dial-up server of Lithuanian ISP "Omnitel").

- at the Kaunas validation site

- A new US machine (Hewlett Packard Sonos 5500); 4 different machines in the whole institute. MiroVideo capture card "DC 30" used for acquisition of US movies.
- Conversion AVI to DICOM (acquisition devices have no DICOM output – too expensive to enhance the devices.
- the newest Version of the SAMTA application.
- capturing colour movies of ¼ original image (full screen) size and playing them back on an old 486 PC.
- transmission over Ethernet (on a regular base: images plus reports).
- Angio machine (GE), ExaByte storage;

- GE machine having a direct DICOM output (port 4006 is used for DICOM communication over Ethernet), image data is sent uncompressed.

- at the Palanga validation site

- Oral presentations of the SAMTA partners (as part of the international conference / workshop "Good practice for Telemedicine") followed by discussion on telemedicine in general and the SAMTA.
- Presentation of the SAMTA application for some physicians from the Klaipeda region;
- Discussion on the needs for integration the SAMTA application software with existing database / information system at the Palanga validation site (this would be interesting for the physicians, also the support of signals (1D data). This should be implemented in the future (DICOM supports waveforms; supplement 30 – currently "letter ballot").
- Economical and legal issues of telemedical services (not yet solved in Lithuania).

4.1.1 Guidelines for the necessary computer resources

During the performance of tele-medicine trials the most important components of computer hardware have been found out. Due to enormous variety of computer components on the market only the guidelines can be specified:

- in order to ensure proper display and play-back of medical image sequences at real-time rate the amount of random access memory (RAM) should be sufficient to hold the operating system, the necessary software and the whole image sequence.

  E.g. a PC with MS Windows'95/98 operating system and the software developed under the SAMTA project should have the following amount of RAM in order to play-back the movies specified below:

X-ray angio movie	512*512 (8 bits), 12 frames/s, 4 s	RAM 32 M byte
greyscale ultrasound	786*576 (8 bits), 25 frames/s, 2 s	RAM 32 M byte
colour ultrasound	786*576 (24 bits), 25 frames/s, 1 s	RAM 48 M byte
colour ultrasound	786*576 (24 bits), 25 frames/s, 2 s	RAM 80 M byte

- in order to display images correctly, the screen resolution (therefore the display control hardware as well) should be capable to hold the whole image in true colour (24 bits/pixel) mode.

  E.g. the recommended resolution is: for 512*512 angiographic movies - at least 800*600; for 786*576 ultrasound movies - at least 1024*768.

4.2 Local co-operation /exchange/

The needs for cooperation are presented in the chapter 3.2. Using the SAMTA application software, physicians of all validation sites are able to fulfill the requirement for the needs. However, a lot of organisational and financial efforts should be added for a smooth and extensive usage of the results. For example, at the Vilnius validation site the Radiology, Radiosurgery and Diagnostic Departments were involved in SAMTA project. However, practically one person (young physician A.Uzkalnis, who knows computers very well and simultaneously takes part in activities of these departments) captured images during CT scan, angiographic images, sonographic and gastrointestinal endoscopic images/ movies. For this purpose he used the SAMTA application software "Sirdis". It enabled him exchange listed above images between different departments at the Vilnius validation site hospital, and with the partners in Kaunas, Palanga and Abromiskes.

However, other physicians of that hospital are only starting to understand benefits of the SAMTA project now.

4.3 Final network setup

The infrastructure of academic network of Lithuania (LITNET) was used as a base for the SAMTA project tele-medical trials. Three of four validation sites of Lithuania (i.e., the sites in Kaunas, Vilnius and Palanga) have permanent connections to the LITNET. The Lithuanian SAMTA partner KTU (i.e., Image Processing and Multimedia laboratory (MMLAB) of the Kaunas University of Technology) has broadband permanent connections to the LITNET, because the laboratory is not far away from the University Computer Centre, where the LITNET central node is installed. However, the Elektrenai validation site is in the rural region, and all the problems related to communication channels are very acute there. The narrow-band communication channels are typical situation for majority of rural health care institutions in Lithuania (and in all the European countries, perhaps). Thus, the Elektrenai validation site is good example of bad communication channels in rural regions. Moreover, a lot of patients are sent for rehabilitation to the Elektrenai sanatorium. This site uses dial-up modem connection over analog telephone line.

The general scheme of WAN (Wide Area Network) connections used during the final SAMTA validation phase is presented on Figure 4.3-1.

It should be worth underlining, that during the SAMTA project lifetime all the validation sites had improved computer networking facilities.

- The Kaunas (KIC-CC) and Vilnius (VUEH) validation sites had unreliable 2 Mbit/s radiolinks before the SAMTA project. Now they have the 10 Mbit/s fiber optic connections;
- The Palanga validation site (PIPPR) changed from dial-up connection to a permanent one;
- The Elektrenai validation site (AS-ERH) had only dial-up connection (ordinary phone lines) before the SAMTA project, and no Internet service provider was available in the region of Elektrenai. During the SAMTA project trials the Omnitel Company started their activities as Internet service provider in that region. Then, authorities of Abromiskes sanatorium gave a permission to set up the dial-up Internet service from that provider. Finally, at the end of the trials (after our repeated recommendations) the authorities made decision to order a leased line for permanent Internet connections in the future.

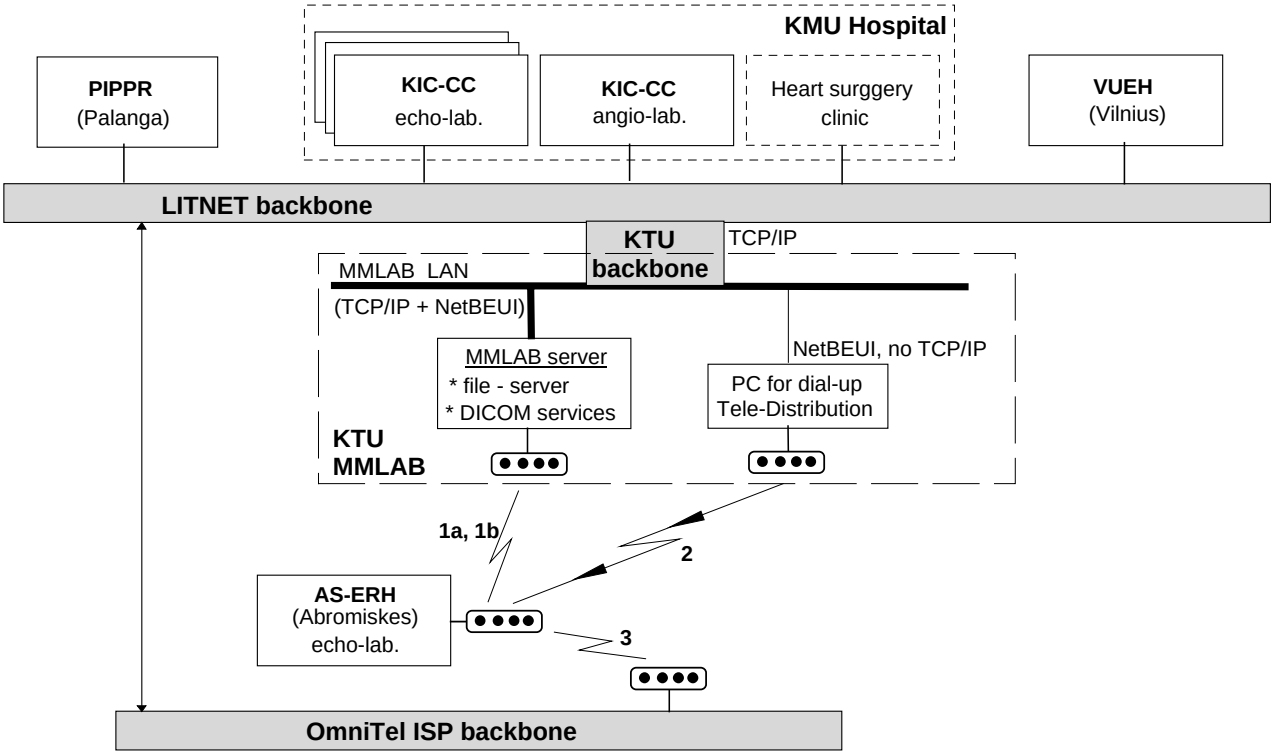

Figure 4.3-1 The WAN connections between the SAMTA validation sites in Lithuania at the final validation phase

Thus, we present a summary of telemedical trials in this chapter. A lot of experiments were performed transmitting echocardiographic and angiographic medical data through narrow-band communication channels using dial-up phone lines as well as permanent Internet connections.

The DICOM format data exchange over TCP/IP (Internet - type) networks was used for tele-medical trials.

The trials were performed in a Wide Area Network (WAN) using four (alternative) cases of communication channels:

1) *long distance calls through phone lines:*
   a) *direct calls between two sites;*
   b) *calls from the rural hospital to the server (computer) of a partner, where the "call-back" function was activated;*
2) *long distance calls through phone lines using intermediate provider of teledistribution service;*
3) *dial-up connections from rural hospital to local provider of Internet service (in the same city / region).*

The mentioned above cases are marked by symbols *1a, 1b, 2*, and *3* on fig.4.3-1 .

Tele-medicine trials (both tele-consultation and tele-distribution [1]) between the validation sites having permanent TCP/IP network connections and inside them were arranged quite effectively.

The DICOM data exchange over the dial-up TCP/IP connections is a special case due to peculiarities of dial-up Internet (i.e. dynamic IP assignment, temporal and not enough reliable connections). Therefore alternative ways of arranging the connection for the Elektrenai validation

site were tested (1a, 1b, 2, 3 - see Figure 4.3-1[1]) in order to optimise the efficiency of data exchange, the cost and cost sharing. We would like to underline, that Elektrenai validation site (Abromiskes sanatorium) serves here as an example of the so called " Dial-up networking" (DUN). Thus, the results described below represent situation at any rural hospital connected to Internet through dial-up phone lines.

1a *The direct long distance call through the dial-up connection to the tele-medicine partner*

Long distance call through the dial-up connection usually is less reliable than a local one. It operates at lower speed (4.8-9.6 K bit/s) than a local connection. The throughput of local connection usually is:

- 14.4 Kbit/s (minimum)
- 16.8-19.2 Kbit/s (average)
- 33.6-56 Kbit/s (maximum).

The cost is usually covered by the site, which initiates the connection. Therefore this approach suits better for tele-expertise service, when there is a need for the second medical opinion at the Dial-up networking site, i.e. at the rural hospital site.

During tele-distribution the data is transferred from medical centre (which is usually on-line site) to the rehabilitation hospital (Dial-up networking site). It is more essential to initiate the connection and to cover its cost by the on-line site. Unfortunately such an initiation does not comply with the hierarchical principles of computer network organisation, so the other solutions were tested (see description bellow).

1b *The direct long distance call through the dial-up connection from a rural hospital to a server of the tele-medicine partner where the call-back feature enabled*

Started as an approach to share the telecommunication costs more naturally, the call-back feature proved its efficiency only for local connections (i.e. in the same city or region). It was not reliable in the case of long distance calls.

2 *The direct long distance call through the dial-up connection to* ***intermediate*** *tele-distribution service* ***provider***

The most effective way of arranging a tele-distribution service is to use an intermediate server to store the transferable data temporarily. Such a server lets to schedule the data transmission for non-working hours when the telecommunication channels are much less loaded, operate at higher speed, and are more reliable. Unfortunately, the IP addresses automatically assigned for a temporal dial-up connection might be in conflict with the IP addresses of permanent connections. This issue can be easily solved using an additional computer, which accesses the temporal files on the intermediate server using any network protocol except TCP/IP, makes scheduled dial-up TCP/IP connections to a Dial-up networking site, and DICOM data exchange afterwards.

3 *Dial-up connection to local Internet service provider (ISP) combined with encrypted data exchange to a tele-medicine partner*

A rural hospital (Abromiskes sanatorium in our case) purchases the dial-up connection service from a local provider of Internet services. In case of Abromiskes sanatorium such a local provider was "Omnitel" company node in Elektrenai. Thus, Abromiskes sanatorium has to cover only local communication fees for getting teleconsultation from a partner

[1] The MMLAB was used as an example of "tele-medicine services provider" due to easily available and easy configurable facilities for the SAMTA project only.

situated far away from the sanatorium (i.e. from the Kaunas Institute of Cardiology). It should be underlined, that the Internet service for dial-up networking is inexpensive (~ 3-4 Euro/month). The price is fixed, if a user does not exceed certain amount of hours during his teleworking sessions.

As local dial-up connections are operating at higher speed (comparing with the long distance calls) the effect of network bottleneck night be reduced. This is especially important for tele-expertise sessions.

According to the results of the tele-medicine trials, the most effective schemes are suggested for the case, when a rural hospital has only dial-up networking facilities:

for *tele-expertise*	dial-up connection to local Internet service provider (ISP) combined with encrypted data exchange to a tele-medicine partner;
for tele-distribution	dial-up long distance connection to *intermediate* tele-distribution service provider.

5. FURTHER ACTIONS, WHAT REMAINED TO BE DONE

The managers of the health care institutions are going to be informed on advantages of the SAMTA software for a daily work of their physicians. It would stimulate to be acquainted with, and to apply DICOM standards in practice for medical information exchange.

More physicians from the validation sites might be invited and taught to use the SAMTA software. Then it might be possible to get feedback from them on the software for improving it.

The mentioned above effective schemes for medical data exchange might be implemented in other Lithuanian rural hospitals, which exploit inexpensive dial-up networking facilities at the moment, i.e.:

for *tele-expertise*	dial-up connection to local Internet service provider (ISP) combined with encrypted data exchange to a tele-medicine partner;
for tele-distribution	long distance calls through the dial-up connection to *intermediate* tele-distribution service provider.

CEN/TC-251 "mirror" group should be created in Lithuania (it is beyond the scope of the SAMTA project).

Legal background for telemedical services have to be prepared in Lithuania and other European countries. The KTU team started this action after the end of SAMTA project.

6. LESSONS LEARNED (DECISIONS, RECOMMENDATIONS)

Data exchange appeared to be successful and scaleable over the wide range of network technologies (from 4.8 - 16.8 Kbit/s dial-up modem connection up to 100 Mbit/s fast Ethernet LAN) . For lower data exchange rates (especially not exceeding 64 kbit/s) it is preferable:

- to use lossy image compression in order to reduce transmission time;
- to send only the most important (separate) frames lossless compressed, if necessary;
- to connect to the nearest Internet provider (ISP) and use DICOM data exchange over an encrypted virtual channel, instead of making long distance call;
- to use the intermediate telemedicine server, if tele-distribution service should be provided over the low bandwidth and the dial up connections. However, such a solution is not fully DICOM compatible though it is based solely on DICOM exchange. Because of the intermediate server it is impossible to get a confirmation about the success of the data transferred from the final destination to the original sender.

7. REFERENCES

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ANNEX

International Conference/ Workshop

"Good Practice for Telemedicine"
June 14 - 17, 2000

The main objective of the Conference/ Workshop is to make known (bring nearer to users (physicians) the new inexpensive telemedicine technologies and its developments according to the European International project SAMTA (Open Scaleable Architecture for Multimedia Telemedicine Applications):

http://samta.offis.uni-oldenburg.de or

http://www.mmlab.ktu.lt (go to => R&D => Projects).

The SAMTA application software allows a user to start exploitation of telemedical services using narrow-band network technology (i.e. ordinary telephone lines), and gives a possibility to migrate to a higher speed network technology later. Due to the **open** and **scaleable** architecture of the system, the user will be able to scale up his workstation to wider-band communication channels in the future without changing the User Interface (which he has already got accustomed to). Therefore, significant investments would be saved (and especially important that learning of a new user interface would be avoided).

The main features of the product:

1) conformance with the DICOM (Digital Imaging and COmmunication in Medicine) file format;
2) medical image acquisition and review on a Personal Computer;
3) marking frames (on a medical movie), and saving them as another file;
4) geometrical measurements on an image;
5) operations within the report of medical investigation and within images: then saving, printing and archiving of the selected information.
6) image compression for sending them through communication channel;

The telemedical application software is based on the standards of both medical imaging (DICOM) and information technology (e.g. ODBC, Video for Windows = Microsoft DirectX, etc).

7.1.1 Scientific / organizing Committee

Chairman:	Prof. Peter JENSCH	(Germany, Oldenburg University)
Vice-chairman:	Assoc.Prof. Jonas PUNYS	(Lithuania, Kaunas University of Technology)
Secretary:	Dipl. Inf. Joerg Riesmeier	(Germany, Oldenburg, OFFIS)

Members:	Dr. Nandor BALOGH	(Hungary, Budapest, “CorPusNet”)
	MD. Renaldas JURKEVICIUS	(Lithuania, Kaunas Medical University)
	Dr. Didier LEMOINE	(France, Rennes, “ETIAM” comp.)
	Prof., MD Ramunas NAVICKAS	(Lithuania, Kaunas Medical University)
	MD. Albinas STANKUS	(Lithuania, Palanga, Institute of Psychophysiology and Rehabilitation)

7.1.2 Meeting dates and venue – general information

June 14 – 17, 2000. Venue of the meeting:

June 14 (morning) **Kaunas**	**Opening lectures** at the auditorium 156, Studentu Str. 56 (building of the faculty "Design & Technology"
June 14 (afternoon) **Kaunas**	**Teaching / Demonstration sessions** in parallel: ➢ at the Image Processing & Multimedia laboratory of the KTU; address: room 305, Studentu Str. 56, Kaunas; ➢ at the Cardiology Clinics/ Institute of Cardiology of the KMU; address: Eiveniu 2 / Sukileliu Str. 17, Kaunas
June 15 (afternoon) **Vilnius** **Abromiskes**	**Demonstration sessions:** ➢ Vilnius University Emergency Hospital ➢ Abromiskes sanatorium (former Elektrenai Rehabilitation hospital)
June 16 (noon) **Palanga**	**Presentation/ demonstration** of European International projects for telemedicine: **SAMTA**, **RETAIN**, and Products of the **ETIAM** company (FR) Address: 4 Vyduno Str., Institute of Psychophysiology and Rehabilitation
June 17 **Palanga**	**Meeting** of the **SAMTA** project **partners**

If you need more information about the conference, contact Jonas Punys:
Image Processing & Multimedia laboratory at the Kaunas University of Technology.

E-mail: media@mmlab.ktu.lt
jpunys@mmlab.ktu.lt
punys@santaka.sc-uni.ktu.lt

The latest conference updates
are on http://www.mmlab.ktu.lt/mmlab/SAMTA

PROGRAMME

June 14: Kaunas	*9:30 - 10:00*	Arrivals and registration: auditorium 156, Studentu Str. 56 (building of the faculty "Design & Technology"
	10:00 - 10:30	Introduction to the project SAMTA: Open Scaleable Architecture for Multimedia Telemedicine Applications: The main objectives and results of the European International project SAMTA *J.Punys[1], V.Punys[2,1] (Lithuania),* *M.Eichelberg[3], P.Jensch[4], J.Riesmeier[3] (Germany),* *D.Lemoine[5] (France),* *N.Balogh[6] (Hungary).*
	10:30 – 10:50	Presentation how to use the hierarchical structured report for Echocardiography on the computerised workstation *R.Jurkevicius[7] (Lithuania)*
	10:50 – 11:10	Presentation how to use the structured report for Coronography on the computerized workstation *R.Navickas[8] (Lithuania)*
	11:10 – 11:25	Coffee break
	11:25 – 11:40	Compression of Echocardiographic and Angiographic Medical Images *J.Puniene[1], V.Punys[2,1] (Lithuania)*
	11:40 – 11:55	Mitral annulus motion detection analysis based on digital image processing *R.Jurkevicius[7], V.Vaitkevicius[1], J.Punys[1] (Lithuania)*
	11:55 – 12:10	Relative Digital Densitometry technique: investigation of bone tissue regeneration *R.Markeviciute[9], L.Gradauskas[10],* ***V.Marcinkevicius[1], J.Punys[1]***
	12:10 – 12:20	Digital Image Processing based comparison of MR and CT images

[1] *Image Processing & Multimedia laboratory, Kaunas University of Technology (KTU)*

[2] *Institute of Mathematics and Informatics*

[3] *OFFIS institute at the Oldenburg University*

[4] *Oldenburg University*

[5] *ETIAM company in Rennes*

[6] *CorPusNet in Budapest*

[7] *Co-ordinator for Echocardiographic Diagnostics at the Cardiology Clinics of the Kaunas Medical University*

[8] *Co-ordinator for Coronarographic Diagnostics at the Institute of Cardiology of the Kaunas Medical University*

[9] *MD, Ragutis company*

[10] *Radiology Clinics at the Kaunas Medical University*

V.Punys[2,1], E.Monastyreckiene[10], L.Gradauskas[10]

12:20 – 12:30 Digital Technologies for reduction of radiation exposure for patients during CT examinations

V.Punys[2,1], E.Jonaitiene[10], L.Gradauskas[10]

12:30 – 13:15 Discussion on the topics:

- Are there needs for sending medical images in rural hospitals of Lithuania ?
- Are there needs for sending/ receiving medical images in medical centres ?
- Legal and ethical issues of telemedicine; What kind of **strategy** suggests Health Care Ministry ?
- Is there a market for telemedicine in the Eastern and Central European Countries ?

13:15 - 14:00 Lunch

14:00 – 17:00 **Demonstration (1)** of the **SAMTA** application architecture

J.Punys[T], V.Vaitkevicius[T], V.Perlibakas[T], L.Sinkunas[T], V.Marcinkevicius[T], S.Sinkunas[T], V.Punys[I,T] (Lithuania, KTU)

Free of charge teaching sessions of the SAMTA application software (users are invited to register in advance).

Teaching / demonstrations in parallel at the Image Processing & Multimedia laboratory of the KTU[T], and at the Cardiology Clinics/ Institute of Cardiology of the KMU[M] :

14:00 – 14:30 Echocardiography session (for ~ 5 + 5 users; Lithuanian language)

Dr. R.Jurkevicius at KMU, and M.Sc. V. Marcinkevicius at KTU: comments by the physician I.Tamosuitis (Kaunas Hospital no.3)

14:30 – 15:00 Coronography session (for ~ 5 + 5 users; Lithuanian language)

Prof. R.Navickas at KMU, and M.Sc. Vytautas Perlibakas at KTU

15:00 – 15:30 Echocardiography session (for ~ 5 +5 users; Lithuanian language)

Dr. R.Jurkevicius at KMU, and M.Sc. Vytautas Vaitkevicius at KTU

15:30 – 16:00 Coronography session (for ~ 5 + 5 users; Lithuanian language)

[T] *Image Processing & Multimedia laboratory of the KTU; address: room 305, Studentu Str. 56, Kaunas*

[I] *Institute of Mathematics and Informatics*

[M] *Cardiology Clinics/ Institute of Cardiology of the KMU; address: Eiveniu 2 / Sukileliu Str. 17, Kaunas*

Prof. R.Navickas at KMU, and M.Sc. Vytautas Perlibakas at KTU

16:00 – 16:30 Echocardiography session (for ~ 5 +5 users; Russian language, if requested)

Dr. R.Jurkevicius at KMU, and M.Sc. Vitalius Marcinkevicius at KTU

16:30 – 17:00 Coronography session (for ~ 5 + 5 users; Russian language, if requested)

Prof. R.Navickas at KMU, and Eng. Linas Sinkunas at KTU

14:00 – 14:30 **Demonstration (2):** Face identification program (Forensic Medicine)

M.Sc. V.Perlibakas at KTU[T]

14:00 – 15:00 **Demonstration (3):** Opportunities of **speech processing** technologies in medicine

Ph.D. A.Rudzionis[A]*, Ph.D. V.Rudzionis*[A] *(Lithuania)*

[A] *Speech Research Laboratory of the KTU; address: room 302, Studentu Str. 56, Kaunas*

June 15: Vilnius	*15:00 – 17:00*	Demonstration at the Vilnius University Emergency Hospital[GP] *Dr. A.Uzkalnis (Lithuania)*
	15:00 – 16:00	Demonstration and discussion on possibilities to apply the SAMTA application software for CT images, endoscopy movies, etc. (Lithuanian language).
	16:00 – 17:00	Demonstration of the SAMTA application software (English language)
Abromiskes	*18:00 – 19:00*	Demonstration at the Abromiskes Sanatorium (Echocardiography) *Dr. N.bickauskaite, dr. J.arlauskas, eng. O.kaminskiene*
June 16: Palanga	*12:00 – 12:20*	Summing-up presentation "The main objectives and results of the European International project SAMTA" *J.Punys, V.Punys (Lithuania),* *M.Eichelberg, P.Jensch, J.Riesmeier (Germany),* *D.Lemoine (France),* *N.Balogh (Hungary).*
	12:20 – 12:40	RETAIN (Radiological Examination Transfer on ATM Integrated Network) European International project *D. Lemoine (France)* *M. Eichelberg, P.Jensch (Germany), et al.*
	12:40 – 12:55	New health care informatics products of the ETIAM company: • DICOM Eye • MEDIEM *D.Lemoine et al. (France)*
	12:55 – 13:10	Ultrasound / Angio images and movies for telemedicine: Experience in Hungary *N.Balogh (Hungary)*
	13:10 – 13:45	Demonstration of the SAMTA application software at the Palanga Institute of Psychophysiology and Rehabilitation *Dr. A.Stankus (Lithuania)*
	13:45 – 14:45	Lunch
	14:45 – 15:45	Discussions on the telemedicine : • Are there needs for sending medical images in rural hospitals of Lithuania ? • Are there needs for sending/ receiving medical images in

[GP] Start of the meeting at the Reception Dept. of the Vilnius University Emergency Hospital; address: Siltnamiu Str. 29, Vilnius

		medical centres ? • Legal and ethical issues of telemedicine; What kind of **strategy** suggests Health Care Ministry ? • Is there a market for telemedicine in the Eastern and Central European Countries ?
	15:45 – 16:00	Conclusions of the conference
June 17:	9:00 – 16:00	Meeting of the SAMTA project partners
Palanga		