FINAL REPORT

HC 4011, InterCare

The Interworking and Interoperability of Networked Services for Healthcare using Internet-based Technology

Project co-ordinator: IMS

TELEMATICS APPLICATIONS PROGRAMME (Healthcare)

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❖ InterCare ❖

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The Interworking and Interoperability of networked services for Healthcare using Internet-based technology

HC 4011

An 'umbrella' project of the

European Commission - DG XIII
Healthcare Telematics Applications Programme

incorporating

Cardlink 2, Hector, *Star*☆, Synapses and TrustHealth

Final Report

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Abstract:	This final report of InterCare describes the umbrella project combining and demonstrating the results of the best of the 4th Framework Healthcare projects to build new Internet-based services and end-user applications to deliver seamless care in six regions across Europe. The results have major commercial potential and also relevance to CEN/TC251

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HC4011 InterCare

The Interworking and Interoperability of Networked Services for Healthcare using Internet-based Technology

Summary

InterCare is an umbrella project combining and demonstrating the results of the best of the 4th Framework Healthcare projects to build new Internet-based services and end-user applications to deliver seamless care in six regions across Europe. The results have major commercial potential and also relevance to CEN/TC251.

❖ InterCare ❖

Setting the Scene

Healthcare delivery across Europe is changing; it is becoming more dispersed and therefore putting greater demands on systems to support seamless care processes.

InterCare has used the following results of five complementary projects to provide large-scale solutions to the needs of national demonstration sites in six countries.

- electronic patient record (Synapses)
- security (Trusthealth)
- mobile communications (Hector)
- patient data cards (Cardlink 2)
- regional telematic services (*Star☆*)

The six regions are in Ireland (Eastern and North Eastern Health Boards), Italy (Lombardia), Sweden (Stockholm County), The Netherlands (Schiedam), Greece (Crete) and Finland (Helsinki & Uusimaa).

Approach

The project had an aggressive workplan, particularly in the first 12 months. Regional needs were fed into a process of analysis and object oriented modelling of the results of the feeder projects. Some convergence of the object models was attempted at this early stage. Detailed specifications were produced.

The work of the project then split into two, addressing in parallel the development of the InterCare common products and also the 25 end-user applications that would use the services. Site preparations commenced. The systems were extensively tested and reported within the validation activity.

In order to determine the value brought to regional healthcare, the sites undertook a study of the metrics to be used by the evaluation. These were then used to assess the impact of InterCare.

The final phase involved consolidating earlier modelling work and contrasting this with the work of the CEN/TC251 Continuity of Care project.

Detailed exploitation plans were also developed.

Results and Achievements

The main achievements of the project are in three areas:

1. Software products. The InterCare products are the five common services (Card Management Server, Electronic Patient Dossier Server, Security Server (Access Control), Healthcare Information Server, and Patient Identification and Reference Manager) plus the 25 local applications developed at the demonstration sites.

2. Six demonstration sites in Italy, Ireland, Netherlands, Sweden, Finland, and Greece.

All demonstrations had a preliminary evaluation. The main result is that the systems are delivering the planned benefits although further evaluation is required in order to identify long-term seamless care benefits.

3. Models and systems architecture. These started in the earlier phase and continued through to the end of the project. The results form a significant exploitable result.

Conclusions and Plans for the Future

Each participating country also has its own plans to continue with the demonstrator sites, rollout the systems to a wider user-base, and to exploit the results. The commercial participants also have plans for selling the products outside the InterCare demonstrator regions.

In addition InterCare will continue beyond the end of the project but as a forum and not as a joint venture.

Within each country the participants will build on the demonstrator sites and expand the InterCare approach within their chosen environments.

The results of the project will be disseminated in the normal way through the deliverables of the project and the Final report and through a series of events based on the outcomes of the demonstrator sites.

The models and architectural concepts will continue to be promoted at conferences and similar events. Also there is already an exchange with CEN/TC251 project team members.

Contact Details

Project Name:

InterCare – The Interworking and Interoperability of Networked Services for Healthcare using Internet-based Technology.

Research Area:

Regional Telematic Services for Healthcare.

Timescale:

01.06.98 - 31.05.00

Budget:

Overall cost: 8506 kECU

EC contribution: 3469 kECU

Keywords:

Healthcare telematic service. CORBA. Object-oriented. Healthcare models. Patient Identification Server. Card Management Server. Security Access Control. Healthcare Information Server. Electronic Patient Record. Regional demonstrations. Seamless / continuity care.

Key Project Participants:

The following represent the main partners in the project. Many more key participants were involved. They can be found from the project web site.

Irish Medical Systems	(IE)
North Eastern Health Board	(IE)
DSW	(NL)
Stockholm County Council	(SE)
STAKES	(FI)
Regione Lombardia	(IT)
Regional Administration Authority of Crete	(GR)

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2. Part II – Final Report

2.1 Setting the Scene

In 1998 the European Commission's Telematics Application Programme in Healthcare funded the InterCare project funded to consolidate some of the results of the previous five years of investment in RTD&D. In particular the emphasis was on delivering practical *products* that can be exploited in the healthcare informatics marketplace in order to improve both the health and economy of Europe.

Furthermore the work of the 3rd and 4th Framework Programmes had resulted in fragmented research results, none of which had sufficient critical mass to have significant impact. One proposed solution to this problem was to encourage projects within a similar domain to work together and to gain that critical mass. However, this approach overlooked the fact that the customers of telematic applications look for solutions to the problems of delivering effective *healthcare*, not solutions to *technological* problems.

The InterCare consortium recognised that healthcare is becoming more dispersed and more specialised. The factors driving this trend are both economic (large centralised hospitals are expensive) and because of the development in medical devices that enable specialist treatment to be given at places outside the hospital. This trend however exacerbates a problem that has long existed within health services, namely poor (often non-existent) communication between information systems creating an environment of disjointed care just when the patient requires it to be seamless.

With this background, the InterCare project was established to combine the results from the most important EC funded healthcare telematics projects at the time in the areas of:

- the electronic patient record (Synapses)
- security (Trusthealth)
- mobile communications (Hector)
- patient data cards (Cardlink 2)
- regional telematic services (*Star☆*)

…in order to deliver the necessary set of integrated technologies to solve the problems facing the providers of healthcare. The primary objective was to achieve a convergence of results and to demonstrate & promote the synergy between these projects in six key regional demonstrator sites across Europe.

The sites in Finland, Greece, Ireland, Italy, Netherlands and Sweden were selected because they were the key national demonstration sites in each country. As such they are committing a significant investment to prove the benefits of healthcare telematics. The funding facilitated the integration and migration of the separate projects to ensure that each site was able to demonstrate the real added value of the InterCare approach.

Finland

The Helsinki Health Department provides primary health services and, via Helsinki Hospital District, specialised care to the citizens of Helsinki. Geographically, Helsinki is divided into seven districts. Each district has a health centre which is responsible for the provision of health services in its district. Uusimaa Hospital District is Finland's biggest hospital District and it operates in 9 hospitals for the population of Uusimaa region. In Uusimaa region there are 24 health care centres but the

municipalities operate them. The health care centres use the services of the Uusimaa Hospital District by referring their patients to the hospitals of the Uusimaa Hospital District.

The Helsinki University Central Hospital (HUCH) serves as a referral hospital for the Helsinki Hospital District and the Uusimaa Hospital District with the total population of 1.3 million. HUCH occupies a special position in Finnish health care as it serves the whole country in the treatment of certain diseases that are very rare or require specialist knowledge or costly equipment. Patients referred to HUCH from health centres or by private doctors are either hospitalised or seen in outpatient clinics. The municipalities of the Province of Uusimaa own HUCH. The hospital is divided into a number of responsibility centres, either clinical departments or internal service units.

Greece

The Greek site consists of the island of Crete. The user population embraces 18 primary health care centres, a multitude of medical offices, 4 medium size hospitals, 2 large size hospitals/referral centres and hundreds of medical doctor offices. Most of the users in Crete have access to computer and networking facilities.

The Regional Government of Crete in co-operation with FORTH, OANAK, ForthNet, and medical personnel, has launched an ambitious program to enhance infrastructure of all health-care organisations on the island. OTE, the public telephone company has upgraded communication lines – backbone network of the island is based on FDDI. All these activities are partially funded by national and international funds.

Ireland

The National Health Strategy for Ireland demands the sharing and integration of patient information across the range of services provided by many different centres and agencies. The specific user needs arise in the acute hospital sector, in community support services and in primary care. This primary care provided by general practitioners and high street pharmacy services must be transparently integrated with the other sectors. The integration must include communications, arranging patient services, electronic patient records and patient held records. The nature of the health service allows patients free choice in their selection of service provider, hence patient information must be portable, accessible and capable of being communicated.

The region involved in InterCare may be viewed as Ireland in its entirety with demonstrator sites in the Eastern, North Eastern and North Western Health Boards covering 2 million of Ireland's 4 million population. The demonstrator sites include hospitals, GP clinics and high street pharmacies. The potential financial savings are considered to be very high however the major benefits are in service quality improvements and enhancements to patient care – for example, a reduction in the number of referrals and lengths of stay would reduce through faster results reporting.

Italy

Lombardia Region has about 9 million inhabitants, with 44 Local Health Care Unit (U.S.S.L.), 197 public and private accredited Hospitals with about 1 million and 3 hundred thousand hospitalisations in 1996. The Public Health Department provides general guidelines for primary care, secondary care, and emergency; provides regulation of health care market, control of costs, assurance of quality. It is responsible for information systems development and improvement. 75% of the regional government's budget (equivalent to 7000 MECU) is for health. There are 100,000 healthcare employees of which 25% are physicians, 8,500 of which are in primary care.

The Region is upgrading its technologies and procedures in the healthcare so as to improve its citizens' quality of life, expand employment opportunities and enrich the professional content of existing jobs, whilst maintaining economic efficiency. InterCare has been part of the Lombardia

Region's major "Regional Intranet for Health" project which will evolve to more than 3,000 applications.

Netherlands

The Dutch demonstrator site is situated in the west of the Netherlands and involves the region around three main hospitals (Schieland Hospital in Schiedam, Holy Hospital in Vlaardingen and Reinier de Graaf Hospital in Delft). Delft is the national demonstrator site for health telematics (HealthCare 2000). This region has a population of 380,000, and around 150 GP's, 50 pharmacies and 200 medical specialists. Approximately 60% of the population in the region is insured with Public Health Insurance Company DSW. The region has a regional communications network for HealthCare providers connecting almost all GP's, all three general hospitals and laboratories, a psychiatric hospital, some pharmacies and other HealthCare specialists, two nursing homes, and Public Health Insurance Company DSW.

The largest need that being addressed is the lack of information about the use of medication by a person. Pharmacists need an overall view over the medication taken by a patient, in order to be able to localise possible contra-indications. This lack of information results in many time-consuming calls to and from the pharmacy, in the prescription of wrong or unnecessary medication, thus generating great costs and needless risks (drug interactions) to the patient.

Sweden

The Stockholm County Council has 1.8 million inhabitants (20% of the Swedish population), and the Health Care delivery system for this population has been subjected to severe financial constraints for several years. In January 1997, a new IT-strategy was adopted for health care in the Stockholm County Council. The Bangemann vision of a new architecture based on several layers and the research and development performed in previous and ongoing EU programmes (RICHE, *star*☆, HANSA) has had an impact on the new strategy. The county (healthcare region) required an infrastructure which supports the continuum of care and a platform which allows for a flexible and incremental development of applications, whilst maintaining a link to legacy systems.

2.2 Approach

The approach taken enabled the project to fulfil its original objectives which were to:

- Build on the result of five complementary "best of breed" projects to form a new project with the necessary critical mass to integrate the results across project lines.
- Produce integrated products that will be commercialised by the industrial members of the consortium.
- Demonstrate the results at key demonstrator sites across Europe where they form an integral part of a national strategy.
- Help to solve different aspects of the problems facing the provision of inter-organisational seamless care.
- Have six demonstrator sites that will become the flagships for the Healthcare Telematics Application Programme, showing how the results from different fields of medical informatics combine to form the *Health Information Society*.

Being an umbrella project the project commenced by correlating the anticipated results from the contributory projects with the requirements of each demonstrator site. The flow of the project follows the sequence of workpackages as shown below:

- WP2 – Demonstrator Designs

  To take the results from the contributory projects to produce detailed designs for the implementations at each of the demonstrator sites.

- WP3 – Integration of Contributory Projects

  To develop a set of integrated generic middleware services capable of being used at each demonstrator site – the InterCare Common Products. The level of integration was only that necessary to ensure interoperability at a specific site.

- WP4 – Local Application Development

  Each participant involved in the project has put significant investment in interfacing to and modifying legacy systems and end-user applications which are diffused across the local health care networks. These systems are integrated in order to work seamlessly in a smooth operation environment which will provide regional user applications.

- WP5 – Verification

  To validate the results to ensure they meet the user requirements and beta test before real usage in the Demonstration phase.

- WP6 – Demonstration and Evaluation

  To show the results of the project. The commercial success of the products depends upon the six sites being high quality reference sites. Therefore the objective was simply to produce six, high quality, extensively utilised, demonstrator sites that deliver:

  - data for the evaluation process
  - visible evidence of success to visitors of the site

- WP7 – Consolidation and Exploitation

  This workpackage had two main objectives:

  - The first was to bring together the lessons of the integration workpackage (WP3) and to initiate any further development work necessary to consolidate the results.
  - To promote and exploit the results emerging from the demonstrator sites and from the consolidation exercise of this workpackage.

- WP1 – Project Management

In more detail, the approach taken is described in the following sections:

Demonstrator Designs

The activity has been devoted to specification work concerning:

- the applications that were going to be developed at the demonstrator sites, and
- the five InterCare common products based on components from the InterCare contributory projects, and to be used by the demonstrator applications.

As was decided in an early stage of the project, UML (Unified Modelling Language) has been used as the common modelling language to specify the applications and products. After some investigations to find a suitable modelling tool to support the specification activities, it was agreed by most partners to use the Rational Rose 98 modelling tool.

A dictionary of classes was straightforwardly assembled (later revised) from the sites' UML models as a first harmonisation effort, accompanied by some guidelines for the continued specification and integration work. The resulting demonstrator site and product specifications were assembled and merged into the two common specification documents "D2.1 Product Design Specifications" and "D2.2 Demonstrator Design Specifications", both being deliverables from the project.

The demonstrator design specifications document contains use cases and scenarios (diagrams and detailed use case descriptions in natural language and/or sequence diagrams), class models (diagrams and class definitions), implementation plans and architectural considerations. The product design specifications also comprise the use case and logical views as well as, for most products, interface specifications expressed in CORBA IDL (Interface Definition Language).

It was clear at the end of this activity that further integration and consolidation of the models was required and this was deferred to the Consolidation and Exploitation workpackage.

Integration of Contributory Projects

This activity included the set of tasks necessary to arrive to the definition and the implementation of a set of servers as defined within the project programme. On this basis, five core, Internet-based common products have been specified and developed.

All of the specifications and the implementations have been guided by the sites' specific requirements and hence have immediate validation and exploitation channels. The work resulted in two deliverables: D3.2 InterCare Common Products Interface Specifications and D3.1 InterCare Common Products.

This activity took inputs from the formalisation of both products and applications requirements following on from the Design activity described above. The use of Rational Rose meant using Object Oriented techniques (and hence the resulting benefits) throughout the project. The end product was a set of interfaces in IDL format. This again was the project standard and is how the project will publish its interfaces in the public domain. Being *interfaces* they can be used for the implementation of the server side – through the generation of a skeleton structure of the server – and *stubs* for the parallel development of end-user applications.

To implement the products the project decided to use a middleware software layer, represented by a generic ORB (Object Request Broker) conforming to CORBA (OMG) specifications.

This global technical environment (CORBA and Object Orientation) had been chosen at project level as the most promising environment for the innovation in healthcare systems. This choice was aligned to world-wide technological trends, the enormous work in standard specifications being done by OMG also in healthcare sector through CORBAmed, and, most importantly, is the only one addressing distributed systems to which clients need to access transparently using standard communication protocol (the TCP/IP compliant IIOP).

The work of the specifications and implementation was not a purely a re-engineering of the contributory projects software modules (where they existed) or porting of them to a different architectural platform (the ORB based one). InterCare focussed on the fact that all the servers should co-operate to support a seamless care environment and the various servers have been extended in functionality aiming towards a global coverage of the healthcare view of information and processes requirements. The evidence and the results obtained from this work are mainly formalised in the interfaces specifications of the InterCare Common products and are physically constituted by the IDL of the interfaces.

From the pure technical point of view, the presence of several sites with different technological environments meant that the development work had to take particular care over the portability and

openness of the results. For the servers, the compliance with the CORBA specifications was sufficient to achieve these aims. The work only remaining factor was to decide which commercial ORB product to use. Tests on the portability between OrbixWeb 3.1 by IONA and VisiBroker by VisiGenic have been done as well as Java based development tools. VisualCafe 3.0 and JBuilder 3.0 have been used for the development of the services on JDK 1.1x or with JDK 1.2. In some cases, C and C++ code has been encapsulated in a Java based interface.

The work on the products has not just been limited to the middle tier of the three-tier model of the system. During the testing of the development some work was also done on the presentation part. For example, the IC-HIS provided an application (the generic "Yellow Pages" application) and some technical requirements in some sites in relation to the final users or the network infrastructure have been explored and tested as prototype releases of the products interface (i.e. servelets or applets).

Further integration and harmonisation was achieved than that originally planned. In particular, the HISA CEN standard compliant DHE® system, a European result from the RICHE, EDITH and HANSA projects, has been encapsulated in the IC_PIDRM and provides the basic maintenance functions to the module.

This overall activity was complex and became a much larger task than planned. The objective was to stabilise the services offered in the InterCare products but resulted a more work than expected. The work of this activity complemented the parallel work of the development of local applications, i.e. the end-user products that would use the InterCare common services, as described in the following section.

Local Application Development

Architecturally the work of this activity relates to the development and/or modification of end-user client applications. Within InterCare it was planned that many applications would be created to use the common services. In practise there were a total of 25 applications that made use of InterCare results.

Each of the applications was described in the workpackage deliverable. They were categorised as:

- **HealthCare Integration Infrastructure (HCII):** Applications of general use. HCII InterCare applications present general and interoperable Internet-based solutions, towards integrated healthcare services. They compose the *background technological infrastructure* (in terms of both, H/W installations and S/W settings) on which the various healthcare services are integrated and offered. In this respect, they could be considered as a set of 'common products', much in like with the other InterCare common products. The use of interoperable Internet-based technologies for each of these HCII applications is general and flexible enough to for them to become European standards.
- **HealthCare Integrated Service (HCIS):** Applications that present the real *end-user applications* in the sense that they compose the set of healthcare integrated services offered to the user. HCIS InterCare applications are mainly *interconnected software components*, which are build upon HCII applications and InterCare common products making use of standard Internet-based technology and state-of-the-art remote-processing enabling technologies (e.g., CORBA, CORBAmed, Java, Active-X etc). The underlying component-based architecture of the applications, make their exportation to a pan-European environment feasible.
- **Clinical Information System (CIS):** These applications are presented by respective *legacy systems*. These systems were either inherited by the InterCare contributory projects (e.g., Cardlink II, Hector, *Star*☆, and TrustHealth) or, were designed and developed from scratch in the context of the InterCare project.

All applications described in terms of their regional context, a technical description and model, and any dependency on background technology.

Verification

The software developed by the above two activities (Integration of Contributory Projects and Local Application Development) required extensive quality assurance testing prior to installation at customer sites. This was the role of the Verification activity by concentrating in establishing a common base for the beta testing of the InterCare products. This involved the collection and compilation of common criteria as well as common procedures, in line with QA standards. It has been accepted, throughout, that all individual products have been developed and tested according to international standards and conform to ISO 9001. The Verification activity is concerned only with the QA issues of the InterCare products, which result from existing or adapted products.

The activity's final document was a report that was designed to be a major checkpoint in the project to ensure that the work of the previous development workpackages had met the user requirements expressed in the initial phases of the project. The structure of the document was in line with the philosophy adopted throughout the project, i.e. the development of Common Products based on components from the InterCare contributory projects and End-User Applications built specifically for each of the six demonstrator sites.

The verification for each common product or local application has been the responsibility of the developers with the involvement and assistance of users (both end users and local-application integrators). In order to co-ordinate the verification effort, two questionnaires were circulated to the product developers. The completed questionnaires provided the basis for the "harmonisation" and "homogenisation" of the verification procedures and reporting for all the InterCare Common Products and Local Applications. For InterCare Common Products and whenever and wherever possible, the verification was carried out both as "standalone" as well as together with the Local Application(s) that make use of their services and functions. Similarly, for InterCare Local Applications the verification was either carried out using the appropriate InterCare Common Product(s) or using simulators, which were specifically built for testing and validation purposes.

Demonstration and Evaluation

The applications being demonstrated and evaluated are described in the following table. Further details can be found in deliverable D4.1 End-user Applications.

Site	Application	Service
Italy: *Lombardia region*	PATRES	Telematic Administration System
	REHAL	Resources for Health services Archive
	SANICARD	Chipcard with patient-information
	HICAR	Healthcare Information (Yellow Pages)
	RIC	Request Organiser distributed booking
	PROCOM	Transmission of reports
Netherlands: *Schiedam region*	PHARM-EPR	Electronic Patient Record
	EXHIS	Healthcare Information (Yellow Pages)
Sweden: *Stockholm region*	AHHC	Clinical information for Home Healthcare
	ERM	Referral Management
Finland: *Helsinki region*	IC-VPMR	Virtual Patient Medical Record
	IC-HIS SSR	Security Services and Report
	IC-HIS RS	Regional Statistics
	IC-PIDRM	Patient Index Reference Manager
	IC-HIS YP	Healthcare Information (Yellow Pages)
Ireland: *North Eastern and Eastern Region*	CARD2000	Medical Card Administration System
	DMS	Diabetes Management System
Greece: *Crete region*	PCDD	Patient Clinical Data Directory
	TCC	Tele-Cardiology and Tele-consultation

The purpose of the demonstration and evaluation activity was twofold: firstly to establish the criteria for the evaluation at each site, and secondly to deliver demonstrations of the InterCare capabilities to potential users and the general public.

In order to assess the success of the products and demonstrator sites, metrics and baseline-data are included as part of the evaluation work. This was based on the approach and frameworks of two previous European projects: SHINE (AIM) and MEASURES (Esprit).

At an early stage in the project all sites had defined their objectives for the InterCare project. These objectives are used as a starting point for a metrics framework. The parameters are used to evaluate the objectives and baseline data were developed in the first phase of this activity. The work concentrated on an evaluation of the *healthcare services*, not on the *software*. All assessment therefore concentrates on the measurements of services and determines if the InterCare software can be considered an improvement to the current situation.

To be able to give an overview of all the benefits that are assessed, and also to give an overview of the services and benefits of InterCare services, a metrics matrix is compiled. This matrix will also be used as a base for comparisons between the different demonstrations. The metrics-matrix is based on a classification of the InterCare benefits, dividing them up in three categories, and specifying a number of services for each category, as explained below.

Also, as part of the evaluation, various open days and other events were held to promote the results of the project. This enabled healthcare professionals and other health service decision makers to see the systems in operation and evaluate the applications. Where possible, all applications are also demonstrated on the Internet so that they can be accessed and assessed worldwide. The demonstrations on Internet can be found using the following URL: http://intercare.imsgrp.net.

Although the evaluation phase was reduced in duration, nonetheless an effective evaluation of the demonstrations was possible.

Consolidation and Exploitation

The role of the Consolidation activity is to bring together the results of the previous work into a single exploitable architectural model for InterCare systems and then to derive the InterCare *business object* components. The work focussed on consolidating the models from earlier in the project and then comparing it with the work of the CEN/TC251 Continuity of Care project in order to identify recommendations from InterCare that could benefit the work of CEN.

The approach used was to develop analyse the models produced for each of the servers and products modelled during the earlier phase of the project. Once a common understanding and data dictionary had been developed, then a meta model in class diagrams describing the InterCare Common Products (IC-CMS, IC-EPDS, IC-HIS, IC-SS, IC-PIDRM) was produced. This has led to the required harmonisation and generation of common business objects (IC-BO), now referred to as *patterns*.

The work continued by comparing the InterCare meta model with the work of CEN/TC251/N99-124, “Health Informatics – System of Concepts to Support Continuity of Care”, prENV xxxx:2000 E, European Committee for Standardisation, 2000. This has resulted in some recommendations for the project team.

Exploitation

The exploitation approach has continued along a number of paths:

1. Individual country-specific seminars and workshops
2. Numerous conference papers on different aspects of the project

3. Feed results into the standards bodies such as CEN and OMG.
4. A project web site
5. A project brochure.
6. Personal contacts within the professions.

Beyond the end of the project this will consolidate at two levels:

- the creation of a market for the InterCare approach
- the individual marketing plans for countries and partners

The former will set the ground rules, undertake the co-ordination, liaison and European level exploitation activities and support the activities of the countries. The latter will operate within their own areas, building on the demonstrator sites and expanding the InterCare approach within their chosen environments as described in detail in the Exploitation Plan.

The creation of a market for the InterCare approach will derive from the activities and aspirations of the sum of the countries and will be managed by the InterCare Group which will consist in the first instance of representatives of the InterCare partners along with a User Advisory Group.

2.3 Results and Achievements

In terms of the main achievements for exploitation from the InterCare project, these can be broken down into three main areas:

1. **Products – middleware internet services and end-user applications**

   The InterCare products are the five common services (IC-CMS, IC-EPDS, IC-SS, IC-HIS, and IC-PIDRM) plus the 25 local applications developed at the demonstration sites. This work was undertaken in workpackages 3 (Integration of Contributory Projects) and 4 (Local Application Development).

2. **Six demonstration sites**

   - Italy Lombardia region
   - Netherlands Schiedam region
   - Sweden Stockholm region
   - Finland Helsinki region
   - Ireland North Eastern and Eastern Region
   - Greece Crete region

   This work took place in workpackages 4 (Local Application Development), 5 (Verification) and 6 (Demonstration and Evaluation).

3. **Models and systems architecture**

   The models and systems architectures were derived primarily from workpackages 2 (Demonstrator Designs) and 7 (Consolidation and Exploitation) but also from workpackages 3 (Integration of Contributory Projects) and 4 (Local Application Development).

2.3.1 Products – middleware Internet services and end-user applications

The architecture of the InterCare software products conforms to the widely accepted three-tier distributed systems model: client (or end-user) applications, middleware services, and a back-end database or information source. Therefore the exploitable *products* of the project are the InterCare Services and End-user Applications.

InterCare Services

The common InterCare services (middleware, Internet-based, CORBA compliant, etc) services that were developed are described in much greater detail in the project deliverables. In summary they are:

IC_CMS Card Management Server, as a module of a wider Card Management System implemented and compliant with the specifications and the software produced in the Cardlink 2 Project

IC_EPDS Electronic Patient Dossier Server, a module implemented on the basis of specifications and software results provided by Synapses Project, able to deal with the specifications of Emergency Health Care Record structure as derived from the Hector Project

IC_HIS Health Information Server, a module representing a functional and architectural evolution of the former Regional Enterprise Manager and Local Enterprise Manager from the *star*☆ project

IC_SS IACS the InterCare Access Control Server as a module of the Security Server, an implementation compliant with both the specifications of TrustHealth Project and also the CORBAmed HRAC specification

IC_PIDRM Patient Identification and Reference Manager, a module derived form re-engineering of the former Patient reference Manager in the *star*☆ Project, incorporating also "Patient Identification" capability as per CORBAmed PIDS specifications.

They are derived and extended from the work of the contributory projects. A great deal of effort was put into making then interoperate so that they could be combined in operational settings. The detailed descriptions, models and interface specifications can be found in project deliverables D3.1 InterCare Common Products and D3.2 InterCare Common Products Interface Specifications.

End-user Applications

The end-user applications are presented in the context of their demonstrator sites. For further information on the application and the evaluation results, please see deliverables D4.1, D6.1 and D6.2.

Finland

IC-HIS VPMR - The application provides a browser based viewing on the patient's medical record data in different healthcare units. The system includes legacy systems wrappers and user interface. The application is the key application for the healthcare professionals.

IC-HIS SSR - The application provides a browser-based system viewing the use of patient medical record in different healthcare units. The security applications are designed to keep track of the use of medical records and delivered medical information. The approach is based on the following schema: Who, When, What and Why has used patient medical record data and has the user got the information. The systems report both security personnel and citizen as a patient.

IS-HIS RS - The application provides a browser-based system viewing statistics from different points of view such as provider, patient and purchaser. Information is concerning services such as episodes in hospitals, out-patient visits in different clinics and waiting times for the services, financial facts and resources.

IC-PIDRM - The common IC-product provides the master patient index-services. The main service is such as patient search in central and local domains and reference entry registration, querying, update. The professional are using the application to find the patient's episodes and out-patient-visit in the different healthcare units. Only national unique personal number identifies the patient's.

IC-HIS YP - The common IC-product provides a browser-based info-system viewing regional healthcare services and working as a portal to other services. The systems include basic information of the units participating the demonstration.

Greece

PCDD is a middleware service that indices the EHCR (Electronic Health Care Record) segments of patients' health records and facilitates global access to patient clinical objects in feeder systems, i.e. geographically distributed, heterogeneous, autonomous clinical information systems.

The PCDD maintains a distributed registry of feeder systems, patient key demographics, their EHCR segments, clinical metadata, and references to clinical objects. The data model of the PCDD is based on the Subjective Objective Assessment Plan (SOAP) model that originated from the primary healthcare domain. Access to detailed information on particular healthcare encounters is delivered on a case-by-case basis. Each feeder information system is responsible to provide an export schema and map it to the schema of the directory. With regard to updates, different update schedules can be applied at different sites. The core technologies of the PCDD are X.500/ LDAP directories, CORBA, data extraction gateways (such as ODBC-to-LDAP), and related Internet technologies.

Scope of the PCDD application: Recently, due to the greater mobility of the population as whole, national and international healthcare networks are increasingly used to facilitate the sharing of healthcare-related information among the various healthcare actors. This sharing of information resources is generally accepted as the key to substantial improvements in productivity and better quality of service. Thus, a Healthcare Information Infrastructure (HII) that enables the coherent integration of heterogeneous components is necessary to reduce the inherent complexity of the related tasks. The core of the HII is middleware services that facilitate interoperability through open standards and public or protected interfaces. The seamless integration of distributed EHCR segments requires interoperability of heterogeneous autonomous information systems.

These considerations led to the design of the PCDD *federation*, which provides information integration at the enterprise-level and is enabled by a directory infrastructure that implements a distributed registry of EHCR segments. This approach realises a federation of clinical information systems, is capable of supporting any consolidation efforts of today for Virtual EHCR services, and can function successfully as part of a global directory service in the future. The hierarchical structure of the directory, although limited at first sight, provides a powerful way to index the geographically distributed EHCR segments and can facilitate the provision of a Virtual EHCR service. The directory maintains a distributed registry for feeder systems and patients in the federation, as well as references to specific clinical objects in the EHCR segments of these patients. Since the directory stores access information for clinical objects in the EHCR segments, it may act as an access mediator. Thus, the treating physician, assuming *authorisation* is granted, may use one of the available access methods, to access relevant clinical objects in the feeder systems.

PCDD Features & Overview: During a single healthcare episode many professionals, involved in a variety of medical acts, administer medical care. Healthcare administration personnel, healthcare professionals, social care professionals, as well as patients need to selectively interact with health-

related information. Each of these user groups has not only different needs in terms of information access, security, and quality of service, but also is involved in different tasks, medical acts, and healthcare procedures. Consider now the Virtual EHCR problem. A physician that accesses a patient's healthcare record needs an overview of the patient's EHCR segments, since in most cases only a small fraction of the complete record will be selected and presented in detail. That also means that when accessing a particular clinical information system there is a need for extracting only a subset of the information stored in it. The real issue here is not only how to access specific information systems that maintain EHCR segments, but also how to identify and index the essential information in them.

The indicative screen dumps below, shows the utility and use of PCDD for *searching*/*accessing* patients in the distributed healthcare network of Crete (from various geographically distributed clinical information systems), and viewing respective clinical data. Especially from the *PHCCIS: Primary HealthCare Centre Information System*, which also compose one of the applications of the InterCare Crete demonstrator).

PCDD and InterCare common products

IC-SS/*IACS* - Several levels of security exist; namely information system security, operating system security, database system security, network security, communication security, etc. The presented approach does not face security isolated in a per-process (or use-case) point of view. Instead it follows a two level approach that can guarantee *greater availability*, integrity, and *confidentiality*. (***1***) The ***first level of security*** is implemented by means of the HYGEIAnet Virtual Private Network (VPN) that offers Committed Information Rate (CIR) for medical applications and is suitable for both auditing and statistics. This security level increases service availability and can implement restrictions on virtual servers and directories. In addition, since the HYGEIAnet VPN is connected to the Internet by means of firewalls, it is capable of controlling both incoming and outgoing traffic by means of IP address grant/ deny restrictions. (***2***) For the PCDD to be able to offer secure services it needs to be able (a) to ***authenticate*** each client's principal identity, role and sensitivity, and (b) to transmit information ***confidentially*** and with integrity. It is evident that the existence of a trust infrastructure needs to evolve as part of the HYGEIAnet. (***3***) ***Access control*** is achieved by means of user profile information. In this context any patient should be able to have complete access to all personal information. A physician should have access to all information that has been provided by him, as well as to his/ her referral data. In addition patients should be able to grant and restrict access to their personal information. Of course this may lead to very tight security constraints that is capable of making ineffective the use of healthcare information systems. Hence more emphasis needs to be paid on auditing "*who* accesses *what* type of information at *what* time," instead of trying to enforce very tight security constraints.

For 2 and 3, the role, and the respective '**access allowance**' by the InterCare **IACS** and Security Services product are crucial.

IC-EPDS - The rational behind PCDD is to act as a *Patient Meta Record* (PMR) middleware service. The *use* of the PMR as a middleware service is threefold; it facilitates semantic mapping between heterogeneous information systems; it can facilitate semantic queries; it can be used as an information source for the workflow management of applications. The *goal* of the PMR is to provide semantically consistent data model of the clinical objects residing in diverse healthcare information systems. A semantically rich model to which the models of all clinical information systems are mapped should drive the PMR approach. Thus, it is mainly a *top-down* approach, conceptually different from the *bottom-up* approach represented by PCDD.

a) The objective of the Synapses Project, and of the *EPDS* InterCare product, is to facilitate the sharing of health records among information system consistently, simply, and securely. The approach that has been followed is that of middleware servers that enable healthcare professionals to access information from feeder systems. The *Synapses Federated Healthcare Record* (SynFHCR) provides a harmonised view of the healthcare record drawn from feeder systems, and

is realised through a series of specific responses to formal requests for Synapses objects, i.e. record components which are in the simplest form clinical data sets. *The Synapses approach bares some similarity with the PMR approach in that in its deployment it involves the definition of basic query types and the clinical constructs they may involve*. Associated access methods facilitate the extraction of these clinical objects from feeder systems. Note, however, that the deployment cost of such a solution is really high.

b) The *star*☆ project identified a set of core services that are used by a range of user services i.e. multimedia patient dossier, telemedicine, as well as control and management of healthcare resources. These core services are the Patient Reference Manager, the Regional Enterprise Manager, the Security Server, the Public Key Manager, the Local Enterprise Manager, the Act Manager, the Patient Dossier Manager, and the Booking Server. Core services care classified into regional services that are delivered by regional centre, and local services that are delivered by each healthcare organisation. PCDD corresponds to the Regional Patient Reference Manager (RPMR) which provides patient identification information facilities as well as information on contacts that patient have had in one or more healthcare organisations. The *star*☆ approach is conceptually close to PCDD, with a number of minor differences.

PCDD working environment and installations:

PCDD integrates clinical data information from 3 different CISls, namely:

- PHCCIS (Primary HealthCare Centre Information System)
- PHEMS: Pre-Hospital Emergency Management System- the HECTOR pilot-approach within the HECTOR project, which actually presents the way that the HECTOR projects contributes to the InterCare project, and
- PSCIS (Paediatric Surgery Clinical Information System).

All these systems are InterCare local applications and are installed in functional healthcare units from June 1998 till now.

Ireland

HIS - The HIS developed by SAPHIS is made up of three parts:

1. A front-end application called the "Yellow Pages" – this is what a user will see when they access the web.
2. A repository of regional information called the "Regional Enterprise Manager" – this provides the user with a view depending on the service or geographic proximity of a care service provider. Information has been gathered by the partners involved and will be ready for input.
3. A "Local Enterprise Manager" – this will give access to the (legacy system) HealthCare Services Information System (HSIS).

The application is targeted towards Irish citizens and has been implemented to cater for the current difficulties in disseminating health service and related information to the general public. The application aims to address one of the key issues in our Health Strategy: *The Department of Health and the Health Authorities will continue to ensure that patients and clients have ready access to the fullest possible information about their entitlements and how to avail of them*.

The HSIS is made up of 2 parts - an Information Resource section and Interactive Functionality. Phase 1 (see below) was completed in September 1999.

Information Resources

1. Benefits & Entitlements

2. Support Groups
3. Health Education
4. Health Directory (address book of Irish health agencies)
5. Patients Rights (Patients Charter, Freedom of Information Act etc.)
6. Links (gateway to Irish health agencies and other appropriate resources on the WWW)
7. Medical Conditions
8. Surgical Procedures
9. Medications
10. Information for Schoolchildren
11. White Papers (specifically related to health)
12. Information for people with a disability
13. Information for the Elderly

Information for these sections requires extensive research, consultation and compilation which was carried out by a multidisciplinary working group with representation from IT, Healthcare Professionals, Administration and the General Public.

Interactive Functionality

1. Personal Brochure Facility: this will allow the citizen to add items of interest to a holding area which can then be printed for offline reading.
2. Feedback Facility: This will provide a mechanism for citizens to give feedback on the site. Their comments are held in a database and suggestions fed back to the group responsible for site updates and developments.
3. Online Application Form Requester: This will allow the citizen to request form(s) e.g. medical card applications, E111s etc. The requests will then be forwarded to the appropriate health agency that will post the form/s to the citizen. Unfortunately, it is not feasible at the moment to have application forms available online as forms vary from agency to agency and some applications require supporting information e.g. relating to the applicant's means. However, should the situation change, an online application facility will be introduced.

CARD2000 System - This application is a Medical Card Administration System used by Health Board Administrative Staff and utilises the IC_PIDRM developed by LISPA. A Medical Card, which is means tested, entitles the holder to free healthcare. The system is used in the assessment process (determination of entitlement to hold a card) and if a card is granted, the citizen's (and his/her dependants) details are held to maintain a current record for ongoing assessment of benefit entitlement and for the conduct of entitlement reviews.

Under the InterCare Project, access to the system will be extended to General Practitioners to assist them in determining the medical card status of their patients. It will also provide them with access to their panel listing i.e. patients registered with their practice that are eligible for free healthcare. The current method of distributing panels is by hard copy which is time consuming and unwieldy for both the General Practitioner and Health Boards. General Practitioners who have Practice Management Systems will be able to obtain electronic panel listings for upload.

The CARD2000 System was implemented in the Eastern Health Board area in May 1999. There are currently over 200 users based in Hospitals, Community Care Headquarters, large Health centres, and EHB Headquarters. The North Eastern Health Board implemented the system in November for 40 users.

DMS - Diabetes Management System is an application targeted towards health care professionals involved in caring for patients with diabetes in a shared care environment and also makes use of the IC_PIDRM. The main groups of users are diabetic nurses, general practitioners, endocrinologists, consultants and the Central Pathology Laboratory.

The application has been implemented according to the users' (i.e. the healthcare professionals mentioned above) requirements. The projects within the Telematics Application Programme are expected to be user-driven and this clearly means that end-users must play a key role in specifying the requirements and driving the technical work. These requirements have been elicited in an iterative fashion over the past year, and have been recorded in a Software Requirements Specification document, following the IEEE 830-1993 guidelines.

The DMS enables an authorised healthcare professional to find information relating to a specific patient in their care. This information includes demographic details, patient and family histories, dietary and nutritional information, details of previous episodes of care, current treatment regimens and the facility to add (by laboratory personnel only) or retrieve laboratory test results imported directly from the Laboratory Information System (LIS). The DMS also permits the generation of a variety of reports.

The application is currently implemented in MS Visual Basic Version 5 on a P.C. running under MS Windows NT4 with a background software framework of MS SQL Server 7.0 and MS Access '97/2000.

Development of higher versions is based on feedback from the users of the Diabetes Management System, and also the integration strategy with the IC PIDRM. We are currently examining the latest PIDRM specification to finalise the integration strategy.

Italy

PATRES - The application is devoted to the unique identification of a patient present possibly in different local databases and its alignment vs. a central Regional Master Patient Index. The application allows inputting of querying parameters as coming from legacy systems vs. the Master Index. Recognised central information is then used for querying vs. other local patient databases. Due to the differentiation of the target and business scope of application delivered at Central Regional Domain and at local hospital (with territory departments) level, one version of the application exploits directly Java services pointing to the Master Patient Index, whilst the other exploits also the CORBA support of data distribution, implementing an local identification super domain, even if not having a Master Patient Index (the generated IC_PIDRM patient class is the reference master for such domain). In addition, unique identification through various id domains is maintained also for abstracts of entries in the local systems of info regarding patient contacts that can be identified by type provision structure, dates and navigated.

REHAL - The application provides a view; applicable to different health care operational structures about the performance given in the provision of care both in hospitalisation and in outpatient care settings. The application work on anonymous data, extracted from the organisation of services provided by IC_HIS and requests and performances registered as references in IC_PIDRM. In addition to the statistic values of the information obtained (i.e. all the admission/discharges in a certain period in a certain hospital for a certain diagnosis), the exploitation of IC_PIDRM functions provides the possibility of navigate in linked episodes happened (to the anonymous patient), offering research and epidemiology opportunity to the users. For this purpose, the installed application is dedicated to health care professionals.

SANICARD (Civicard) - The current application is provided as a special module for health care support provided inside the "Civicard" used in Brescia province and it represents a prototype of the possible future regional card. The health care supported functions are constituting one of the various dedicated modules in the chip of the "Civicard", together with other dedicated sectors devoted to transport, public services etc. The application aims to read and register on the card both patient basics information, emergency data and an abstract of the requests of care (services and drugs). During the process of registration of new abstract request data, these info are also passed to a central archive under a "reference entry" behaviour, in such a way in the process of provision (i.e. of drugs from

pharmacy or outpatient care in ambulatory settings) the data can be cross-checked and updated without the support of paper reporting. For this scope and considering the maximum need of transparency for the usage of card requested by healthcare professional, the card libraries are interfaced via an encapsulation of functions inside a set of commercial General Practitioner (as the main requester) products (i.e. Iatros software in Brescia). The same applies for the main providers (i.e. pharmacy terminal interfaces).

HICAR - The application is a combination and the result of a synergy between InterCare development and telematics services and Tele-regions SUN2 project (with "InfoCare" application) for the creation of regionally approved and standardised in contents yellow pages for health care. The exploitation of IC_HIS services is transforming these kind of yellow pages, accessible to all the citizens, from a static descriptive presentation of a healthcare organisation in a powerful and precise public service to know about the services provided in a Region always with "live" information, accessed in existing operational legacy systems dedicated to daily activities, via IC_HIS.

The application is so constituted by typical web based software with html pages, that are not static, but that are relying on a resources database. From the application is possible to interrogate the presence and the availability of health care resources in the Region.

RIC - The application is offered to provide facilities on a distributed booking process in the net both for health care professionals and patients, both seen as requesters. After passing through a necessary identification process both of the patient and the healthcare professional as authorised requester, on the basis of the healthcare service identified a searching on availability on the several structures in the net is made and the possibility for booking shown. At the confirmation about the possibility chosen, a transaction is made on the remote legacy booking system and a registration of the request performed is kept as track in the reference entry of IC_PIDRM. Controls on concurrency of processes between the InterCare application and the local application running in the legacy systems are kept to grant consistency of the process and integrity of the data.

PROCOM - The application, as a refinement of KHIRA application set in Tele-regions SUN2 project, aims to improve controlled and secured transmission of reports from decentralised units to central domain, substituting a previous manual process of data passing. The application, linked to electronic mailing facilities, controls data formal correctness before sending and creates a secure token during transmission (tunnelling). Used at the moment only for performances reporting, the same can be extended to type of professional communications. In addition, some central services about support of correctness of data recording can also be invoked from remote sites (i.e. DRGs calculation using standard certified software).

Netherlands

PHARM-EPR - The demonstration-site in Schiedam demonstrates PHARM-EPR using two common products that are developed within the InterCare project: IC-EPDS and IC-CMS. The Common products are described in D3.1. Details about PHARM-EPR can be found in D 4.1.

The following services are provided:

- Querying patient medication data from the information systems of the local Hospital and a local Pharmacy using a browser
- Security provided by using smart-cards and industry standard protocols
- Querying smartcards for medication, application and card-status information
- Updating smartcards and application information

EXHIS - The Yellow Pages part of the Dutch demonstration site, locally known as 'Zorgwijzer Nieuwe Waterweg Noord' demonstrates EXHIS, a local application compliant to the IC-HIS. Detailed information about EXHIS can be found in D4.1.

This part of the demonstration provides the following services:

- Up to date information about various topics concerning health, insurance, and care at any place any time
- Response forms for communication to healthcare organisations
- Maintenance performed mainly by local enterprise managers therefore self-regulating and largely independent.

Sweden

IC-AHHC (Advanced Home Health Care Application) - The Palliative healthcare unit in Stockholm north-eastern area provides healthcare services to palliative patients in their homes. The unit is organised into three sub-units, one home healthcare unit for each of the northern and southern part of the area and one hospice unit.

The Palliative unit recognises team-oriented work procedures, where the care teams may include professionals from different care categories such as medical, nursing and paramedical. Also, as much of the care activities are performed in the patients' homes, the co-operation with community based home service units is developing.

The professionals in home health care are working mobile and often independently of each other. Clinical information needs to be captured at the point of care and made available to other team members as rapidly and adequately as possible. Documentation needs to be shared at different levels - between professional categories, between professional/non-professionals care givers, between the sub-units (a patient may be in his home during the day and at the hospice unit during the night), between units having different responsible authorities (e.g. Palliative unit and community-based home service) and between different specialist healthcare organisations.

Today the medical and nursing decisions, observations and care activities are mainly documented manually and the need for a computer-based application support is obvious.

The following general requirements were put up for the application:

1. To support extended communication exchange between team members and to improve the timing in exchange of information, in order to improve the quality of medical judgements and avoid inconsistencies between medical decisions taken by different team members.
2. To store information about medical decisions and observations made by different healthcare professionals being part of a care team. Parts of the information must be able to be shared among the team members, while other parts will not be shared.
3. To support access of specific information concerning healthcare decisions and treatment plans located in other units based on agreement and business rules.
4. To support the follow-up of care actions and treatments in terms of business goals, for example level of pain.

AHHC (Advanced Home Health Care) is an application that is built to meet these requirements. This demonstrator includes:

- Care Documentation application
- Care Documentation Administration application

...and uses the following server modules:

- CD - Care Documentation Server (module CD)
- EM - Enterprise Manager (module EM; the EM component is also accompanied by EM Administration application)

For access control AHHC consults the IC Common Product IC-IACS. The Enterprise Manager was originally developed within the STAR project, and may be seen as a specialisation of the IC-HIS common product.

The CD component contains functionality to create, maintain and search clinical information and supports shared care among different professionals in a care team within or between care units. It is generic and can be adjusted to support different health care settings by supplying the relevant classifications by means of the CD Administration tool.

The AHHC is working in a true CORBA/IDL and object-oriented environment. All used server components are fully specified in IDL and all persistent objects are stored in an object-oriented database.

CD

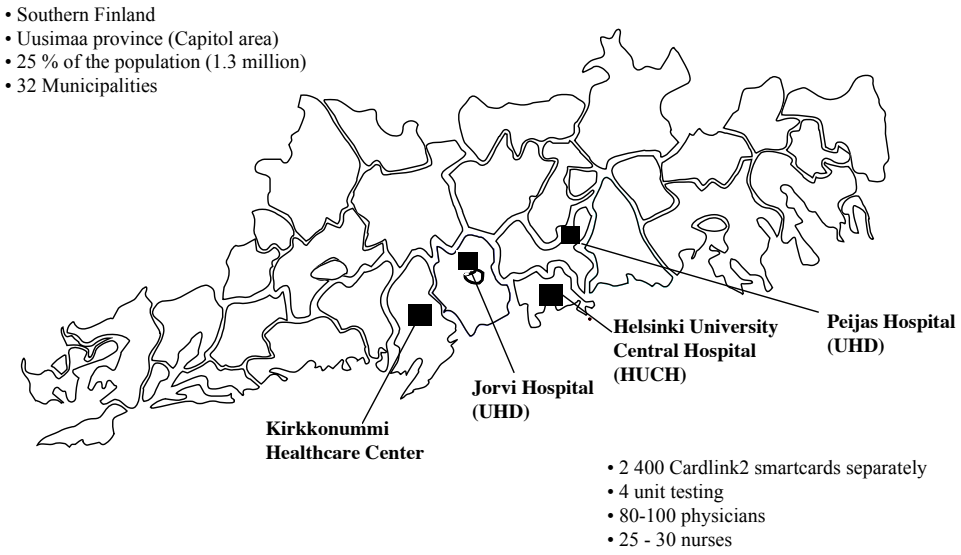
- The CD server provides services to manage objects of different types relevant for care documentation purposes, such as: Patient, Request, Healthcare Contact, Health Characteristic, Identified Problem, Action/Activity and Care Plan. There are also services to define and maintain classifications of different types, including classifications of Actions, Health Characteristics and Healthcare Contacts (e.g. according to type and role). The EM Server provides services to manage objects of types: Healthcare Party, Healthcare Professional, Healthcare Organisation and Healthcare Service.
- The AHHC application provides functionality to create and maintain clinical information and patient demographic data. Each professional category documents according to specified documentation models definable as classifications using the administrator tool but is free, when access rules allow, navigating in the documentation across categories and collaborating units.
- AHHC provides functionality to use pre-defined and to define new cross-category views on clinical information along parameters such as health aspect, time-period, professional category, units with which one co-operates, type of note, type and role of contact, etc - that can be combined.
- The application also includes functionality to support the planning of care, to document performed care and to support the evaluation of the outcome of prescribed investigation and treatment activities in relation to stated goals for care.
- Care plans may extend over care unit borders and include planned prescriptive actions from several professionals working at different units. The common agreement part of the care plan is maintained at the main responsible care unit while the planned action objects are distributed over the units in the federation.

2.3.2 Six demonstration sites

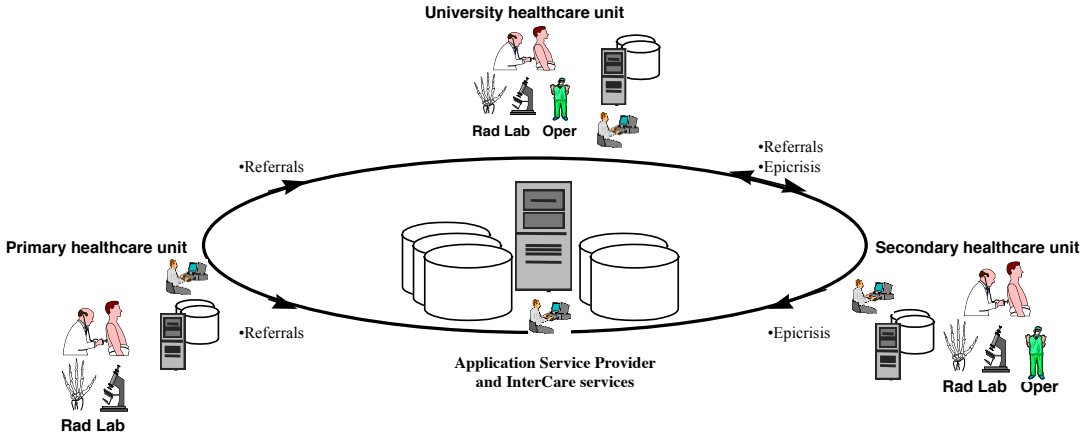
Finland

The demonstration environment in Finland includes a set of logically co-operative applications able to support a seamless care environment and services. The demonstration environment includes four healthcare units. There are 4 healthcare units participating in the demonstration. Kirkkonummi-Siuntio Healthcare Centre is representing the primary healthcare. The Jorvi hospital and Peijas Hospital are

representing the secondary healthcare units and Meilahti Hospital is representing the university level hospitals. The technical environment for demonstration is based on application service provider, which is Helsinki Telephone Company.

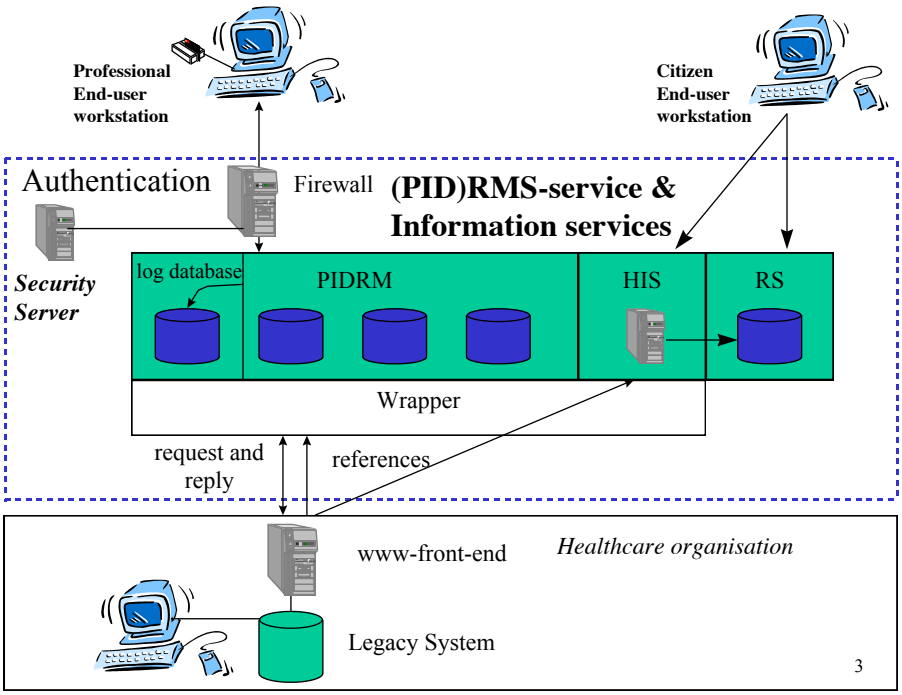


Functionally regional services such as InterCare services are common services not only for the healthcare units and professional but also for citizen. From the clinical point of view the target is that citizen contact first the primary healthcare unit, occupational healthcare unit or private sector. If the patient needs a more specified treatment or specialist, the next treatment unit is a secondary healthcare unit such as Jorvi or Peijas Hospital in this demonstration. In average 80 % of the patients who need secondary healthcare services are treated in right level and units. The university hospital selects the patients based on the referrals. In the demonstration environment about 10 - 20 % of the patients needs university level medical treatments. The service chain is composed of these healthcare units.

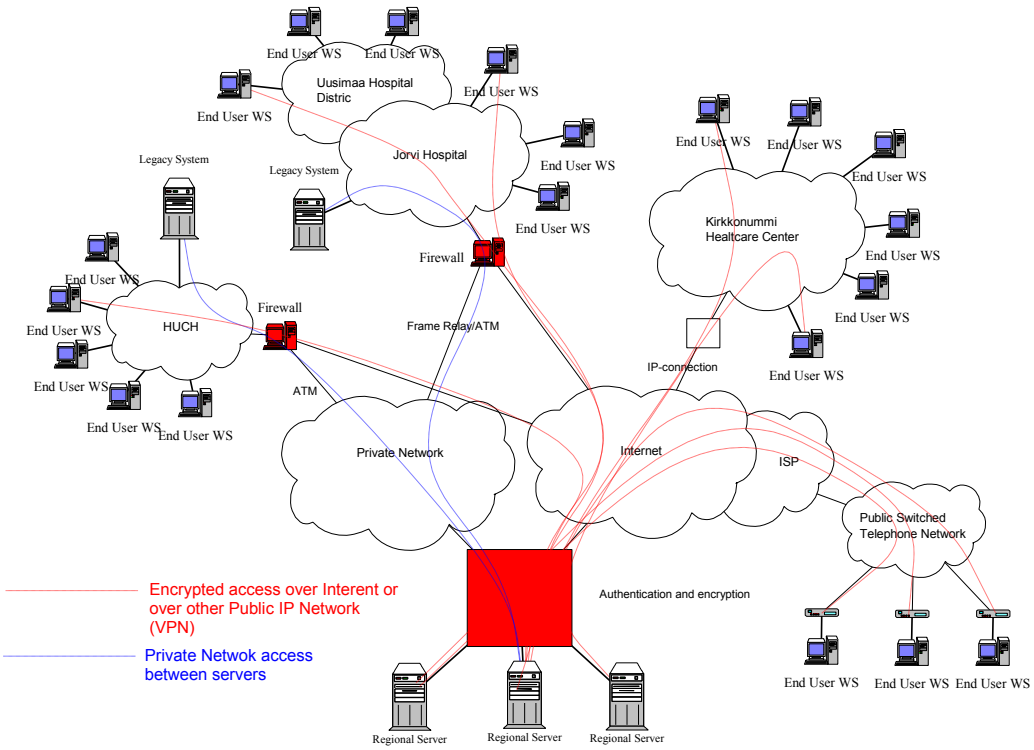


The technical environment and specifications are described in deliverables 4.1 and D5.1. The IC-products and services for the professionals and citizen to be demonstrated needs technical architecture and healthcare specified services. Technically described, the environment is composed of different products and services. The professionals need to have a more secure environment. The Finnish legislation requires electronic authentication and encryption functions. The Services for the citizens are based on common Internet technology without electronic authentication and encryption. The legacy systems of the healthcare units that are participating in the demonstration are completed with the wrapper technique to review the medical record information. The medical records in the legacy

systems are also completed with the consent of the patient, which gives the right to access the medical record data.



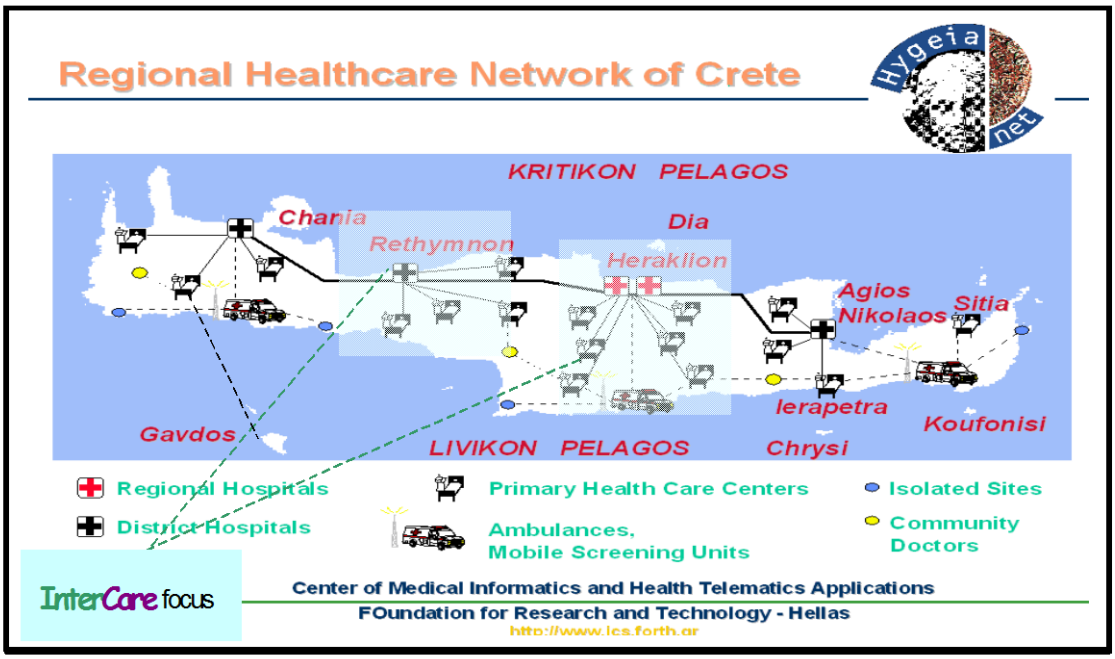
The network environment is partly private and public. All the medical record data transferred in the public net is encrypted. In the demonstration are, the network can be described in the following way:



Greece

The Greece/Crete InterCare partnership consists of:

1. Regional Administration Authority of Crete (RAAC)
2. Foundation for Research and Technology – Hellas (FORTH)
3. Hellenic Telecommunications and Telematic Applications Company (FORTHnet)
4. Eastern Crete Development Organisation (OANAK)



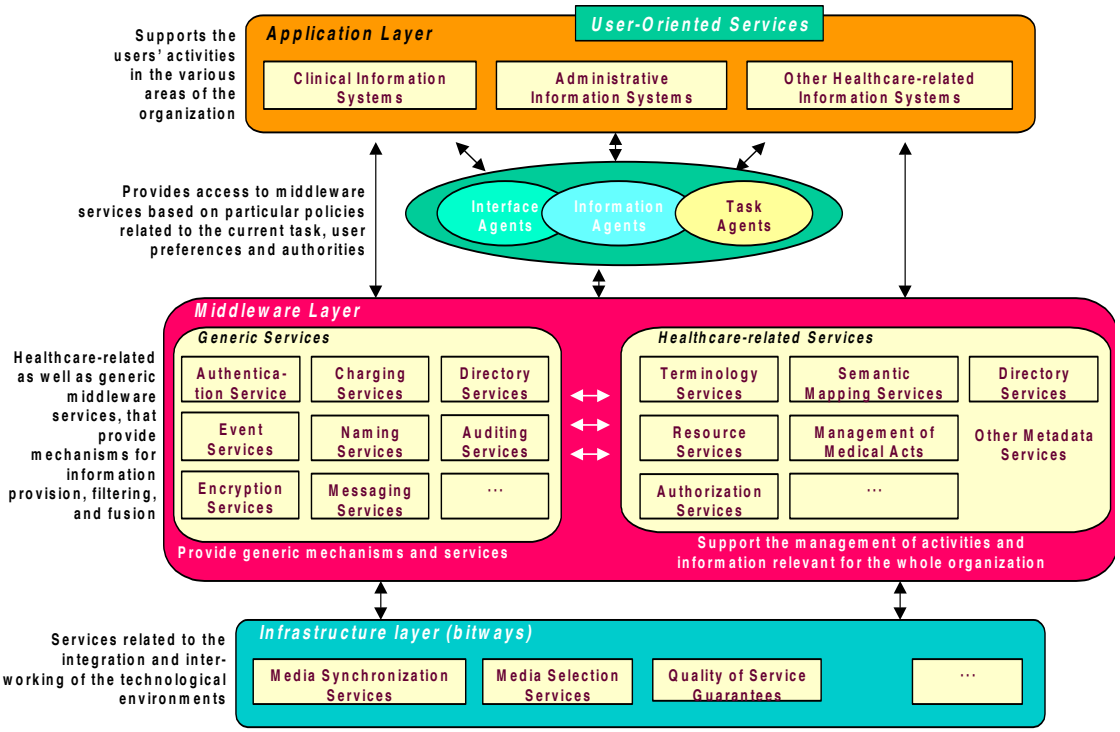
Overview

The following consists of the Greece/Cretan InterCare demonstrator:

The Crete Integrated HealthCare Communications Infrastructure: Internet-based communication lines throughout the whole island of Crete compose it. The main nodes are 5 regional Hospital, and about 10 healthcare centres. For InterCare the Rethymnon county is selected as the demonstrator (2 healthcare centres and one hospital, see Figure below). All of these nodes were wired (with ISDN lines, wireless communication lines, and local Ethernet installations in each medical functional unit), by FORTHnet.

The Integrated HealthCare Network of Crete (IHCNC): Composed by (***a***) CISs installed in various healthcare units (hospital clinics and healthcare centres), (***b***) *Patient Clinical Data Directory*- ***PCDD*** services, for accessing and navigating through the segments of the virtual electronic healthcare records of patients in the Crete region. PCDD is the fundamental local InterCare application provided by FORTH.

The HYGEIAnet Crete healthcare network: Composed by, (i) IT healthcare groups (like the HTA: Health Telematics Applications group of FORTH), (ii) Medical functional units (hospital clinics, and healthcare centres), and (iii) Healthcare professionals (heads of hospital units and healthcare centres and general practitioners through out the island of Crete). The whole network is meant (in the future) to be in the service of the Regional Administration Authority of Crete (RAAC), who is actually the main body for exploiting IT healthcare technology.



The HYGEIAnet Reference Architecture in the region of Crete

A reference architecture model describes a system in terms of basic functional elements and the interfaces among them. It clarifies where protocols need to be defined and identifies groups of functionality, without implying a specific physical implementation. The Greece/Crete HYGEIAnet reference architecture, shown in the Figure above, guides the development of a *health-telematics network* in the Crete region, for the provision of *integrated services*, *the HYGEIAnet*. It provides a general framework in which healthcare-related information systems may be integrated to provide media-rich services to healthcare professionals, social workers, and the public. Users are primarily interested in information processing applications, which they may own or gain access to as end-users via communications networks. These services are 'enabled' by other underlying, transparent services provided by information and network service providers. Applications and enabling services employ certain information processing services and systems for data transport, which may be distributed throughout the existing HII. Thus, the HII consists of three basic components: *applications*, *enabling* or, *middleware* services, and *network infrastructure*.

Ireland

The Irish InterCare demonstrator is mainly focused on integrated healthcare services as offered by the HSIS: Healthcare Services Information System. The architecture makes possible the use of the IC-HIS InterCare common product, in particular its specifications and common IDL definitions.

The National Health Strategy for Ireland demands the sharing and integration of patient information across the range of services provided by many different centres and agencies. The key theme is the provision of seamless care to individuals in the most appropriate and cost effective setting. This can be problematic when the range of caregivers may be diverse and located in geographically separated locations.

The basic effort of the InterCare Irish demonstrator was focused on the design and development of an integrated *Healthcare Services Information System (HSIS), a Diabetes Management System (DMS)*, and the *Card2000* system.

Integrated HealthCare Resource Information Services from the Irish Eastern & North Eastern Health Boards (ENEHB)

The demonstration site for HSIS had the following goals:

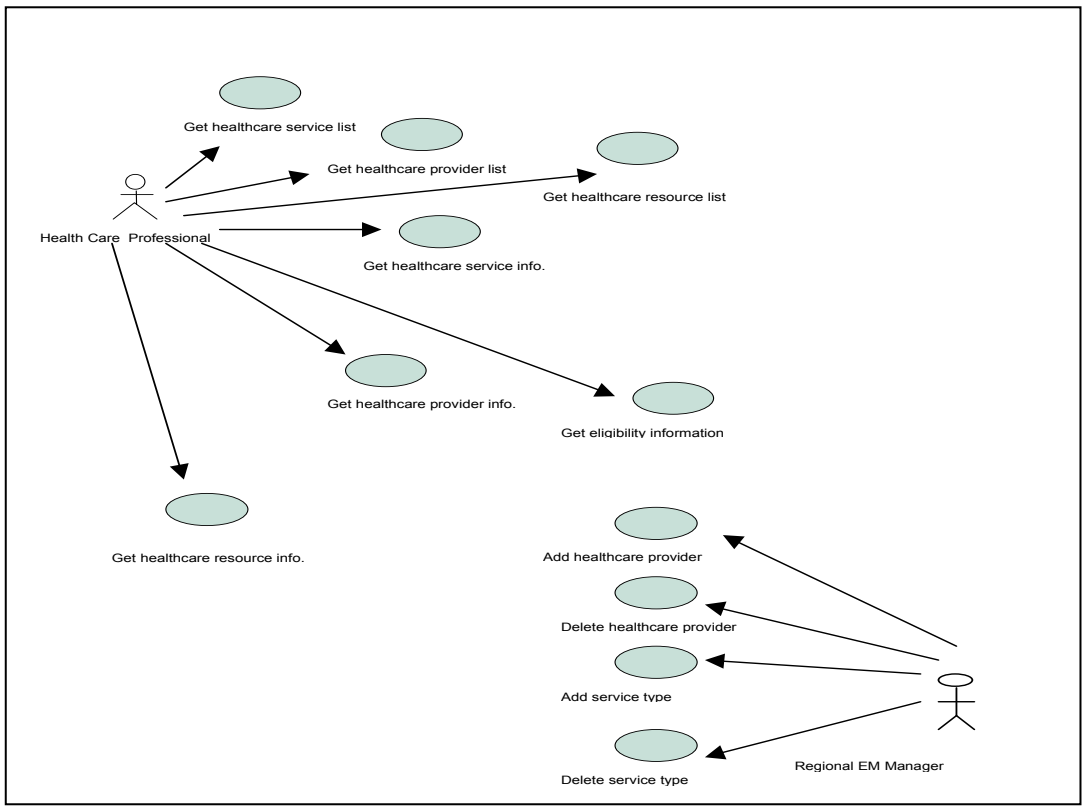
- *Health & Social Services* available with contact names, addresses & numbers
- *Public information* bank on common *medical complaints*
- Information on the *health & social status of the population* in the regions
- *Contact point* for further information
- *Integration* with the North Eastern Health Board (NEHB) *Intranet* site, so as staff of the organisations can have access to this wealth of information

The HSIS services are accessible from GP practices, pharmacies, health centre sites, public information points and other Internet accessible points. They will also be used to give health care professionals access to NEHB's Medical Card System, which is used to determine eligibility of a client to free medical care. This model will then be used for health professionals to gain access to other health care systems through HSIS.

The following scenarios are indicative of the HSIS's offered services.

- *Access to Health & Social Services Information:* Currently a client/health care professional might have to ring or visit a health care site to gain access to health & social care information – this is timely & costly and leads to inefficiency. HSIS demonstrates how this information is now available at the push of a button.
- *Access to a Healthcare Application:* When a client presents themselves to a health care professional (HCP), the HCP needs to know if they are eligible to free health care or not. This can be a timely process which will now be improved by means of an on-line access to the HSIS.

HSIS in the context of ENEHB network of healthcare services:
Use Case diagram



Inter-departmental & Inter-hospital Diabetic Patient Monitoring Services by the St' James & Tallaght Hospitals

A major change has taken place within the Dublin region. The three small city centre FDVH Hospitals (Meath, Adelaide, National Children's Hospitals) have recently moved to a new Tallaght Hospital (600 beds) 12 km south-west of Dublin. Many of the patients who currently attend St. James's Hospital will transfer to the Tallaght Hospital and likewise many FDVH patients will transfer to St. James's. Both hospitals are under the Trinity College Dublin Medical School umbrella so it is obvious that considerable additional communication facilities will be required.

Patients with *diabetes* in Dublin have the option of arranging their care with preferred GP's and hospitals and are likely to make their choice based on convenience, or their perception of quality of services available. In addition, more than one GP or consultant may be responsible for the care of a diabetic patient. A diabetic patient may be the concern of a number of consultants, e.g. a renal consultant, dietician, cardiologist etc. It is important that each healthcare professional responsible for this patient in this shared care situation, has access to their patients data, especially lab data.

For example, a consultant in one hospital may refer a diabetic patient's case to a consultant in another healthcare institution. The second consultant will require access to the patient's lab data. There is a need for an InterCare environment to make this data available.

Another common scenario, occurs when a GP in the catchment area of the hospital, sends a patient sample to St. James's hospital pathology lab for investigation. A GP may wish to make reference to a patients previous results carried out by another consultant. Instead of receiving the results over the telephone or by post, it would be preferable to have access to this lab data through th e Diabetes Patient Manager system. It is expected that InterCare will fulfil this need.

Medical Card Administration System: User Identification Services of the Irish InterCare Demonstrator

The primary objectives of the InterCare Project in the Eastern & North Eastern Health Board's is to:

- Integrate and exploit the key deliverables from parent framework developments (security architecture, "Yellow Pages") into a combined strategy with project partners.
- Assess other project deliverables, review security mechanisms and incorporate the core data set into the standards for demonstrations.
- Bring together the isolated islands of information in Hospitals, GP's and Community Services into a single seamless environment. This will be achieved through the use of Internet technologies.
- Build on results of local projects and developments.
- Integrate with national initiatives.
- Facilitate inter organisation approaches to care in the context of revised service and organisational structures.

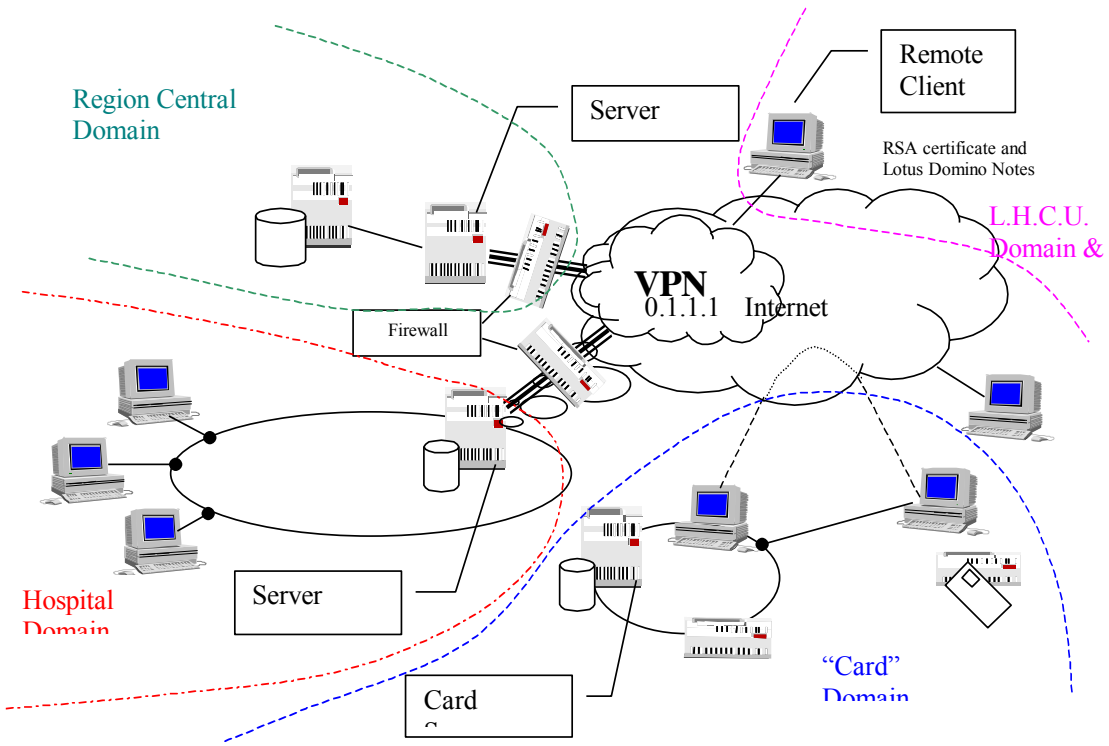
The new *CARD2000: Medical Card System* is accessed via the Yellow Pages (HSIS application based on the IC_HIS principles and specifications; presented in the first release of D4.1 deliverable). CARD2000 is used to determine eligibility of a client to free medical care. This model will then be used for health professionals to gain access to other health care systems through our Yellow Pages.

The efficiency of health professionals will increase, because less time will have to be spent in gathering information on health & social services available.

Italy

The demonstration environment for InterCare experimentation takes into account the provision of a set of logically inter-related applications able to support a seamless care environment. Inside the limits of experimentation, both the applications and the infrastructures are not uniquely seen and at disposal of all the sites connected, but a differentiation is made, based on interest expressed and physical communication situation available in each structure. Under these conditions, there is an extended site, the Fatebenefratelli hospital, able to exploit most of the applications, with just the exclusion of Sanicard (Civicard) that has a defined experimentation circuit in the zone of Brescia. On the other side, the set of Local health Care Units and Hospitals correlated in the experimentation are mainly able to support the usage of applications that have the lower level of inner privacy requested: this is due to the fact the at regional level, is not yet available a net offering the basic technological security infrastructure, as expected to be at the beginning of the project. The delays in this action surely produce limitations in the wideness of the experimentation, but do not affect the value and the portability of the results in a global net of health care actors.

From the logical point of view, the following figure presents the global technical scenario in place.



Infrastructural scenario for IC demonstration in Lombardia Region

From this picture it is possible to identify a set of "domains" in which homogeneity exists from the point of view of the environment, technical or functional.

In the **"Hospital Domain"** the applications dedicated to the execution or the control of secondary care actions or requests from primary to secondary care apply (view of reference entries in Rehal application, requests for booking in RIC application).

In the **"Regional Central Domain"** Services valuable horizontally as patient identification are positioned (Patres application) or visibility on regional resources (Hicar);

In the **"L.H.C.U. & GPs Domain"** Services for communication are positioned from the territory to a third party (the various aspects of Procom);

In the **"Card Domain"** the services are valid for different kind of "actors" domains, but are based on the availability of cards in the Brescia area (Sanicard as Civicard health care sector)

InterCare services – Lombardia

The set of InterCare services available in the Lombardia Region is focussing and centring on the process of request and provision of care, seen in its medical as well as administrative aspects. The aim of experimentation was so driven to provide, via a logical access to a portal of telematics health services, to provide the tools that, combined, can follow and satisfy the information and elaboration needs in a care request-provision life cycle. In particular, the booking process is the moment in which a request (and more widely – using InterCare concepts – a reference entry) is generated in the net. The completion of the request – provision cycle generate new data on the medical record of the patient and new administrative data in the view of control of costs. Leaving out the last item, all the Lombardia InterCare applications constitute a set of inter-related support application to the request-provision of care cycle, and can be seen autonomously as an explosion and an exploitation of the set of basic services put at disposal by the various InterCare products.

The following schema positions around the booking, represented in the **RIC** application, all the other developments subject to demonstration.

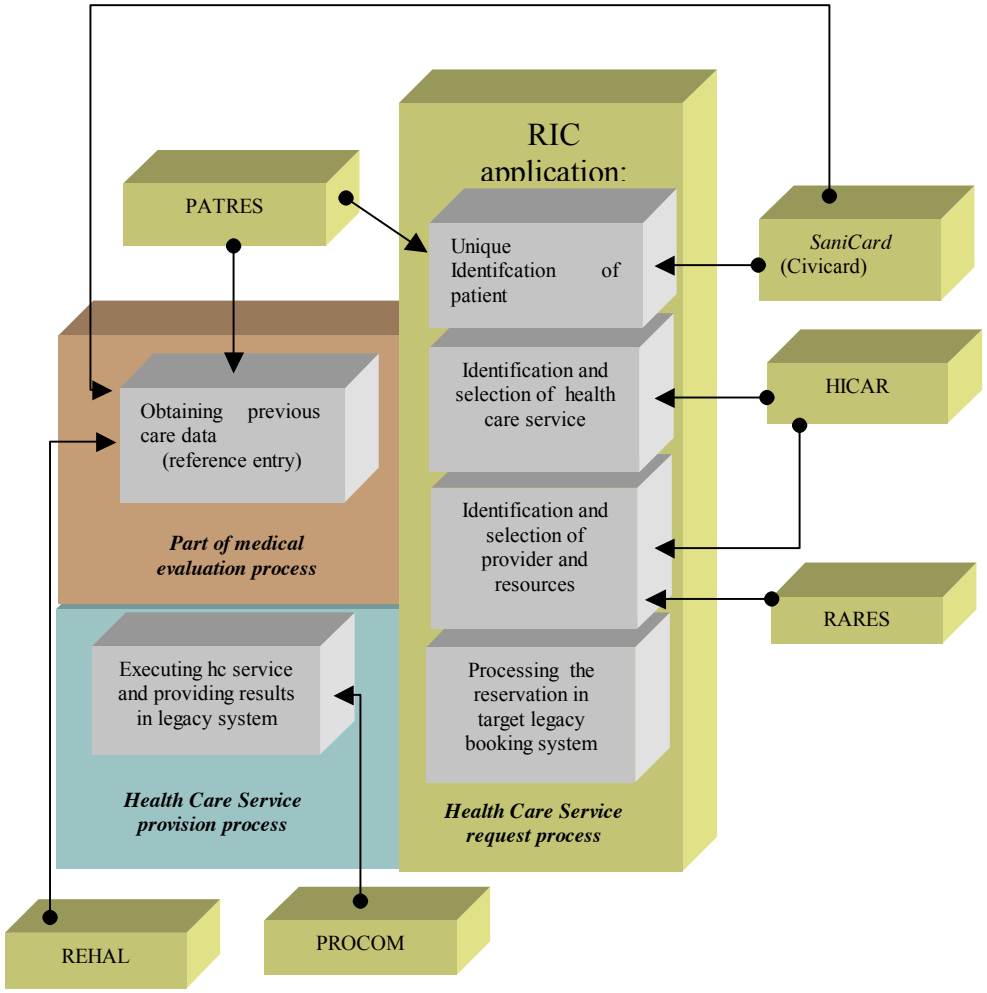


Fig. 2 The applications set under demonstration

Having described the context, the characterisation of each application constitutes its ability to make extensive usage of the services offered by the InterCare products, in terms of production and acquisition of information, to comply with the seamless execution of a care process.

In particular a description of each of the applications is here under given (taken from InterCare D4.1 documentation):

Netherlands

The Dutch demonstration site includes two local applications: PHARM-EPR (Pharmaceutical EPR-server) and EXHIS (Extended Health Information System). These applications are demonstrated separate from each other, but both within de Schiedam-area.

The PHARM-EPR part of the demonstration is shown in figure 1. With the PHARM-EPR application it is possible to query medication information of participating patients from both the Hospital Information System and the Pharmacy information systems, using a browser and a connection to the Internet. Access to the PHARM-EPR application is provided using smartcards.

In the demonstration site a pharmacy, the 'Rembrandt apotheek' is connected (as a feeder and a client) to the EPDS and can get information from the Schieland hospital. The Hospital Information System is used as a feeder. The specialists and GP's involved are only clients to the system.

In the Dutch healthcare system GP's and hospital specialists can prescribe medication. The prescriptions from the GP are issued at a pharmacy where the medication is given to the patient, the prescriptions of the specialist are issued at the hospital pharmacy and in case a patient leaves the hospital, at the local pharmacy. Sometimes these prescriptions can cause problems. When a prescription is marked as repeat-medication and there have been changes compared to the previous prescription, the patient is asked for the reason of this change (e.g. higher dose, changed volume).

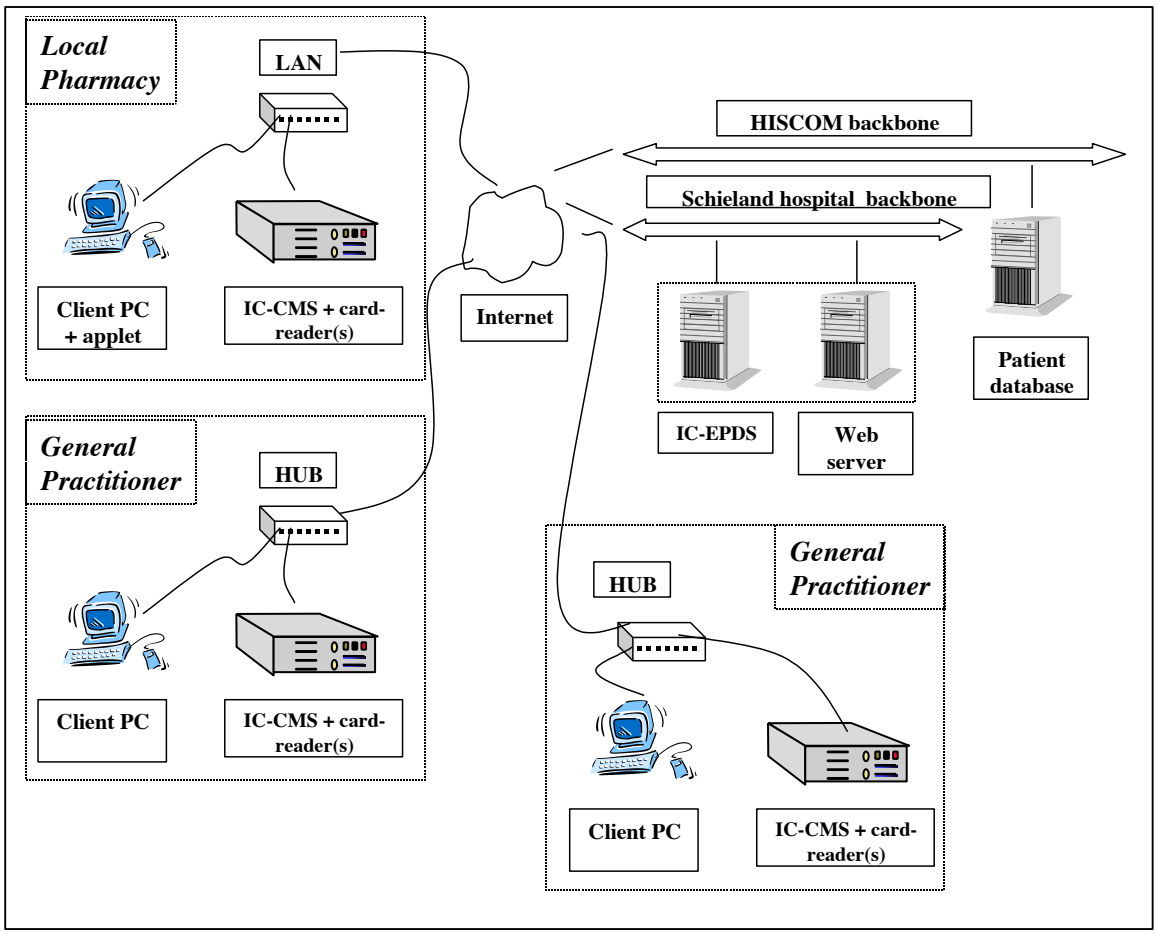


Figure 1 The set-up of the PHARM-EPR part of the Schiedam demonstration

If the patient cannot respond to this question, an inquiry is made at the GP's or Hospital specialist's by phone or fax. It usually takes a few hours (3-6 hours) before the problem is solved and the medication can be supplied to the patient. Other problems can be caused by interaction between medication prescribed and medication that was prescribed earlier. With this system the GP and the hospital specialist can enter the pharmacy-system during the consult by using PHARM-EPR, so interaction of medication will be detected at an earlier stage and the GP or hospital specialist can correct the prescription. The pharmacist contacts the GP or hospital specialist also when remarks can be interpreted in more than one way or when an alternative medicine is offered to the patient.

Dutch citizens are related to one GP, who monitors their medical status. During holidays or weekend-shifts, an attending doctor can write a prescription. In order to know what happened during the absence of the official GP, PHARM-EPR can be used to check for these prescriptions. When a patient needs repeat-medication from a prescription written by a hospital specialist, PHARM-EPR can be used to find out the exact name and dose.

The EXHIS-application that is part of the Dutch demonstration site is open to all citizens by means of public Internet. The EXHIS-part of the demonstration can be seen in figure 2.

General healthcare information can be gathered using various media, like brochures, calls and web sites. Because this information is unorganised, finding the information needed can take a lot of time. EXHIS categorises and summarises information from local healthcare organisations, and decreases the search-time needed. In offering response forms, the communication between healthcare organisations and the public improves as well. Usually the knowledge to manage an Internet site is not present within a lot of the local health-organisations. EXHIS is self-regulating, it provides an easy-to-use web-enabled functionality for representatives of regional health-organisations (called local managers) to add, change and delete the categorised information on their organisation. Healthcare professionals can use EXHIS to inquire if a patient is insured for the medical treatment needed. Inquiries can be made by means of a call or fax, but in many cases no inquiry is made and healthcare professionals are not paid at all. De demonstration-site is open to authorised healthcare professionals in the Schiedam-region.

Sweden

Two years ago Stockholm adopted an IT-strategy that included a service-oriented multi-layer architecture. The technical infrastructure, SLL-net, is now in place. A net with high capacity is available between Hospitals in the region and between Hospitals and Primary Healthcare Centres.

The implementation of business-oriented services has been dragging. Some components are now available like a Code-server, a Census-server and a Shared Patient Register giving access to information about all contacts a patient has had with the healthcare structure.

Changes in the healthcare structure are constantly taking place. The requester – provider roles are now more distinct and many healthcare units, even a hospital, have been privatised. Another main trend is that more patients are treated in their homes by multi-disciplinary teams.

A special unit ASiH was established some years ago to deliver healthcare services to palliative patients in their homes. AHHC is an application that is built to support these care services mainly using the information services available through the component Care Documentation server (CD). CD is one of the components available in the InterCare architecture in Stockholm.

The development in InterCare is supposed to contribute to additional services. Complementary projects are working in parallel.

Stockholm is responsible for the development of one component in the InterCare Architecture – the Information Access Control Server (IACS).

As part of the demonstrator applications, Stockholm has developed some additional components:

- Care Documentation Server (CD)
- Enterprise Manager (EM)
- Extended Referral Manager (ERM)

These components are integrated parts of the InterCare Architecture by specified IDL interfaces.

To demonstrate the Swedish site applications a special demo-lab has been established in Stockholm north-eastern healthcare area (NÖSO). The purpose of the demo-lab is to constitute a technical platform on which to run and demonstrate the applications that are developed in the project, to different users, user groups and other interested parties within healthcare, so that these parties can see and understand that the applications can be used, and provide those effects and additional values, which are the purposes of the applications.

During the development period, the demo-lab has also been used to receive successive deliveries from the developers and verify that the new deliveries were consistent to the demonstrations and scenarios that were already in use.

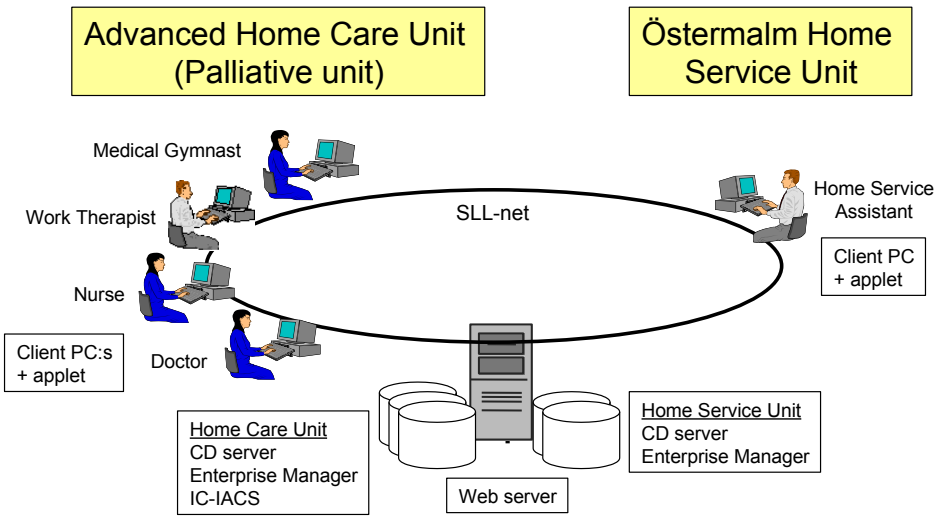
The demo-lab is technically equipped with the hardware and software needed for running the two Swedish demonstrators, the AHHC (Advanced Home Health Care) and the ERM (Extended Referral Management) applications. The server components are installed on a powerful PC and clients within the firewall communicate with the server via SLL-net (TCP/IP).

Both Swedish demonstrators run on PCs under Windows/NT version 4.0 Service Pack 5. AHHC and ERM components interoperate using Orbix 3.0, Orbix Names and Orbix Web 3.2, all from Iona Technologies. The persistent care documentation objects are stored in an O-O database managed by ObjectStore PSE Pro (for C++), version 3.0 from Object Design. The network protocol is TCP/IP.

All client applications use JDK 1.2 and are run as applets using Applet Viewer. However, they may also be run as applets using Netscape or Internet Explorer browsers, or as applications.

The AHHC demonstrator is also going to be demonstrated and validated at location at the Palliative unit, Stockholm north-eastern area, where end-users of several professional categories from this unit and from the community Home service of Östermalm will participate.

One-site and two-site configurations have been built up corresponding to the Palliative care unit stand-alone usage situation and the Palliative care unit - Östermalm home service unit collaborative situation.

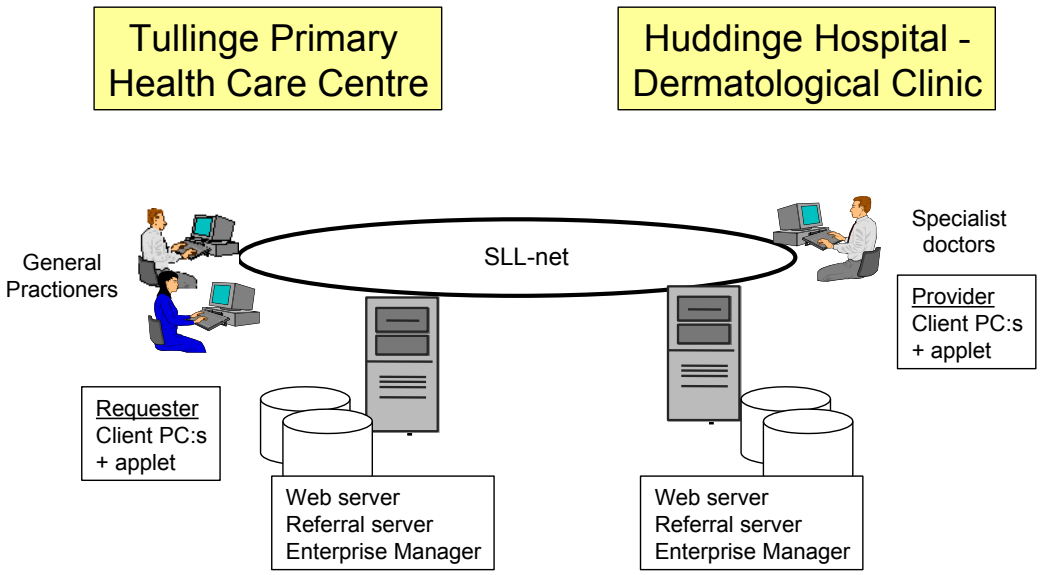


AHHC application demonstration set-up

The CD servers are prepared with the unit relevant classifications, the EM servers with the unit relevant organisational and professional structures.

Via the AHHC application graphical user interface, the end-user at each site creates and maintains documentation about clinical observations, decisions and care plans. The objects representing the contents of the documentation are stored in the care documentation database (object-oriented) at each site. The CD component uses IACS for access control. Enterprise Manager keeps data on the organisational structure and professionals at each particular site. Objects maintained by the various components, located within or at different sites, communicate by means of CORBA. A care plan, for instance, which is common to the Palliative unit and Östermalm home service unit as the particular patient is a patient at both units, comprises objects (e.g. planned activities) distributed over the units' CD servers according to activity responsibility. In the demonstrations, the kind of support that the AHHC application provides in such shared care situations are demonstrated.

The Extended Referral Manager is going to be demonstrated using a two-site configuration realising the Tullinge Healthcare Centre - Huddinge Hospital Dermatological Specialist Clinic requester/provider collaborative situation.



ERM application demonstration set-up

The EM servers are prepared with the unit relevant organisational and professional structures and referral templates are defined.

No electronic patient record systems are going to be used at the end sites in the demonstration phase. When the life cycles of referrals and referral answers are finished as concerns the manager (this is decided by the users at the requester and provider side), they are going to be archived manually.

A special RM administration tool has been built to handle the patient data. To secure patient identity, this component consults a regional citizen demographic repository server for some basic demographic data (not shown in the figure above).

2.3.3 Models and System Architecture

This section gives a brief overview of some of the modelling and architectural work of the project. There is far too much to be summarised within a few pages of a final report so the reader is referred to the project deliverables for more information.

InterCare Patient Identification and Reference Manager

IC-PIDRM is based on the results of the *Star*☆ project, and one of the main focal points within InterCare is the integration of this result with results from other feeder projects, such as: the Electronic Patient Dossier Server (from Synapses); the Health Information Service (from *Star*☆); the Card Management System (from CardLink); and the Security Server (from TrustHealth).

The former *Star*☆ PRM (Patient and Reference Manager) was based on the concepts of provision of identification support for a patient, despite the fact that his/her related information was stored in various legacy systems. To reach this target, in an internet based environment, *Star*☆ PRM had to play with a central Ids references repository from which, via hyperlinks, was possible to arrive and query a remote system applying the correct patient identification used locally. Anyway, it was necessary that the application includes knowledge about the system to query for.

The same was applied in case of another important support given by *Star*☆ PRM that was the identification of a part of a local medical report, accessed by its proper local patient-related identifier.

With the emerging on newly proof on the market distribution platforms, as CORBA with the ORB implementation is, the *Star*☆ PRM is now converted in the InterCare PIDRM, having both an architectural and functional evolution, both in relation to the CORBA based implementation and with the possible exploitation of a federated distributed environment in which other InterCare products offer better and dedicated support to obtain and to query for data stored in legacy systems.

Part of the PIDRM concepts implemented derive from a comparative analysis made on the basis of the OMG's CORBAmed PIDS (Person Identification Services) specifications, as described in CORBAmed document 98-02-29, and its further refinements.

What is peculiar of IC-PIDRM in relation to CORBAmed PIDS, is its more deep dedication to the problems of Identification of the patient (so in healthcare environment) and the relation of such identification with methods for accessing his/her distributed healthcare record.

In the following chapters, will be provided a description of the context of application of IC-PIDRM and its limitations, a description of the basic conceptual model on which the IC-PIDRM is instantiated, the external behaviours of the server, depicting its business logic and its components, and finally the available IDL for the interfaces.

InterCare Electronic Patient Dossier Server

The *enterprise* viewpoint includes the main user requirements for the Synapses architecture and a description of a number of aspects of the Synapses environment. The main requirement is the provision of a computing environment which facilitates the integration of a number of modules with existing or legacy systems in the clinical laboratory. The second requirement is that an open approach is used enabling interoperability and inter-connectivity in a vendor and platform independent manner.

Synapses clients

The elements with which a Synapses server communicates are shown in deliverable 7.2. There are three types of client components, clinical clients, Synapses administrator clients and system

administrator clients. Multiples versions of these three types of clients can exist at each implementation site.

Clinical Client

A clinical client is an aspect of a system used to request and receive clinical objects which are defined according to the Synapses information model.

Synapses Administrator Client

A Synapses Administrator client is an aspect of a system which is used to connect with the synapses server in order to manage the Synapses information model and to retrieve information relating to audit trails.

A system administrator client is an aspect of a system which connects to a Synapses server in order to manage the components of a Synapses system such as security, user information, patient index etc. The functions addressed by the system administrator are outside the scope of the Synapses project but they are included here as they are important requirements of a Synapses environment.

Feeder Systems

Feeder systems are another type of system aspect with which an EPDS system communicates. There can be multiples of feeder systems connected to the server. A feeder system is any system which contains information relating to patients which it wants to share. A Synapses server could be seen as a type of feeder system. The interfaces between the Synapses server and the four elements mentioned above are described in more detail in the deliverable using use-case diagrams.

InterCare Card Management Server

The presentation of IC-CMS interfaces contains descriptions based on the process and use case models of the various InterCare demo sites.

The models, presented in this document, form the stable basis of the IC-CMS, a common product, already in use in the Dutch demo site of DSW in Schiedam. In combination with a trusted authorisation organisation (in the form of a Security Server [IC-SS]) the IC-CMS manages the access to the confidential electronic patient dossier.

The IC-CMS acts as a mean of authentication of both patient and health care professional. Health professionals use Health Professional Cards (HPC) and patients carry Patient Data Cards (PDC). Both cards are used as logon keys to various information servers (Hospital Information Server, General Practitioner Information Server) whereas the PDC can also be used as a data carrier (i.e. small Electronic Patient Record [EPR], containing patient address and medication).

As outcome of this scenario, interface descriptions are given for the IC-CMS which, when combined with the descriptions of the other servers, is used in a CORBA middleware supported environment.

This chapter explains the functional environment and the model of IC-CMS from which the interface of IC-CMS is derived. The information presented here is partly based on InterCare Project deliverable D2.1. First, some general characteristics are given, with some historic background information, and then the context and limits are described. Finally, the model is described from which the interface is derived. These descriptions are also given in IDL, to be directly used in a CORBA-enabled environment.

InterCare Healthcare Information Service

The IC-HIS component comprises:

- A front end application, the Yellow pages application
- An intelligent repository the REM which memorises the regional healthcare organisation and which supports the secure diffusion of information according to front-end applications requirements.
- A local component, the Local Enterprise Manager which purpose is to publish information which is managed at the local level (for example information like the period of time when a healthcare professional could be contacted...etc).

The work done in InterCare has been concentrated on the REM component. The REM (Regional Enterprise Manager) functionality could be briefly depicted into three main types:

- administrative oriented queries
- activity oriented queries,
- resource oriented queries.

The analysis of the demonstration site requirements shows that the resource-oriented queries are not requested. So, it is not presented here in order to point out the more important functionalities from the end user point of view.

These functionalities are:

- The administrative oriented query which consists in retrieving organisations or elements of organisation (care units or healthcare professionals), and their relevant detailed information (localisation, communication means).
- The activity oriented query gives the list of medical services offered by a healthcare organisation or element of organisation.

InterCare Security Server

The requirements on the InterCare Security Server specified by the InterCare common product developers and demonstration sites concern, in essence, access control. As a result of the discussions held in the project, the decision has been taken to define the deliverables of the Security service common product as a limited implementation of an *access control* server (IACS), accompanied by a system of concepts and guidelines for applying the server in the healthcare domain as seen by the InterCare community and mainly directed towards role-based access control.

The aim of the information access control server is to check the legitimacy of access requests from healthcare agents e.g. healthcare professionals, patient-related persons (e.g. patient relatives) partaking in the care of a patient, patients as well as from citizens to healthcare information resources which need to be secured according to defined business rules.

The access control subsystem does not check whether an individual really is the individual that he/she claims to be. This must be handled by an authentication service managed from a card system, login component or other type of component. Authentication of programmatic entities may be handled using SSL.

When called to decide on the permissibility of an access request, the information access control server must be delivered data by the client (i.e. another InterCare common product) making it possible to evaluate if the request is in accordance with the applied access policies and rules. The data must specify which resource is requested (e.g. patient-related healthcare demographic or clinical

information), and describe who (e.g. which healthcare professional) is securely identified (authenticated) and wants to access this resource, and values for additional security attributes which are constrained by the used access rules.

The work builds on results from InterCare contributory projects, TrustHealth and Star, from OMG/CORBA security, CORBAmed (HRAC/RAD) and Tempora project (Esprit E2469).

Convergence, Summary and Comparison with work of CEN/TC251

The InterCare common products are adaptations of results from other projects to provide efficient and integrated support to the HC domain. Thus InterCare (IC) is an umbrella project where these results come together. The IC common products are the result of that work. In this paper we have presented an integrated view of the common products consisting of an integrated model that describes the how the information handled by the products fit together. To this end we have introduced an inter-product relationship model that describes the individual relationships between concepts in the various product models.

The products are the EPDS (Electronic Patient Dossier System) that handles the information records that contains the data. There is the PIDRM (Patent Identification and Reference Manager) that controls references to patients across feeder system borders. There is also the CMS (Card Management System) that handles small amounts of data in the cards together with identification information about the cardholder which may be a HC professional or a patient. There is the HIS (Healthcare Information Server) which holds information about HC professionals. Finally there is the SS (Security Server) that handles access rules and access rights.

The integrated model has strong similarities with ENV12265 which has been replaced with ENV13606. There are also strong relationships to NHS's Common Basic Specification (now Healthcare Model) and Electronic Healthcare Record Architecture. This is due to that the HIS, the EPDS, the SS and the PIDRM have adopted as much as possible of these standards.

One of the most influential standardisation efforts so far is the CEN/TC251 "Continuity of Care" (CoC). This work is also based on CBS and CEN/TC251 so there are many similarities between IC and CoC. The differences that do exist are mainly due to the difference in application and scope of the models. The goal of the CoC is to introduce a standard that is used throughout the HC domain from local HC systems to overall administration, in all different HC processes as well as across political administrative borders. Because of its wide scope the CoC is rather more abstract than that of IC which has a scope that encompass the scope of its common products and that of its integrated whole.

2.3.4 Closing Remarks on the Achievements

The project commenced in June 1998 and concluded 24 months later in May 2000. During the project it became clear that due to start-up delays and project restructuring, that an extension would be required to November 2000. However the European Commission contract would not allow the extension and therefore the final few months of the project were compressed in order to finish on time. This was unfortunate, as a better evaluation of the project would have occurred during the extended period.

One of the reasons for the required extension was that being an 'umbrella' project, InterCare expected contributory results that could be used without significant re-engineering. What was found was that the results were not at the required level of maturity and some additional work was required.

2.4 Conclusions and Plans for the Future

2.4.1 Exploitation Plans

The main Exploitation Plans for InterCare are described in deliverable D7.1 Business Development and Marketing Plan, the separate Exploitation Plan and the Technology Implementation Plan (TIP). Below is an abstract of the main strategy as it relates to the whole project. Each participating country also has its own plans.

This will operate at two levels:

- the creation of a market for the InterCare approach
- the individual marketing plans for countries and partners

The former will set the ground rules, undertake the co-ordination, liaison and European level exploitation activities and support the activities of the countries

The latter will operate within their own areas, building on the demonstrator sites and expanding the InterCare approach within their chosen environments as described in detail in the Exploitation Plan.

The creation of a market for the InterCare approach will derive from the activities and aspirations of the sum of the countries and will be managed by the InterCare Group which will consist in the first instance of representatives of the InterCare partners along with a User Advisory Group.

The primary activities of this group will be to identify and agree a Marketing Strategy and to agree the objectives, scope and resources to be applied. Common promotional material will be generated and made available to all the countries to ensure a consistent overall approach and set of messages which will support and enhance their activities.

The results of the project will be disseminated in the normal way through the deliverables of the project and the Final report and through a series of events based on the outcomes of the demonstrator sites. These will be co-ordinated by the InterCare consortium group and will be integrated into the overall HTAP Results programme via PROSOMA and other activities. This will apply also to Awareness actions as understood within this section but the overall exploitation activities will be dictated by the implementation of the Marketing strategy and Business plan outlined in section 5.1. This will be finalised and executed by the InterCare Group.

The product launch strategy for individual and for InterCare common products will be dictated by the individual country participants within the context of the Marketing Strategy. In terms of the project, the results and outputs will be handed over to the InterCare Group in accordance with the agreements set out by the consortium covering rights, investment, commitments, etc. Country launch strategies will be co-ordinated for maximum impact and implemented through the commercial procedures of the local distribution channels.

2.4.2 Finland

The product is an end-to-end controlled regional seamless care patient and administrative information broker with built in data security. This will include IC-HIS, IC-PDRM, IC-IACS along with local applications (HIS SSR, HIS RS &HIS VPMR). This will be offered on a monthly service cost basis rather than as the traditional capital procurement – this provides both a reduced risk model for the client and a unique position for HTC in the market. HTC will utilise the applications providers to implement the components and its role as ASP provides an alternative scenario to the LISIT approach. This is important in terms of the strategic marketing plan.

There is strong on-going non-commercial promotion activity using medias such as the journal of the Finnish medical society, Sairaalatalouslehti (Journal of Hospital Economics), MediUutiset (Medical News) and some IT-newspapers. Also, promotion has taken place in the major national level medical and medical informatics conferences and seminars. Commercial marketing will start as the necessary service product development has evolved enough. The major target is to achieve the role of an opinion leader during year 2000 in this niche market. All the way, there will be to parallel marketing processes which benefit from each other: non-commercial (user groups) and commercial (industrial parties). The first activities of the commercial marketing will take place on June 2000 and the full effort is planned to start in August in the form of a "road show". The marketing of IC type services for the healthcare will be part of the large corporate level e-business marketing in the Helsinki Telephone Corporation. The primary means of marketing and sales of e-services in Finnish domestic markets is personal sales by account managers. This work is supported by the promotion in major seminars and conferences.

2.4.3 **Greece**

The future of InterCare in Greece will be determined by the feedback and usage in the HYGEIAnet Integrated Health Telematics network of Crete. This is supported by:

- Educational Seminars
- Open Days
- Press
- Talks/ Presentations

In the context of the HYGEIAnet the following actions are foreseen and scheduled:

1. *Install* (on-going) beta releases of *PCDD* (Patient Clinical Data Directory) and *TCC* (Tele-Cardiology & Consultation) systems in various healthcare units on the Crete island.
2. *Educate* (on-going) users on autonomous (developed by ICS/FORTH) clinical departmental information systems and on PCDD, TCC services (operations, functionality - human computer interface).
3. *Integrate* others clinical information systems within the PCDD federation. There are contracts with *companies* that offer Laboratory Information System- LIS (PLIROFORIKH ELLADOS S.A.) services and integrated Hospital Information Systems- HIS towards this direction. The goal is to interface and seamlessly integrate these proprietary legacy systems with respective virtual Electronic Health Care Record services (as offered by PCDD).
4. Plans (on-going activity; initial discussions have started) for a *joint-venture* initiative with a (medical) Insurance company (INTERAMERICAN S.A.) in order to offer health telematic integrated solutions and enhance the Greek healthcare services network (clinics, labs, physicians) of the company (in particular for PCDD and TCC system and services).
5. In co-operation with FORTHnet (our associate partner within InterCare and the largest ISP in Greece) there are on-going discussions for a *joint-venture* initiative in order to offer healthcare services to citizens (actually customers of FORTHnet).

The ultimate goal is to make Crete's HYGEIAnet healthcare services (know-how, technology, applications and products) a *model for other regions in Greece*. Towards this direction the developed technology (InterCare solutions, applications and products included) is *disseminated* to various administrative healthcare stake holders (*open-days* organised, *leaf-lets* for products are disseminated, bi-monthly *newsletter* is scheduled).

2.4.4 Ireland

HSIS – In Ireland HSIS will be published on a website: www.slainte.ie. It will have a formal launch involving all of the Irish Partners in InterCare. It will be linked with Ireland's E-Government – health section. The target is Healthcare Agencies and will be promoted at various events such as DOH&C Groups, networking, media, CME Events etc.

Card2000 will initially be used by NEHB and then rolled out to other boards including ERHA. It will extend beyond just the Irish InterCare partners. The target is the Irish Health Boards and again will be promoted through DOH&C groups, networking, etc,

DMS - the Diabetes system is aimed at the Irish market. It will be promoted at Diabetic Day Care Centres & Primary Care centres.

2.4.5 Italy

There are three main active exploitation partners:

1. The Region of Lombardy
2. ASM Brescia
3. Lombardia Informatica

Lombardia Region needs to evolve the current Health Information System towards a "Regional Intranet for Health". The infrastructure and base platform services will therefore be in place to demonstrate the integration of the contributing InterCare projects' services.

A common architecture and technical approach are prerequisites for creating this co-operative environment. It is clear that co-operation must be created through telematic services outside the boundaries of the existing systems to safeguard the investment in legacy systems.

ASM Brescia intends to exploit the results obtained within the InterCare project basically under two lines:

- first of all, completing the multifunctionality of the health smartcard experimented within InterCare (also within the follow-up Digital Site EC funded Equal project) and then arriving to the (hopefully) positive decision to enlarge the distribution of the card to all Brescia citizens (200000),
- then, selling the know how reached to other realities, both as an offer for a unique package of multifunctional smart card management (offered in service and hosted on the Brescia service centre), as well as for each sub-application development and installation (some interested Municipalities have already asked for an offer for a complete package of smart card management)

A possible co-operation with other partners (also within InterCare) is under investigation and could be applied both in terms of joint participation to follow-up European projects or of joint commercialisation of the multifunctional card system.

Lombardia Informatica has considerable experience in European projects and at a practical level within Lombardia Region in relation to infrastructure. The set of architectural specifications and prototypes generated in the project have been considered a valid input for the incremental implementation of telematics services in a Regional healthcare environment. The company has created a sub company – named LISIT – to manage the implementation of a regional telematic health network, named SISS. Ericsson and SUN have joined the new company offering and providing infrastructure and base services. Lombardia Informatica maintains the management of the project and the definition of co-operation services, on which InterCare results can be positioned.

2.4.6 Netherlands

Groups of healthcare professionals, such as district-councils for GP's, are considered the most important target group for PHARM-EPR. Electronic communication between different healthcare professionals is still relatively limited, it is many regions effectively limited to mailbox-systems. After the final evaluation of the demonstration the partners will decide whether and how to promote PHARM-EPR within this market as the evaluation results are still intermediate.

The EXHIS-package is and will be offered to healthcare organisations focusing on the "Yellow Pages"-service: supplying information to citizens using the Internet. A nation wide organisation will be put in place to exploit EXHIS. This will offer a Yellow Pages service EXHIS supplying health information to citizens and across health care organisations and professionals.

HISCOM concentrates on the nationals as well as the international market of healthcare organisations (also non-hospitals. In first instance HISCOM will focus on the support for hospitals, for which HISCOM develops software product. The EPDS can be promoted and marketed through the existing channels.

ACI is planning on marketing IC-CMS (the InterCare Smart Card Management System) and IC-SS (authentication and security). ACI intends to implement, install and gives consultancy service and support on the package of integrated IC-products ACI is responsible for.

2.4.7 Sweden

Stockholm County Council is a good representative of a customer to the products created by the Swedish partners. The actors from Stockholm County Council that have been involved in the project are relevant and adequate user representatives. SISU and the main Swedish InterCare partner Stockholm County Council will be the prime movers in the exploitation of the Swedish applications and IACS server starting in the healthcare units who have been involved in InterCare. An external commercial partner will be sought to collaborate with the exploitation within Public Bodies.

The distribution channels planned will be others than those usually being used for distributing software to healthcare actors. The marketing strategy idea is to work close to communication and datacom companies that provide large organisations with communication facilities throughout the whole organisation cluster. These companies meet healthcare organisations that want to communicate with other units and they get questions about support and applications for co-operation between health care units. Another part in this market strategy is that these actors are interested to have value adding components to supply in addition to the network and access facilities for communication infrastructures that they deliver.

The ERM application will be distributed and put it into work in a selected part of the Stockholm healthcare region including a number of hospitals and primary care units, within one year's of time, after which to successively introduce the application to more parts of the region.

For the Advanced Home Health care application/CD server then to distribute and put it into work in a selected part of the Stockholm healthcare region outgoing from home healthcare, successively extending the use to other units with which home healthcare co-operates in the patient treatment process. As this application is of interest for a growing home healthcare sector, we will then seek channels for distribution of the application primarily to interested users in the Nordic countries.

The exploitation plan for Information Access Control Server, IC-IACS includes the following steps:

1. Evaluate the feasibility of using the functionality of IACS
2. Adjust functions and develop tools to manage definition of rules

3. Finalise the product together with partner
4. Put it into use in prioritised healthcare applications managing data with strong need for access control.

2.5 Contact Points

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Project Details

Project code:	**HC 4011**
Project value:	**8506 kECU**
EC contribution:	**3469 kECU**
Number of partners:	**7**
Number of countries:	**7**
Duration:	**24 months**
Starting date:	**1/6/98**

3. Back Cover

Project Consortium

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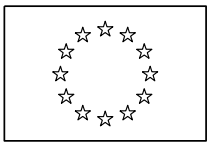

Further information on the TELEMATICS APPLICATIONS Programme:
You can obtain more information on the projects of the TELEMATICS APPLICATIONS Programme from:

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TELEMATIC APPLICATIONS Programme Information desk
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E-mail: telematics@dg13.cec.be
Or on the TELEMATICS APPLICATIONS Programmes' homepage:
http://www.echo.lu/telematics

4. Appendices

A Appendix: Deliverables Cover Pages

The following list shows all project deliverables:

- D1.1 Quality Manual
- D2.1 Product Design Specifications
- D2.2 Demonstrator Design Specifications
- D3.2 InterCare Common Product Interface Specifications
- D4.1 InterCare End-user Applications
- D5.1 Verification Report
- D3.1 InterCare Common Products
- D6.1 Demonstrations
- D7.1 Business Development and Marketing Plan
- D6.2 Evaluation Report
- D7.2 InterCare Consolidated Results
- D1.2 Final Report – Major Promotion of Project Results

The cover page for each deliverable follows.

❖ InterCare ❖

The Interworking and Interoperability of networked services for Healthcare using Internet-based technology

HC 4011

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Healthcare Telematics Applications Programme

incorporating

Cardlink 2, Hector, *Star*☆, Synapses and TrustHealth

QUALITY MANUAL

Workpackage:	WP1
Author:	Paul Cooper/Ranjit Kooner
Dissemination:	RP
Document Number:	INTERCARE/WP1/IMS001
Version:	2.1
Date:	1999-05-12
Web address:	
Abstract:	This is version 2.1 of deliverable D1.1, describing the quality procedures and standards set for the InterCare Project. .

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D2.1 Product Design Specifications

Workpackage:	WP2
Editor:	Mats Gustafsson, Lars-Åke Johansson (SITI/SISU)
Dissemination:	PU
Document Number:	INTERCARE/WP2/SISU004
Version:	1.0
Date:	1999-01-15
Web address:	http://www.imsgrp.com/intercare/ims001.html

Abstract:

This document contains the design specifications of the five InterCare common products: Card Management System, Electronic Patient Dossier Server, Health Information Services, Patient Identification & Reference Manager, and Security Server. The Unified Modeling Language (UML) has been used for the specifications work, and the documentation for each product embodies the Use case and Logical views. Interface definitions (expressed in IDL) and implementation plans are included.

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D2.2 Demonstrator Design Specifications

Workpackage:	WP2
Editor:	Mats Gustafsson, Lars-Åke Johansson (SITI/SISU)
Dissemination:	RP
Document Number:	INTERCARE/WP2/SISU005
Version:	1.0
Date:	1999-01-15
Web address:	http://www.imsgrp.com/intercare/ims001.html

Abstract:

This document contains the design specifications of InterCare demonstrator applications. For each demonstrator, the business objectives, purpose of application and metrics to be used for evaluation are presented. The Unified Modeling Language (UML) has been used for the specifications work, and the documentation for each demonstrator includes the Use case and Logical views. Implementation plans and architectural considerations are included as well.

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Workpackage 3
InterCare Common Product Interface Specifications

Workpackage:	WP3
Author:	Erika Romano, Valerio Verderio, Bruno Frandji, Chantal Choru, Leo Wolf, Hermann Lodder, Joost-Jan Klaveren, Mats Gustaffson [InterCare Consortium]
Approved:	Valerio Verderio (Wp3 responsible)
Dissemination:	Public
Document Number:	INTERCARE/WP3/LISPA022
Version:	1.0
Date:	31/08/1999
Keyword:	*Interfaces, IC products, IC-EPDS, IC-HIS, IC-PIDRM, IC-SS, IC-CMS, CORBA, Business Architecture*

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Workpackage 4
InterCare End-user Applications
(Deliverable D4.1)

Workpackage:	WP4
Author:	Leona Hackett (IE), Jeroen de Hann (NL), Sune Anderson (SE), lars Ake Johanson (SE), Miko Rotonen (FI), Valerio Verderio (IT), George Potamias (GR), [InterCare Consortium]
Approved:	George Potamias (Wp4 responsible)
Dissemination:	RP (restricted to project participants)
Document Number:	INTERCARE/WP4/FORTH006
Version:	1.0
Date:	20/11/1999
Keyword:	*InterCare applications, clinical context, software description, technical specifications, InterCare regional network architectures, UML models, InterCare common products*

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Workpackage 4
InterCare End-user Applications
(Deliverable **D4.1-PartB_2**)

Workpackage:	WP4
Author:	Leona Hackett (IE), Jeroen de Haan (NL), Sune Anderson (SE), lars Ake Johanson (SE), Miko Rotonen (FI), Valerio Verderio (IT), George Potamias (GR), [InterCare Consortium]
Approved:	George Potamias (WP4 responsible)
Dissemination:	RP (restricted to project participants)
Document Number:	INTERCARE/WP4/FORTH007
Version:	Final
Date:	3/4/2000
Keyword:	*InterCare applications, software description, technical specifications, InterCare regional network architectures, UML models, InterCare common products*

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Workpackage 5: Verification Report (Deliverable D5.1)

Workpackage:	WP5
Author:	Themis Manganas, Manolis Velegrakis (OANAK), George Potamias (FORTH), Jeroen de Haan (DSW), J.J. van Klaveren, (ACI), Herman Lodder (HISCOM), Leona Hackett (EHB), Rory O'Moore (SJH), Valerio Verderio (LISPA), Mats Gustafsson (SITI/SISU), Mikko Rotonen (Ussima Hospital), Bruno Frandji (SAFHIS)
Dissemination:	Public Usage
Document Number:	INTERCARE/WP5/OANAK001
Version:	1.0
Date:	31-03-00
Web address:	http://intercare.imsgrp.net/
Keywords:	Common Products, Local Applications, Verification Results, Quality Assurance and Review Criteria, Test Forms

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Workpackage 3
D3.1
InterCare Common Products

Workpackage:	WP3
Author:	Erika Romano, Valerio Verderio, Bruno Frandji, Leo Wolf, Hermann Lodder, Joost-Jan Klaveren, David H. 't Hart, Roland Dahl, Mats Gustaffson, Lars-Åke Johansson [InterCare Consortium]
Approved:	Valerio Verderio (Wp3 responsible)
Dissemination:	Restricted to project participants
Document Number:	INTERCARE/WP3/LISPA026
Version:	1.0
Date:	30/11/1999
Keyword:	IC products characteristics, IC-EPDS, IC-HIS, IC-PIDRM, IC-SS, IC-CMS, CORBA, services offered

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D 6.1-Demonstrations

Workpackage:	WP6
Author:	Valerio Verderio, Gabriella Borghi, Nicola Simeoni, Doriano Basso, Alberto Bonetti, Jeroen de Haan, Petra van der Horst, Mats Gustafsson, Lars-Åke Johansson, Mikko Rotonen, George Potamias, Vassilis Moustaki, Leona Hackett, Róisín Doherty
Dissemination	PUBLIC
Document Number:	INTERCARE/WP6/DSW030
Version:	2.0
Date:	29-05-2000
Keywords:	InterCare Demonstration, Evaluation, Applications, Metrics

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D7.1 Business Development and Marketing Plan

Workpackage:	WP7
Author:	David Lloyd Williams, with contributions from Partner and Associate Partners.
Dissemination	PUBLIC
Document Number:	INTERCARE/WP7/IMS39
Version:	4.1
Date:	27th June 2000
Web Address	http://intercare.imsgrp.net
Keywords:	Business, Development, Marketing, and Exploitation Plan.

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Workpackage 6

D6.2

Evaluation

Workpackage:	WP6
Author:	Jeroen de Haan, Petra van der Horst, Mikko Rotonen, Mika Paavola, Sinikka Ripatti, Leona Hackett, Brid Brennan, Mats Gustafsson, Maria Berglund, Lars-Åke Johansson, Monica Winge, George Potamias, Sara Facchinetti, Valerio Verderio, (Regione Lombardia)
Document Number:	INTERCARE/WP6/D6.2/DSW032
Version:	1.0
Date:	12/07/2000
Keyword:	InterCare Demonstration, Evaluation, Applications, Metrics

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Consolidation of InterCare Common Products (Deliverable D7.2)

Workpackage:	WP7
Author:	Rolf Wohed, Bruno Frandji, Mats Gustafsson, Valerio Verderio, Leo Wolf
Dissemination:	RP
Document Number:	INTERCARE/WP1/IMS040
Version:	1.0
Date:	31/07/2000
Web address:	http://intercare.imsgrp.net
Abstract:	This deliverable presents an integrated model of the InterCare product, which includes several components called common products. The goal of InterCare is to support integration of legacy systems and/or new systems within healthcare. In the former case a wrapper supports the InterCare interface and in the latter case it is part of specification. InterCare provides various common services including a card management system for authentication and storage of medical or administrative data. There is also a security server to handle the complex access rights within healthcare.

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Final Report - Major Promotion of Project Results

Workpackage:	WP1
Editors:	Paul Cooper with contributions from project partners
Dissemination:	Public
Document Number:	INTERCARE/WP1/IMS041
Version:	1.0
Date:	July 2000
Web address:	http://intercare.imsgrp.net/
Abstract:	This document is the Final Report summarising the work done and also pointing to the major promotional events that took place within the InterCare project. The project was an umbrella of a number of contributory projects and developed converged services and applications to deliver seamless healthcare applications across six key regional sites in Europe.

B Appendix: Project Leaflets