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Synapses - Federated Healthcare Record Server

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Abstract. This paper presents an overview of the Synapses Project, funded under the EU Health Telematics Framework IV Programme. Synapses sets out to solve problems of sharing data between autonomous information systems, by providing generic and open means to combine healthcare records or dossiers consistently, simply, comprehensibly and securely, whether the data passes within a single healthcare institution or between institutions. The approach to be taken in Synapses is to build as far as possible on existing results in both technology and standards. The fundamental enabling technologies for Synapses are open distributed computing, object orientation, browsing, information filtering, multimedia, security mediation and telecommunications. The project plans to bring them together, apply them to healthcare, and produce demonstrations validating the approach. The result will be in the public domain in the form of a set of specifications and guidelines.

1. Introduction

A major impediment to progress towards shared care and cost-containment is the inability to share information across systems and between carers automatically. Electronic and paper healthcare records are held in islands of information in independent information systems, each with its own technical culture and view of the healthcare domain. The Synapses project sets out to solve problems of sharing data between autonomous information systems, by providing generic and open means to combine healthcare records or dossiers consistently, simply, comprehensibly and securely, whether the data passes within a single healthcare institution or between institutions. Synapses (HC 1046) is a three year project, starting in 1996, funded under the Health Telematics Programme of the European Commission. The consortium consists of 26 partners from 14 different countries representing the health software industry sector, research institutes and universities, and end-users through the participation of several hospitals.

The fundamental enabling technologies for Synapses are in existence and well understood. Synapses plans to bring them together, apply them to healthcare, and produce

demonstrations verifying the approach. The result will not to be a proprietary product, but will be in the public domain, in the form of a set of specifications and guidelines

This paper presents a brief overview of the aims and objectives of Synapses; as the project is in its preliminary stages, only an indication of the technical approach will be given. Section 2 explains the motivation for the project, Section 3 covers the approach planned and Section 4 presents some conclusions on progress to date.

2. Background and motivation

The delivery of healthcare is undergoing a change from having a single carer relationship to one where the patient is managed by several health professionals at the same time - ***shared care***. Large amounts of information may have to be collected, not only by the traditional verbal means and from physical examination of the patient, but also increasingly by data intensive diagnostic services, such as clinical laboratories and imaging departments. The ability to share mutually comprehensible information efficiently is crucial to achieving progress towards shared care, improved quality of care and cost-containment. By facilitating data sharing, Synapses can provide potentially immediate access by the carer to all relevant healthcare information wherever and in whatever format it is stored. The need for a Synapses-type approach was acutely felt in a number of the Framework III projects, such as TANIT [1] and OpenLabs [2, 3], which were targeted at specialised departments (intensive care and clinical laboratories, respectively), but which not only required data from external systems such as the Hospital Information System and pharmacy systems, but which also provided specialised input to the overall patient record.

For the future, there is general agreement that no single vendor will be able to meet all the information processing needs of an individual hospital, let alone of the whole healthcare sector [4, 5]. Some developments do address the problem, but they are not in the public domain and there is little chance that they will be accepted throughout Europe. Furthermore, the high cost and low profitability of the healthcare systems market conspires to create an environment that does not encourage the optimal use of new technologies and has lead to a fragmented and essentially domestic market with many incompatible systems throughout Europe. So Synapses aims to act as an agent of change encouraging the adoption of standards and participation of suppliers.

3. Approach

The enabling technologies for Synapses are in existence and well understood: open distributing computing in a client-server environment, distributed databases and object-orientation, multi-level indexing and browsing to assist in locating the various components of the record, object dictionaries supported by terminology servers to ensure a common understanding, multimedia handling (since healthcare records are inherently multimedia), intelligent filtering to avoid information overload, security mediation, and telecommunications. The task is to bring them together and adapt them for healthcare, and solve the problems that arise when such technologies are harnessed. The Synapses specifications will be implemented in the form of a server which will be validated in a wide variety of clinical domains with different patterns of usage - within hospitals, among primary carers in a local area, across carers for chronic illness; a total of 11 sites in 10 countries will be involved in the validation process.

The work to be done in the project consists of:

drawing together and building on the extensive work and results in the field of Telematics [1, 2, 3, 6, 7, 8, 9, 10, 11, 12], IT [13] and Telecommunications [14, 15, 16] and in CEN TC/251 (in particular PT1-011) [17, 18], and applying it to the medical record to implement an integrated, communicable and combinable ***Federated Healthcare Record*** (FHCR) for Europe

- validating and demonstrating the results against user need, via a range of client applications, in a variety of settings: clinical, in the community, and among users in other sectors of healthcare
- providing a migration path and the basis of a set of guidelines so that different legacy systems products and architectures can synapse to the server
- showing whether the solution is likely to be easy to use, cost-effective and operationally acceptable.

The kernel of Synapses consists of a set of services which support access to distributed components of the record. Thus conceptually, the components of the healthcare record are brought together via the Synapses server from any number of distributed ***feeder systems***. In order to share information components automatically, it is necessary not only to agree on common protocols for the exchange of information, but also to ensure that the exchange is meaningful i.e. that the participants share a common understanding. In the context of Synapses, which takes an object-oriented view of the FHCR, this means that it is essential to adopt common standards for object class definitions in terms of class names, compositional relationships and basic object types. This standardised set of definitions is called the Synapses ***object dictionary*** and it lies at the heart of the architecture. The object dictionary contains a set of definitions of healthcare objects, which will be mapped onto those data representations used in the synapsed feeder systems. For this mapping to be both implementable and unambiguous, the dictionary must be based on a rigorous common object model or formalism. This formalism will be based on the CEN TC/251/PT1-011 pre-standard and will build extensively on the results of the GEHR Project [8], which go beyond the pre-standard, especially in the area of ethical and legal requirements for sharing of data among clinicians.

The object dictionary is designed to facilitate systems synapsing to the server and hence the associated object model is a high-level abstraction from the complete domain model covering all the information found in the healthcare record. It is concerned only with the ***sharing*** of information and not the detailed content. It is recognised that some of the information contained in the healthcare record can only be interpreted in its original context. The issue of preserving information context has been addressed in the CEN TC/251/PT1-011 pre-standard and GEHR and will be utilised in conjunction with the object dictionary within Synapses.

Associated with the object dictionary is the object manager, which receives requests for data objects from applications and looks up their characteristics from the object dictionary. These characteristics will then be interpreted to determine where the object resides, invoke program (methods) to convert a Synapses request into messages capable of being interpreted by the feeder system and convert the received data into the Synapses exchange format.

In principle, the implementation of any individual object manager will be proprietary but to facilitate transportability it is desirable that the object dictionaries are standardised and made as independent as possible from object managers. To achieve this, object dictionaries

will be implemented as a set of relational tables. However, this does not mean that any particular server must necessarily use these tables dynamically because the data within them can be compiled or otherwise converted into the form required by a local object manager.

The object manager established during the specification stage of the project essentially defines the data model of the object dictionary. To implement a functioning object manager/object dictionary it will be necessary to populate the dictionary with objects which have (i) agreed names, (ii) agreed structures and (iii) agreed methods for storage, retrieval and conversion to and from the exchange format. The names of these methods will be standard but their values will be pointers to code modules residing in local object managers. The software which manages the dialogue between the client message handler and the object manager on the server will be implemented within an overall distributed object environment such as CORBA or OLE.

Access to shareable information would be either from data copied to the server from feeder systems (generally legacy systems) or dynamically from feeder systems via data in the exchange format routed through the server. Where data is copied from the feeder systems into the server, it will be stored in the ***server auxiliary database***. Maintaining the consistency of replicated data is primarily the responsibility of the security mediator. New generation feeder systems implemented according to the object dictionary would automatically integrate with the server and would progressively supplement and replace legacy systems.

4. Conclusions

Synapses is not another communications architecture, nor an expansion of a product or architecture, nor is not intended to constrain local policy or other technical approaches. Rather it enables different systems based on different architectures to use each other's data and should have the effect of increasing their impact. It is to be an open generic means which is available to any company or user. The aim will be wherever possible to add to existing software in preference to changing it.

While Synapses is an ambitious project, the Consortium is confident that by building on existing results and avoiding "re-invention of the wheel" it can succeed. Validation is being carried out on an extensive scale in many countries and in a variety of clinical settings. An essential aspect of the approach to increasing the impact of the project is the organisation of a number of external workshops to be held during the course of the project. The purpose of these workshops is to disseminate the results of Synapses as they become available, not simply to the research community but also to the policy makers and finance providers on whom the success of the project depends since it is they who will ultimately decide whether or not to adopt Synapses as part of their global healthcare strategy. The benefits of Synapses are potentially very far-reaching. For patients, Synapses provides immediate access by the carer to all the relevant healthcare information, wherever and in whatever format it is stored. This will help to ensure that the patient receives the appropriate treatment as quickly as possible avoiding unnecessary duplication of examinations, tests and other procedures. For the end-users, Synapses will make more data immediately available to professionals and carers involved with a patient, and widen the catchment for researchers, teachers, administrators, and providers of resources and finance. From the point of view of industry, Synapses will increase the impact of any product or service that

uses medical records, but widening the range of data available to them, and making the data compatible and comprehensible. Moreover, it will help industry to expand their potential market by facilitating synapsing between their systems and other systems elsewhere in Europe.

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