Another HISA - The new standard: Health Informatics - Service Architecture

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Abstract

In addition to the meaning as Health Informatics Society of Australia, HISA is the acronym used for the new European Standard: Health Informatics – Service Architecture.

This EN 12967 standard has been developed by CEN – the federation of 29 national standards bodies in Europe. This standard defines the essential elements of a Service Oriented Architecture and a methodology for localization particularly useful for large healthcare organizations.

It is based on the Open Distributed Processing (ODP) framework from ISO 10746 and contains the following parts:

Part 1: Enterprise viewpoint
Part 2: Information viewpoint
Part 3: Computational viewpoint

This standard is now also the starting point for the consideration for an International standard in ISO/TC 215.

The basic principles with a set of health specific middleware services as a common platform for various applications for regional health information systems, or large integrated hospital information systems, are well established following a previous prestandard. Examples of large scale deployments in Sweden, Denmark and Italy are described.

Keywords: medical informatics, hospital information systems, standard, SOA, ODP, HISA, CEN, middleware, data-carrying integration platform

Introduction

Healthcare organisational structure consists of networks of centres (hospital cooperations within e.g. counties, individual hospitals, clinics etc.) distributed over a territory, characterised by a high degree of heterogeneity and diversity, from organisational, logistic, clinical, technological and even cultural perspectives. The structure of individual centres is evolving from a vertical, aggregated organisation towards the integration of a set of specialised functional areas (e.g. unit of laboratory analyses, unit of surgery), needing to share common information and to operate according to integrated workflows.

On the one hand it is necessary to support effectively the specific requirements of each unit or user in the most appropriate and cost-effective way whilst on the other hand it is vital to ensure the consistency and integration of the overall organisation, both at local and territorial level. This integration requirement is not only related to the need for improving clinical treatments to the subject of care but is also demanded by the urgent necessity of all countries to control and optimise the current level of expenditure for health, whilst ensuring the necessary quality level of services to all subjects of care.

The large number of databases and applications, mutually isolated and incompatible, which are already operational in healthcare organisations to support specific needs of users, cannot be underestimated. Even within the same centre, healthcare information systems are frequently fragmented across a number of applications, data and functionalities, isolated and scarcely consistent with each other.

Under the present circumstances, the main need for care delivery organisations is to integrate and to make available the existing information assets, to make possible the integration and interoperability of existing applications, thereby protecting investments. During integration activities, continuity of service needs to be achieved whilst gradual migration of existing proprietary, monolithic systems towards the new concepts of openness and modularity occurs. The cost-effectiveness of the solutions, especially when projected on the scale of the whole healthcare organisation, represents another crucial aspect to be evaluated carefully.

The goal can be achieved through a unified, open architecture based on a middleware independent from specific applications and capable of integrating common data and business logic and of making them available to diverse, multi-vendor applications through many types of deployment. According to the integration objectives at organisational level, all aspects (i.e. clinical, organizational and managerial) of the healthcare structure must be supported by the architecture, that must be able therefore to comprise all relevant information and all business workflows, structuring them according to criteria and
paradigms independent from specific sectorial aspects, temporary requirements or technological solutions.

Standards and technological solutions already exist and will continue being defined for supporting specific requirements, both in terms of in situ user operations and with respect to movement of information. The architecture must be able to accommodate such requirements by allowing the specific models to be integrated with the complete information assets of the healthcare organisation and the communication messages to be “services” extracting or importing data from/to the common information as shown in Figure 1.

Figure 1 – A Service Oriented Architecture

The purpose of this standard is twofold:

- to identify a methodology to describe healthcare information systems through a language, notation and paradigms suitable to facilitate the planning, design and comparison of systems;

- to identify the fundamental architectural aspects enabling the openness, integration and interoperability of healthcare information systems.

The architecture is therefore intended as a basis both for working with existing systems as well as for the planning and construction of new systems.

Materials and Methods

The standards body and process

This standard was developed within CEN/TC 251 (www.cente251.org) which is the technical committee for Health Informatics within the federation of 29 European national standard bodies.

The work in health informatics has been mandated by the European Union and the European Standard is published as a national standard in all of the member countries following the approval based on a weighted vote. In this case only one country was opposing the approval.

This work was developed within Working Group 1: Information models by the Task Force HISA led by Gunnar Klein, who was at the time also chairman of CEN/TC 251 and with the two other authors as member of the core group with Frederik Endsleff having a particular responsibility for part 1 and Pier Angelo Sottile for parts 2 and 3.

Experts from the following countries also contributed actively to the development of this standard: Belgium, France, Germany, Hungary, Italy, Norway, Sweden and UK but also as non-European contributors Australia and the USA.

During the extensive formal review process in several stages a total of 112 written submissions where adding to the final version.

Open Distributed Processing

The standard framework for Open Distributed Processing was first developed by the Object Management Group (OMG) and later approved by ISO/IEC as the International Standard ISO 10746 from 1996.

This standard contains a rich set of specification elements and recommendations for the development of open distributed systems. It has successfully been applied in a large number of different industry sectors including, telecom and banking.

At the time of issuing the first ODP standard, there was no available standard for information modeling. Since then UML (the Unified Modeling Language) has been developed and since it has been adopted as the method of choice for health information modelling by both CEN and ISO and many other organizations, UML was selected as the information modelling language for the new HISA standard.

The ODP framework contains five viewpoints. In the HISA standard we have provided health specific advice and definitions for the three upper levels. The two lower viewpoints, Technology Viewpoint and Engineering Viewpoint are applicable for a concrete development and implementation project but there is no point in providing health specific restrictions in a standard.

Results

Part 1: Enterprise Viewpoint

The Enterprise Viewpoint specifies a set of fundamental common requirements at the enterprise level with respect to the organisational purposes, scopes and policies that must be supported by the information and functionalities of the middleware. It also provides guidance on how one individual enterprise (e.g. a regional healthcare authority, a large hospital or any other where this model is applicable) may specify and document additional specific business requirements, with a view of achieving a complete specification, adequate for the characteristics of that enterprise.
The strategic paradigm

The specification of the architecture shall start with a very concise, managerial-oriented document (the “Strategic Paradigm”) that identifies (at a high level of abstraction) the overall requirements and strategic objectives of the envisaged system. It describes, in natural language:

- the rationale and the scope of the IT system with respect to the overall enterprise;
- the fundamental organisational processes (as defined under terms and definitions) that can be identified in the enterprise and that are relevant for the envisaged system;
- the fundamental constraints and objectives to be satisfied.

The HISA standard gives important guidance for an Enterprise on how to model its detailed requirements. The importance of starting from a model of the care processes is emphasized and the following model is offered to clarify the different processes.

Figure 2 – Subdivision of the care process

<table>
<thead>
<tr>
<th>Clinical process</th>
<th>Refinement object: perceived patient condition/health issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management process</td>
<td>Refinement object: mandate, decisions</td>
</tr>
<tr>
<td>Communication process</td>
<td>Refinement object: information</td>
</tr>
</tbody>
</table>

The Enterprise Viewpoint deals with the requirement specification and contains use-cases, process descriptions and models leading to the identification of the overall Service Architecture and the basic clusters of objects. The following are identified:

- Subject of Care Workflow
- Activities management workflow
- Clinical Information Workflow
- Management of authorizations
- Management of resources
- Management of dictionaries and coding
- Interactions with other systems

In the standard, there are detailed use case descriptions specifying common requirements on information management.

It should be emphasized that this standard does not claim to have the description of all possible requirements, only the commonly shared processes of healthcare enterprises.

Part 2: Information Viewpoint

The Enterprise Viewpoint of the HISA standard has identified certain processes. The Information Viewpoint is detailing the information structures using UML class diagrams. The information model is specified without any – explicit or implicit-assumption on the physical technologies, tools or solutions to be adopted for its physical implementation in the various target scenarios. The specification is nevertheless formal, complete and non-ambiguous enough to allow implementers to derive an efficient design of the system in the specific technological environment that will be selected for the physical implementation.

This specification does not aim at representing a fixed, complete, specification of all possible data that may be necessary for any requirement of any healthcare enterprise. It specifies only a set of characteristics—in terms of overall Organization and individual information objects—identified as fundamental and common to all healthcare Organizations, and that shall be satisfied by the information model implemented by the middleware.

Figure 3 – Subdivision of the care process

HISA Information Objects in each package shall be classified as operational or descriptive:

- “Operational”, usually representing the actual (clinical, Organizational, etc.) objects that are continuously generated during (and for) the daily activities. These include the personal and healthcare treatment information on patients, the individual resources used for carrying out the actual activities, etc..

The operational information objects model the entities involved in the daily activities of the healthcare enterprise in the treatment of subjects of care and in the functioning of the enterprise itself.

- “Descriptive”, usually Organization-related, specifying the criteria according to which the Organization works and is organized. It includes general classifications of clinical concepts, rules according to which the activities are performed, and more (e.g. the types of activities which are carried out in the radiology department, the diagnostic classification in use in the clinical setting, etc.).

The descriptive information objects model the entities required for the overall knowledge base that is required by the healthcare enterprises to carry out daily activities related to the treatment of subjects of care and in the functioning of the enterprise itself.
For each “operational” information object, therefore, the model foresees one “descriptive” information object, containing
the main classification data, the properties, the rules and
the default values that are necessary for the management of
the live data instantiated in the “operational” object.

It is noteworthy that the HISA information model is where
relevant using existing standards, such as the European EN
14822: Health Informatics - General Purpose Information
Components which is based on the HL7 Reference Informa-
tion Model.

**Part 3: Computational Viewpoint**

This part of the standard specifies the fundamental character-
stics of the computational model to be implemented by a spe-
cific architectural layer of the information system (i.e. the
middleware) to provide a comprehensive and integrated inter-
face to the common enterprise information and to support the
fundamental business processes of the healthcare organiza-
tion.

The computational model provides the basis for ensuring con-
sistency between different engineering and technology speci-
fications (including programming languages and communica-
tion mechanisms) since they must be consistent with the same
computational object model. This consistency allows open
inter-working and portability of components in the resulting
implementation.

The basic computational objects, corresponding to the infor-
mation objects, will be equipped with standard lower-level
basic interfaces having the scope of adding, updating and
deleting –in short maintaining-, listing, and getting one in-
stance of the main classes described in the information view-
point. These basic methods allow the access to and the ma-
nipulation of each element of the underlying model and secure
the openness of the system.

The higher-level computational objects are equipped with
interfaces managing more complex business logic implement
more complex business transactions on the objects of the in-
formation model, simplifying and ensuring consistency of
developments and building common fundamental procedures
of the organisation.

Examples are:

- Patient/person area, including registering a person,
  Patient Administration (ADT), merging patient iden-
tifiers, period of care, etc.
- Activity management and life cycle, including re-
  quests, planning, booking, etc.
- Clinical and EHC record, including terminologies,
  classifications, problem-orientation, etc.
- Resource management, including standard usages

**Examples of use of HISA based architectures**

In Europe there are a number of large healthcare organizations
that have based their strategic planning on the HISA middle-
ware principles and various technical solutions exist from
different vendors and technical generations. Here are a few
examples:

**Uppsala County Council, Sweden**

This is one of seven healthcare regions in Sweden that have
decided to use the Cambio Spider middleware product. It is
used for all its three hospitals and 35 primary care centres in
one installation. This HISA implementation is based on a
modern Java (J2EE) architecture with choice of Application
Server and SQL database.

This system handles healthcare for all the 300 000 inhabitants
plus as a regional highly specialised care for a million people.
Today there are around 10 000 daily users of the system that
includes, the following applications on top of the HISA plat-
form:

- Care Administration
- Resource Planning
- Electronic Health Record
- Medication management including electronic transfer
  of prescriptions
- Order management for lab, imaging and consultancy
  services

The same system is also used in the counties of Kronoberg,
Jönköping, Östergötland, Västmanland, Kalmar and Värmland
in Sweden and also in Odense in Denmark and in the Faroe
Islands.

**The “Policlinico A.- Gemelli” in Rome “Università Cattolica
del Sacro Cuore”**

The UCSC information system consists of several applications
based on a common architectural approach suitable to ensure
the integrity and consistency of the information assets of the
organisation, from the clinical, organisational and managerial
point of view.

It relies on a healthcare-specific middleware product from
GESI (the DHE®, Distributed Healthcare Environment) of
services allowing different applications to access the common
information heritage and to perform common business proc-
esses through a set of services. On top of the DHE, several
applications provide specific support to the user activities.

The following figure 4 shows at a high level of abstraction,
the overall heterogeneous structure of the healthcare informa-
tion system of the hospital and the centrality of the HISA-
based DHE middleware.
Copenhagen Hospital Corporation (H:S), Denmark

H:S selected in 2002 the DHE product to implement its HISA strategy for 6 hospitals, in all comprising 4000 beds. The DHE serves as the joint data-carrying Integration Platform, forming the basis and common information heritage for a number of clinical and managerial applications.

Among the applications are the medication module and the master patient index with over 10,000 users, fully rolled out and in integral daily running operation throughout the organisation.

H:S is from 1 January 2007 being merged with a.o. Frederiksborg County and Copenhagen County, into the Capital Region, responsible for regional healthcare of all of the region, including 10 hospitals and 1.6 million inhabitants. The master patient index and the medication module is for this purpose currently undergoing rollout in the Frederiksborg County.

Several further DHE based applications are under current advanced development, such as Reporting, Accounting and the Patient portal, utilising the common information heritage.

Information is exchanged not only with the direct HISA interfaces (provided by the DHE) but also through messaging with other standards (utilising the underlying HISA interfaces) such as:

- The Danish national implementations of European standards in Edifact for e.g. laboratory communication and ePrescribing (MedCom).
- Information exchange with other messaging standards such as HL7, XML and Diagnostic Equipment such as for ECG and Imaging

Discussion

HISA is a new standard defining a “Healthcare Informatics Service Architecture” identifying the general principles of the service architecture, to secure openness and vendor-independence:

a) information must be separated from specific applications and accessible through services
b) service logic must be independent from technological issues (i.e. multiple technologies and mechanisms must be possible for accessing the same services)

HISA is also identifying the fundamental elements of a comprehensive information model capable of supporting the whole healthcare organisation and finally the fundamental characteristics of a set of services for managing common information and for performing common business logic

This standard is not an alternative but a complement to other standards for health informatics such as specific messages developed by e.g. HL7 or the general EHR communication standards from CEN and openEHR.

Conclusion

After many years of research and standardization activities, there is now a formal standard for a Service Oriented Architecture (SOA) specific for the requirements of health care enterprises but based on the general principles of Open Distributing Processing. It is now a European Standard but it has been submitted to ISO and is formally under consideration to become an International Standard.

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