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Understandable Logical Design Specifications for HL7 CDA Interoperability

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Abstract

This paper describes the approach adopted by the Turkish National Health Information System to build a national Data Warehouse, covering more than 50 Data Sets, specified by the Ministry of Health, and an EHR for each citizen.

The messages are first specified using a UML logical design model, which is understandable to all stakeholders. These specifications are then mapped to HL7 CDA Release 2 to produce the wire format specifications, xsd's and java classes.

Each message is assembled from stand-alone Data Sets, which populate the Data Warehouse, and Sections which are used to create the EHR.

Keywords:

systems integration, computerized medical record, logical design specification

Introduction

The Turkish National Health Information System is to provide a national Data Warehouse, based on more than 50 Data Sets, and an EHR for each member of the population of almost 80 million people. Data is submitted by hospital clinics and family physicians.

The project is being implemented by a consortium, which includes Datasel, Birim and Sun Microsystems. Interoperability uses HL7 V3 CDA Release 2, with nationally-defined coding schemes and identifiers.

The challenges include the development and implementation of a large number of messages, involving multiple suppliers in a short period, as well as reconciling the central requirements of the Ministry for data analysis and the users expectation of having a useful EHR.

Method

The messages have been designed using a common structure, shown in Figure 1 as a UML diagram. Each Message includes a Header and one or more Data Sets. Each Data Set contains one or more Sections and each Section contains may contain various Data Elements. The Header, Data Sets and Sections include default Context data. This maps to HL7 CDA Release 2 [1] in a straightforward way.

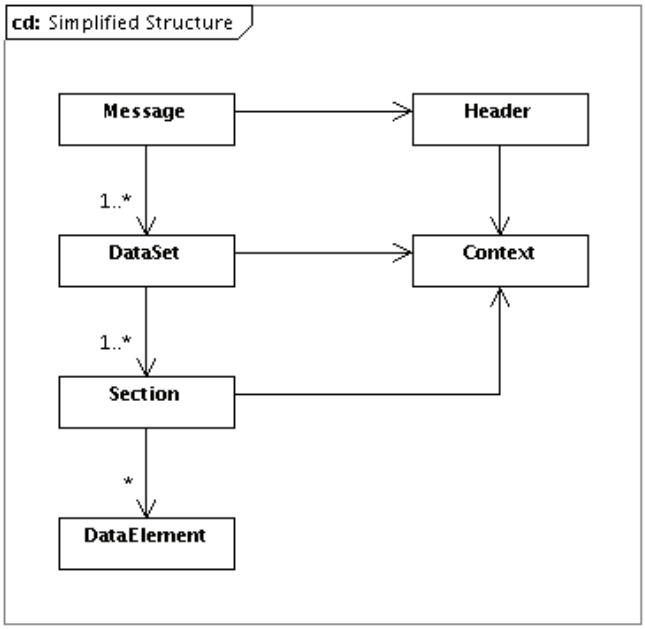

Figure 1 - Simplified logical design of messages

Context data

Each Message concerns one patient (who about), has a specific date (when), a single location (where) and author (who by). This is referred to as Context data and provides the default values of patient ID, date, location, clinic type (e,g, Cardiology) and user (health care party), which apply to all parts of the message, unless more specific data is provided.

Header

In addition to Context data, the Header for each message contains standard metadata, such as unique identifier, time of creation (to the nearest second), name, type and version of the message, realm (e.g Turkey), processing status (e.g. live or test) and confidentiality level.

Data set

The main body of the message contains one or more Data Sets, specified by the Ministry of Health. Examples of Data Sets include patient referrals, discharges, births and deaths. Each Data Set has its own unique identifier and specific version identifier (template ID) and includes Context data. Each Data Set is composed from a number of Sections.

Section

A Section is a standalone data object, which is reusable in different Data Sets. For example the Diagnosis Section (figure 2) may occur in several Data Sets. Other examples include procedure, medication and allergies. Each Section contains a unique identifier, type code, version (template ID) and a human readable free text statement of what it contains (text). It also includes default Context data, as well as its own data elements. Note that some Sections may only contain text and as a result have no additional data elements.

These Sections correspond to HL7 CDA Sections. In CDA the sharing of default Context in Data Sets and Sections is achieved by setting a Context Conduction Indicator to "true".

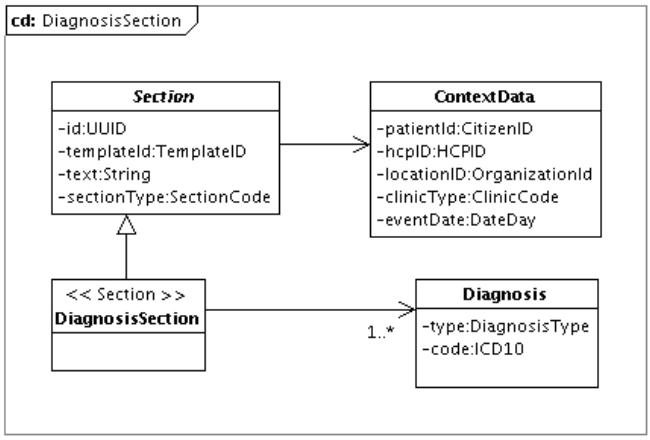

Figure 2 - An example of a section - diagnosis section

Design method

The number of Data Sets and their content will evolve over time, while the header, context and Section definitions are likely to be much more stable.

The data content used throughout the whole system is specified in a single UML model. Each message, Data Set and Section is one view into the model. This provides a comprehensive and consistent specification, written at the logical level, which understood by both users and developers [2]. The UML model is also computer-readable, generating an XML output (XMI).

It is straightforward to map the logical design specifications to HL7 CDA R2 as well as to the applications software used at both the sending and receiving ends. Each Section is mapped to build a library of HL7 templates, CMETs, xsd and Java classes, which can be assembled to build, check and process Data Sets and complete messages, just like putting Lego bricks together.

This method could be used to build a new set of tools, which may simplify development of CDA R2 based messaging solutions. HL7 already has tools for various purposes, but the method employed in this project is simple, flexible and powerful. Such a tool, based on the Eclipse platform, has the potential to boost adoption of HL7 CDA R2 by simplifying the production of stringent HL7 CDA specifications and interfaces.

System architecture

Messages are generated in hospitals, clinics and general practices and then sent to the Ministry of Health. On receipt and after validation, the information is directed as follows:

(a) Data Sets, in an anonymous form, are sent to the Data Warehouse as a resource for management and research.

(b) Sections are submitted to the EHR portal. Persons with a need to know may submit searches to the EHR portal to retrieve views into each patients record according to date (when), clinic (where), author (who) and the type of information required (what); this might be all data or a subset such as medications, allergies, diagnoses etc. The EHR portal returns the appropriate sections, and the human-readable text may be displayed on a web-browser.

The overall system is SOA-based and uses a layered approach, whereby each separate layer only interacts with the layer below the current step, and the lower layer not in any way interacting with the upper one, maintaining system changeability and extensibility, resulting in the layers having distributed responsibility.

Discussion

Some aspects of this project are comparable with the approach recently adopted by the NHS National Programme for IT in England with two main differences. First, the architecture (and scope) is much simpler and, secondly, a logical design specification is used to specify exactly what is required.

The UML-based logical design specification has been invaluable at all stages of the project. It has allowed discussions to focus on the critical issues of what is to be done, rather than on the constraints of representing this using HL7 artefacts. It has greatly facilitated communication between all members of the project, analysts, message

architects, software developers, managers and user representatives, who could not understand detailed HL7 specifications.

References

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