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Health Level 7 Version 3

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As healthcare organisations begin to concentrate on improving efficiency and quality, the optimal cooperation of all involved parties becomes paramount. To reach this goal, computers are being increasingly employed in all areas. One of the essential components of their use is in the realm of communication within and between healthcare institutions.

The Health Level 7 (HL7) communication standards were developed essentially for healthcare systems, enabling electronic communication between nearly all involved institutions and fields. To date, extensive experience is available due to its use in hospitals; with the introduction of the new HL7 Version 3 (V3), all healthcare areas are covered. Current developments show that HL7 has not only become an important communication standard in healthcare, but also delivers impulses for the worldwide standardisation of communication.

Why Communication Standards?

In order to reduce costs and improve the quality of healthcare, computer- based information systems are increasingly being used. Obviously, there is no comprehensive information system that can completely cover *all* of the needs of hospitals and other areas of the healthcare system. As a result, it is necessary to employ information systems from various suppliers. However, these systems must be functionally coupled with each other for cooperative data processing - communication is essential!

In the past, we were faced with the problem that with each application of a new system the “Tower of Babel” became even higher and today, like then, language diversity is expanded by yet another dialect. Each new system has to be adjusted to the existing dialects of the individual institution, leading to high personnel costs for both the supplier and the user. As a consequence of the expanding financial burden of this, both suppliers and users have tended to shy away from integrating their systems.

In addition, new challenges of collaboration and new medical and financial policies enforce electronic communication. How can this be done efficiently?

Interconnecting is not the Same as Understanding!

If patient information such as name, date of birth, maiden name, gender, etc. needs to be exchanged electronically, one of the easiest ways to do this would be to send an e-mail.The only requirement is that a network connects the computer systems with each other, allowing for text messages to be exchanged using simple programs.

With e-mail, information is usually transmitted without a formal structure.The problem in the exchange of patient information is that the message is easy to read and grasp by humans, but requires additional interpretation (parsing) for computers to understand because it is unstructured. Due to this unstructured nature of the sent data, the system receiving the data is unable react appropriately, - e. g. to re-use the data in another context, thus enabling interoperability - and this is an essential requirement of a comprehensive information system.

In order to transmit data in a structured form, an agreement has to precede the exchange between the communication partners. The sequence in which the individual items are transmitted, the exchange format and especially the meaning (semantics) must therefore be defined unambiguously.

In the simplest case, one establishes an interface between each pair of systems that exchange data. This procedure has considerable disadvantages: there is higher expenditure for detailed arrangements between the communication partners concerning the kind and content of the data to be exchanged and numerous complicated communication relationships must be established. For example, for five systems up to 20 different interfaces are, at times, necessary. This causes higher expenditure for maintaining the interface and when replacing a system, multiple interfaces must be redefined.

HL7 – a Communication Standard in Healthcare

Established in the USA in 1987 to pursue the standardisation of communication in hospitals and the entire healthcare system, HL7 provides valuable assistance in the standardisation of the necessary interfaces between systems. HL7 is one of several American National Standards Institute (ANSI) accredited Standards Developing Organisations (SDOs) operating in the healthcare arena. Most SDOs produce standards (sometimes called specifications or protocols) for a particular healthcare domain such as pharmacy, medical devices, imaging or insurance (claims processing) transactions. HL7's domain is clinical, financial and administrative data. The HL7 community also coordinates its efforts with other standardisation bodies such as the International Organisation for Standardisation (ISO) Technical Committee (TC) 215, the European Committee for Standardisation (CEN) TC251 and W3C, and other organisations that make use of existing standards, such as Integrating the Healthcare Enterprise (IHE).

Similar to most other SDOs, HL7 is a not-for-profit volunteer organisation. Its members – providers, vendors, payers, consultants, government groups and others who have an interest in the development and advancement of clinical and administrative standards for healthcare – develop the standards. Like all ANSI-accredited SDOs, HL7 adheres to a strict and well-defined set of operating procedures that ensures consensus, openness and balance of interest. A frequent misconception about HL7 (and other SDOs) is that it develops software. In reality, HL7 develops specifications, the most widely used being a messaging standard that enables disparate healthcare applications to exchange keys sets of clinical and administrative data.

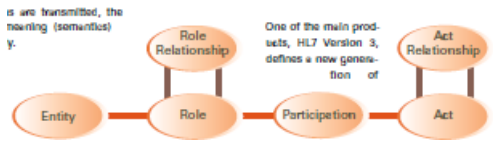

Figure 1: RIM Core Classes

Members of HL7 are known collectively as "the Working Group", which is organised into technical committees and special interest groups. The technical committees are directly responsible for the content of the standards. Special interest groups serve as a test bed for exploring new areas that may need coverage in HL7's published standards. A list of the technical committees and special interest groups as well as their missions, scopes and current leadership is available on this web site.

One of the main products, HL7 Version 3, defines a new generation of communication standards for the specification, development and maintenance of messages and documents for an entire healthcare system. This is reached by a mature methodology for model-based and tool-supported development of messages.

Numerous projects in many European countries (amongst others the Netherlands, the United Kingdom and Germany) have already started using HL7Version 3, with some using it as part of their strategy to build a national infrastructure.

HL7 Version 3

HL7 is the world's leading standard for the electronic interchange of healthcare information. Version 2 of the HL7 standard (HL7 V2) has been widely implemented in over 20 countries, mainly in hospitals. In recent years, Version 3 of the standard (HL7V3) was developed to address the communication needs of the whole healthcare system, including hospitals and also the outpatient area, and to meet the requirements of today's healthcare IT systems.

The HL7V3 development methodology represents a significant step forward from previous ways of developing healthcare messages. However, the benefits arising from using a more sophisticated methodology also bring with them the need to understand a more extensive set of terms and processes.

Reference Models

The Reference Information Model (RIM) is the cornerstone of the HL7V3 development process. An object model created as part of the Version 3 methodology, the RIM is a large pictorial representation of the clinical data (domains) and identifies the life cycle of events that a message, or groups of related messages, will carry. It is a shared model between all the domains and as such, is the model from which all domains create their messages. Explicitly representing the connections that exist between the information carried in the fields of HL7 messages, the RIM is essential to our ongoing mission of increasing precision and reducing implementation costs.

The four RIM core classes (see Figure 1) are an Act, representing any healthcare activity, in which Entities (for example people) participate in certain roles. Act Relationships can connect activities to each other, for example a lab order is related to the lab result. In the following figure, the core classes are shown. The RIM contains many specialisations of these classes, amongst others an observation that is a specialisation of an Act.

Modeling in HL7 V3

To come from “reality” in healthcare to models reflecting this reality (and then to messages and documents for electronic information exchange), HL7 uses the HL7 development framework (HDF).This methodology, meanwhile a proposal to become an ISO standard, starts with narrative descriptions (story boards) and use cases. These are considered as snapshots of a communication scenario and describe dynamic aspects, i.e. all parties involved and their interactions, and also static aspects, i.e. what data is to be exchanged.The later is documented in a so-called Domain Message Information Model (D-MIM), reflecting the data sets and their relationships in a specific domain. A domain in HL7 is defined, for example, by medical means, e.g. laboratory, patient care, pharmacy.

From the D-MIMs, Refined Models (R-MIMs) are derived. R-MIMs are subsets of the whole model, as an example a laboratory, and aimed at one specific communication aspect, for example a lab order or a lab result. Dynamic and static aspects together form an interaction, the reason and required actions for the message, a description of sender and receiver responsibilities (application roles), and a complete structure of what is to be sent.

This kind of consequent modeling seeks compatibility throughout all messages and documents defined in HL7V3. As a result, communication is made simpler between partners on a functional level.The generic approach also ensures that there is no need to develop messages for every single aspect of communication needs.While commonly defined structures are used in many messages, their dynamic implications may vary. Frequently used building blocks like “patient” or “provider”, part of almost every message, are defined as consistent and re-usable structures (“mini”-models).

The more generic a model is defined, the more terminology comes into play in order to refine the generic model towards a specific use. As an example, systolic and diastolic blood pressures are – from an HL7 perspective – observations, a specialisation of an activity (see Figure 1).A generic observation can be considered as a “value container” from a modeling perspective and is “classified” by a code, saying that this observation carries a blood pressure measurement. The time of measurement, and especially the value itself, is conveyed in a value attribute of the respective class and is therefore also in the representation that is actually exchanged between two systems. HL7 V3 uses the Extensible Markup Language (XML) as an exchange format.

The example shown in Figure 2 is only a fragment of a whole HL7 V3 message or document. It is obvious that when it comes to real communication, the data is accompanied by other activities and entities etc., especially the patient.

A Standard in Use

After about ten years of development, HL7 V3 has reached the necessary maturity to be used in routine environments. In early 2000, several countries already started adopting the HL7 V3 Clinical Document Architecture, a “member” of the HL7 family of V3 standards. Finland and Germany, for example, have undertaken projects utilising HL7 V3, partially in the context of governmental-driven healthcare infrastructure programs. Subsequently, HL7 V3 has received international endorsement. The following examples highlight some of the implementations of HL7V3:

• In the United Kingdom, the National Health System (NHS) Information Standards Board recognises HL7 V3 as the strategic direction for NHS standards.The National Program for IT is a 10-year program to build an information infrastructure to improve patient care in England. HL7 v3 was chosen to deliver the messaging requirements, with the National Program working as an early adopter developing message specifications where needed,

• The National IT Institute for Health (NICTIZ) in the Netherlands has chosen HL7V3 as the strategic core standard to implement the National Infrastructure (AORTA),

• In Canada, the national Infoway initiative has endorsed HL7V3,

• The concept for the Lithuanian healthcare system considers HL7 V3 as the main standard for clinical, administrative and financial data exchange,

• In Croatia, the national health system includes central databases and connects general practitioners and hospitals using HL7V3, and

• Several countries in the Asian area are using the Clinical Document Architecture on their way to an individual Electronic Health Record. For example in Japan, CDA R2 is used for referral documents and a new patient data CD-ROM, with pointers to the clinical contents.

Amongst national involvement, the first HL7 V3 communication has been planned across countries. This demonstrates new challenges in terms of different legislations and policies in the countries involved.

As an example, the European Renal Association - European Dialysis andTransplant Association (ERA-EDTA) is broadening the set of data collected about patients on renal replacement therapy. HL7 V3 will be used to exchange data between renal centers and regional / national registries, and between these registries and the European registry. Clinical experts have defined the data set, and the definition of HL7 V3 models and messages is currently in progress.

This, of course, is only a fragment of all of the projects around the world dealing with HL7 V3 implementations. Most recent results were, for example, presented at the International HL7 Interoperability Conference (IHIC). This annual conference shows results of HL7 implementations; information and presentations can be downloaded at http://ihic.hl7.de. At HL7Working Group Meetings, held three times a year for a week each, not only the standards themselves are brought forward in work groups but experiences are also reported.

HL7 V3: Meeting Today's Challenges

The HL7 family of standards is no longer just a definition, but is implemented in many countries. Issues from practical implementations that came up will be addressed in the following refinement steps. HL7 V3, in particular, is a consistent and comprehensive way of modelling healthcare communication requirements covering almost all aspects of the challenges faced by today's healthcare IT systems.

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