Proceedings of the joint GMDS/MIE conference "Medical Infobahn for Europe", August 27 – September 1, 2000, Hannover, Germany

Practical aspects to realize data transfer between a patient administration mastersystem and clinical subsystems using ProtoGen/HL7

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Abstract. At the Medizinische Einrichtungen Bonn the module IS-H of SAP R/3 is used for patient administration. All clinical subsystems will be provided with patient data using HL7 2.3 messages. These messages are generated from HCM messages a proprietary format of IS-H by means of a communication server.

Interface application for subsystems which are not capable of processing HL7 messages are written using the open source C++ class library ProtoGen/HL7. First experiences and remaining problems are discussed.

1. Introduction

The Clinical Centre of the Friedrich Wilhelm University of Bonn (MEB) was build in a "Pavillon-Style". During the last fifty years the clinical departments have been arranged in separate buildings dislocated over a wide campus. Like the different architectural styles different application systems in different hardware architectures are found.

The communication is based on telephone, fax, forms and messengers. You couldn't identify a patient by a unique identification-number. Patient records are stored in the archives of each clinical faculty.

With the implementation of IS-H (Industry System Hospital) - the SAP R/3 module for patient administration - the situation is changing. Now the new and updated demographic and visit information (admission, discharge, transfer; called ADT messages) regarding all patients are entered into IS-H. Every patient gets a persistent unique identification number to which all patient information is subordinated.

The availability of the ADT information makes the transmission of any patient information feasible; e.g., for sending an order to a laboratory, getting back the result report or admitting information and medical images inside a PACS.

2. Methods

A communication between multifaceted subsystems makes different interfaces necessary. Each information transfer needs a customized point-to-point connection. The number of all possible double-sided connections between *n* subsystems is given by *n(n-1).* For instance., if you have five subsystems you need twenty interfaces.

The variability of interfaces requires a lot of human resources and an expensive on-line maintenance. To eliminate custom interface design and reduce costs we decided to use HL7, - an application protocol for electronic data exchange in healthcare environments [1,2] - and to install a communication server (e*Gate 3.6.2 from STC).

The communication server is an interface engine that allows multiple technology systems to talk to each other and to exchange information despite of platform differences. It makes sure that the communication runs only between defined partners. The messages are transferred to the external system unmodified and completely (security of transaction) and only to the specified addressee. The transfer of only these messages which are intended for the distinct system is guaranteed by a filter in the communication server. In place of twenty custom interfaces, data translation and routing occur in a single place: the interface engine.

SAP R/3 only supports HL7 in version 2.1. Therefore the communication server gets the ADT messages in HCM - a proprietary connection protocol of SAP R/3 - and converts it into the current HL7 version 2.3.

The HL7 standard is developed on the basis that an event in the healthcare creates a need for a data flow between systems. For example, if a patient is admitted, the admission, discharge and transfer processes send data to the clinics in order to update them with the new patient information.

IS-H offers over seventy events which we convert into fifty-one HL7 events. We have to decide which of the events include the significant information for the external system. For example, for an outpatient visit IS-H creates three different events:

NP0100	open demographic patient information
NP4000	open case
NP41I0	outpatient visit

The communication server only recognises the NP41I0 event and converts it to a A04 event.

The interface to the Klinik und Poliklinik für Hals- Nasen- und Ohrenkranke (HNO) supports the events given in tab. 1.

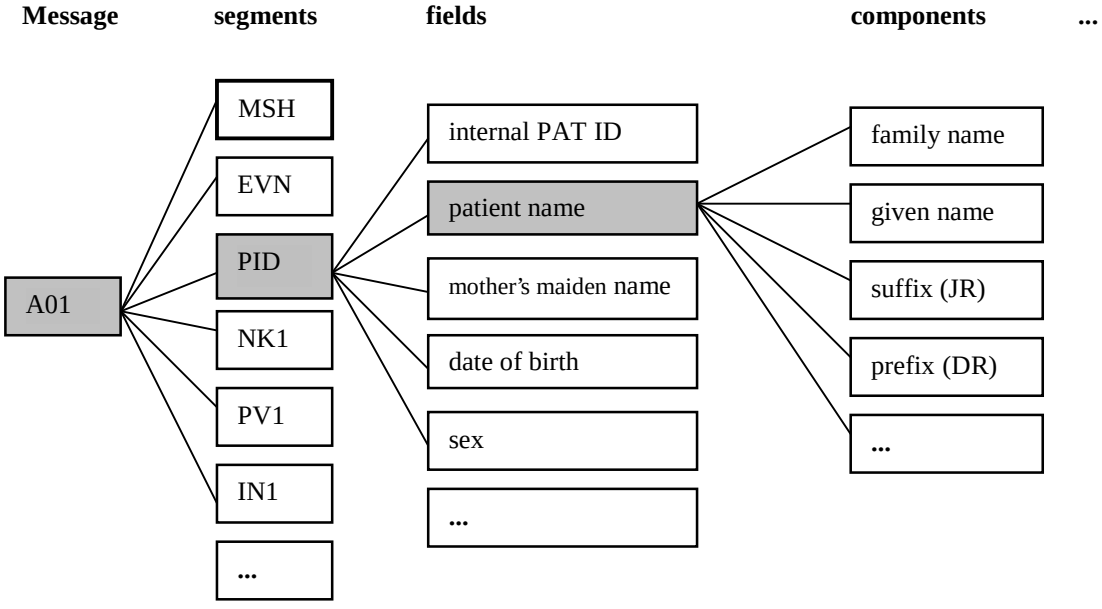
A HL7 message consists of segments. Each message is defined by three letters to represent its type, such as PID (patient identification). Each segment consists of fields, each data field could consist of components and subcomponents as shown in fig. 1.

A speciality of IS-H is the possibility of extensive customizing. Therefore we have to transform a lot of different attributes in user-defined tables for similar data fields. For example the EVN segment - used to transfer necessary trigger event information to receiving applications - contains in one field the reason for the event. For an outpatient visit IS-H offers the possibility of forty reasons. To minimize the expense of maintenance we decide to adopt all attributes as a string. In addition, the meaning of the attributes has to be known to the managers of the subsystems. Therefore, the interface documentation has to be updated regularly.

Table 1: Corresponding HCM and HL7 events of the HNO-Klinik interface.

Description	**HCM-Event**	**HL7-Event**
admission inpatient	NP11I0	**A01**
admission inpatient/short form	NV04I0	**A01**
admission inpatient/emergency	NV07I0	**A01**
Transfer	NV11I0	**A02**
Discharge	NP97I0	**A03**
outpatient visit	NP41I0	**A04**
outpatient visit/short form	NP44I0	**A04**
outpatient visit/emergency	NP47I0	**A04**
change an outpatient to an inpatient	NWFASI	**A06**
change an outpatient to an inpatient/short form	NWFAKI	**A06**
change an outpatient to an inpatient/emergency	NWFANI	**A06**
change an inpatient to an outpatient	NWFSAI	**A07**
change an inpatient to an outpatient/short form	NWFSKI	**A07**
change an inpatient to an outpatient/emergency	NWFSNI	**A07**
update transfer	NV12I0	**A08**
update outpatient visit	NP42I0	**A08**
update outpatient visit/short form	NV45I0	**A08**
update outpatient visit/emergency	NV48I0	**A08**
update discharge	NP98I0	**A08**
update admission inpatient	NP12I0	**A08**
update admission inpatient/emergency	NV08I0	**A08**
update admission inpatient/short form	NV05I0	**A08**
cancel admission inpatient	NP12IS	**A11**
cancel transfer	NV12IS	**A12**
cancel discharge	NP98IS	**A13**
cancel outpatient visit	NP42IS	**A11**
merge patient - internal ID	NP0600	**A40**

Figure 1: Composition of HL7 ADT messages



We faced the problem to connect some subsystems to IS-H which were not equipped with a HL7 interface. We looked for a simple and inexpensive solution to retrofit these systems with a HL7 interface. This can be achieved with little effort using the class library ProtoGen/HL7 [5,6] written in GNU C++. The source code of this library is freely available under the GNU-copyright. It can be ported to all Unix-like operating systems supporting the GNU C++ compiler. The library defines distinct classes for data-types, segments and messages of HL7. With this library HL7 interface applications can be built which parse HL7 messages on the input and interact with a subsystem database on the output side using a native database interface or ODBC.

The pilot system connected to IS-H was the subsystem of the Klinik und Poliklinik für Hals-, Nasen- und Ohrenkranke [7]. Due to the lack of a suitable interface to the database of the subsystem, the designed HL7 interface application was used to convert the HL7 messages to ASCII format. The ASCII format can be parsed directly by a client written in the 4gl-language Progress of the database system.

The current version 1.3 of ProtoGen/HL7 implements the complete HL7 2.2 standard. Since the HL7 2.3 standard is not already supported by ProtoGen/HL7 the source code has to be extended in order to be capable to parse 2.3 messages. Especially the ADT-A40 message for patient data merging had to be added to the library. As discussed above the range of valid keys in the HCM-HL7 translation was extended. Therefore the class definitions of the data-fields in ProtoGen/HL7 have to be modified accordingly in order to avoid parsing errors.

We chose Linux as operating system platform for the HL7 interface application. Standard PC hardware can be used for Linux which is also GNU copyrighted. Further Linux supports a lot of networking standards (TCP/IP, IPX and others), thus a simple integration into heterogeneous Unix/Windows environments is possible.

The HL7 messages are transferred from the communication server to the Linux HL7-gateway by using the ftp protocol. The HL7-gateway is acting as an ftp server. Each message is transferred as a single file with a unique filename which consists of a consecutive hexadecimal number. Therefore the order of the messages received can be easily ascertained. The HL7 interface application is periodically running as background cron job in 3 minute intervals.

In addition to the pilot Linux HL7-gateway two additional gateways are running in test mode at this time.

3. Discussion and Conclusion

Supplying the clinical subsystems with ADT messages and as well with a unique patient identification number allows a communication transfer between different hardware and application systems. This ensures that all systems are talking about the same patient. Multiple patient data acquisition is no longer necessary. This fact is especially important to guarantee a high level of quality in a healthcare system.

To be on state of the art regarding HL7 version 2.3, HCM messages are translated to HL7. This procedure, however, implicates the loss of some information. For example the postal address of the admitting and consulting doctor is transmitted by HCM, but not by HL7, because HL7 lacks an address field in PV1 the patient visit segment.

Although some time has been spent to modify the ProtoGen/HL7 library and to build an interface application, time and money can be saved by interfacing subsystems via HL7 to IS-H, instead of building special interfaces for each subsystem on the communication server.

References

[1] HL7 STANDARD VERSION 2.3 © 1997.

[2] K.U. Heitmann, B. Blobel, J. Dudeck, HL7 Kommunikationsstandard in der Medizin Kurzeinführung und Information, Köln 1999.

[3] G. Quade, B. Burde, F. May, L. Beck and A. Goldschmidt, Worldwide Telemedicine Services Based On Distributed Multimedia Electronic Patient Records By The Second Generation Web Server Hyperwave, Proc AMIA Symp 1999, 916-20.

[5] G. Schadow, ProtoGen/HL7 - an implementation of HL7 in C++. http://aurora.rg.iupui.edu/~gunther/, 1996.

[6] G. Schadow, U. Föhring and T. Tolxdorff, HL7-Implementation in C++ - ein automatisierter Ansatz. HL7-Workshop, Göttingen, Oct. 26, 1996.

[7] H. Reucher, R. Rödel, Th. Breuer, A. Przewodnik and C. Herberhold, Klinikeigene Entwicklung eines Informationsystems für die Bonner HNO-Klinik: Konzeption und Einsatz der I. Stufe im ambulanten, diagnostischen und operativen Bereich. In: M.P. Baur, R. Fimmers, M. Blettner (eds.), Medizinische Informatik, Biometrie und Epidemiologie - GMDS '96. Medizin Verlag München, 1997, pp. 39-43.