

New Standards for Cardiology Report and Data Communication: An Experience with HL7 CDA Release 2 and EbXML

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Abstract

The diffusion of health standards, connected to technological infrastructure, finally opens the road to a new way of interconnecting and integrating different clinical solutions. New standards coming from established Organizations such as HL7 and DICOM, are going to be integrated with Communication Organization to build the Health environment Info-structure of the next decade. The purpose of this work is to show how this is possible, using simple and affordable methods: The recently approved HL7 Clinical Document Architecture Release 2 standard for message packaging and the newly approved ebXML 3.0 specifications. These promising standards can be used in conjunction with Web-Services and Web Service Description Language (WSDL) technology. This type of solution allows to be totally independent from the development platform, from the programming language and the operating system used. EbXML is an XML framework for business-to-business (B2B) environment developed by the ebXML Initiative.

1. Introduction

The purpose of this work is to spread through the web,

structured and semi structured documents, both inside a hospital business LAN, and outside in a perspective of regional or national collaboration, all under role based and fine grained security constraints.

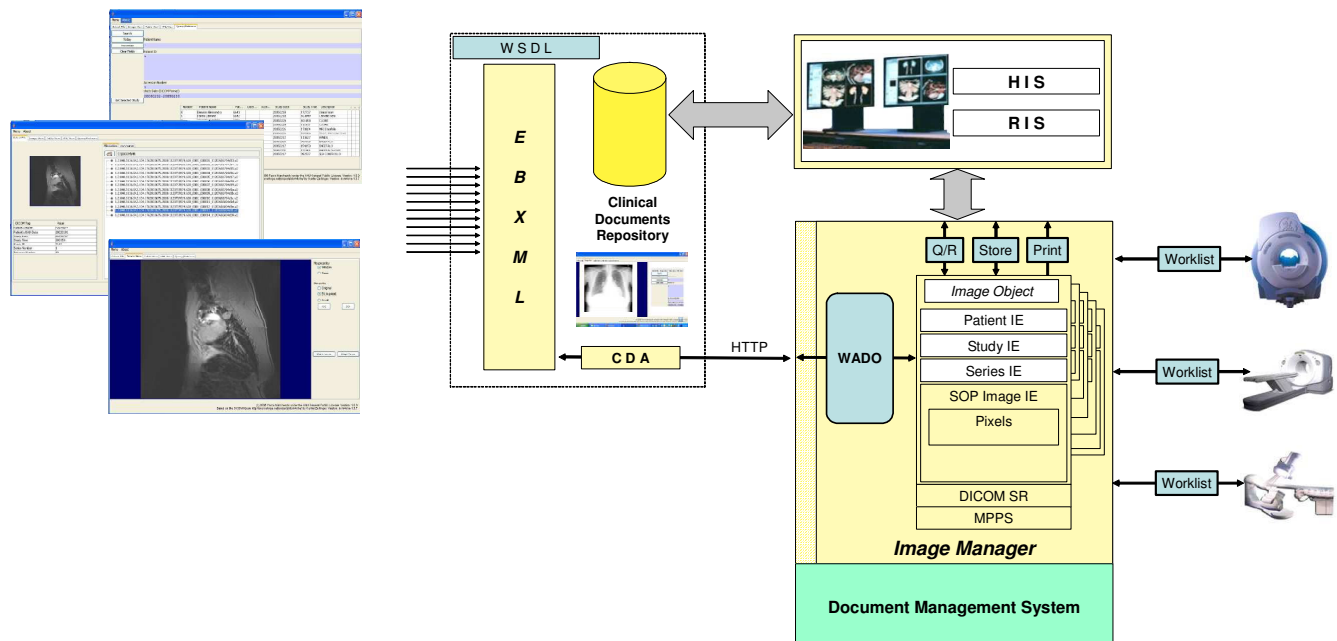
The architecture of the realized system is non elementary, in fact it is the result of the integration of manifold application realities.

2. Methods

The realized system uses a central image manager to which are connected different modalities, like a Magnetic Resonance, a digital angiography device or other DICOM compatible medical devices.

Every functional island DICOM enabled devices, present in our institute can send an image, a report, a DICOM KO (Key Object), a DICOM Waveform or in general a DICOM object, that contributes to form the report or the shared clinical document that the RIS is going to create. Further, the image manager act as server DICOM, and at the same time can reply as a WADO (Web Access to DICOM Persistent Objects) server [7].

This is the peculiarity that allows a CDA R2



document to link information coming from a diagnostic modality.

CDA R2 [5], the HL7 Clinical Document Architecture uses the eXtensible Markup Language (XML) with a semantic structure that allows a profitable use of well known multimedia formats joined with the data of clinical pertinence: instrumental examinations reports, chemical laboratories results, administrative data, etc. The overall view of a patient status is composed by a multitude of heterogeneous information, represented with the use of images, cine-loops and waveforms, textually with collected laboratory reports and related information.

The following piece of xml code represent the HL7 CDA R2 document filled with external links in a text field to a WADO service.

```

<idextension="320002961"root="2.16.840.1.11388
3.2.9"/>
<code="11488-4"
codeSystem="2.16.840.1.113883.6.1"
displayName="Consultation note"/>
<title>Cardiologic Clinical Data Set</title>
<effectiveTime value="20050828"/>
<setId extension="2961.2005.03.28.20.10.09.9"/>
<versionNumber value="2"/>
....
<code="10153-2"
codeSystem="2.16.840.1.113883.6.1"
codeSystemName="LOINC"/>
<title>Past Medical History</title>
<text>
<paragraph ID="image1">
<content>
<linkHtml title="MR Image"
href="http://tianiserver.ifc.cnr.it/imageaccess.js?
requestType=WADO&studyUID=1.2.250.1.5
9.....&seriesUID=1.2.250.1.59.....9&....."/>
</content>
</paragraph>
</text>

```

Or with the use of an ObservationMedia :

```

<observationMedia classCode="OBS"
moodCode="EVN">
<id root="10.23.4567.345"/>
<value mediaType="application/dicom">
<reference
value="http://www/radiology/wado.php....."/>
</value>
</observationMedia>

```

The service offered by WADO converts a DICOM

object in a web browser digestible object and therefore it delegates the job of conversion to the central server. In simple words: starting from a DICOM document is possible to convert the native DICOM into jpeg or other simpler alternative format (image/gif, image/png, image/jp2, video/mpeg).

Besides it is possible to instruct the server to de-identify (Anonimizer function) the image, or to show only a particular ROI (Region Of Interest). Following the WADO standard, the response from the server should be a text/html or text/plain object. The DICOM object is identified by three parameters: Unique identifier of the study (studyUID), Unique identifier of the series (seriesUID), Unique identifier of the object (objectUID). So that a typical WADO web service invocation become:

```

http://tianiserver:8080/dcm4jboss-wado/wado
?requestType=WADO
&studyUID=1.2.250.1.59.40211.123458.78934
&seriesUID=1.2.250.1.59.40211.7890076.4556
&objectUID=1.2.250.1.59.40211.267810.87991

```

We can notice that the ampersand character (&) must not appear in their literal form, except when used as markup delimiters, we have to use "&" or "&#38;" instead.

In this implementation we used a Image Manager/WADO server from Tiani Medgraph AG.

The other part of the system is represented by the Ebxml server, this is the OASIS ebXML Registry Reference Implementation Project (ebxmlrr) from sourceforge.

This is the registry/repository that contains all the CDA Rel 2 Clinical document architecture documents, required for the correct operation of the entire system. The RIS (Radiological Information System) is entrusted to build a CDA document beginning from the report. It is possible to follow two routes:

1. The automatic "data link" to the performed examination images.
2. The driven "data link" to the performed effected examination images.

While the second is preferable from the operational point of view, the first one it is preferred by the physician or by the technician involved in the manual connection.

With the action "data link" we mean the connection between the report and the images or documentation that were used to obtain the report. In our cath-lab we have used the second path, because it is clear that if the diagnostic modality acquisition produce little data, the

images to be included inside the report are few, while if a more onerous diagnostic modality is used like in our Cath-lab or in a RM, XA or CT, things change, and it becomes a prudent choice to link only essential documents inside the report. However it is possible to leave also the option to download the whole DICOM acquisition, or in the case of images in movement (loops), to recover an Mpeg film as conversion from the original one.

3. Access control

The roles and the access policies assume an important aspect in the overall care of the patient.

The access policies to the system and to data have to be diversified, based on the operator role .

In fact a ward physician, a medical doctor, the ward nurse, the technician and finally the patient, belong to different groups, and they have different rights.

Even the patient needs somehow the ability to access his own data, with a specialized view.

The idea is therefore, to use a role system management, that is the most elegant and fine grained possible, this possibility is offered us by the XACML (eXtensible Access Control Markup Language) language used by the new accepted ebXML V 3.0 standard.

Ebxml version 3.0 allows immediately to use this type of configuration file, a problem that arises is that of the management and creation of such files, very complicated when the degree of complexity increases.

Fortunately some aids exist provided by the open-source community, one of these it is the xacml control center present in the project XACML.NET [6].

The possibility to use open software allows the realization of complexes scenarios, lowering the cost of implementation, although the most greater drawback is that of the lack of a complete engineering, and of a system configuration dashboard.

4. DICOM image viewer

The system, allows also the sharing of cardiologic information suitable for remote consultation or second opinion.

In the case the physician wants to consult the whole acquisition or to seek other complete examinations of the same patient, the ebxml-system is not ideal. To solve this, we have developed an helper application that can be used both, as a DICOM viewer for images coming from the WADO system, and as a DICOM Query/Retrieve tool to seek and to directly download complete Examinations coming from distributed Image managers.

At the moment we cannot find in the open-source software panorama an application like this. There are plenty of DICOM viewer applications, but none of them

had the Query/Retrieve functionality, for this reason we decided to build our own.

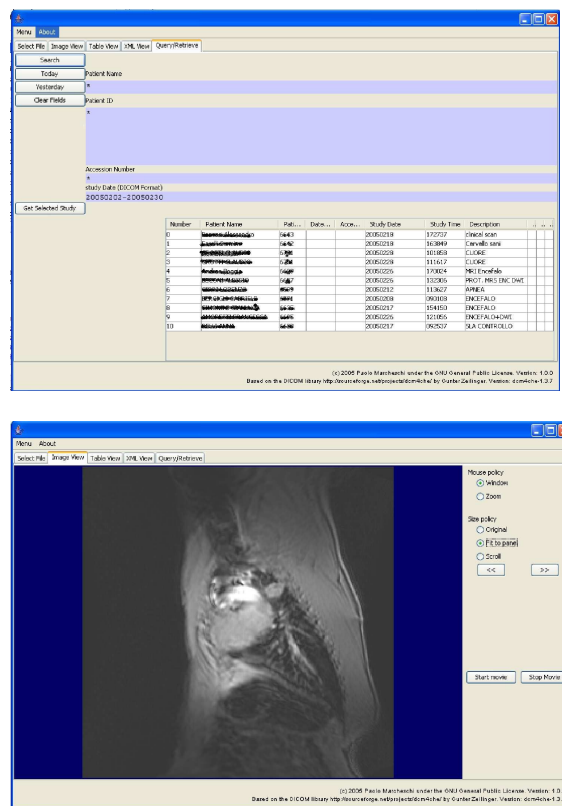


Figure 2. The DICOM Query/Retrieve tool in action

This viewer is based on the open-source work by Gunter Zeilinger with the dcm4che DICOM Library[10]. It is an extension of the Dcm_Inspector program from IFTM Institut für Telematik in der Medizin GmbH [4].

It has the basic common features of a DICOM viewer, and can work as a Query tool with “Today” and “yesterday” buttons, it allows query based on search strings (Patient ID, Patient Name, Accession Number, Study Date) . It supports the new JPEG2000 Lossless and Lossy standard for the compression of digital images, and as well the JPEG Lossless and Lossy compression schemas.

The application has a small footprint, and it is developed in the Java programming language 1.5 [3], this language permits to run it under every Operative System that java supports. For the moment, It was tested under Linux and Windows XP OS, and the basic query/retrieve interface works under MACOSX too.

5. Discussion and conclusions

The here proposed method of data harvesting and sharing

is at the moment in experimentation and evaluation phase. In this period radiology technicians and physicians are getting used to the new way of interacting with radiological information. We found that it is a very simple method of sharing radiological information. Thus the use of ebXML is on one hand to be wished, owing to the fact that it is a OASIS Standard and very secure with the use of cryptography and role based authentication, but on the other hand it is very difficult to install, to learn and to manage. Maybe this product is at a very early stage of production and needs to be consolidated. The WADO system is a very interesting and functional tool and can be used without a real client application, but only with a modern web browser. We found that this approach can be useful to integrate already installed acquisition modalities in an effective simple and low cost way, opening the possibility to create a central node for distribution and archiving of biomedical signals.

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