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Introduction to IHE

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Abstract. Integrating the Health Care Enterprise (IHE) is an initiative from the Radiological Society of North America (RSNA) and Healthcare Information and Management Systems Society (HIMSS) to provide a test bed, demonstration and specification of how standards such as DICOM and HL7 can be used to provide an integrated environment. The definition of integration profiles is critical to this specification. © 2004 Published by Elsevier B.V.

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1. Introduction

Both HL7 and DICOM are standards that have a great deal of flexibility. In addition, there is also some overlap, i.e. one could perform certain functionalities in either one of the two standard domains. For a particular standard service, there are several options, and, when the HL7 and DICOM standard interact, there is not necessarily an obvious mapping between the attributes from both messages. Sequencing of the various messages is not defined in either one of the standards. If two vendors connecting their equipment have a different interpretation or implementation, interoperability and integration issues occur. All of this is defined by the IHE in a set of specifications, in particular, the IHE technical framework.[1] Furthermore, demonstrations at the Radiological Society of North America (RSNA) and Healthcare Information and Management Systems Society (HIMSS) tradeshows, and their preceding connectatons, whereby vendors connect and test their standard implementations, are conducted.

PACS features and functions are labelled or called in a different manner by various vendors. For example, does a PACS archive include a Workflow manager to provide work lists to the workstations, an image manager such as a database, or only actual image storage? The IHE definition of "actors", exactly defining a particular functionality in an unambiguous manner, is critical so that a potential user can determine what he is getting, and to determine the potential gaps in the functionality. The IHE Integration Profiles

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[1] The specifications as well as numerous educational papers and presentations are all available from the www.rsna.org website.

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define a ''Use Case Definition'', identifying these actors and their relationship to the described transactions, an interaction diagram showing sequencing between the various commands, and the actual message definition, including the definition of attributes.

2. IHE profile overview

A vendor can claim compliance with a particular IHE integration profile when it successfully passes the connectaton requirements. This is a major benefit to a potential user, because the statement of a device being IHE ''compliant'' is far more specific and useful than claiming DICOM or HL7 ''compliance''. The Integration profiles specify exactly what part of DICOM and HL7, or any other standards are used and their sequencing. For example, it specifies that the DICOM ''Storage Commitment'' transaction, which is used to transfer the responsibility for image from an acquisition device to the Image Manager, is sent AFTER the transaction to exchange the number of images and procedure status (DICOM Modality Performed Procedure Step). Imagine that a receiving device had expected this to be exchanged in a reverse order, i.e. first receiving the Storage Commitment and then the Performed Procedure Step. A potential incompatibility would occur. The actual message definition is also important, including the mapping. For example, it is possible to trace a Patient ID that is part of an image header, back to the DICOM Modality Worklist, and then to the HL7 order message. Patient ID is a good example for potential interoperability issues, because there are several Patient IDs in the HL7 messages, while there are only two options in DICOM: The Patient ID field, and the Other Patient ID field. The Integration profiles specify these details.

The most important profiles are as follows:

Scheduled Workflow: The Scheduled Workflow Profile spans multiple domains, i.e. from a Radiology Information System, which initiates the order for a procedure using a HL7 message, to an acquisition modality, which retrieves that information using the DICOM Worklist, to a PACS archive which receives the generated images. Image management information to transfer responsibility to the PACS, and information about the content of the procedure is exchanged as well.

It is rare for an institution to have their RIS, and PACS and all their modalities from a single manufacturer, which is why the usage of this profile is so important. Not only does this profile include the definition of the image exchange, it also specifies how other information that might be used as ''evidence'' information, such as a measurement on an Ultrasound unit is exchanged in a standard manner.

Patient Information Reconciliation: The reconciliation profile is meant to reconcile the information from a PACS with the RIS, allowing the technologist to enter the demographic and ordering information at the PACS. This is common for emergency cases (which are unscheduled), or whereby the patient demographic information is not available at the time of the examination. Another typical use case is where the information was entered incorrectly, and needs correction. This is an important profile to make sure the PACS and RIS stay synchronized.

Consistent Presentation of Images: The consistent presentation of images spans both the hardcopy and softcopy domains. It allows for images to be presented on these media in a manner where they are, if not identical, then at least as similar as possible. This process is

constrained by hardware resolution and capabilities. Consistent presentation is comprised of two parts, i.e. the grayscale consistency, and the presentation consistency. The presentation consistency, for example, maintains annotations such as a measurement, zoom factor, a certain window and level value, over different devices from various manufacturers, and also over time. The grayscale consistency is even more critical. For example, matching the grayscale image presentation on a CR modality workstation to the presentation on a PACS workstation, and then to the printed film which could be generated from the CR or the PACS workstation can be a challenge. A major step towards accomplishing this consistency is the support of this profile by all vendors.

Presentation of Grouped Procedures: The Grouped Procedure profile is important any time there could be a discrepancy between the actual performed and scheduled procedures. For example, an order might be placed for a CT chest and abdomen, while the technologist performs this in a single CT procedure, requiring the images to be divided into the two procedures. The different studies may require readings by two different specialists. Ideally, an acquisition modality should be able to perform the grouping/ungrouping aka merge/split feature. However, in many cases, modalities are not quite ''IHE compliant'' with regard to this specific profile, and a technologist might need to perform the grouping/ungrouping manually at a QA station. Intelligent software that can do this automatically, or assist the technologist by ''guessing'' which images should go under which procedure is becoming available.

Access to Radiology Information: The Access to Radiology Information profile is especially important for workstations, whereby images with or without presentation states, reports and other evidence materials, such as measurements, can be accessed in a standard manner.

Key Image Note: Identification of clinically significant images assists a physician in ''sifting'' through a stack of images. This is especially valuable with the increase of the number of images in a procedure that could be hundreds for a multislice CT or MRI. Most vendors store this information currently either in the image header, or in their image manager in a proprietary format. By supporting this profile, if a user has a PACS system from vendor A and, for example, a web-enabled viewing system from vendor B, these key images would be identified preventing the physician having to browse again through these hundreds of slices. Note that this profile generates a separate DICOM ''Key Object Note'' that merely contains a pointer to the significant images/objects and corresponding text, which could identify certain information about the nature of the key images (e.g. ''for surgery'').

Simple Image and Numeric Reports: These reports can contain simple numerical information such as measurements, and refer to the exact locations of these measurements on images. This is a good example where the clear definition of these actors and their transactions allows for better interoperability preventing overlaps, or worse, gaps in functionality because it is common to have a system from one vendor that only handles report generation, for example using speech recognition, a system from another vendor that stores the reports, which can be done at the RIS or PACS; and yet another device that views the reports, often at a RIS station or PACS workstation.

Basic Security: This profile is relatively new, and defined to facilitate institution compliance with the HIPAA regulation for patient privacy and information security. Audit

trails are especially tricky because they can originate from devices from different manufacturers, which is addressed by this profile.

Charge Posting: Patient demographics and accounts, in addition to insurance and guarantors are exchanged to allow for a more accurate, complete and timely posting of the charges. This is done in a manner so that the "charge poster" does not need to understand the internals of the radiology department.

Post-Processing Workflow: Post processing is becoming more common, in particular the 3-D processing on dedicated workstations, or the processing of images using Computer Aided Diagnosis (CAD). It is uncommon for a PACS vendor to provide these features in as part of their basic viewing functionality. It is usually provided by an OEM vendor or partner. To allow for a graceful integration of these specialties with the PACS system, a special workflow profile is important.

Reporting Workflow: Worklists for reports can be provided to allow for queries in addition to their transcription and verification. It is a parallel to the imaging workflow profile, with as difference that instead of images, the reports are managed.

Evidence Documents: Measurements, logs (e.g. for cardiology procedures), results and observations can be generated both at modalities and workstations. This profile allows for a standard manner to record, store and retrieve this type of information.

In conclusion, when considering a RIS, PACS or modality purchase, it is strongly recommended to specify compliance with the appropriate IHE profiles. Most vendors have their IHE statements available on their website. In addition, the tools that are used to test these profiles against (MESA tools) are available in the public domain at the RSNA website as well. These tools and test procedures are an excellent source for generating an acceptance test.