Deploying DICOM Effectively: “Some Assembly Required”

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Deploying DICOM Effectively

Primary Topics:

• Planning
• Purchasing
• Installing
• Maintaining
• Troubleshooting
• Studying
Hospitals are like children:

Each one is unique

But in many ways they are much alike

… and so are clinics, imaging centers, etc.
Planning

**Own your architecture**
- Base it on standards
- Choose the pieces that meet your needs
- Understand the “Big Picture”
- Balance unique needs & standard benefits

**Identify the owner**
- Staff, or consultant, or long-term vendor
- Ongoing initiative; not “One-and-Done”
Doesn’t it Just Work?

Can I just ask for “DICOM”?
- Yes, if you don’t care what pieces you get
- Pieces can be implemented independently
- Depends on what the product needs to do

Won’t vendors just give me what I need?
- (We try to, but …) your input matters
- DICOM has it ≠ vendors use it (intelligently)

Know what is possible
Ask about your top priorities
IHE Profiles as Models

IHE helps vendors implement & test functions that span multiple systems

Profiles are implementation guides
• how to use existing standards
• to address a specific problem scenario

Connectathons are test events
• managed testing of Profile implementations

IHE helps users purchase & integrate multi-system solutions
• list required IHE Profile support in RFPs

www.ihe.net -> User Handbooks
Other Profiles address:
- Radiation Exposure Monitoring (REM)
- Post-Acquisition Workflow (PAWF)
- Portable Data for Imaging (PDI)
- Cross-enterprise Image Sharing (XDS-I.b)

[wiki.ihe.net -> Integration Profiles (Catalog)]
• When buying a PACS system, you use DICOM to integrate:
  – Modalities (e.g. CT, MRI, X-ray, US, NM, etc.)
  – Workstations (3D, CAD, Review, etc.)
  – Radiology Information Systems (RIS)
  – Printers (color and grayscale)
  – Others……..

Commonly known by most hospitals
Key DICOM Features

- **Basic DICOM features:**
  - Send and receive images
  - Query and Retrieve from an archive
  - Download Patient information to modalities
  - Print images

- **Not so basic DICOM features:**
  - Reliable storage of images
  - Track image acquisition workflow
  - Store images as viewed by clinician
  - Generate and display reports
  - Tag important images
  - Others...........

*Only basics commonly known by most hospitals*
Translate Features into DICOM Requirements

• Describe in terms of:
  – SOP Classes
  – Information Objects
  – Service Class User, Service Class Provider
  – Storage Commitment
  – Presentation State
  – Etc.

• … some hospitals don’t speak “DICOM”
Integration Services

• Professional services from vendors:
  – Understand their products well
  – Can typically tailor the integration better to their systems

• Professional services from consultants:
  – Typically understand many products
  – Typically better employ best of breed solutions and help with “finger pointing”

Both types of consulting services can greatly increase the probability of a successful outcome
Mainstream IT

• DICOM uses standard network technology
  – Network skills are very important

• Need to understand
  – TCP/IP, routers, hubs, switches, cables, subnets
  – Archive technology
    • RAIDs, Magnetic Tape, Cloud
    • How much on-line storage do you need
Purchasing
“Translate” required hospital features into SOP Classes (or IHE Profiles)

Need
“I want my modalities to integrate patient information with my RIS”

Translation
“RIS shall support Modality Worklist Information Model – FIND SOP Class as an SCP”
“Modality shall support Modality Worklist Information Model – FIND SOP Class as an SCU”

OR
“RIS and Modality shall support IHE Scheduled Workflow”

*Important education for PACS Administrators*
DICOM Conformance Statements

• Documents how product implemented DICOM
• Well-defined format
• Required for all products
• Publicly available (often on Web sites)
• Facilitates comparisons of products
• Detailed information
At a minimum, hospitals (PACS administrators) need to read SOP Class Tables

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an SCU:

<table>
<thead>
<tr>
<th>SOP Class Name (SCU)</th>
<th>SOP Class UID</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR Image Storage</td>
<td>1.2.840.10008.5.1.4.1.1.4</td>
</tr>
<tr>
<td>Secondary Capture Image Storage</td>
<td>1.2.840.10008.5.1.4.1.1.7</td>
</tr>
<tr>
<td>Modality Worklist Management - FIND</td>
<td>1.2.840.10008.5.1.4.31</td>
</tr>
<tr>
<td>Modality Performed Procedure Step</td>
<td>1.2.840.10008.3.1.2.3.3</td>
</tr>
</tbody>
</table>

Compare Product A - SCU table
with Product B - SCP table
# Overview Section

<table>
<thead>
<tr>
<th>SOP Classes</th>
<th>User of Service (SCU)</th>
<th>Provider of Service (SCP)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Image Transfer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT Image Storage</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Query/Retrieve</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study Root Information Model FIND</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Study Root Information Model Move</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Workflow Management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modality Worklist Information Model - Find</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Print Management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basics Grayscale Print Mgt.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Radiology Information System (RIS)

Provide scheduled patient and exam info to modalities
• Modality Worklist SCP

Receive and process updates from Modalities
• MPPS SCP
Receive and store acquired images
- Storage SCP

Respond to queries for patient studies/images
- Query/Retrieve SCP
- Storage SCU

Print images?
- Print SCU

Provide conformation of storage
- Storage Commitment SCP
Modalities

Query for Patients and exams to be performed
• Modality Worklist SCU

Send acquired images to PACS for storage
• Storage SCU

Print acquired images?
• Print SCU

Query for prior exams
• Query/Retrieve SCU

Confirm storage of images on PACS
• Storage Commitment SCU

Update RIS on progress of exams
• MPPS SCU

Send Radiation Dose information
• Dose SR SCU
Workstations

• **Quality Assurance Workstation**
  – Image Storage SOP Classes (Various) – SCU/SCP
  – Study Root Query/Retrieve Information Model – Find – SCU
  – Study Root Query/Retrieve Information Model – Move – SCU
  – Basic Grayscale and/or Color Print Mgt Meta SOP Class – SCU
  – Grayscale Softcopy Presentation State – SCU/SCP
  – DICOM SRs (Various) – SCU/SCP
  – Others

• **Film Digitizer**
  – Secondary Capture Image Storage – SCU
  – Modality Worklist Information Model – Find – SCU
  – Storage Commitment Push Model SOP Class – SCU
PACS Vendors say “We support Storage”

- Usually means (at least):
  - CT, X-ray, CR, MR, US, Secondary Capture
- Ask, does it include:
  - MG, NM, PET, Color US, Multiframe Echo
Many PACS don’t use DICOM with own workstations
• Q/R necessary for 3rd party workstations, such as 3D, NM, etc.
• Workstation:
  • Study Root Query/Retrieve Information Model – Find – SCU
• PACS:
  • Study Root Query/Retrieve Information Model – Find – SCP

Print: Ask Black/White (grayscale) and/or Color (RBG)
• Modality or Workstation
  • Basic Grayscale Print Management Meta SOP Class – SCU
• Printer
  • Basic Grayscale Print Management Meta SOP Class – SCP
Secure storage of data on archive

Real feature is to manage disk space on modality

- Automatically delete images on modality?
- User interfaces makes deletion easy?

- Modality – Storage Commitment Push Model SOP Class – **SCU**
- Archive - Storage Commitment Push Model SOP Class – **SCP**
“I’m interested in IHE Profile X. Who does it?”

• Testing Database:
  • IHE Connectathons – Comprehensive
  • Lists Vendor Names
  • http://connectathon-results.ihe.net

• Product Database
  • IHE Integration Statements – Voluntary
  • Specific Products / Versions
  • http://product-registry.ihe.net
Installing
Configuration

- **DICOM network configuration**
  - AE Title, Port Numbers, IP Address
  - Prone to human error; be diligent

- **System Specific Details**
  - Procedure Code Lists
  - Acquisition Protocols
  - User lists
  - Etc.

- Be prepared to communicate these details to your vendor before installation
Acceptance Testing

• Have a plan
  – Vendors will test some things
  – Know what is important to test for you

• Prepare to communicate
  – Your vendor will need configuration details
  – Early (well before installation) is better

• Consider public DICOM tools
  – Can do basic validations, etc.
Maintaining

• Display Calibration
  – DICOM Greyscale Display Function

• Configuration Evolution
  – New Procedure Codes
  – New Acquisition Protocols
  – New User lists
  – Etc.

• Software Upgrades
  – Can be as involved as initial installation
Troubleshooting

• There are public tools that can be very helpful (See “Tools for DICOM”)
  – Network Sniffers
  – DICOM Viewers
  – Validators
  – DVTK
  – Open Source Clients
  – Open Source Servers
• Society for Imaging Informatics in Medicine
  – Growing set of “Need To Know ePubs”

– Imaging Informatics Professional (IIP)
  • Training and Certification

– Practical Imaging Informatics: Foundations and Applications for PACs Professionals
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Thank you for your attention !