

Deploying DICOM Effectively: “Some Assembly Required”

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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.

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 \neq 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

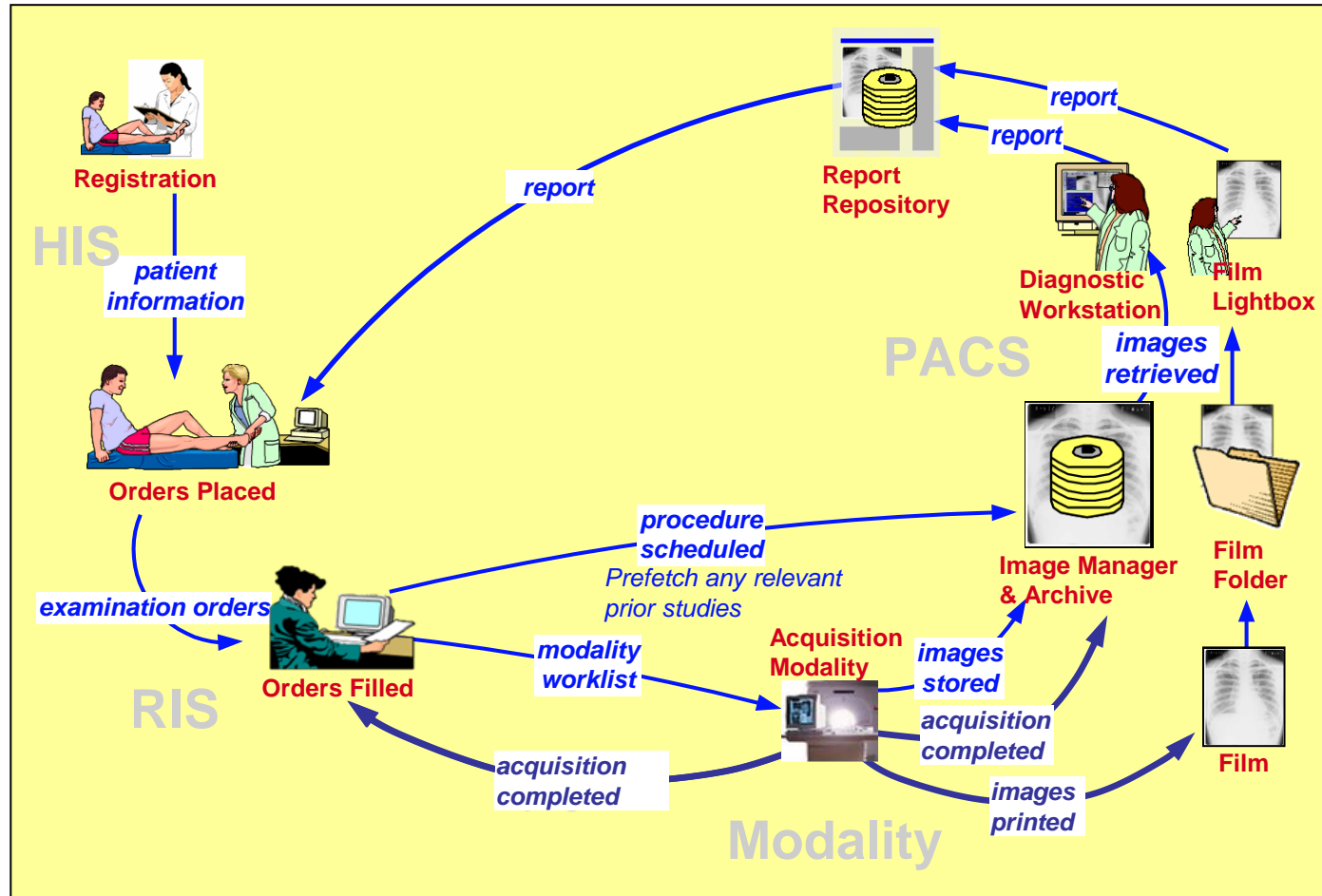
IHE helps users purchase & integrate multi-system solutions

- list required IHE Profile support in RFPs

www.ihe.net -> User Handbooks



IHE Scheduled Workflow



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)

PACS is a Major Catalyst



- **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"**

- **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

- **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

Learn How to Speak “DICOM”



- **“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

- **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

SOP Class Name	SOP Classes as a SCU	Unique identifiers
This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an SCU:		
SOP Class Name (SCU)	SOP Class UID	
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	
Modality Worklist Management - FIND	1.2.840.10008.5.1.4.31	
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	

***Compare Product A - SCU table
with Product B - SCP table***

DICOM Conformance Statements



Overview Section

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Image Transfer		
CT Image Storage	Yes	No
Query/Retrieve		
Study Root Information Model FIND	No	Yes
Study Root Information Model Move	No	Yes
Workflow Management		
Modality Worklist Information Model - Find	Yes	No
....		
Print Management		
Basics Grayscale Print Mgt.	Yes	No
....		

Provide scheduled patient and exam info to modalities

- Modality Worklist SCP

Required
Features

Receive and process updates from Modalities

- MPPS SCP

Optional
Features

Receive and store acquired images

- Storage SCP

Respond to queries for patient studies/images

- Query/Retrieve SCP
- Storage SCU

Print images?

- Print SCU

Required
Features

Provide conformation of storage

- Storage Commitment SCP

Optional
Features

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

Required
Features

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

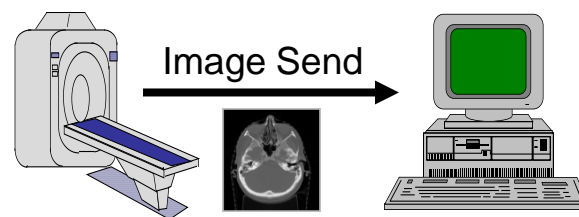
- Dose SR SCU

Optional
Features

- **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



Query and Print Questions



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**

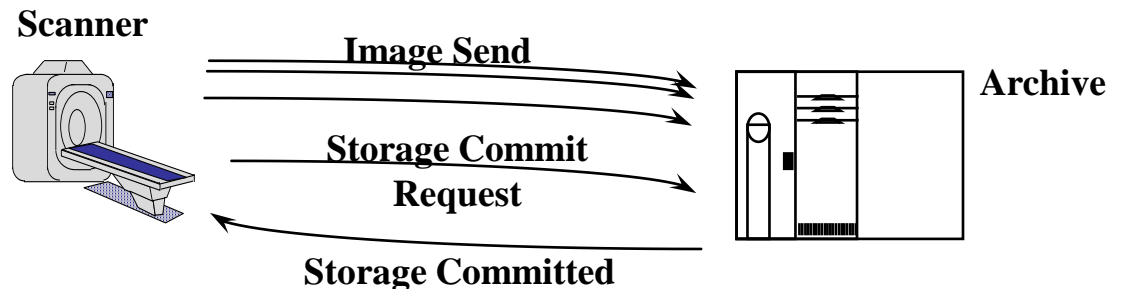
Print: Ask Black/White (grayscale) and/or Color (RGB)

- **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

- **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**

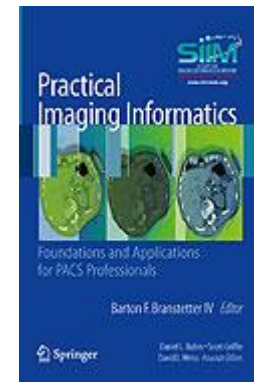
Acceptance Testing

- **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.

- **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**

- **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**
 - <http://www.siimweb.org/>
 - 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 !