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Deploying DICOM Effectively: Some Assembly Required

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Leading Innovation >>>

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, 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

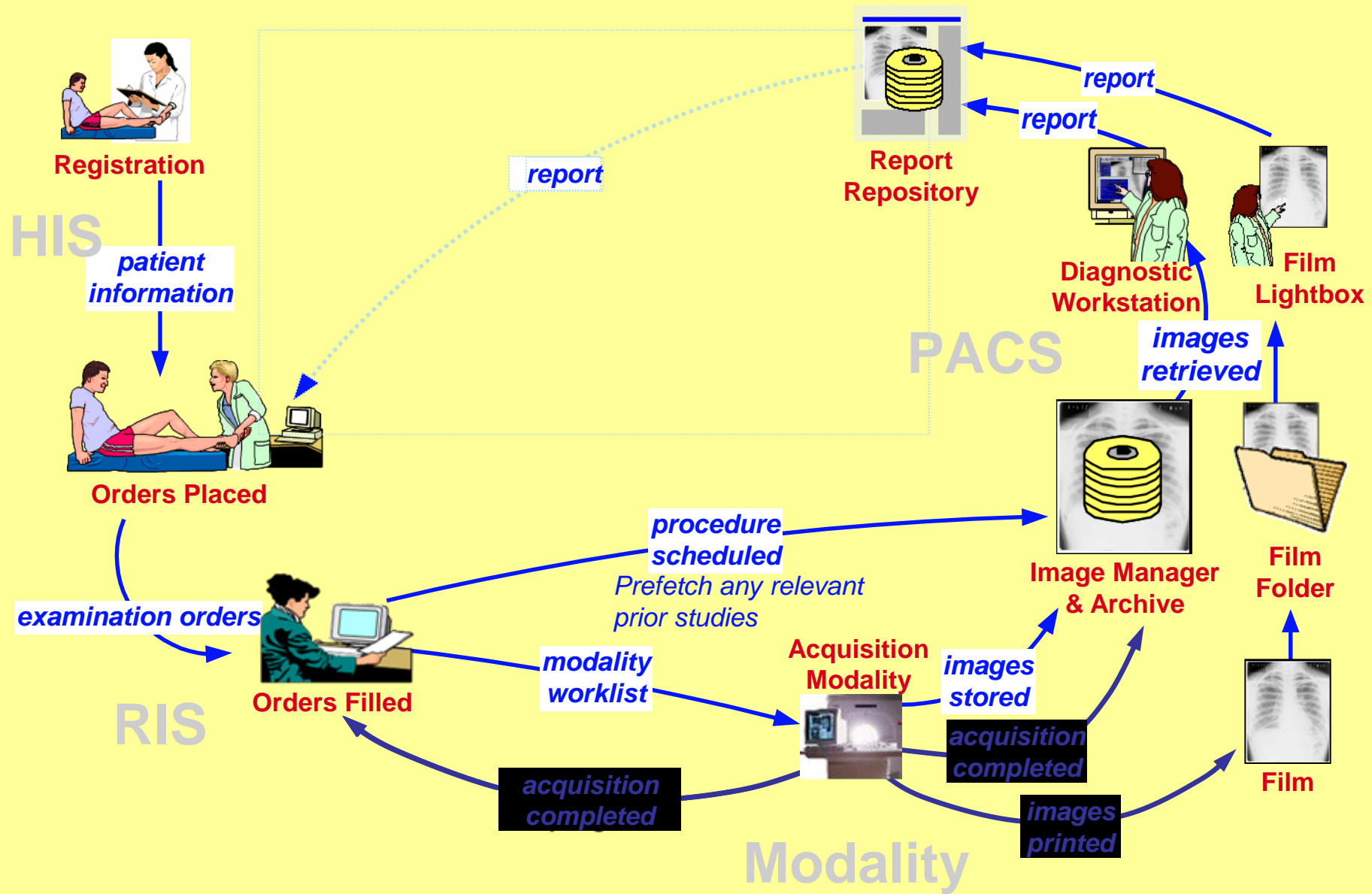
- managed testing of Profile implementations

IHE helps users purchase & integrate multi-system solutions

- list required IHE Profile support in RFPs



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



- **This is a problem for hospitals that do not know how to speak “DICOM”**
 - **SOP Classes**
 - **Information Objects**
 - **Service Class User, Service Class Provider**
 - **Storage Commitment**
 - **Presentation State**
 - **Etc.**

- **Professional services offered by vendors and consultants**
- **Vendors understand their products and can typically tailor the integration better to their systems**
- **Independent consultants typically understand many products and can 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**
 - this skill is very important
- **Need to understand**
 - TCP/IP, routers, hubs, switches, cables, subnets
- **Archive technology important**
 - 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”

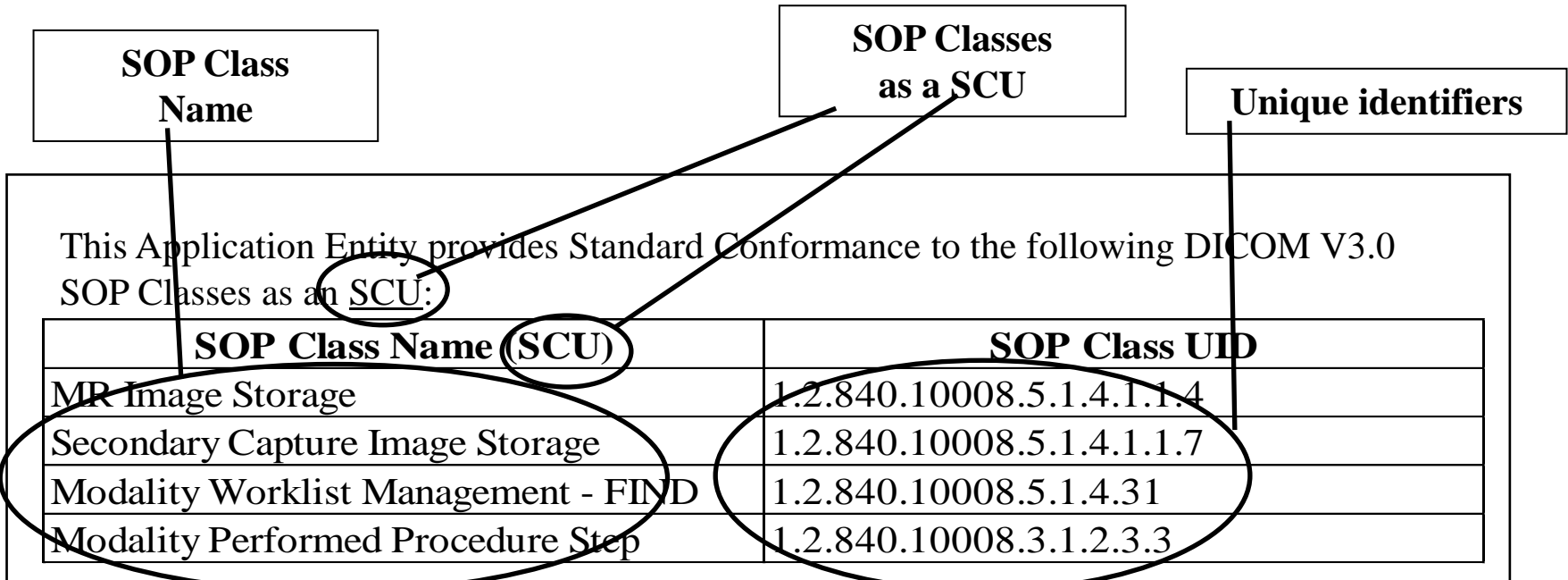
OR

“RIS and Modality shall support IHE Scheduled Workflow”

Important education for PACS Administrators

- **Documents how product implemented DICOM**
- **Required, Public, often on Web sites**
- **Well-defined format**
- **Facilitates comparisons of products**
- **Detailed information aids a knowledgeable DICOM person greatly**

- 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 a product's SCU table
with another's SCP table***

New DCS format Executive Overview

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 Work-list 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 Work-list 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**

DICOM Storage – “push” images

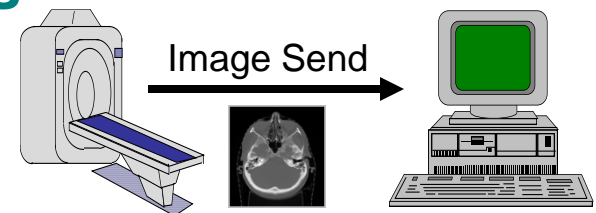
- Question for archives, workstations and modalities

PACS Vendors say “We support Storage”

- At a minimum it usually means, CT, X-ray, CR, MR, US, Secondary Capture (for a PACS)
- But you need to ask, does it include MG (mammo), NM, PET, Color US, Cardiac Echo (US multi-frame)?

Specific to the modality (e.g. a CT image is NOT a US image)

- Send CT Images – CT Image Storage SOP Class – SCU
- Receive CT Images – CT Image Storage SOP Class - SCP



Query/Retrieve – “pull” images from archive

- Question for archives, workstations and some modalities

Many PACS don't use DICOM with own workstations

- Q/R is often only used with 3rd party workstations, such as 3D, NM workstation, etc.
- **Workstation asking query**
 - Study Root Query/Retrieve Information Model – Find – SCU
- **Archive being queried**
 - Study Root Query/Retrieve Information Model – Find – SCP

Print – one simple question, **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**

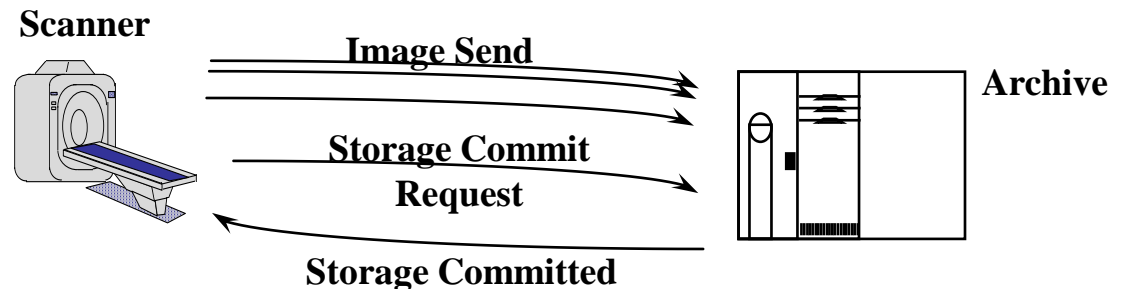
Storage Commit Questions

Guarantee 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?**
- **Modalities do Storage Commitment but do nothing?**
- **Modality – Storage Commitment Push Model SOP Class – SCU**
- **Archive - Storage Commitment Push Model SOP Class – SCU**

Difficult for hospitals to understand because they don't see the workflow



“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**

- **Have a plan**
 - Vendors will test some things
 - Know what is important to test for you
- **Be prepared to communicate these details to your vendor before installation**
- **There are public tools that can be helpful (See “Tools for DICOM”)**

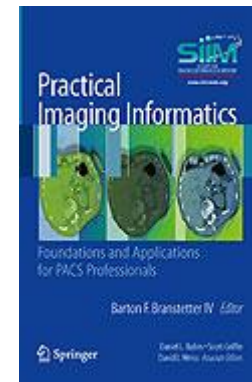
- **Display Calibration**
 - **DICOM Greyscale Display Function**

- **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 object viewers**
 - **Validators**
 - **DVTK**

- **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 !