

# 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 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**

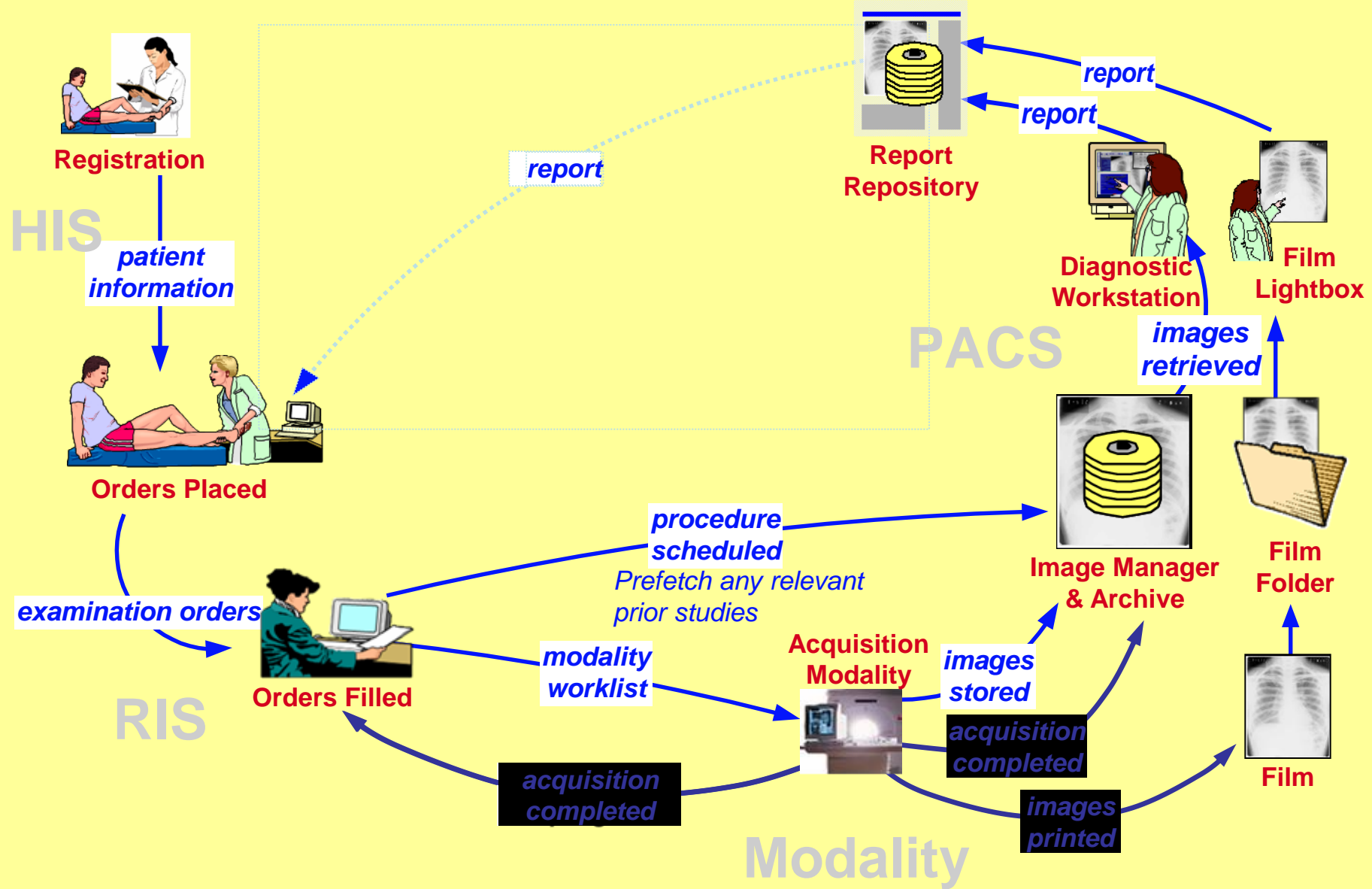
- managed testing of Profile implementations

**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](http://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***

- **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**

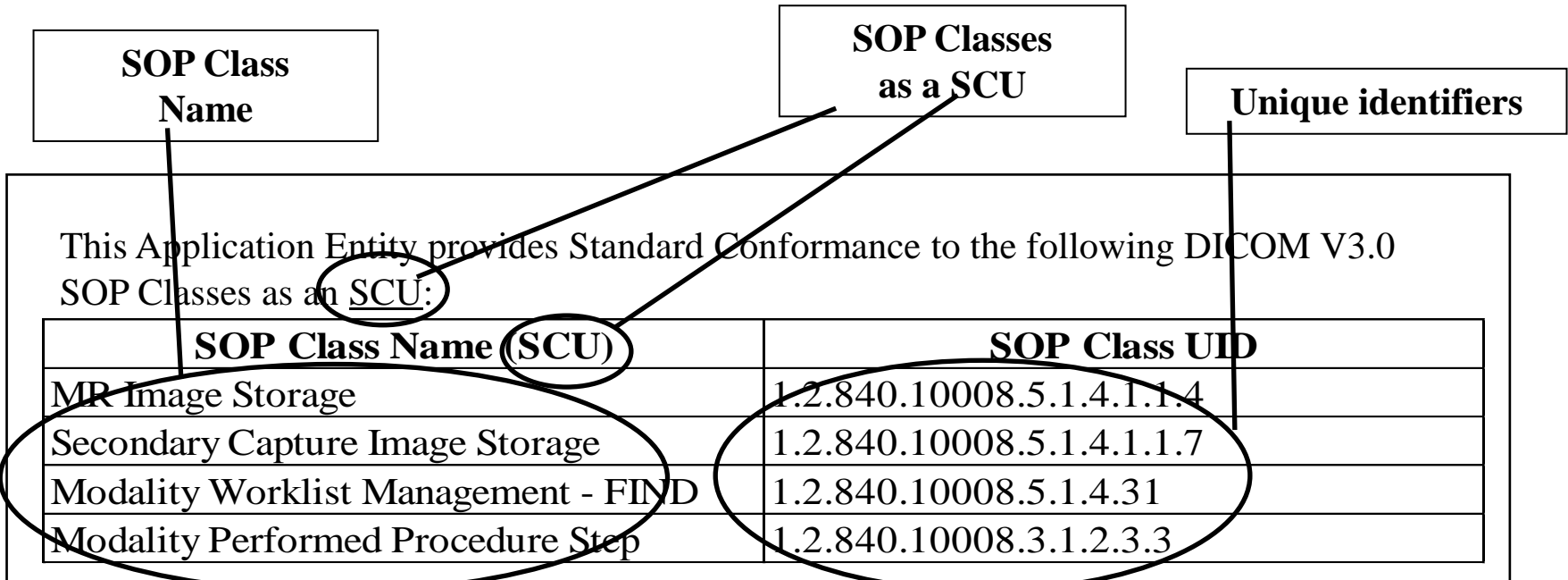
**“RIS and Modality shall support IHE Scheduled Workflow”**

***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)
<b>Image Transfer</b>		
CT Image Storage	Yes	No
<b>Query/Retrieve</b>		
Study Root Information Model FIND	No	Yes
Study Root Information Model Move	No	Yes
<b>Workflow Management</b>		
Modality Worklist Information Model - Find	Yes	No
....		
<b>Print Management</b>		
Basics Grayscale Print Mgt.	Yes	No
....		

## Provide scheduled patient and exam info to modalities

- Modality Work-list SCP

Required  
Features

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## 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

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## 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

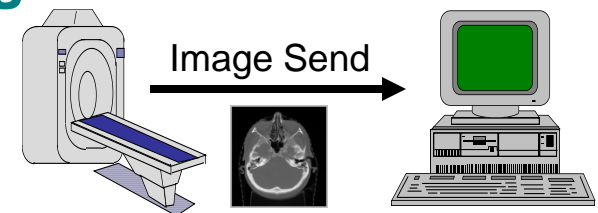
- Question for archives, workstations and modalities

## 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 3<sup>rd</sup> 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**



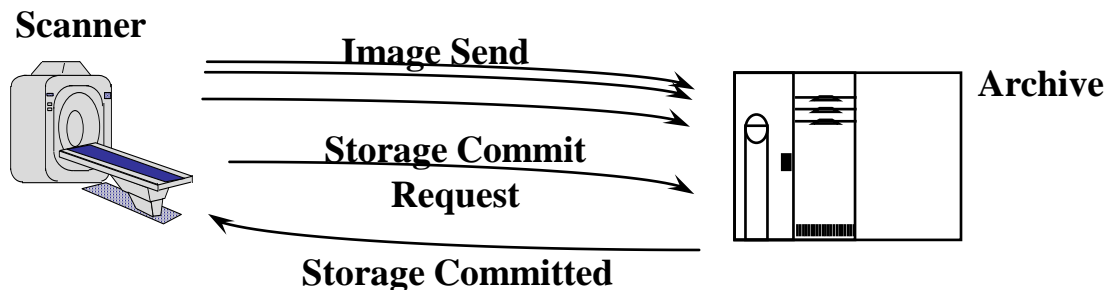
# Storage Commit Questions

**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

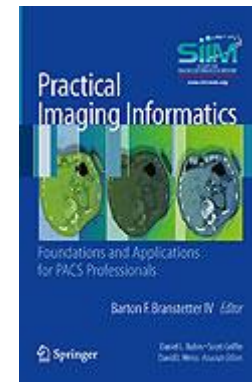
- **DICOM network configuration**
  - AE Title, Port Numbers, IP Address
  - Prone to human error; be diligent
- **System Specific Details**
  - Procedure Code Lists
  - Acquisition Protocols
  - User lists
  - Etc.
- **Be prepared to communicate these details to your vendor before installation**

- **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 !***