

# 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

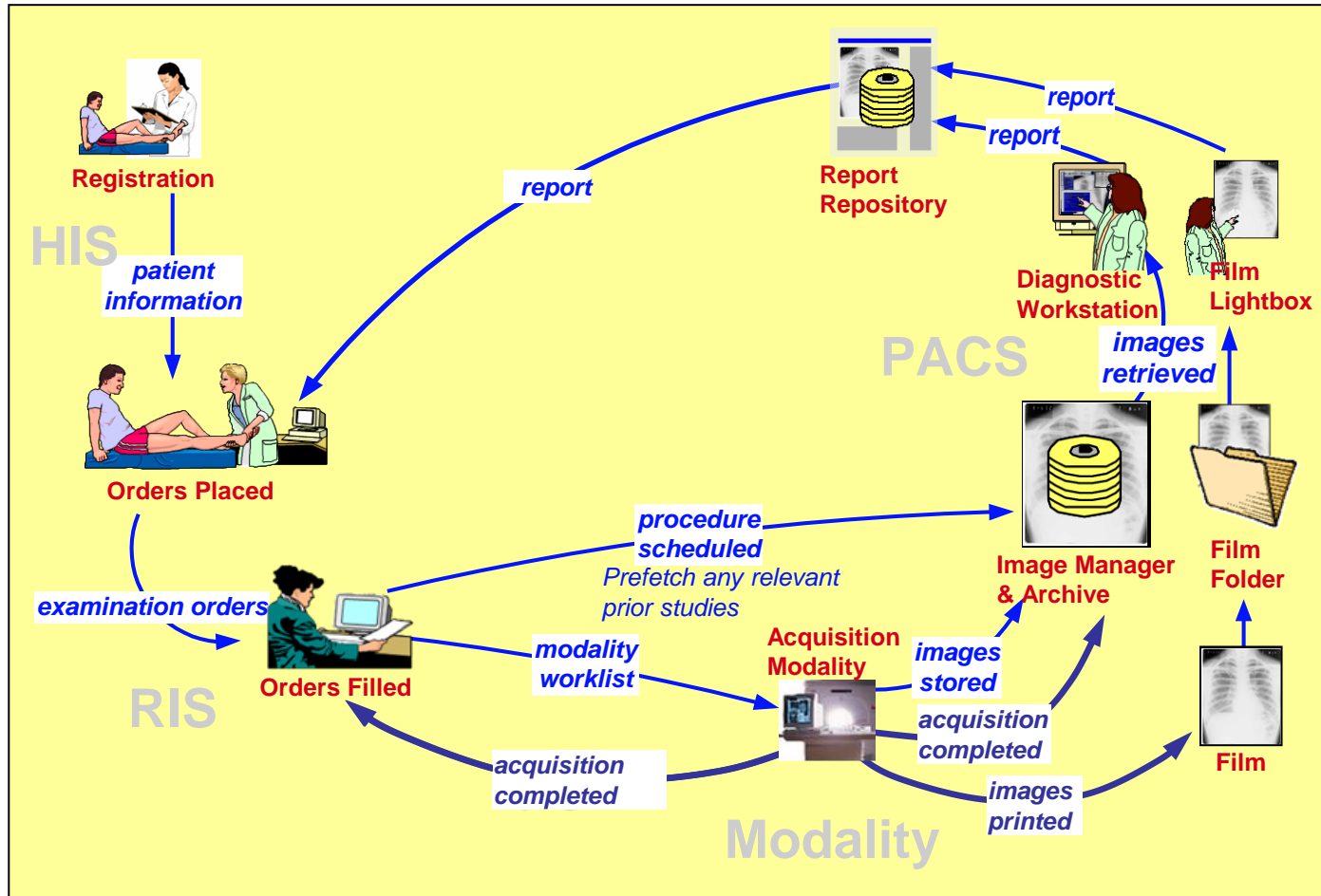
**IHE helps users purchase & integrate multi-system solutions**

- list required IHE Profile support in RFPs

**[www.ihe.net](http://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](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***

# 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**

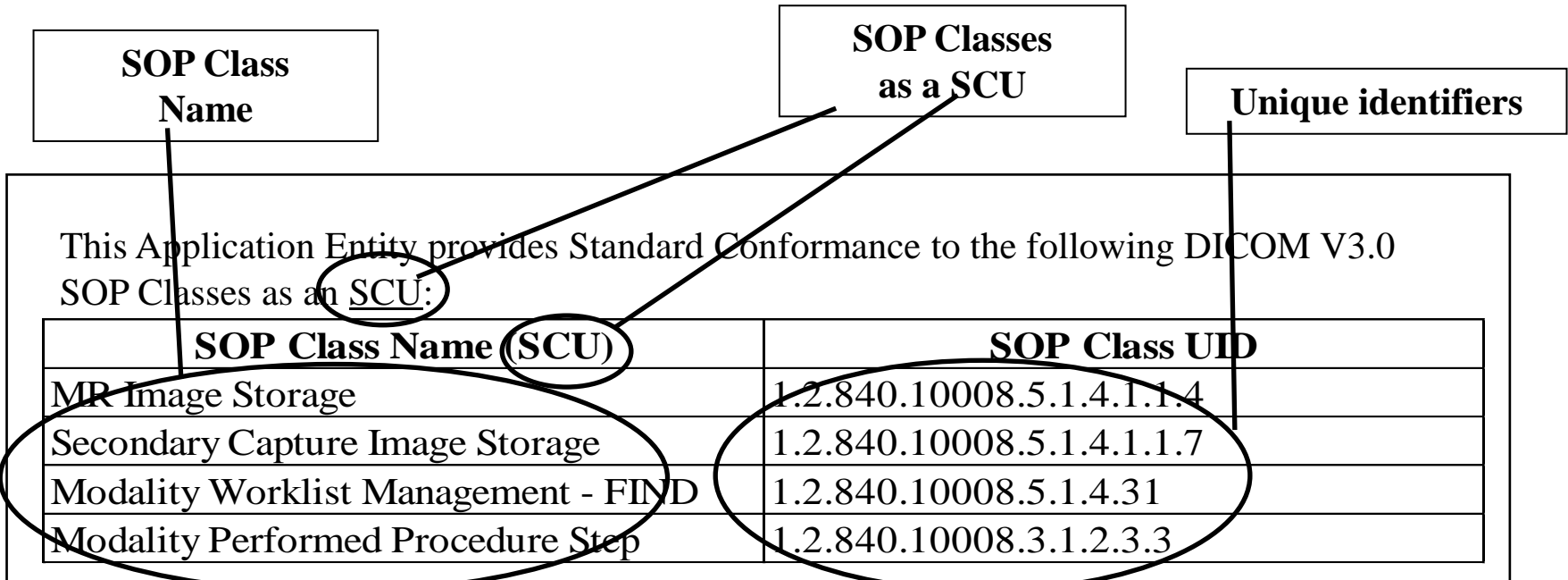
**“RIS and Modality shall support IHE Scheduled Workflow”**

***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***

## Overview Section

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 Worklist 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 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

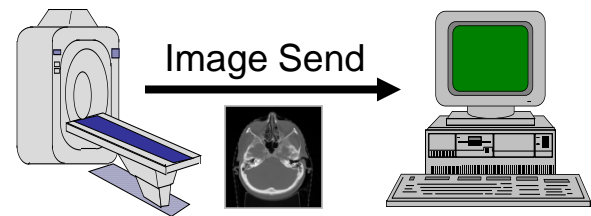
- Dose SR SCU

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



## Many PACS don't use DICOM with own workstations

- Q/R necessary for 3<sup>rd</sup> 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)

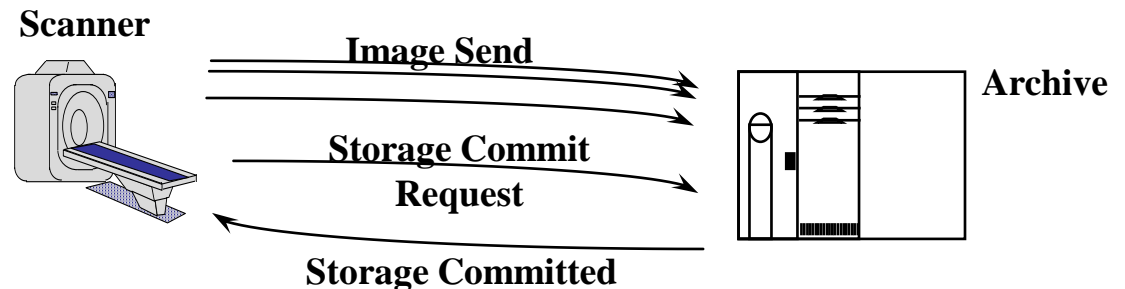
- **Modality or Workstation**
  - Basic Grayscale Print Management Meta SOP Class – **SCU**
- **Printer**
  - Basic Grayscale Print Management Meta SOP Class – **SCP**



## 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**

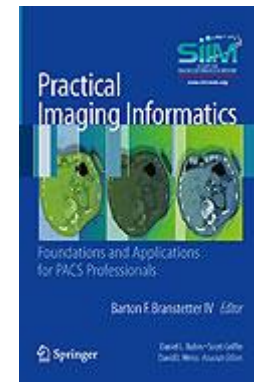
# Acceptance Testing

- **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 !***