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DICOM℠
Digital Imaging and Communications in Medicine

Deploying DICOM Effectively: "Some Assembly Required"

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TOSHIBA
Leading Innovation

Deploying DICOM Effectively

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Primary Topics:

- **Planning**
- **Purchasing**
- **Installing**
- **Maintaining**
- **Troubleshooting**
- **Studying**

Planning

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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?

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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

IHE Scheduled Workflow

Registration

HIS

patient information

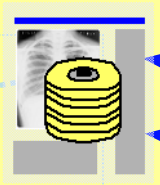
Orders Placed

examination orders

Orders Filled

RIS

report

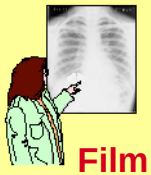


Report Repository

report

report

Diagnostic Workstation



Film Lightbox

PACS

images retrieved

Image Manager & Archive

Film Folder

procedure scheduled

Prefetch any relevant prior studies

modality worklist

Acquisition Modality

images stored

acquisition completed

acquisition completed

images printed

Film

Modality

IHE Profiles as Models

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.**

Integration Services

- **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

Mainstream IT

- **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

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"

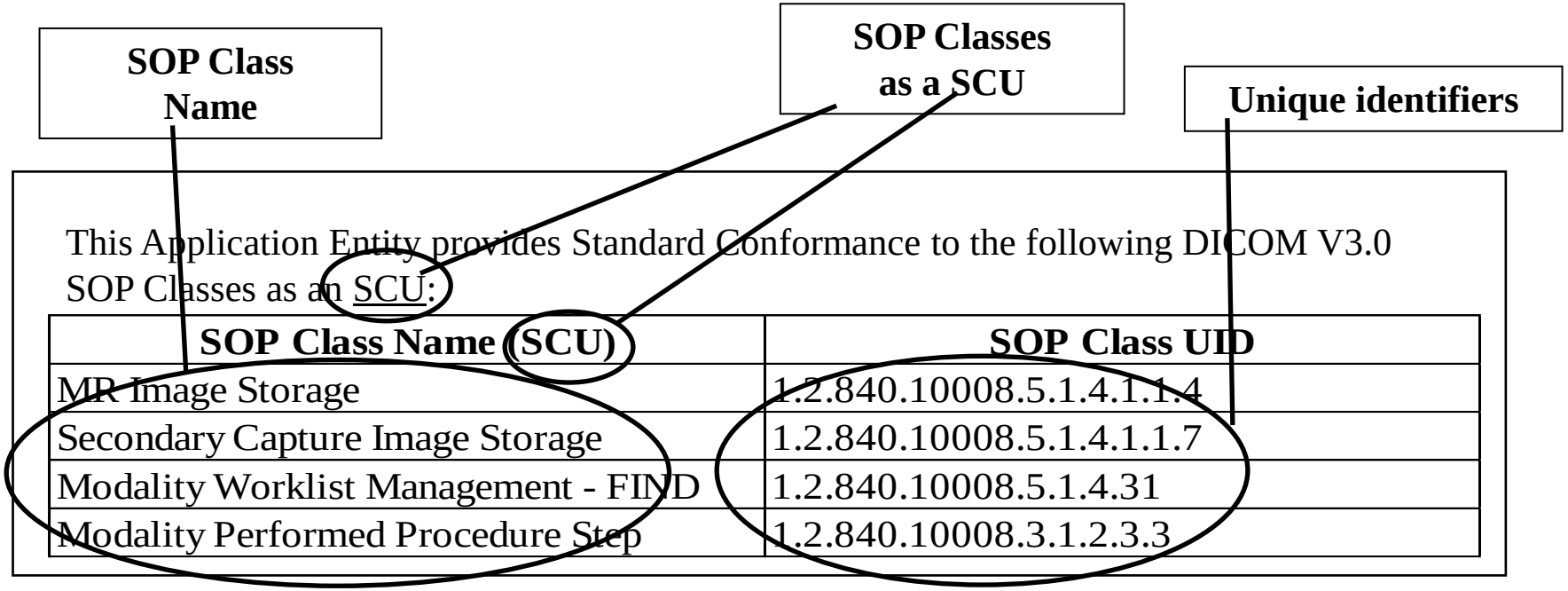
Important education for PACS Administrators

DICOM Conformance Statements

- **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**

DICOM Conformance Statements

- **At a minimum, hospitals (PACS administrators) need to read SOP Class Tables**



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
….		

Radiology Information System (RIS)

Provide scheduled patient and exam info to modalities

- **Modality Work-list SCP**

Required Features

Receive and process updates from Modalities

- **MPPS SCP**

Optional Features

PACS

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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

Modalities

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

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**

DICOM Storage Questions

DICOM Storage – "push" images

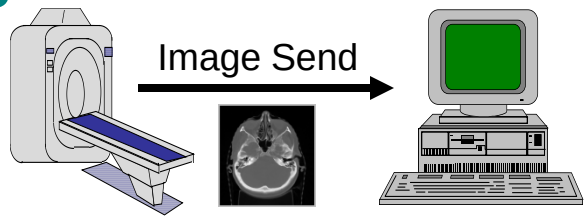
- Question for archives, workstations and modalities

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 and Print

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

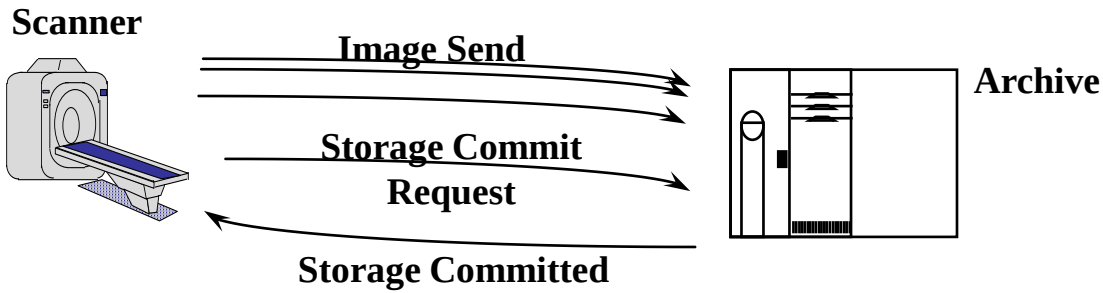
Storage Commit Questions

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



IHE Resources

"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**
- **Be prepared to communicate these details to your vendor before installation**
- **There are public tools that can be helpful (See “Tools for DICOM”)**

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

SIIM

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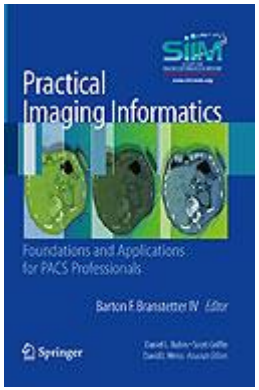
- **Society for Imaging Informatics in Medicine**
  - **http://www.siimweb.org/**
  - **Growing set of "Need To Know ePubs"**
  - **Imaging Informatics Professional (IIP)**
    - Training and Certification
  - **Practical Imaging Informatics: Foundations and Applications for PACs Professionals**



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Thank you for your attention !