RSNA 2008

Imaging Informatics Updates

DICOM

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DICOM Update

- Supplement status as an indication of the scope and pace of DICOM activities
- Enhanced family of objects – features and new modalities
- Segmentation storage
- Radiation Dose reporting
- Display and presentation
- Encapsulated documents
- Specimen identification
- Hosted applications

2006 Supplements

- Sup 111 – Segmentation Storage
- Sup 112 – Deformable Spatial Registration Storage
- Sup 133 – Email Transport

2007 Supplements

- Sup 107 – Substance Administration Information
- Sup 110 – Ophthalmic Tomography Image Storage
- Sup 114 – DICOM Encapsulation of CDA
- Sup 116 – X-Ray 3D Storage
- Sup 127 – CT Radiation Dose Reporting

2008 Supplements

- Sup 117 – Enhanced PET Image
- Sup 122 – Specimen Identification (Revised)
- Sup 123 – Structured Display
- Sup 125 – Breast Tomosynthesis
- Sup 128 – Cardiac Stress Testing SR
- Sup 130 – Ophthalmic Refractive Measurements

Trial Implementation Supplements

- Sup 74 – RT Delivery Worklist
- Sup 95 – Audit Trail Messages
- Sup 96 – Unified Worklist

Letter Ballot Supplements

- Sup 119 – Instance & Frame Retrieve
- Sup 132 – Surface Segmentation
- Sup 137 – MPEG2 MP@HL

Public Comment Supplements

- Sup 120 – Extended Presentation States
- Sup 126 – Colon CAD SR
- Sup 129 – Electrophysiology SR, Log
- Sup 133 – Color Palette Storage & Q/R
- Sup 135 – SR Imaging Report Transformation to CDA
- Sup 139 – Enhanced XA/XRF Informative Annex
- Sup 140 – XA/XRF Presentation State

Work in Progress Supplements

- Sup 43 – Ultrasound ND Storage
- Sup 115 – Evidence Documents
- Sup 118 – Application Hosting
- Sup 121 – Modality Procedure Plan
- Sup 124 – Display Parameter Communication
- Sup 131 – Bone Mounted Implant Description Storage
- Sup 134 – Implantation Plan SR
- Sup 136 – DOT Mammography
- Sup 138 – Crestal Implant Storage
- Sup 141 – Enhanced MR Color Image
- Sup 142 – Clinical Trial De-identification
- Sup 143 – Macular Grid Thickness and Volume
- Sup 144 – Ophthalmic Axial Measures

Enhanced Image Objects

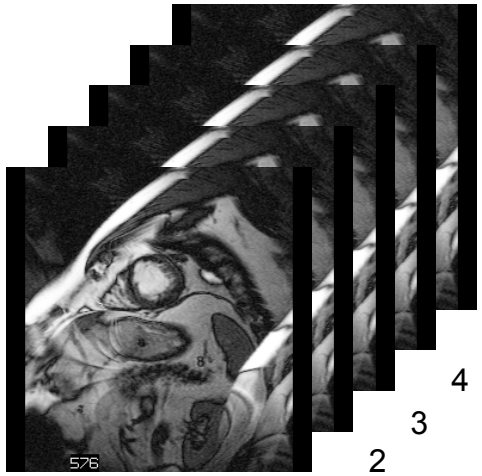
- “Old” objects
  - single frame
  - not up to date with technology changes (MDCT)
  - too much optional, ambiguous, or proprietary
- “New” (enhanced) objects
  - multi-frame (faster performance, better compression)
  - better organized (volumes, dynamic contrast)
  - encode advanced acquisition technique
  - mandatory rather than optional terms & attributes
- All new image types are enhanced family

Enhanced Image Objects Technique Attributes & Terms

	CT		MR	
SOP Class	Original	Enhanced	Original	Enhanced
Attributes (Mandatory)	18 (0)	41 (39)	44 (2)	103 (94)
Terms (Enumerated)	4 (2)	86 (18)	38 (9)	228 (47)

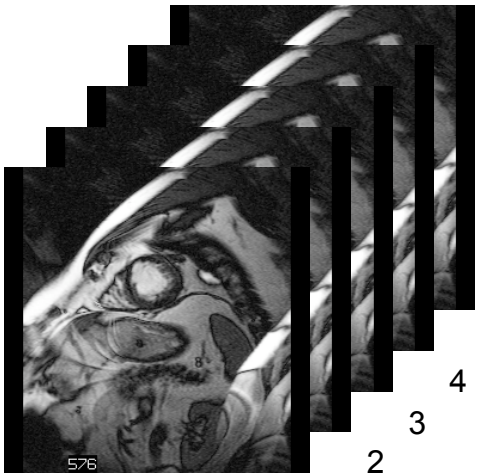
Trigger Delay Time

Temporal Position Index



Dimension Index Pointers:

1. Stack ID
2. In-Stack Position
3. Temporal Position Index



Time (2)

Space (1)

Enhanced Image Objects

- 2002/03 – Enhanced MR
- 2004/07 – Enhanced CT
- 2005/09 – Enhanced XA/XRF
- 2007/01 – 3D X-Ray
- 2007/10 – Ophthalmic Tomography
- 2008/01 – Enhanced PET
- 2008/08 – Breast Tomosynthesis

Segmentation Objects

- Raster-based segmentation
  - encoded as an image
  - binary (is segment or not)
  - probablistic (% voxel is likely to be segment)
  - occupancy (% of voxel is segment)
- Surface segmentation
  - 3D mesh – same as implant descriptions

Radiation Dose Encoding

- Increasing international public and regulatory scrutiny of radiation dose from imaging
- Existing encoding in images & PPS inadequate
- Need persistent object related to irradiation events
- SR-based encoding
- Sup 94 – Radiation Dose Report
- Sup 127 – CT Radiation Dose Report
- CP 687 – Dose Reporting for Mammography

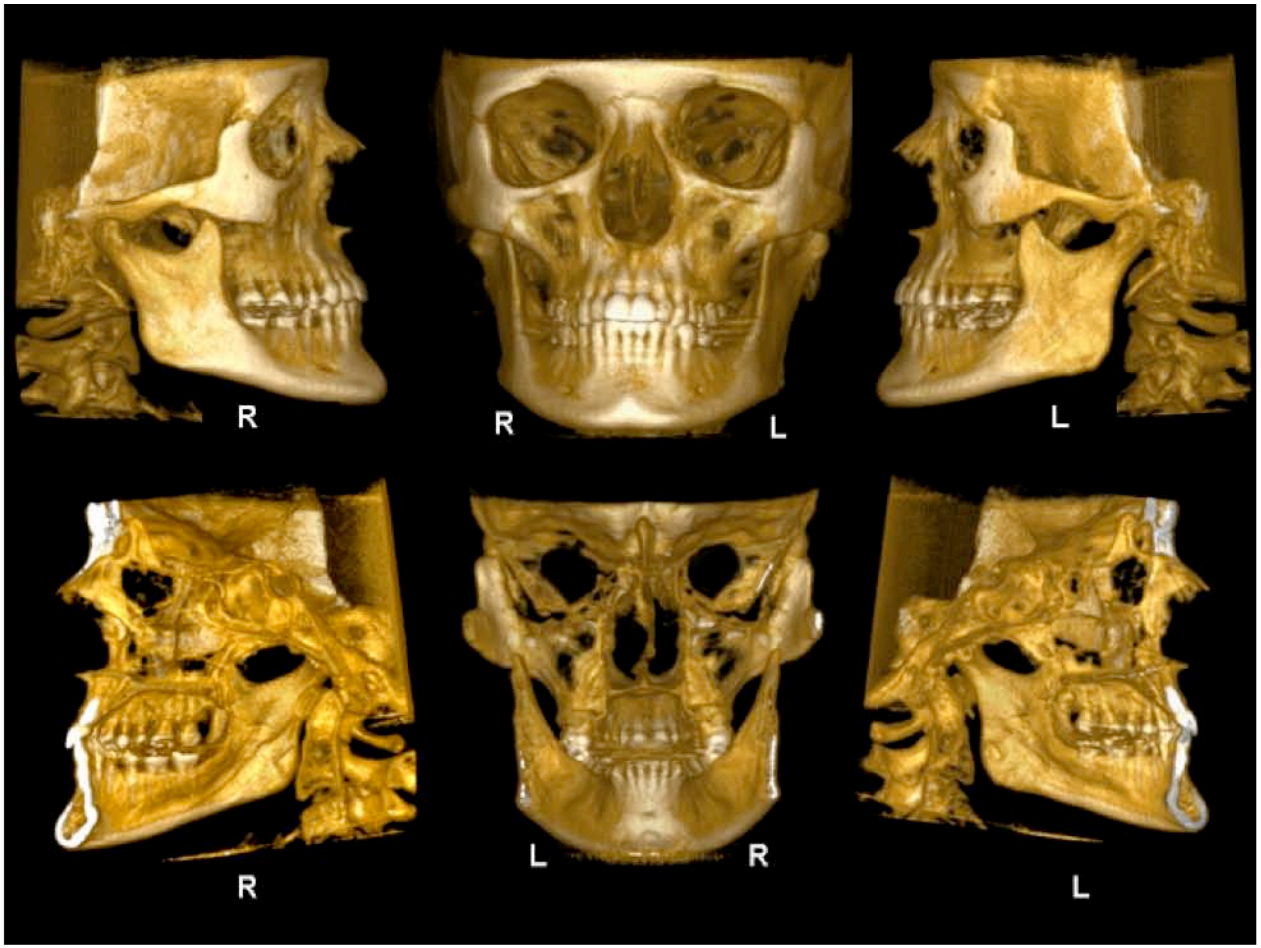
CT Radiation Dose Reporting

- Significant concern about radiation dose of screening MDCT exams
- Difficult to estimate/monitor from images alone
- Acquire, store and analyze information about “irradiation events” separately from images
- IEC defines metrics
- DICOM defines encoding in Sup 127 (as SR objects)
- NEMA (vendors) committed to timely implementation
- ACR CT dose registry will use Dose SR
- IHE Radiation Exposure Monitoring (REM) Profile

Display & Presentation

- Structured Display
  - how to layout specific sets of images
  - as opposed to hanging protocols, which are rules for a class of images
  - dentistry initiative, general mechanism
- Communication of Display Parameters
  - for managing display device calibration
  - centralized storage of QC results
  - JIRA initiative

Structured Display



Document Encapsulation

- For storing and distributing “external” documents within PACS
  - digitized paper
  - page oriented results
  - other structured document formats
- Sup 104 (FT 2005/03) - PDF
- Sup 114 (FT 2007/01) - CDA (HL7)

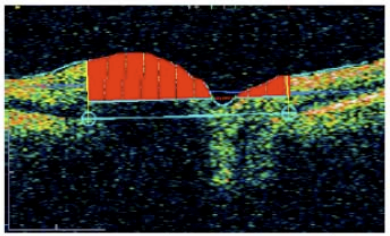
Encapsulated PDF

A

STRATUS OCT
Optic Nerve Head Analysis Report - 4.0.1 (0056)

DOB: 11/12/1932, ID: 148536, Female

Scan Type: Fast Optic Disc OD
Scan Date: 12/6/2006
Scan Length: 4.0 mm

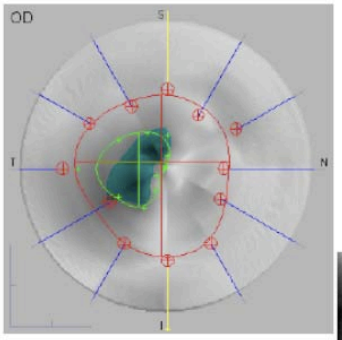


Individual Radial Scan Analysis

Rim Area (Vert.Cross Section):	0.49 mm²
Avg Nerve Width @ Disk	0.42 mm
Disk Diameter:	2.09 mm
Cup Diameter:	0.25 mm
Rim Length (Horiz.):	1.85 mm

Cup Offset (microns): 150

Signal Strength (Max 10): 4



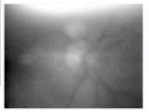
Optic Nerve Head Analysis Results

Vert. Integrated Rim Area (Vol.)	0.785 mm³
Horiz. Integrated Rim Width (Area)	1.959 mm²
Disk Area	2.917 mm²
Cup Area	0.599 mm²
Rim Area	2.318 mm²
Cup/Disk Area Ratio	0.205
Cup/Disk Horiz. Ratio	0.456
Cup/Disk Vert. Ratio	0.459

Plot Background:

☐ None ☐ Absolute ☑ Aligned and Shaded

Cup Offset for Topo (microns): 150
Cup Area (Topo): 0.428 mm²
Cup Volume (Topo): 0.024 mm³



SCAN 1 : Results not Modified.
SCAN 2 : Results not Modified.
SCAN 3 : Results not Modified.
SCAN 4 : Results not Modified.
SCAN 5 : Results not Modified.
SCAN 6 : Results not Modified.

Signature: _____

_____

Physician: , M.D.

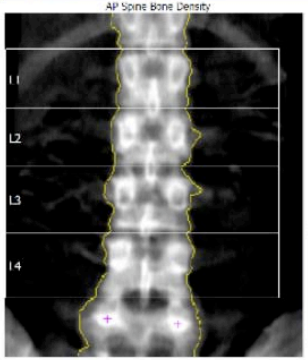
P

A

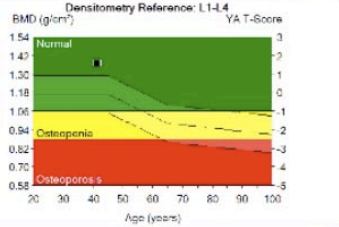
GE Healthcare
726 Heartland Trail
Madison, WI 53717-1915

Patient:		**Facility ID:**	
Birth Date:		**Referring Physician:**	
Height / Weight:		**Measured:**	1/9/2002 10:41:55 AM (6.00)
Sex / Ethnic:	Female Asian	**Analyzed:**	10/1/2007 3:09:05 PM (12.00)

AP Spine Bone Density



Densitometry Reference: L1-L4



Region	BMD [1] (g/cm²)	Young-Adult [2] T-Score	Age-Matched [3] Z-Score
L1	1.357	1.9	2.0
L2	1.392	1.6	1.7
L3	1.353	1.3	1.4
L4	1.373	1.4	1.5
L1-L4	1.369	1.6	1.7

COMMENTS:

Image not for diagnose

Printed: 10/2/2007 3:43:15 PM (12.00/5:3:00:50:00:12.0 0.00:9.56 0.00x1.05 38.9%Fat-12.0%
0.00:0.00 0.00:0.00
Filename: lwang_gregg295.ufx
Scan Mode: Standard

1 -Statistically 68% of repeat scans fall within 1SD (± 0.015 g/cm² for AP Spine L1-L4)
2 -USA (Combined NHANES (ages 20-39) / Lunar (ages 20-40)) AP Spine Reference Population (v120)
3 -Matched for Age, Weight (females 23-180 kg), Ethnic
11 -World Health Organization - Definition of Osteoporosis and Osteopenia for Caucasian Women: Normal = T-Score at or above -1.0 SD; Osteopenia = T-Score between -1.0 and -2.5 SD; Osteoporosis = T Score at or below -2.5 SD; [WHO definitions only apply when a young Healthy Caucasian Women reference database is used to determine T-Scores.]

GE Healthcare

Prodigy
90696

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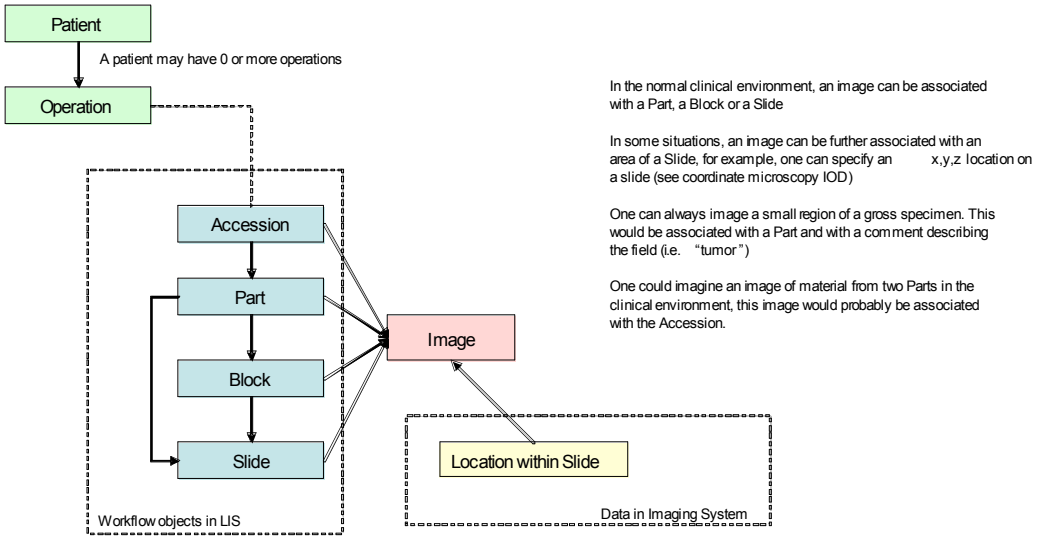
Specimen Identification

- Sup 122 – Specimen Identification
- Renewed interest by pathology group
- Original attempt was too simplistic

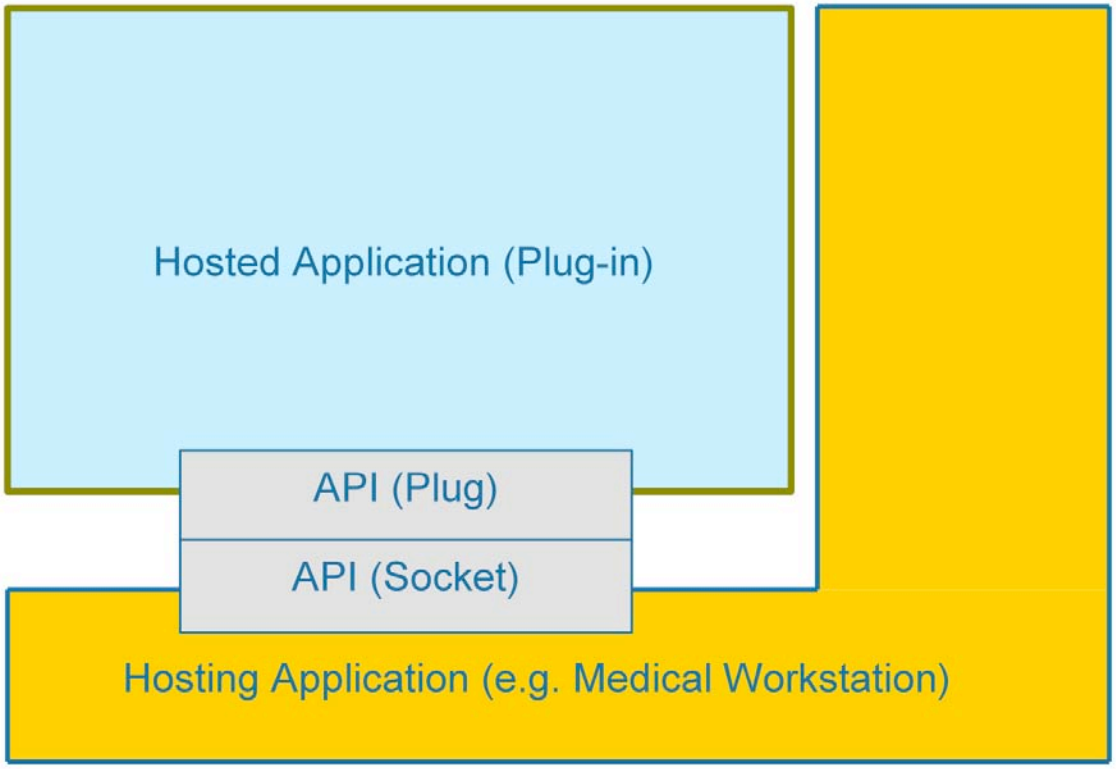
Integration of Images and LIS in Anatomic Pathology



Other work ...

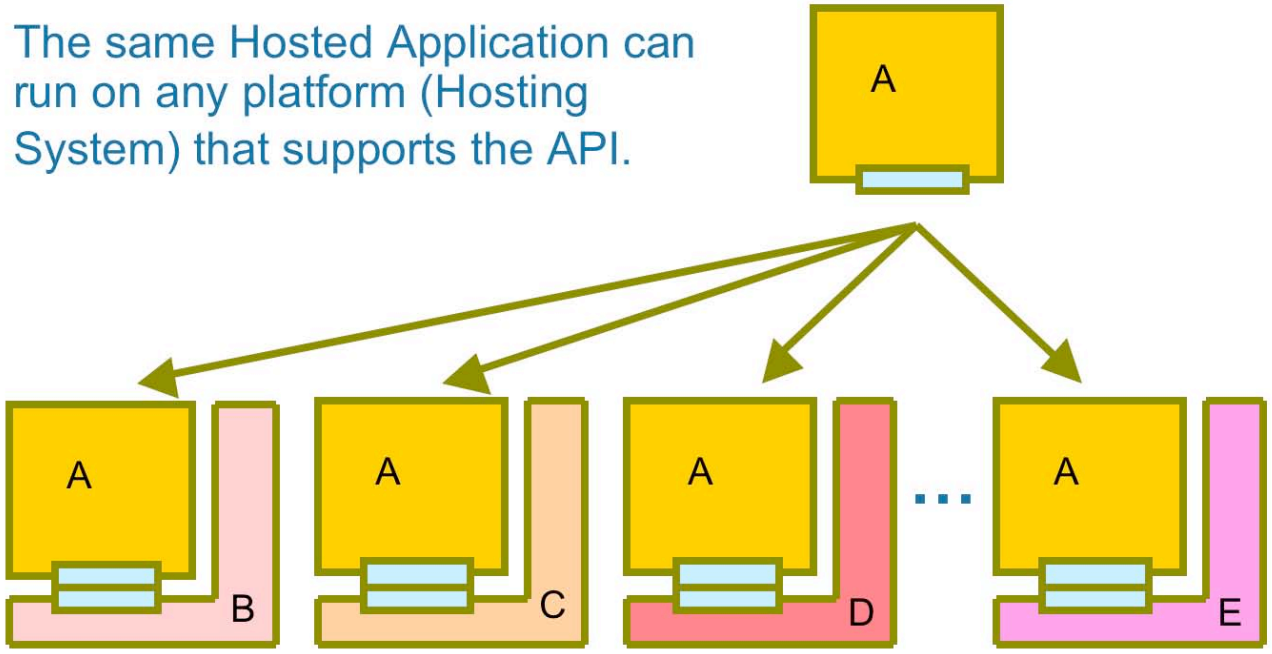
- Substance administration query/verify
  - e.g., for modality to check contrast sensitivity
- Unified worklist
  - re-visit use cases for General Purpose Worklist
  - 1:1 scheduled:performed steps
  - push (notify) & pull (query) models for tasks
  - RT first users
- Frame level retrieval
  - for large (enhanced) multi-frame images
  - e.g., to view an SR reference to a subset of frames

Hosted Applications



Hosted Applications

The same Hosted Application can run on any platform (Hosting System) that supports the API.



Hosted Applications

- Platform neutral hosting
  - Web Services end points on local host
- Bulk (pixel) data transfer
  - via URI's which may be local files
  - memory-mapped files for efficiency
- Meta-data interfaces
  - binary – entire original file
  - native – XPath query of DICOM attributes
  - abstract – N dimensional model

Conclusion

- DICOM continues to track modality technology advances and new modalities
- Revisiting outmoded objects
- Increasing diversity of non-image objects
- Greater 3D emphasis as registration, segmentation and fusion become routine
- Other innovative work in new areas, including hosted applications API