NORTHWESTERN
UNIVERSITY

The Proposed Northwestern Collaboration with NA-MIC

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Who are we?
3 separate (non-profit) entities

- Northwestern University
  - Feinberg School of Medicine
    - Department of Radiology
- Northwestern Medical Faculty Foundation
  - Multi-specialty physician practice
    - 500 physicians, 1000 healthcare professionals
- Northwestern Memorial Hospital
  - 700 bed facility

Department of Radiology

- 60 radiologists (46 FTE)

- 28 radiology residents

- 285 Staff

- 400,000 radiology procedures per year

- Large research operation
  - MR
    - Neuro and Functional MRI
  - Cardiac CT and MR
  - (Digital) Mammography
  - Informatics
    - Largest GE PACS R&D partner 1999-2004
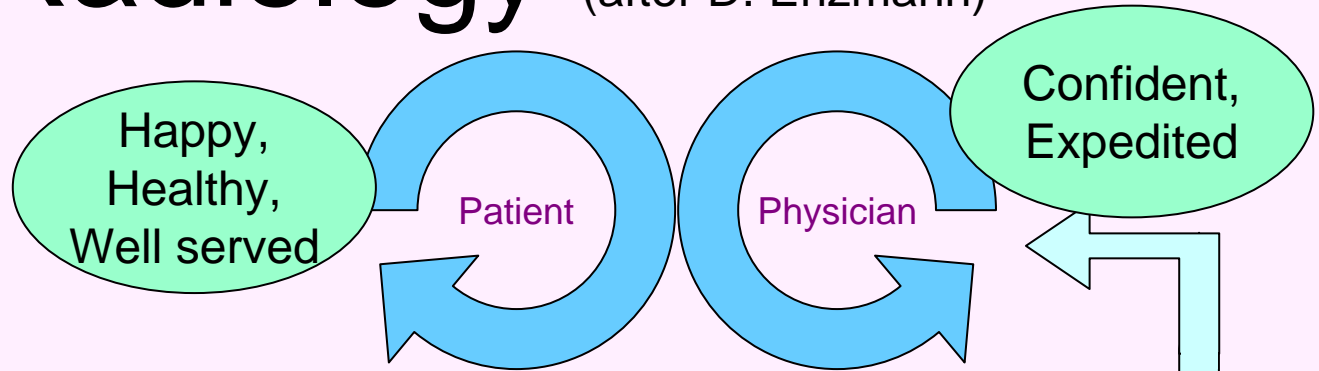
Clinical Environment

- 70 modalities from 11 vendors
- Large GE PACS
  - 1.9 million studies
    - 145 million images
  - 30 diagnostic workstations; 70 other workstations
  - Ubiquitous web access
- Large Cerner RIS
- 100% human dictation and transcription
  - Homegrown Lucene index of 2M reports

Academic Radiology

- **C** linical work

- **R** esearch

- **E** ducation

- **A** dministration

- **M** anagement

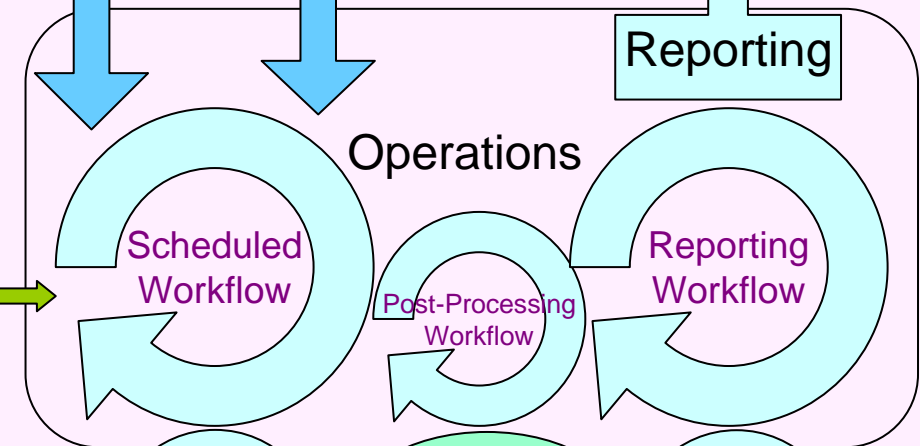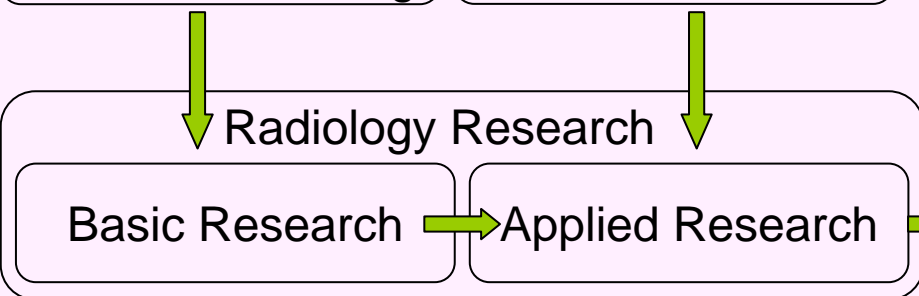Continuous pressure to increase volume, accuracy and efficiency of these tasks

Radiology (after D. Enzmann)

Happy, Healthy, Well served

Confident, Expedited

Patient

Physician

Scheduling | Ordering

Reporting

Peer Reviewed Research Funding

Industry Collaboration

Radiology Research

Basic Research → Applied Research →

Operations

Scheduled Workflow

Post-Processing Workflow

Reporting Workflow

Technical Billing

Expert, Efficient

Professional Billing

Residency

Medical School

RT School

MBA School

Patient

Physician

Scheduling

Ordering

Reporting

"The Hospital"

Scheduled Workflow

Post-Processing Workflow

Reporting Workflow

"Organification"

HIPAA

IRB

FDA

FDA

FDA

MQSA

Validation

New Acquisition Techniques and Technologies

New Post Processing Techniques

New Knowledge to us

Image Based Clinical Trials

Wet Science

New Knowledge to others

"The Lab"

www.radiology.northwestern.edu

Patient   Physician

Scheduling   Ordering

Reporting

"The Hospital"

H I P A A

I R B

Scheduled Workflow

Post-Processing Workflow

Reporting Workflow

"Organification"

FDA   FDA   FDA

MQSA

New Acquisition Techniques and Technologies

New Post Processing Techniques

Validation

Image Based Clinical Trials

Wet Science

New Knowledge to us

New Knowledge to others

"The Lab"

www.radiology.northwestern.edu

Trouble in Paradise (I)

- Clinical Workstations
  - Commercial workstations typically cannot be "evolved" by the end users
  - GE has not innovated the PACS workstation in several years
  - GE Advantage Windows, other specialty workstations, and PACS workstation pathways not converging (fast enough?)
  - GE is investing in other areas (EMR, etc.)
  - Market driven engineering does not work
    - Vendors (including GE) focus on sales requirements of early and late majority
      - The latter have not reached impasses that early adopters have already reached and will never ask for things that they have yet to imagine

Trouble in Paradise (II)

- Research (Workstations)
  - Imaging research perfomed in the lab on MatLab, IDL, (and vtk and itk?!)
    - Trapped forever in the lab?
  - Difficult to find, de-identify and work with large number of clinical studies
  - Difficult for clinical radiologist to find time to collaborate with their basic science peers

Our little Nirvana

- Build a (open source) workstation that meets the needs of both the clinical and research medical imaging communities

- Leverage off of existing NA-MIC / Slicer strengths in the research space

- Have a clinical / research mode switch
  - Warn of experimental use in research mode
  - De-identify in research mode

Requirements

Clinical

- IHE Reporting Workflow
- Hanging protocols
- Bread and Butter Vis.
- Bread and Butter Regis.
- Annotation and Markup
- Reporting
- QA/QC
- FDA

Research

- Advanced apps
- Advanced Vis
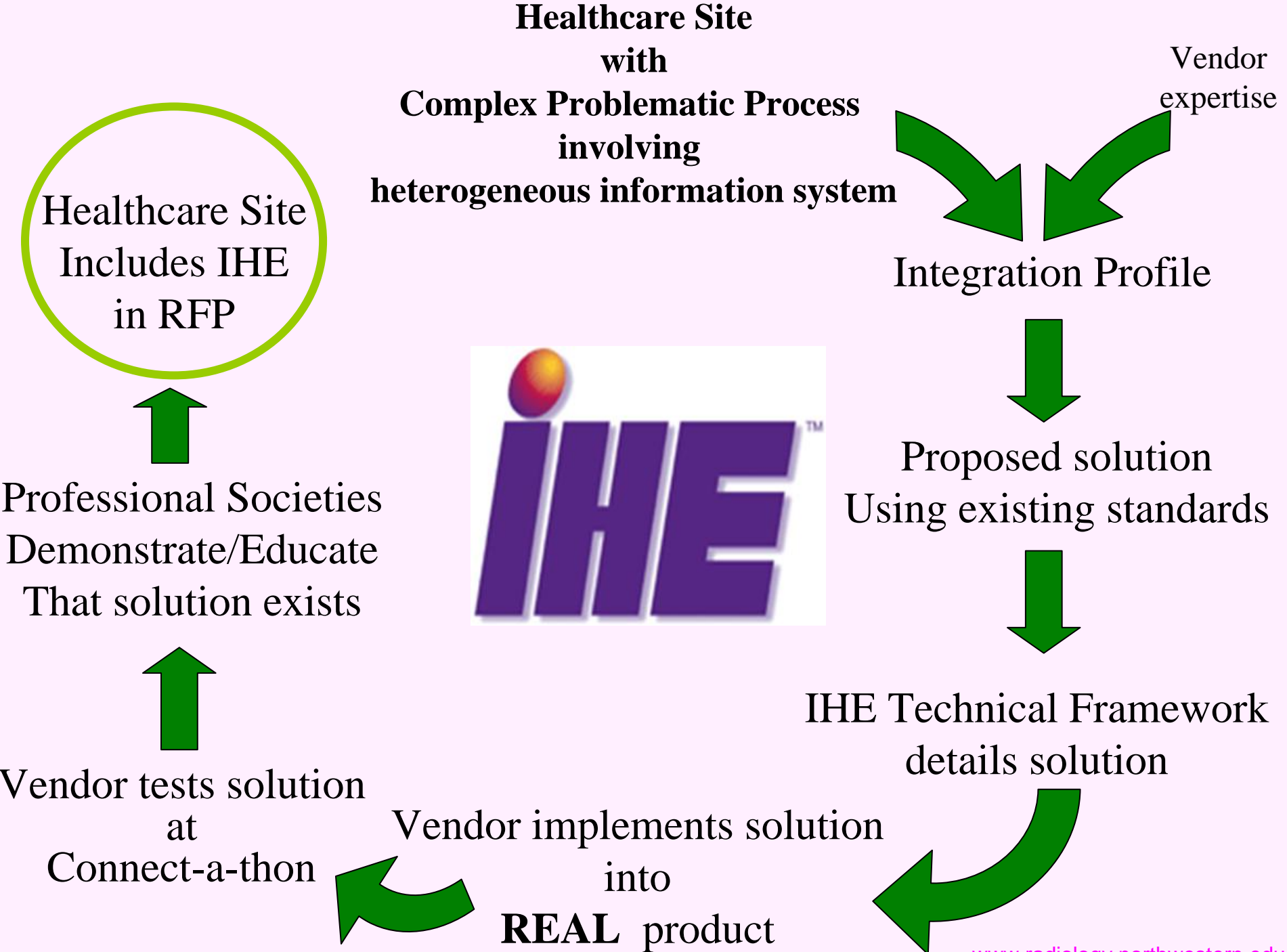- Advanced Registration
- Advanced Segmentation
- LONI pipline

Both

- DICOM WG23
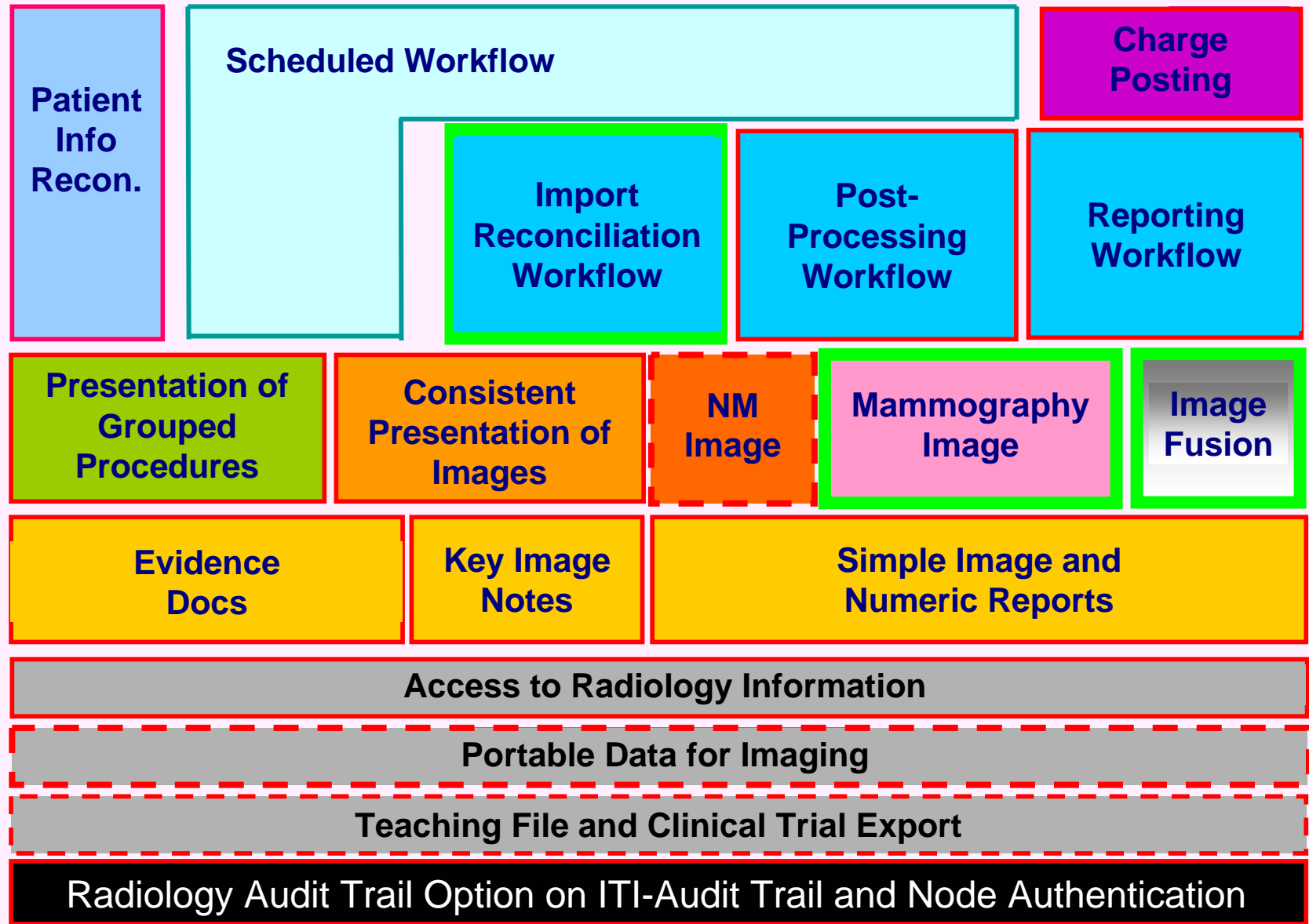- Feedback to developers
- Rapid release cycle

What is IHE?

IHE

Integrating the Healthcare Enterprise™

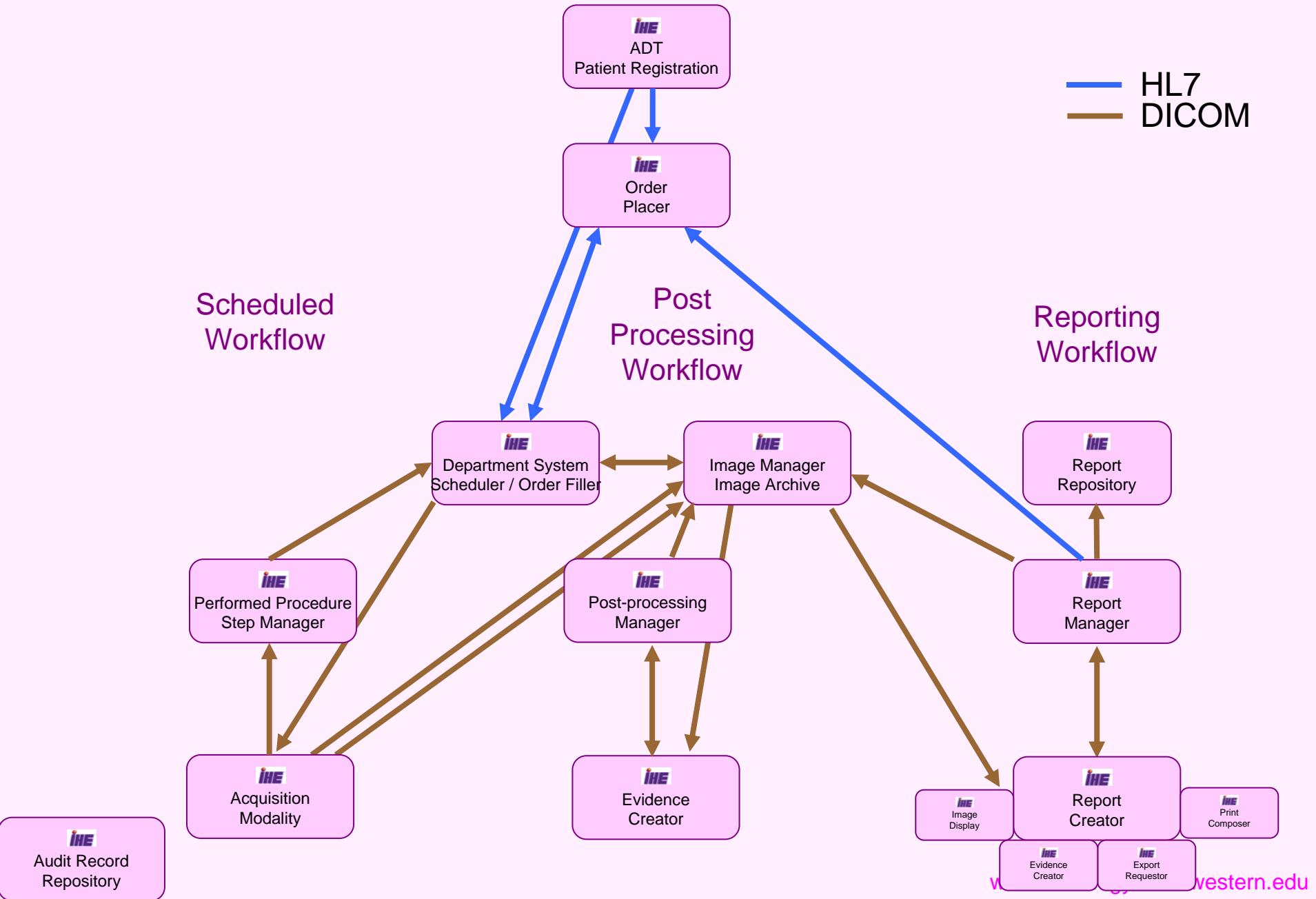"A process that drives the use of existing standards to solve complex healthcare information processes that span multiple, heterogeneous information systems."
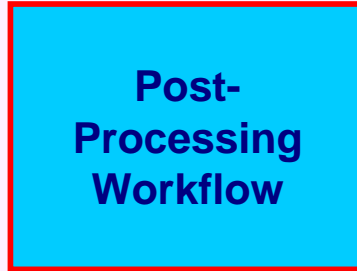
Healthcare Site
with
Complex Problematic Process
involving
heterogeneous information system

Vendor expertise

Healthcare Site
Includes IHE
in RFP

Integration Profile

Proposed solution
Using existing standards

Professional Societies
Demonstrate/Educate
That solution exists

IHE Technical Framework
details solution

Vendor tests solution
at
Connect-a-thon

Vendor implements solution
into
REAL product

IHE Radiology Integration Profiles

2006

Patient Info Recon.	Scheduled Workflow		Charge Posting
		Import Reconciliation Workflow	Post-Processing Workflow	Reporting Workflow

Presentation of Grouped Procedures	Consistent Presentation of Images	NM Image	Mammography Image	Image Fusion

Evidence Docs	Key Image Notes	Simple Image and Numeric Reports

Access to Radiology Information

Portable Data for Imaging

Teaching File and Clinical Trial Export

Radiology Audit Trail Option on ITI-Audit Trail and Node Authentication

ADT
Patient Registration

Order
Placer

HL7
DICOM

Scheduled
Workflow

Post
Processing
Workflow

Reporting
Workflow

Department System
Scheduler / Order Filler

Image Manager
Image Archive

Report
Repository

Performed Procedure
Step Manager

Post-processing
Manager

Report
Manager

Acquisition
Modality

Evidence
Creator

Image
Display

Report
Creator

Print
Composer

Audit Record
Repository

Evidence
Creator

Export
Requestor

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IHE

Patient Info Recon.

Scheduled Workflow

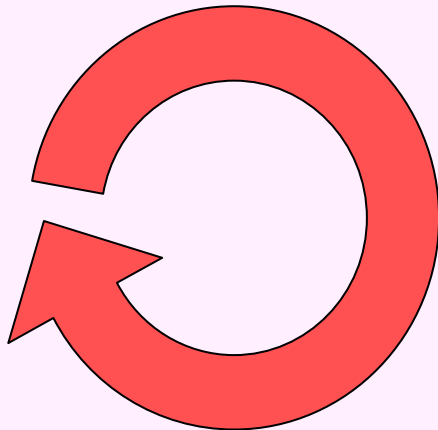**Post-Processing Workflow**

Reporting Workflow

Modality Worklist

Post Processing Worklist

Reporting Worklist
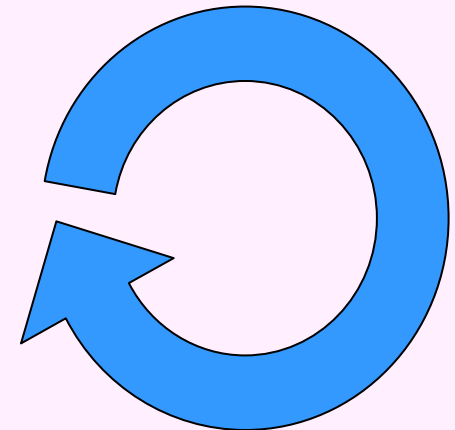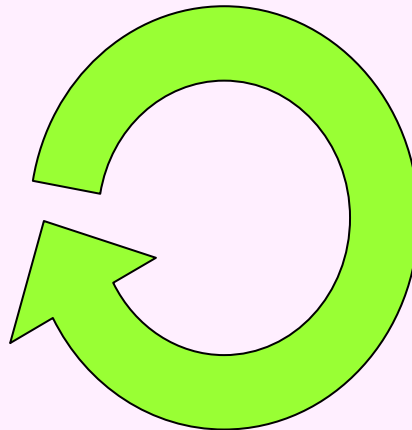
Modality

CAD / 3D

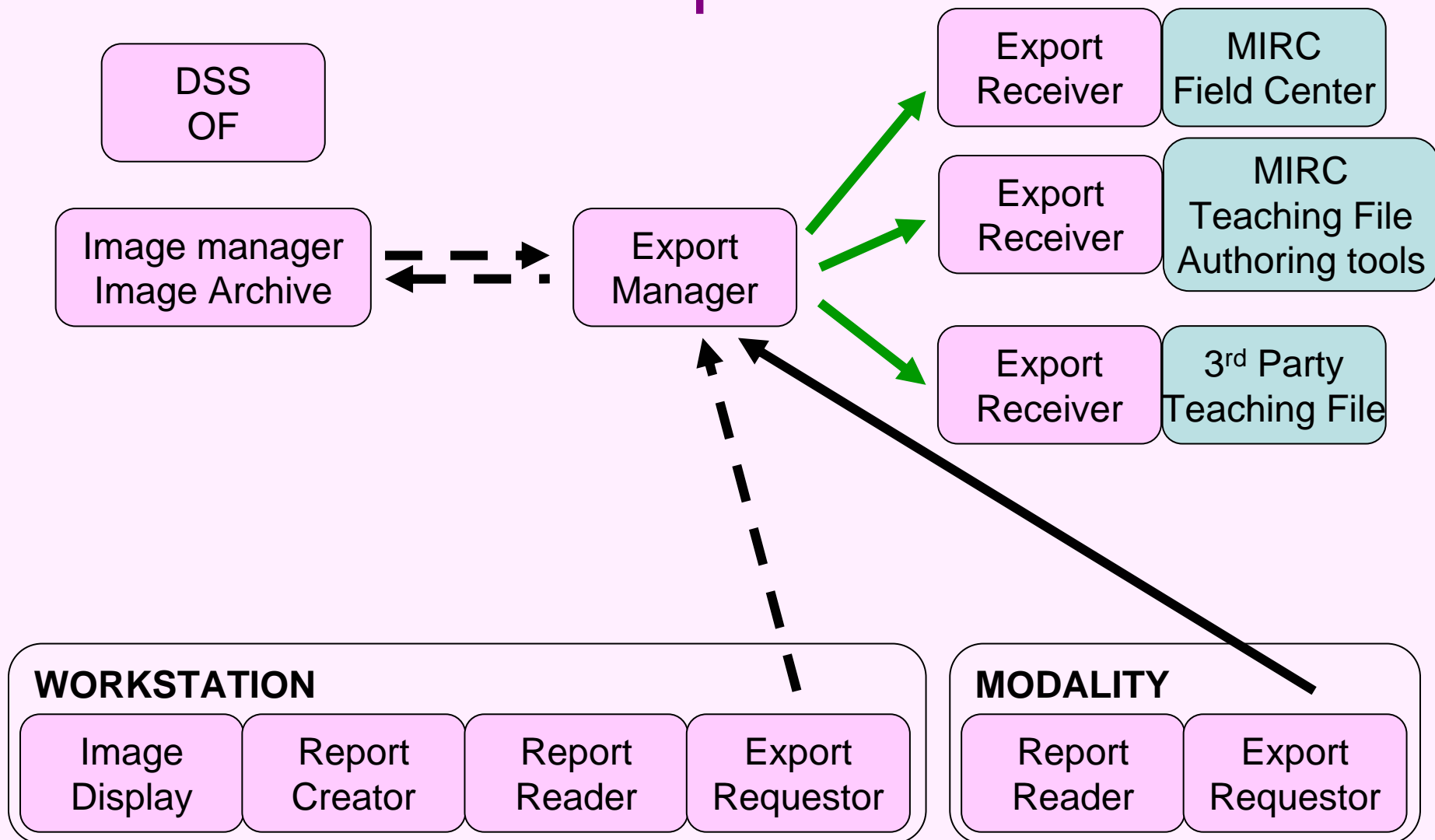Diagnostic Workstation

Commonalities

- Make a worklist
- Query for the worklist
- Claim a workitem
- Tell when you start
- Tell when you finish
- Store (and commit) your results
- Tell what you did
- Automatic handoffs – no fumbles

Reporting

- **IHE Reporting Workflow SETS YOU FREE**
  - *Exposes worklist driven workflow*
- 5 ways to report: N, SR, MadLibs, VR, HT, SYB
- DICOM S/R provides the object architecture
  - Integrate "evidence documents" such as CAD and measurements
- Must be able to deliver HL7 v2 ASCII rendition
- Need to freely convert to/from HL7 CDA (xml)
- Need standard lexicons (BIRADS, RadLex)
- Need library of standard radiology report templates (CDA)
- Need "advanced" communication options

IHE Teaching File and Clinical Trial Export

DSS OF

Image manager
Image Archive

Export Manager

Export Receiver — MIRC Field Center

Export Receiver — MIRC Teaching File Authoring tools

Export Receiver — 3rd Party Teaching File

WORKSTATION

Image Display | Report Creator | Report Reader | Export Requestor

MODALITY

Report Reader | Export Requestor

TRIP™

Transforming

the

Radiologic Interpretation Process

Improve the QUALITY and QUANTITY of
work performed by radiologist in digital environment

Other interesting things

- Change the way radiologists work; *reduce variance*
- Affects all of CREAM
- Improve delivery of radiologist value add to referring physician
- Software instrumented to document and feedback Δ in Q and Q to radiologist
- UI
- Navigation
- Auditing / Logging

- Integration of all modalities
  - Image
  - 2D, 3D postprocessing
  - CAD
  - Sound, sonification, audification
- Work management
- Time management
- Interruption management
- Communication management

Hanging Protocols

- Must be **DICOM** Part 60 compliant

- Must support all (17?!) **DICOM** Image Objects

- Must be very robust

- Must be configurable based on procedure code, etc., etc.

Bread and Butter Vis, Reg, Seg

- 3D MIP, MPR, surface render, etc. built into routine viewing (of appropriate data sets)

- Simultaneous rendering of single frame of reference stack

- Facile routine operations

- IHE Image Fusion
  - Deformable Spatial Registration Object
    - DICOM Supplement 112
  - Color Softcopy Presentation State Object
    - DICOM Supplement 100

Annotation and Markup

- caBIG Imaging Workspace developing SIAM
  - Standard for Image Annotation and Markup
  - DICOM S/R versus/compatible with XML and Grid Services
  - Semantic interoperability of annotations
- DICOM Key Image Notes for clinical use

QA / QC

- Technical quality of images
  - Feedback to technical staff
- Report discrepancies
  - Peer review

DICOM WG 23: Application Hosting

- "Plug-ins" for clinical diagnostic workstations
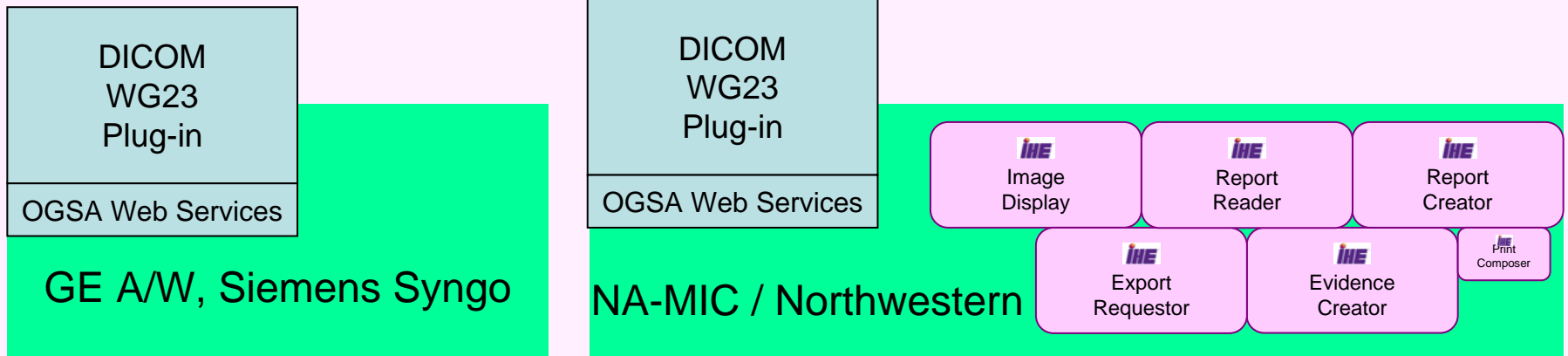
My Super Algorithm / Functionality

OR

VTK
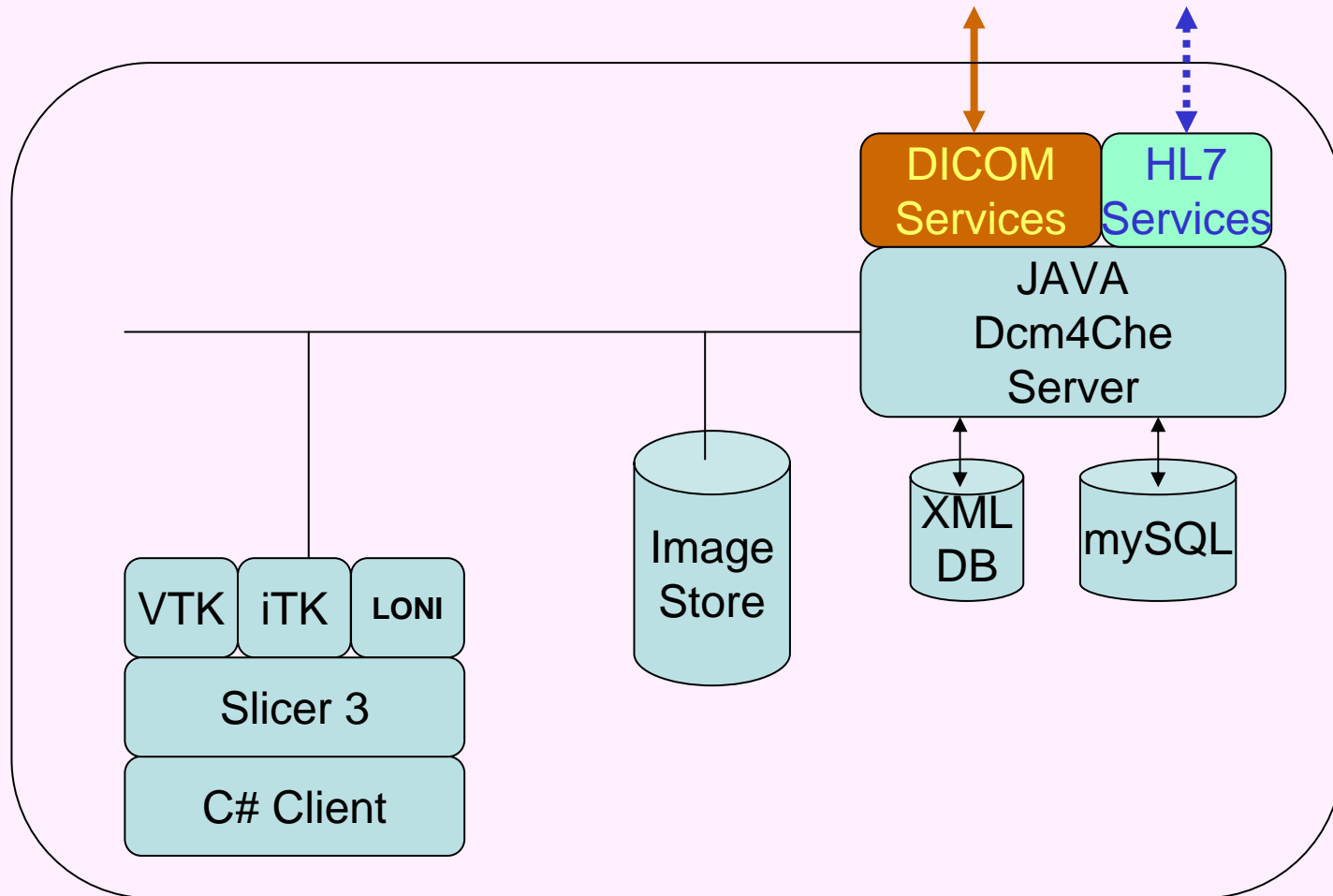
iTK

otherTK

DICOM
WG23
Plug-in

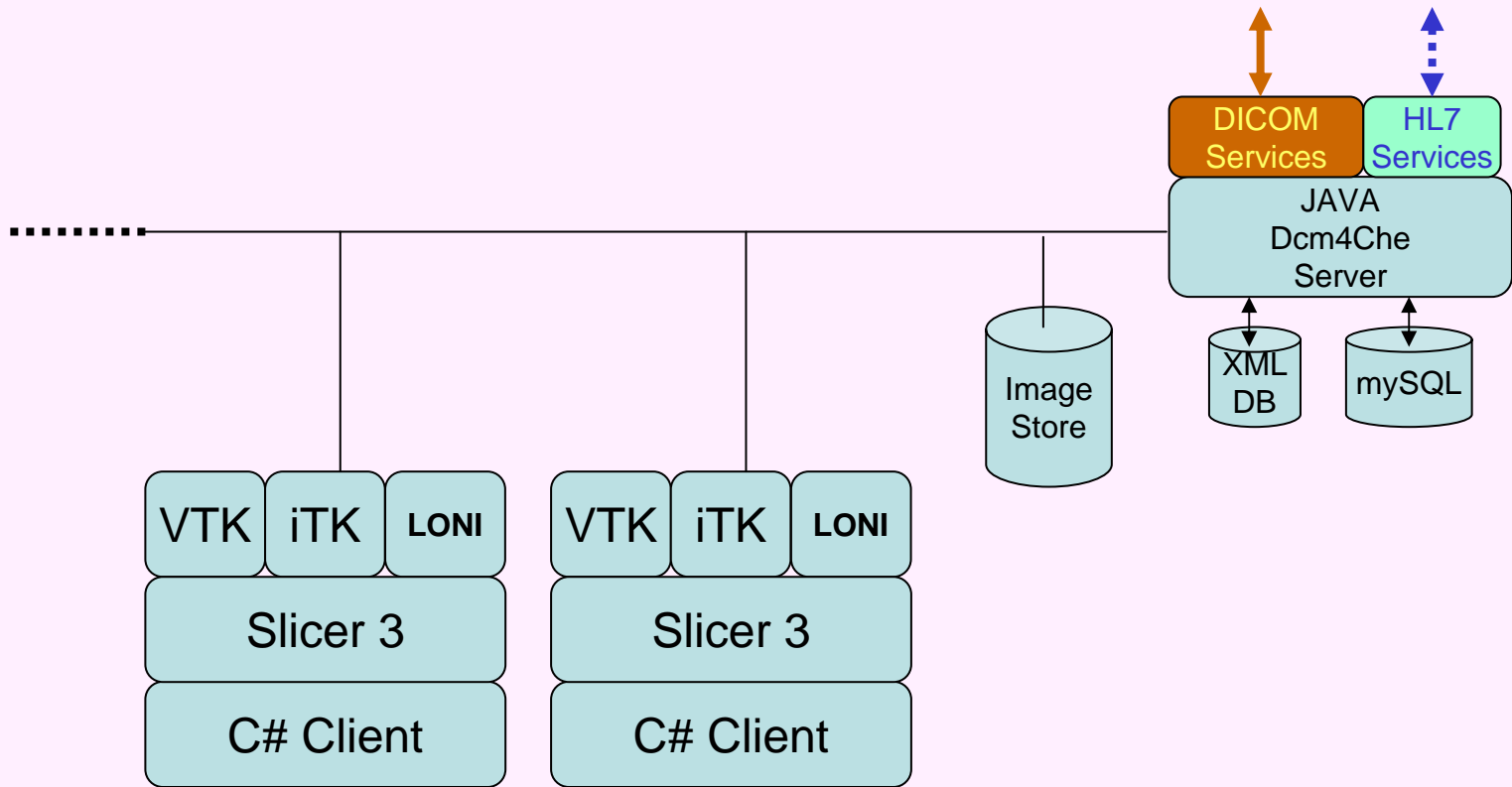OGSA Web Services

GE A/W, Siemens Syngo

OGSA Web Services

NA-MIC / Northwestern

IHE
Image
Display

IHE
Report
Reader

IHE
Report
Creator

IHE
Export
Requestor

IHE
Evidence
Creator

IHE
Print
Composer

What does NA-MIC Northwestern look like?

Why?

A "Translation Station" for Radiology

- Clinical efficiency for the radiologist
- Development platform for radiology research
- Evaluation and validation of new functionality
- Facile collaboration between clinicians and researchers
- Rapid iteration cycle

Next Steps

- Northwestern team to attend Project Week with intent to understand Slicer 3 architecture and integration points.

- Awaiting funding decision on collaboration from NIH