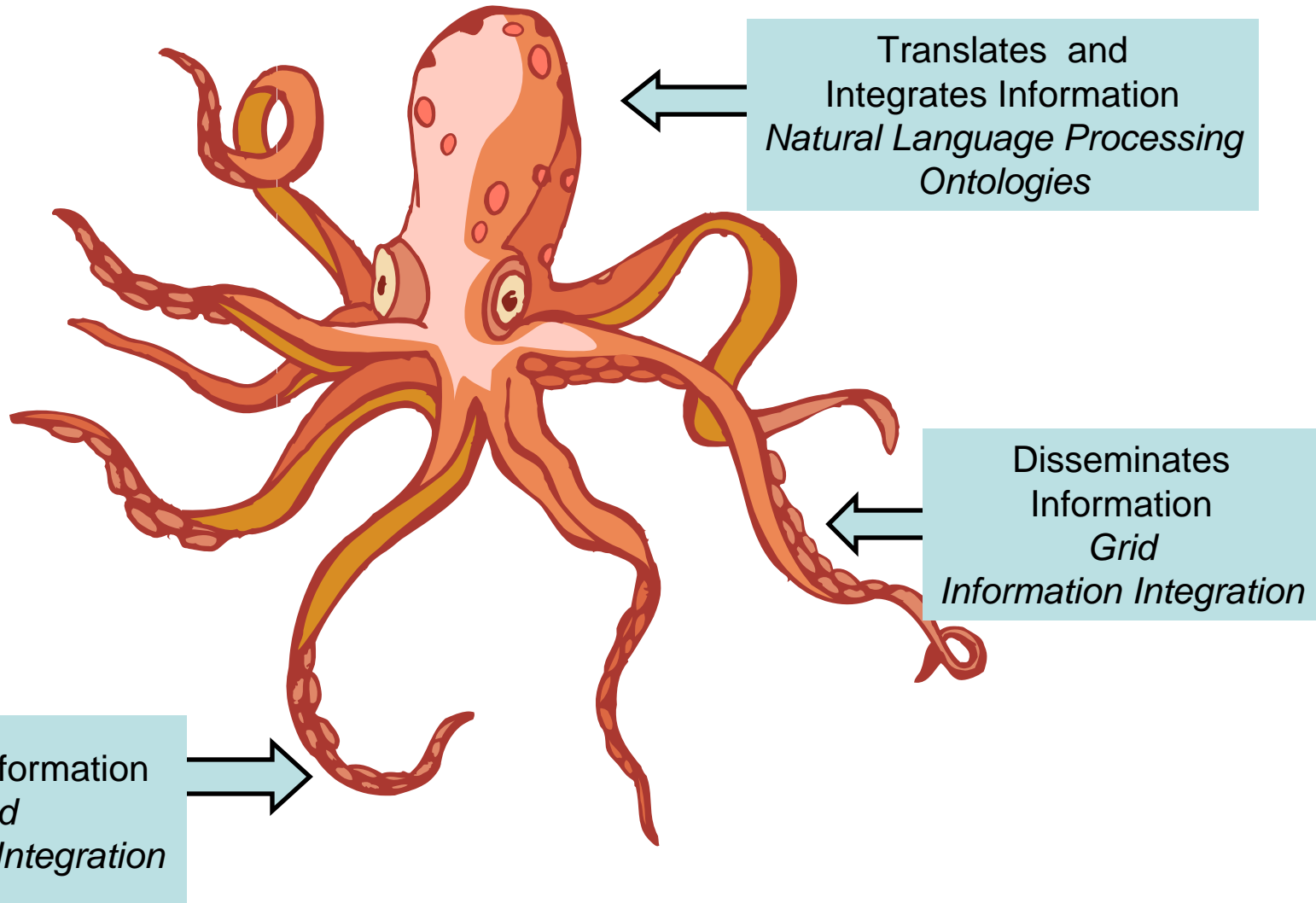




Image Based Cooperative Groups and caBIG Imaging

Joel Saltz, MD, PhD
Department of Biomedical Informatics
Ohio State University Medical Center, Columbus, OH

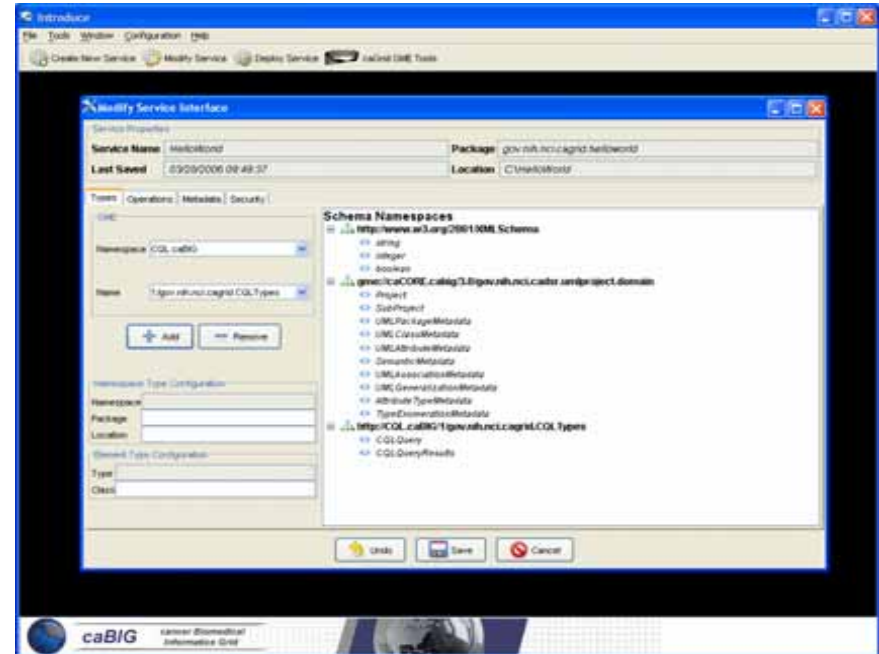
Biomedical Informatics and Middleware



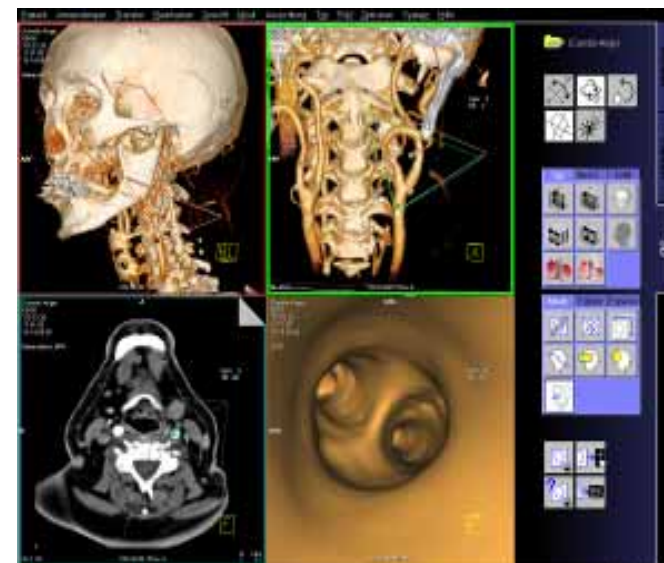
caGrid: Core and IVI Middleware Extensions

- caGrid Components
 - Language (metadata, ontologies)
 - Security (GAARDS)
 - Advertisement and Discovery
 - Workflow
 - Grid Service Graphical Development Toolkit (Introduce)
 - Efficient Bulk Data Transport (IVI middleware)
 - DICOM compatability (IVI middleware)

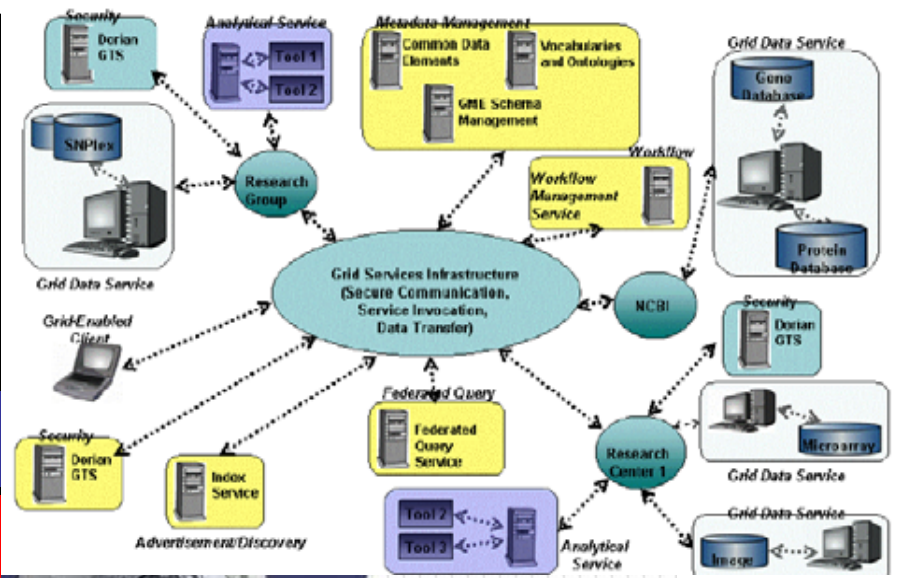
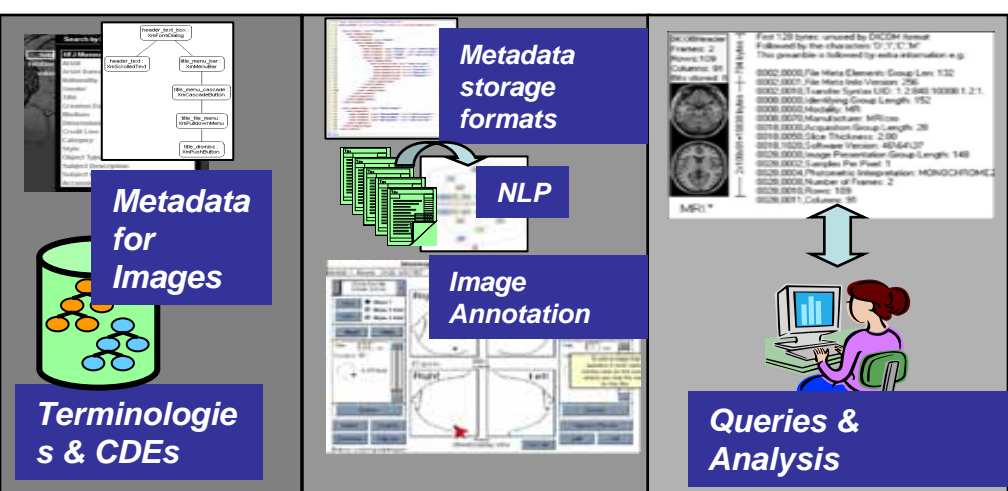
- Production caGrid software released Dec 2006



caBIG™ In Vivo Imaging Workspace



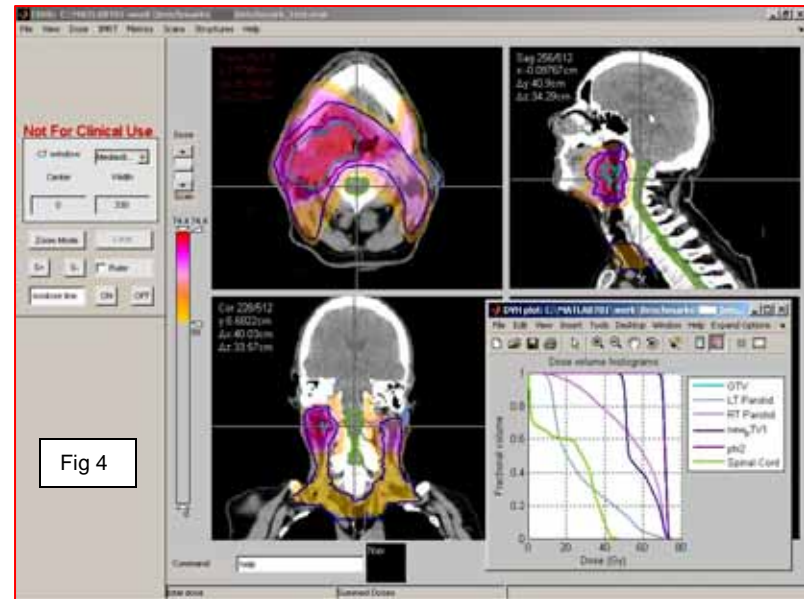
- Project 1: Middleware
- Project 2: XIP: Extensible Imaging Platform
- Project 3: AIM: Annotation and Image Markup
- Project 4: Vocabulary



Vocabularies & CDEs **Data Capture Formats & Tools** **Data Re-Use Applications**

caBIG In vivo Imaging Testbed Collaborations with Cooperative Groups

- QARC,ATC, RTOG, Children's Oncology Group – Central review, query, cooperative radiation treatment planning, high end computing for radiation treatment planning calculations, server side rendering of very large images/datasets, integrated access to Radiology, Pathology data
- CALGB – Central Review and grid based PET/CT analysis, group based read/write/edit access to data, integrated access to Radiology and Pathology data
- ACRIN – Distributed access, query, group based read access to data



In Vivo Imaging Middleware (IVIM)

- Create the core infrastructure for Grid enabling imaging applications
- Services, tools and APIs
 - DICOM–Grid interoperability
 - High-performance data transfer
 - Creation and deployment tools for imaging-based grid services
- Layered on the caGrid toolkit



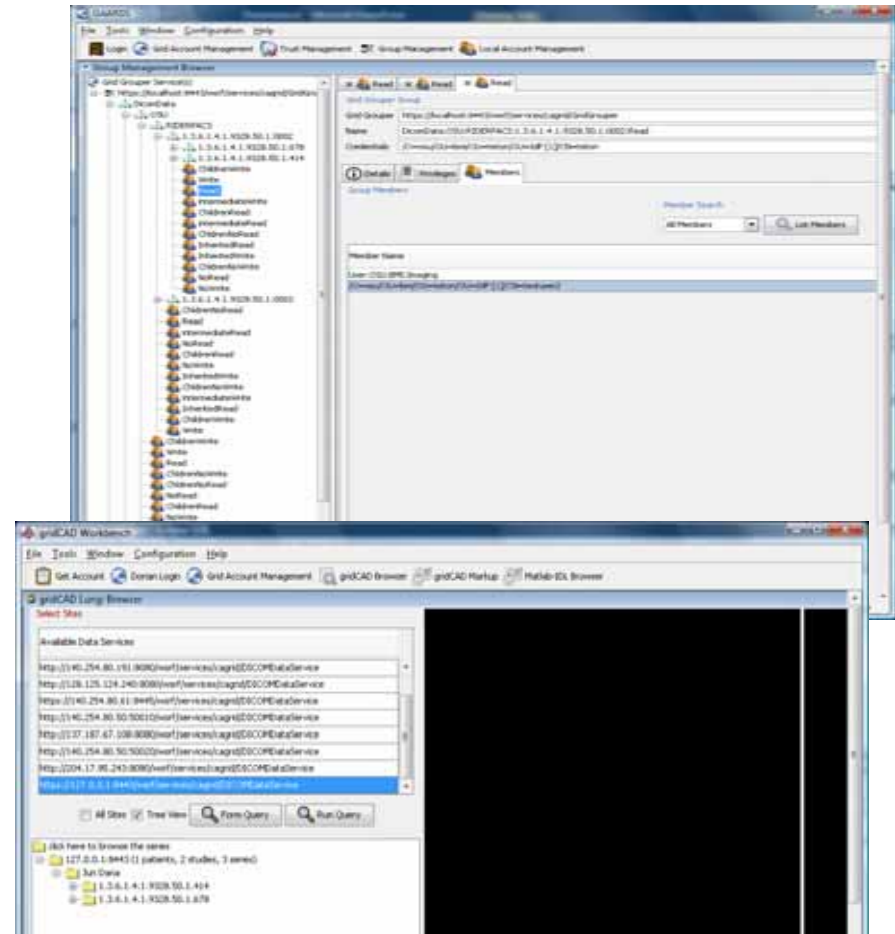
IVIM Core Capabilities

- DICOM Data Service
 - Provides a two way interface between caGrid and DICOM entities
 - Supports DICOM *C_FIND*, *C_GET*, *C_MOVE*, and *C_STORE* commands
 - Bulk Data Transport enabled
- VirtualPACS
 - Provide DICOM messaging interface to caGrid DICOM data services
 - Federate multiple grid services
- Generic Image Data Service
 - Provides a two-way interface between caGrid and images on a file system
 - Can be extended to use a database that contains image metadata
 - Bulk Data Transport enabled
- Bulk Data Transport
 - GridFTP is the grid service used for transfer of data
 - Supports image retrieval and submission
 - Data generated dynamically based on grid service requests



IVIM Data Instance Level Authorization

- Data service may expose data for multiple clinical trials and research studies
 - Need to restrict access to individual datasets
- Fine-grain authorization for data access
 - Based on the user's **identity and roles** in trials and studies
 - Data services determines access restrictions using authorization information managed in GAARDS GridGrouper
- Authorization for gridFTP data transfer
 - gridFTP is out of band, with its own security mechanism
 - Security harmonization between gridFTP server and caGrid GAARDS uses **requester-only** policy, based on the identity of user who originally requested the data from the grid service
 - **Leverage caGrid GAARDS and HTTPS for encryption, authentication, and coarse-grain user authorization**



IVIM Ancillary Components

- Generic Image Data Service
 - Provides a grid interface to image repositories, supporting high performance query, retrieve, and store operations
 - Capable of managing spatio-temporal, multi-channel, multi-resolution images with large number of regions and components
 - Not specific to image formats
- Dynamic Service Deployment
 - On-demand deployment of services on remote grid nodes
 - Avoids transmission of large datasets or sensitive data
- SDK
 - Extensions to Introduce that allow a user to create, modify and deploy DICOM-aware grid services
- IVIWizard
 - Provides a deployment wizard that allows researchers and PACS administrators to configure DICOM Data Service to provide grid access to their PACS

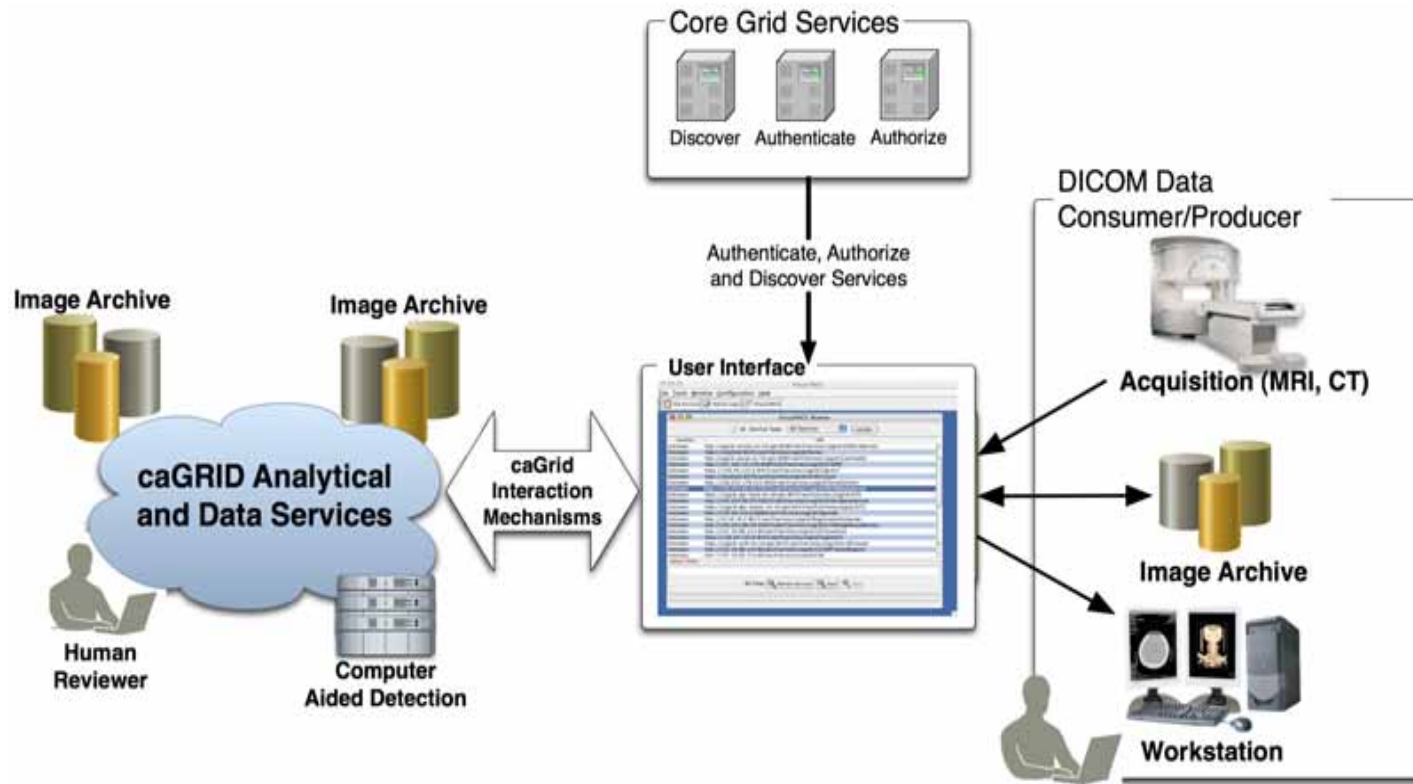


System Architecture - Virtual PACS

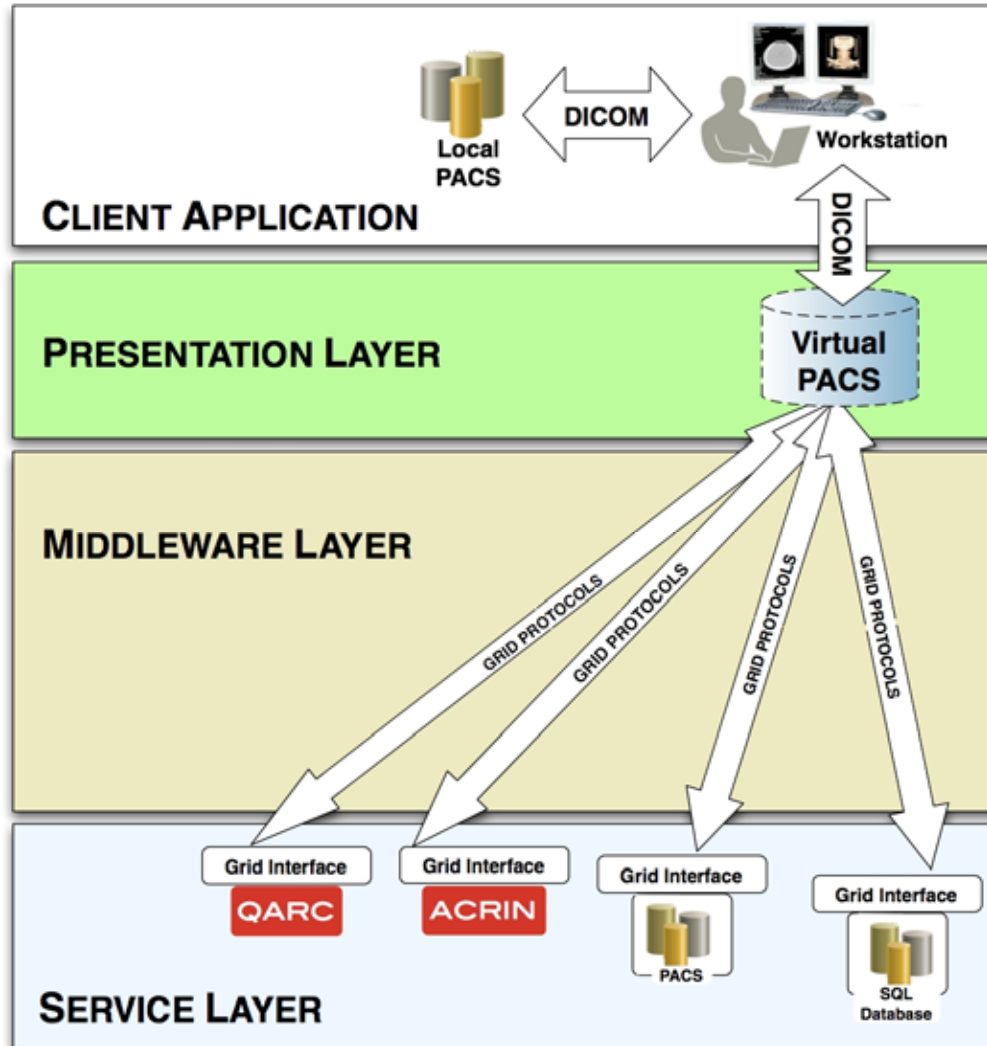
Present a PACS interface to analytical and data sources on the grid.

Use your own DICOM Workstation

Virtual PACS federates services on the Grid using caGrid



Three Tier Virtual PACS Design



Use the VirtualPACS client to:

- Login to obtain grid credentials
- Discover DICOM Services advertised on caBIG
- Select all or a subset of discovered DICOM services
- Start a VirtualPACS which federates selected services and allows interaction from a DICOM Review Workstation



File Tools Window Configuration Help

Get Account Dorian Login Virtual PACS

1. Click to launch the services browser

VirtualPACS: Browser

all Service Type: DICOMDataService Locate

Location	URL
Unknown	http://140.254.80.50:50010/wsrf/services/cagrid/DICOMDataService
Unknown	http://140.254.80.50:50020/wsrf/services/cagrid/DICOMDataService

2. Services queried from caGrid Index Service and discovered services appear here

Select Sites

All Sites Refresh Services Start Stop

3. Click to start a VirtualPACS for selected DICOMDataServices

cal
er



Use a Commercial DICOM Review Workstation to download images from remote DICOM grid services via the VirtualPACS

Screenshots of Osirix a freely available DICOM Review Workstation

1. Create and execute a DICOM Query

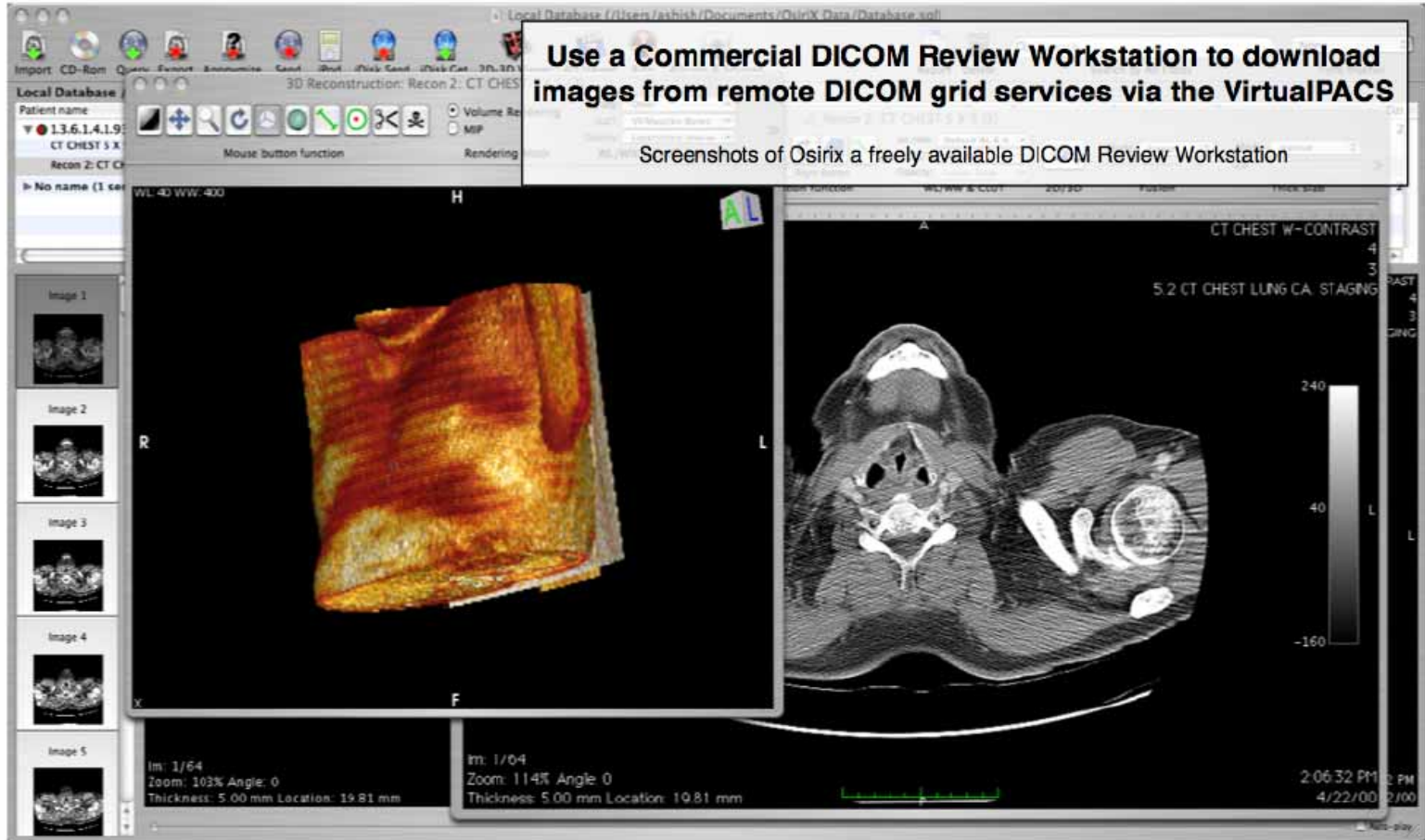
2. Query results will appear here

Patient Name	Patient ID	Description	Modality	# of Images
	1.3.6.1.4.1.9328.50.1.0002	CT CHEST W/ CONTRAST		0
	1.3.6.1.4.1.9328.50.1.0002	CT CHEST W/ CONTRAST		0
2		CT CHEST 5 X 5	CT	0
3		Recor 2: CT CHEST 5 X 5	CT	0
	1.3.6.1.4.1.9328.50.1.0002	CT CHEST W/ CONTRAST		0
	1.3.6.1.4.1.9328.50.1.0002	CT CHEST W/ CONTRAST		0
	1.3.6.1.4.1.9328.50.1.0002	CT CHEST W/ CONTRAST		0
	1.3.6.1.4.1.9328.50.1.0003	CT CHEST W/ CONTRAST		0
	1.3.6.1.4.1.9328.50.1.0003	CT CHEST W/ CONTRAST		0
	1.3.6.1.4.1.9328.50.1.0003	CT CHEST W/ CONTRAST		0
	1.3.6.1.4.1.9328.50.1.0003	CT CHEST W/ CONTRAST		0
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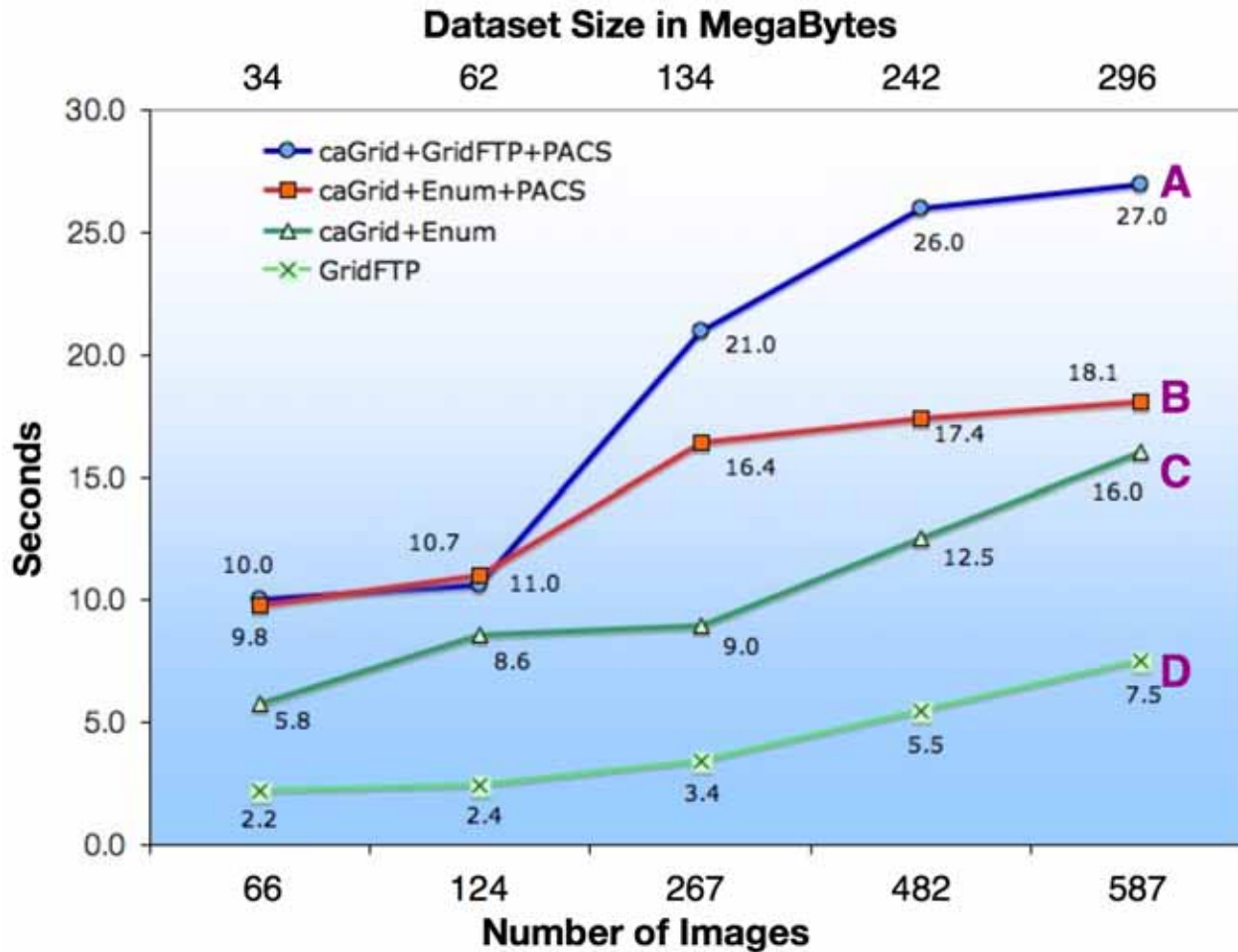
Im: 1/1
Zoom: 103% Angle: 0
Thickness: 3.00 mm Location: 184.10 mm

10:54:27 AM
1/12/06





Virtual PACS Performance



gridIMAGE

Application background

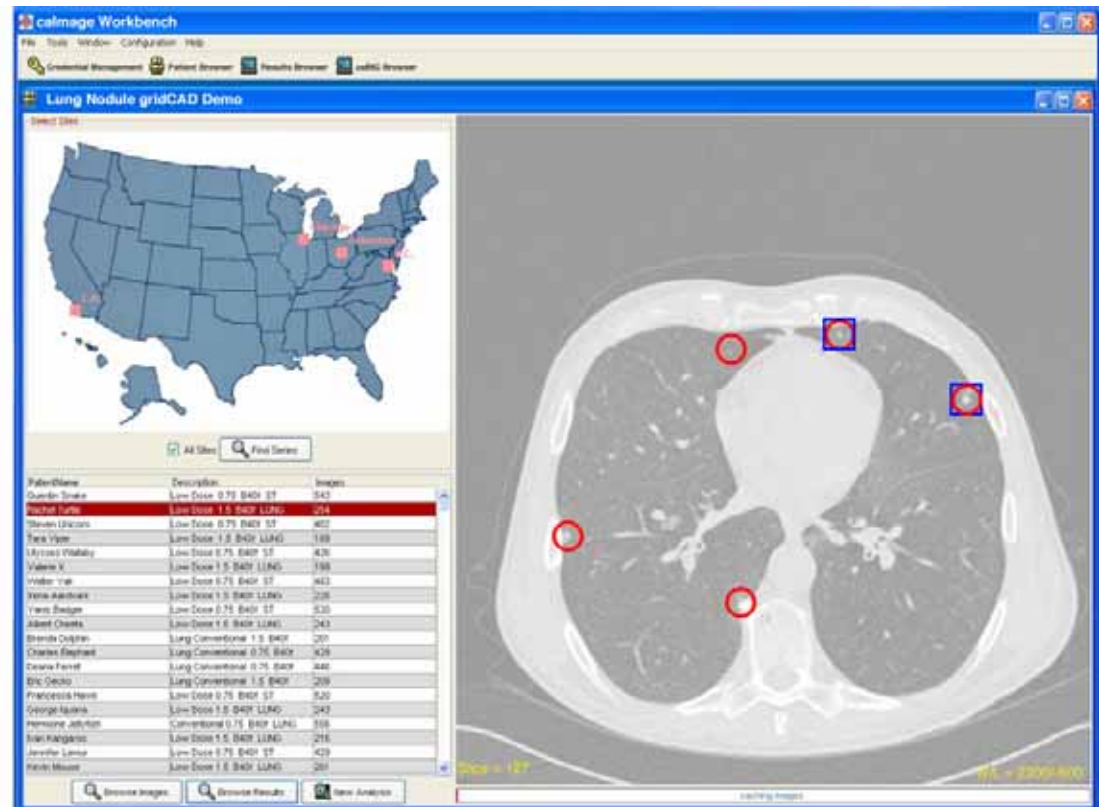
- A grid-based application that enables distributed access and review of DICOM images
- Supports cross-institute, geographically distributed research collaborations and clinical decision support
 - Multiple human reviewers
 - Multiple data repositories with large number of subjects
 - Distributed compute and storage systems
 - Multiple CAD and research algorithms
 - Grid services constructed using proprietary CAD algorithms, Matlab, IDL
- Enable parameter studies and clinical and preclinical trials
- Facilitate algorithm development and validation through the use of many distributed, shared image datasets
- XIP based implementation planned



gridIMAGE

Application screenshot

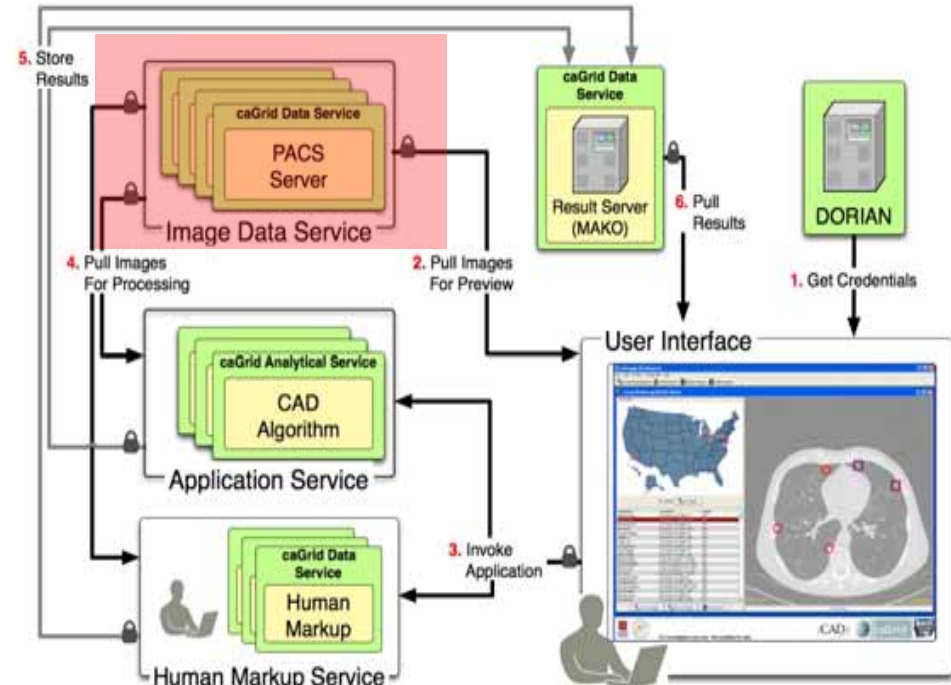
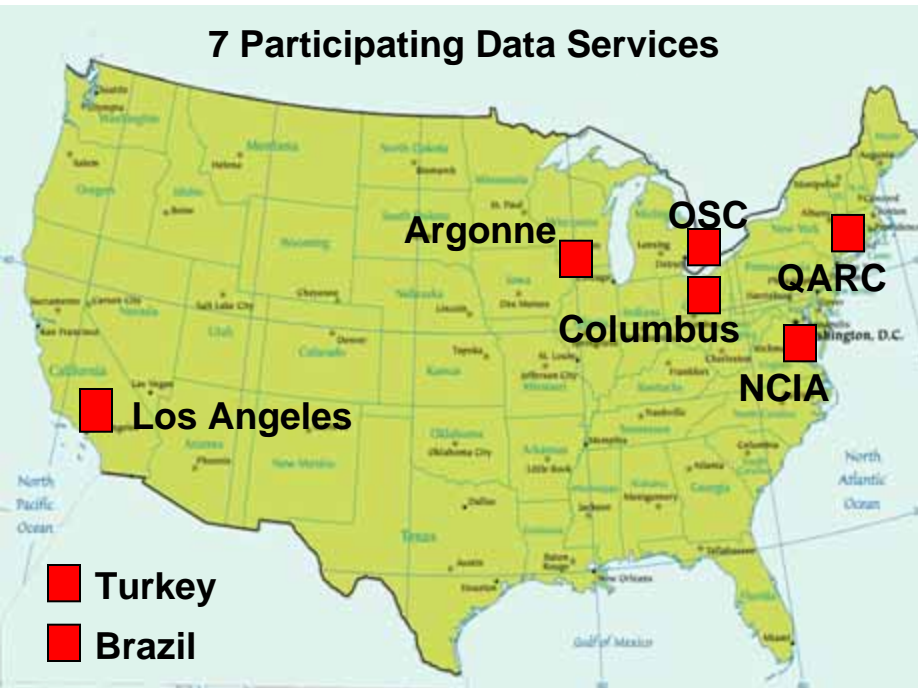
- Discover and select DICOM image data sources
- Query for datasets
- Submit orders for CAD analysis or human review of datasets
- Query for existing orders
- Retrieve images for human review and markup
- Submit markups to results service
- Retrieve markups and display, overlaid on original image



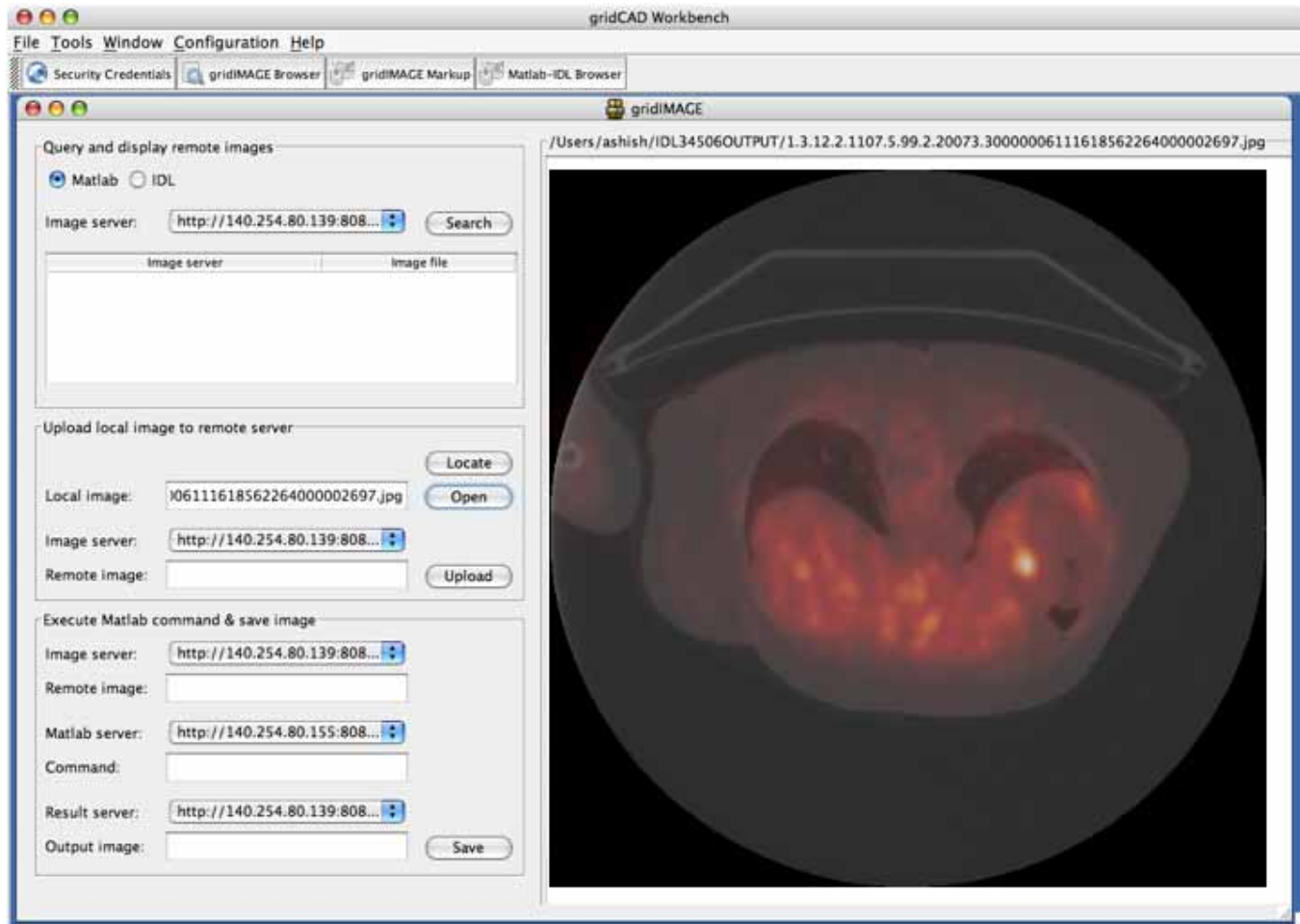
Central Review/CAD Demonstration Project (joint with U Maryland)

- Expose data in PACS servers as caGrid Data Service
- Open source DICOM server — PixelMed
- GridFTP based data transfer
- Participating sites include: Columbus, Chicago, LA, NCI-Washington DC, QARC Providence, Brazil and Turkey

7 Participating Data Services



GridIMAGE Support for CALGB Imaging Core (Michael Knopp MD): Central Review; IDL CT/PET Analysis



caGrid Enabled CERR Client

- From Jim Purdy's slide:
 - Volumetric CT images, target volume organ at risk contours, treatment plans, 3D dose distributions submitted by study participants converted to Matlab
 - CERR datasets are then used for protocol compliance review
 - Facilitate distributed review of CERR datasets, secure grid based infrastructure used for distribution of datasets and collection of reports
- MATLAB client caGrid interface done; ongoing work with Walter Bosch to develop caGrid enabled CERR client



Closing Issues

- How will we scale curation process to permit widespread interoperability?
- Semantic and structural interoperability with other grids (CTSA, CVRG, BIRN, eScience etc)
- Interoperability with medium and high end data and computing resources
- Grid Governance



Golden Spike – Transcontinental Railroad

