RCET Report

January, 20, 2005

RCET Team

Providing an infrastructure for quality assurance and data management in radiation therapy clinical trials

Physicists

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(Informatics Expert: 0.1 FTE)

RCET Modules

RCET INFRASTRUCTURE

Database

Server

SOAN

WebSys

- RTOG Data
- DICOM-RT Objects
- DICOM Network services
- Rapid Review

NetSys

- Fast DRR
- Dose matrix algebra
- 2D and 3D visualization
- 2D and 3D Contour and ROI
- 2D, 3D segmentation Image processing
- Brachytherapy Modules

Data Mining

- Image Feature based Data Mining
- Context based Data Mining

Image Transmission and Storage

- Wavelet Transforms

RCET Activities

ATC directed:

- Testing and “bug” fixes of **ATC Method 2** (In progress)
- Installation and testing of **ATC Method 3** at NCIC (In progress)
- Draft guidelines for the use of IMRT in clinical trials (submitted 12/04)

Other areas:

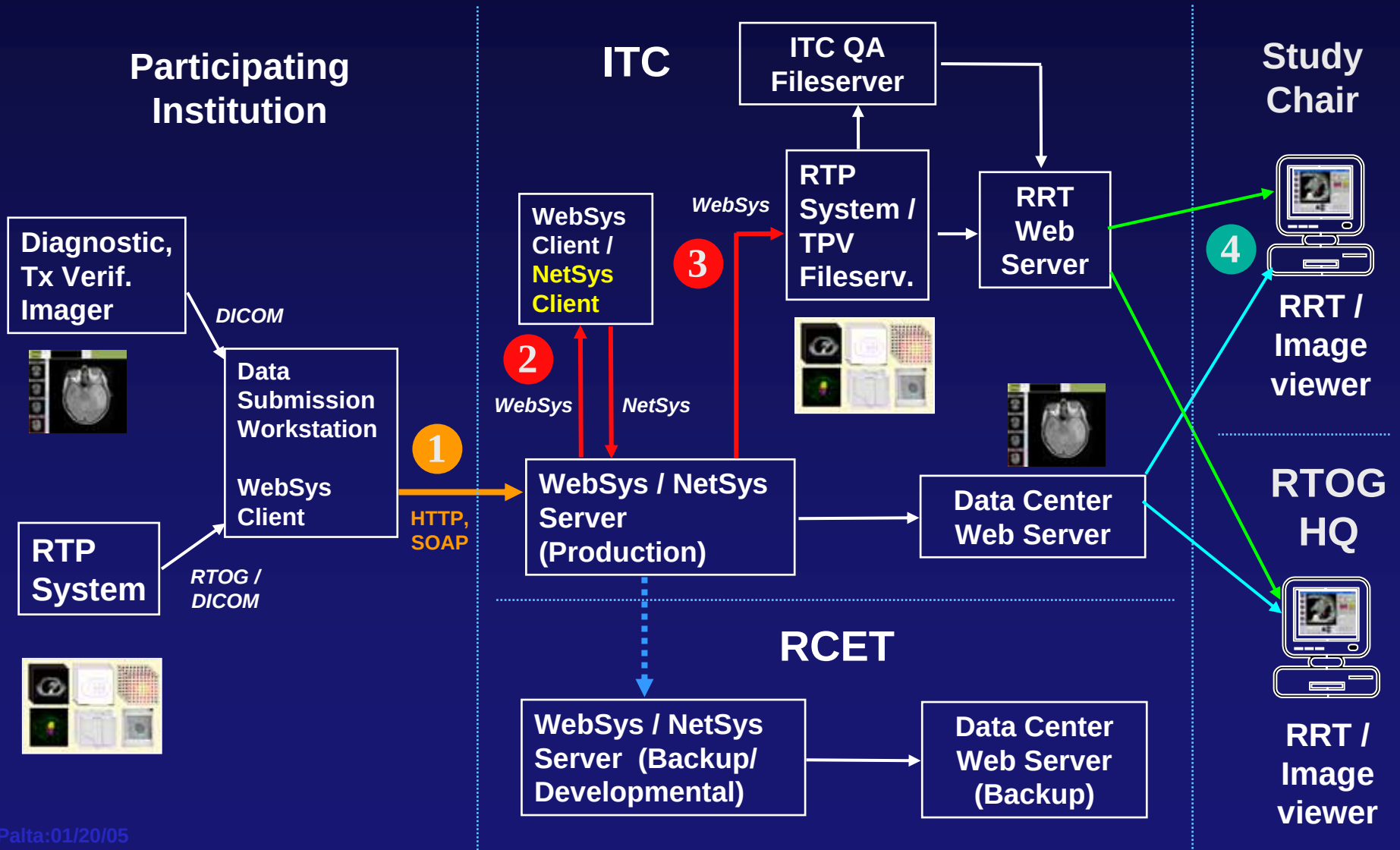
- Integrating the Healthcare Enterprise in Radiation Oncology (IHE-RO)
  - An ASTRO initiative
    - Seamless connectivity in Radiation Therapy
- NCI Cancer Experts Corps
  - Provide an infrastructure for remote peer-review
    - Web-based services (WebSys enabled rapid review)

RCET Activities

RCET research and development:

- Development of data mining algorithm (image feature and context based)
- Advanced algorithms for imaging data transmission and storage (Wavelet transforms)
- New modules for NetSys
  - Fast DRR
  - Dose matrix algebra
  - 2D and 3D visualization
  - 2D and 3D contours and ROI
  - Image segmentation and image processing
  - LDR Intracavitary Brachytherapy

ATC Method 2 (WebSys Services)



ATC Method 2 (Current Status)

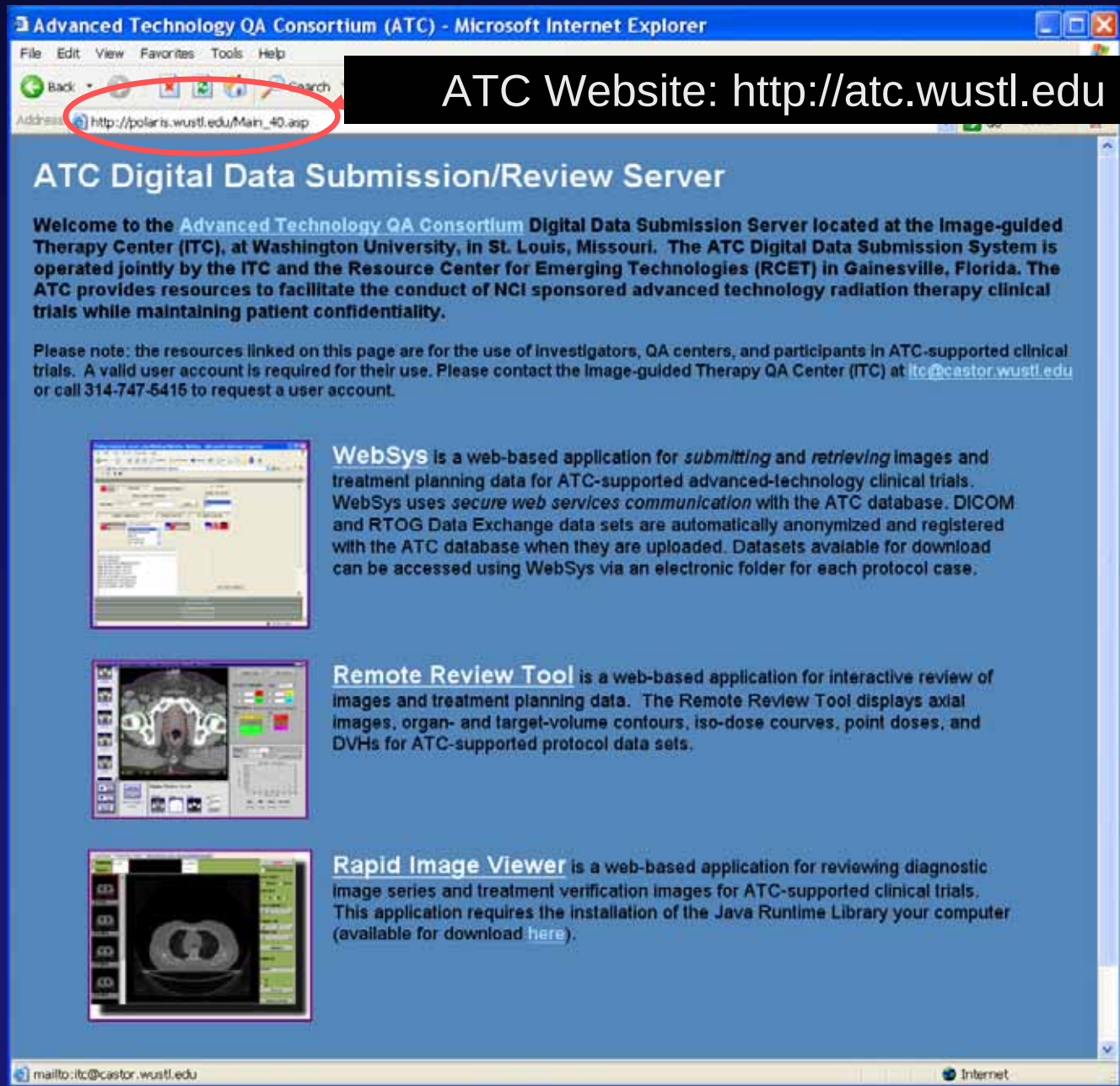
For Elekta (Precise Plan), CMS (Focus and XIO), MDS Nordion, Philips (Pinnacle), and Varian (Eclipse), ATC Method 2 can accomplish the following:

- Data (DICOM and RTOG) submission using a secure networking mechanism, which is conformant with HIPPA requirements.
- All data submitted through ATC Method 2 is auto-registered with a central database.
- Electronic folder reports all accepted modalities with a summary for the dataset.
- Submitted data are immediately available for retrieval using electronic folder.
- For diagnostic DICOM datasets, images are available immediately for rapid-review via the Rapid-Review applet.

ATC Digital Data Submission Server

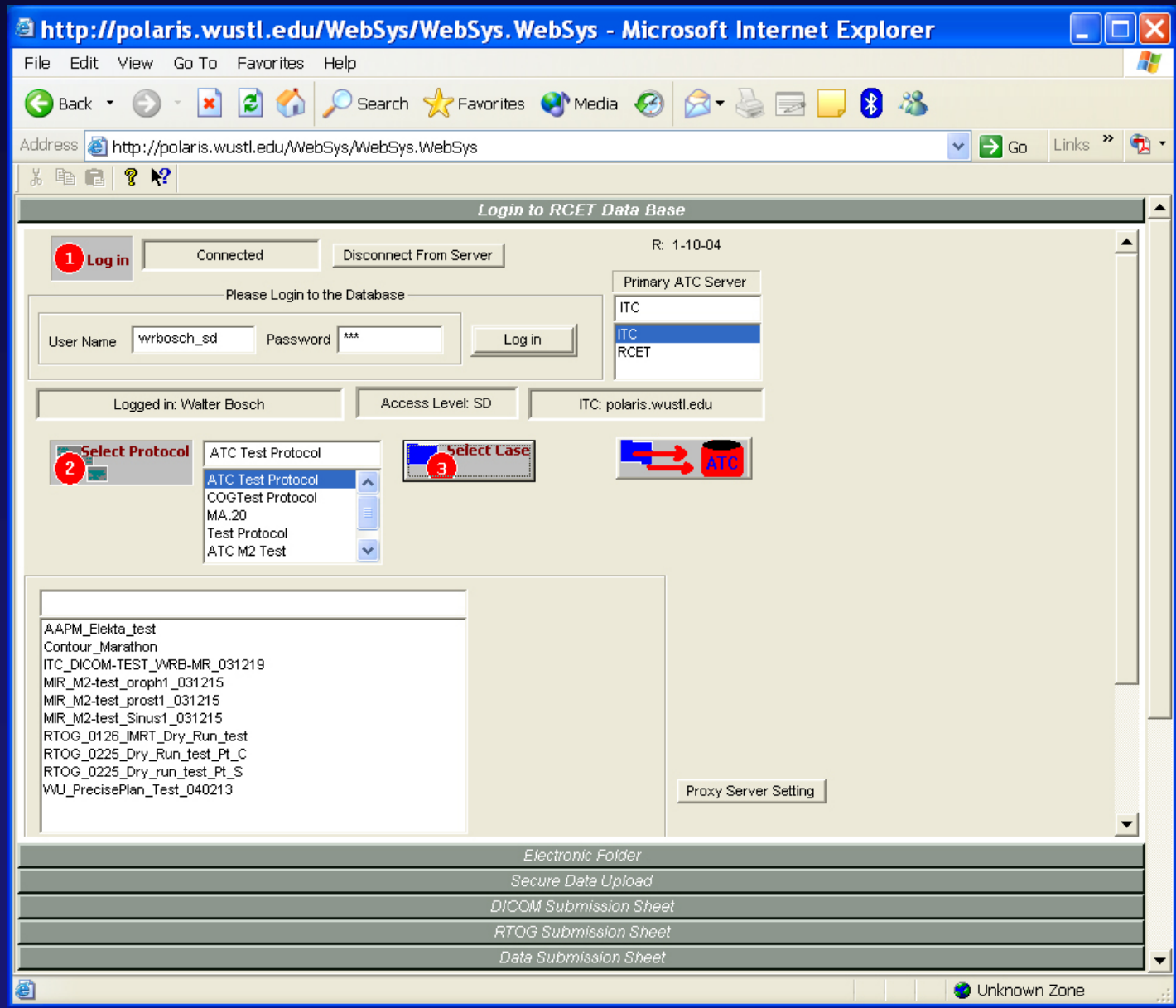
Provides links to

- WebSys – secure upload/download
- RRT – image segmentation and dosimetry review
- Rapid Image Viewer – diagnostic image display



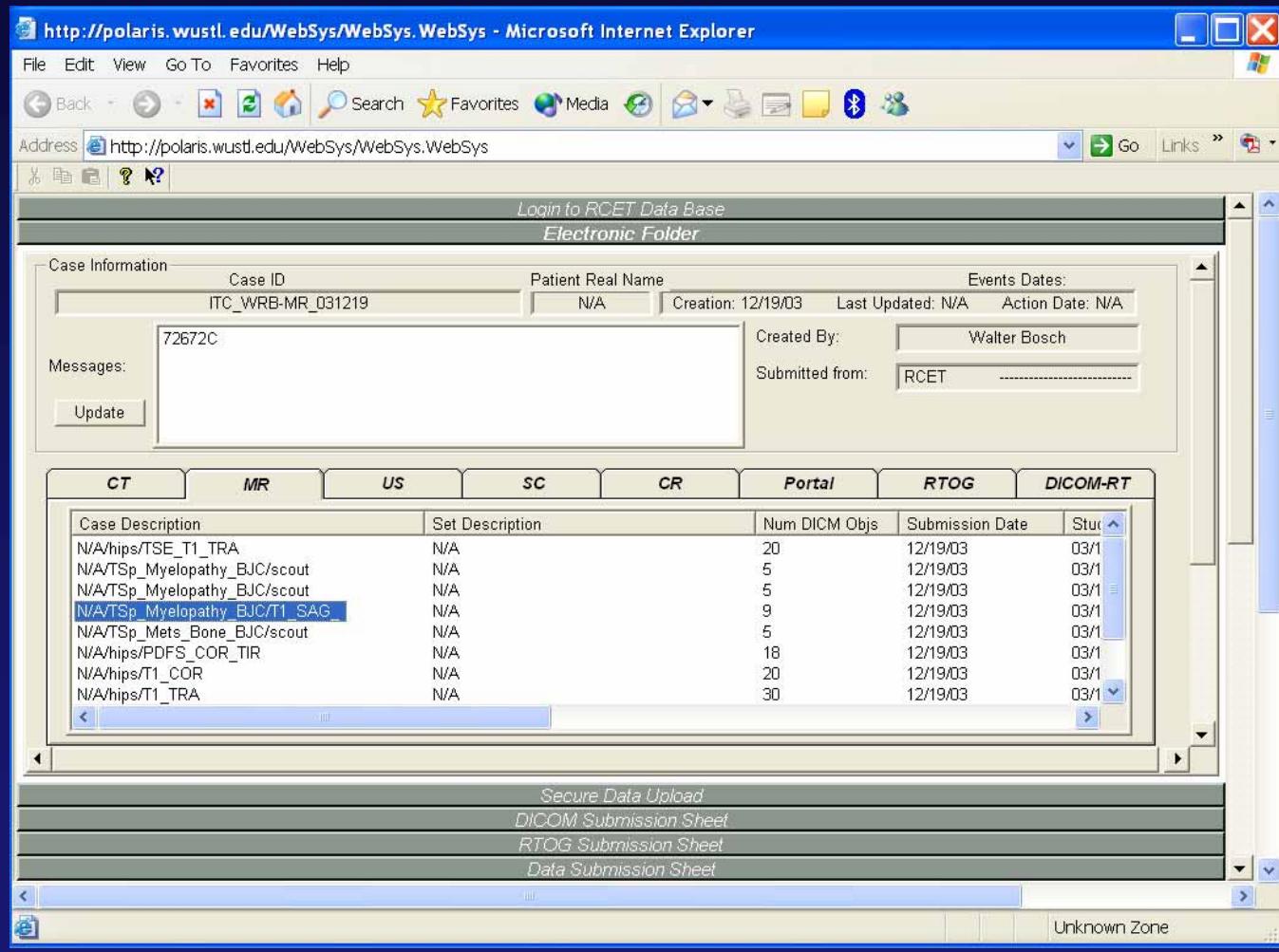
WebSys

- Secure upload of images and treatment planning data
- Supports DICOM and RTOG Data Exchange format
- Images and data are anonymized and encrypted prior to upload

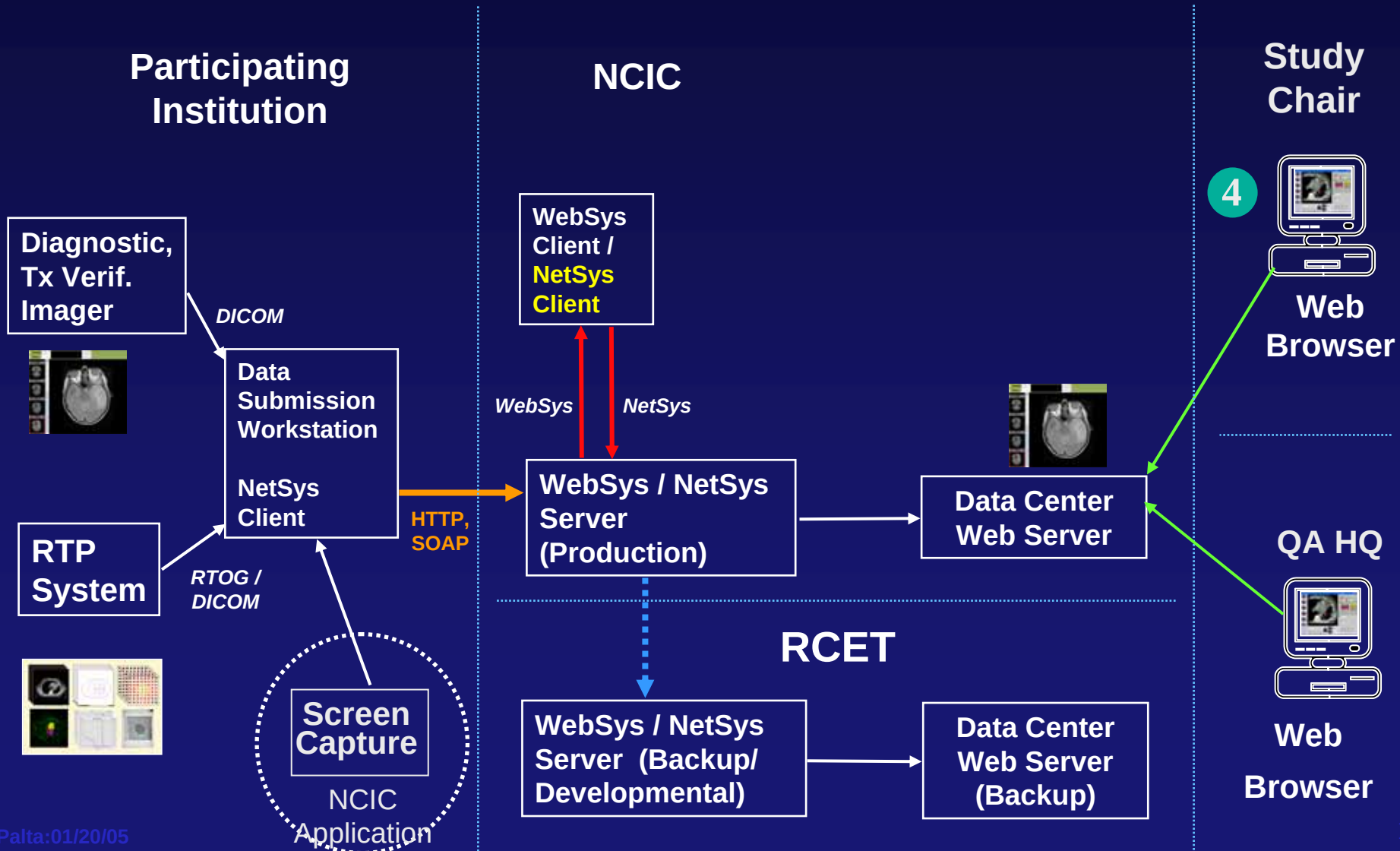


WebSys

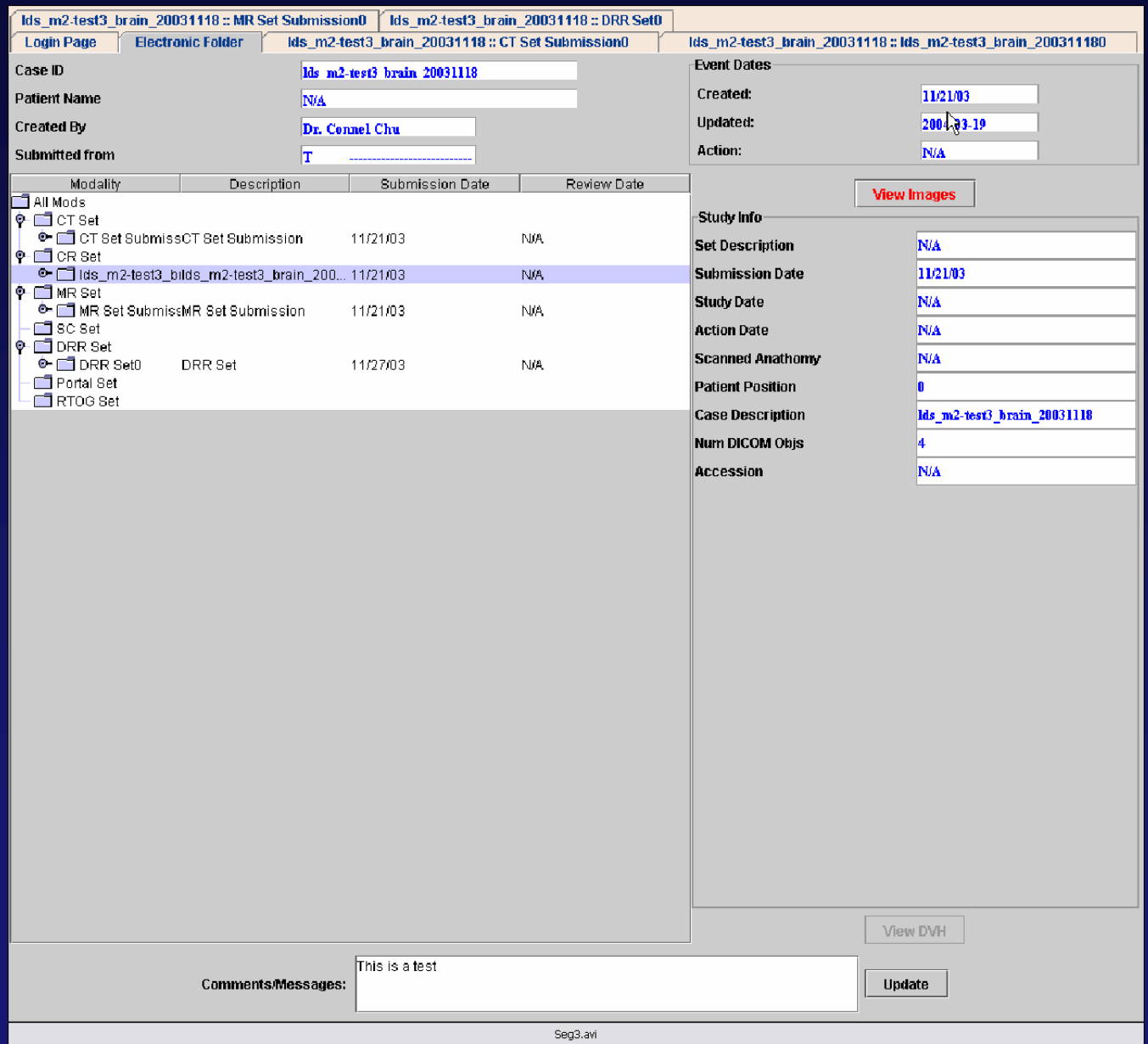
- Secure download of data
- Access restrictions: own data (user), entire protocol (study director)



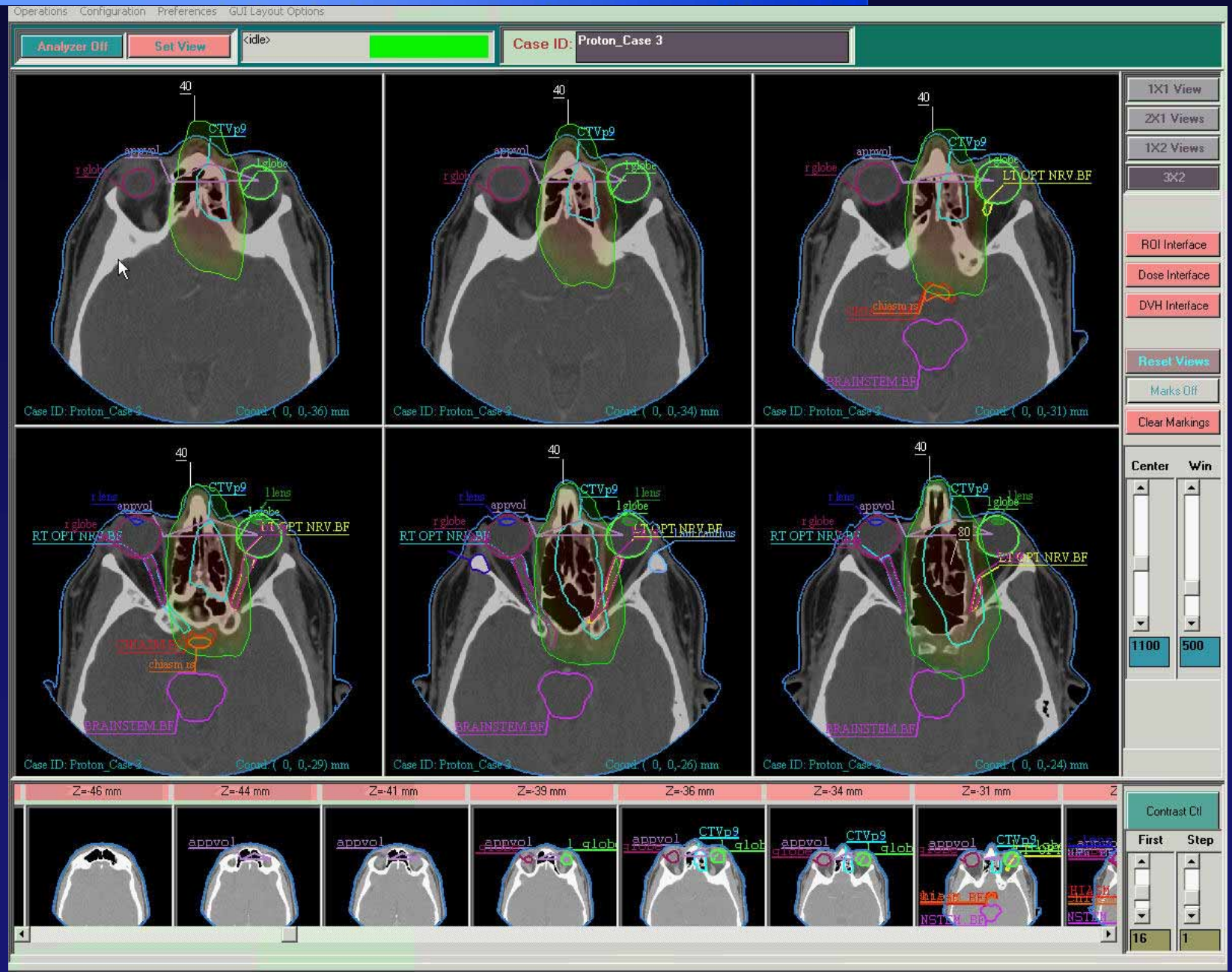
ATC Method 3 (NetSys Services)



Electronic Chart



NetSys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Center
Win
1100
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CTVp9
appvol
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RT OPT NRV.BF
chiasm rs
BRAINSTEM.BF
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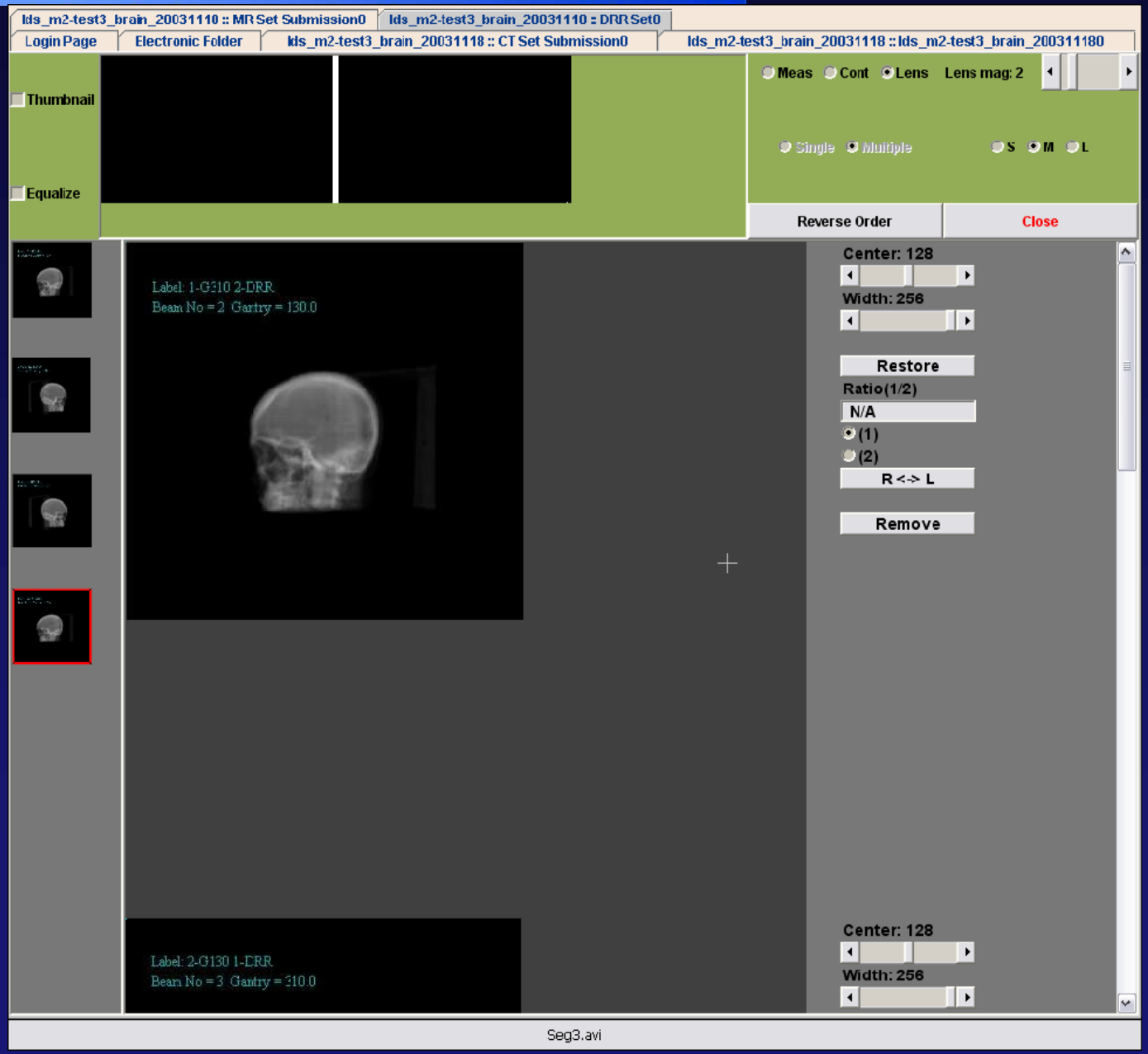
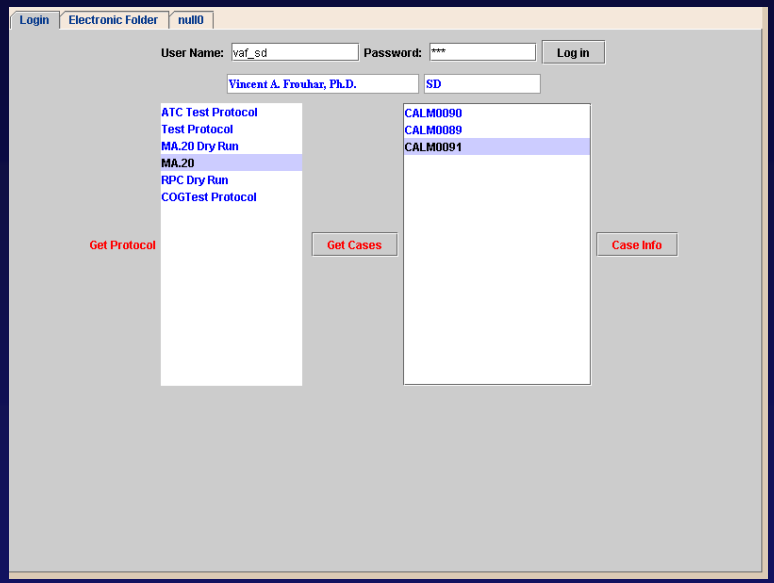
Contrast Ctl
First
Step
16
1

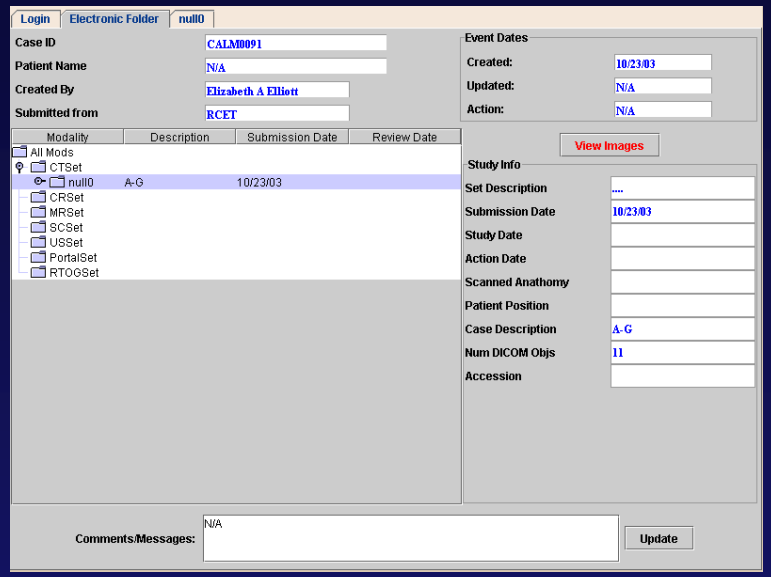
RT Image Review



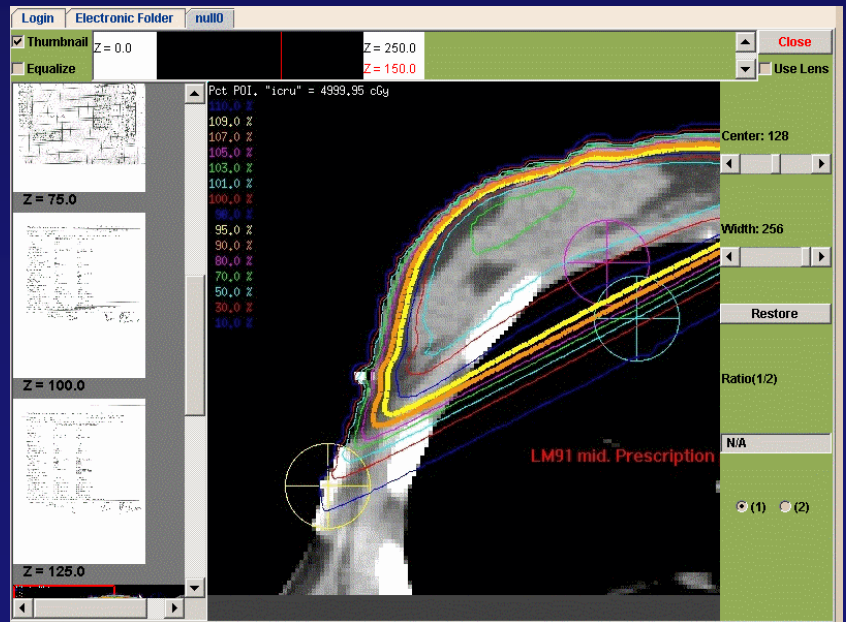
ATC AdvancedTechnologyConsortium

Providing support in quality assurance and data management for radiation therapy clinical trials





Rapid Review



Integrating the Healthcare Enterprise In Radiation Oncology

IHE-RO

An initiative spearheaded by Palta and Tripuraneni on behalf of ASTRO

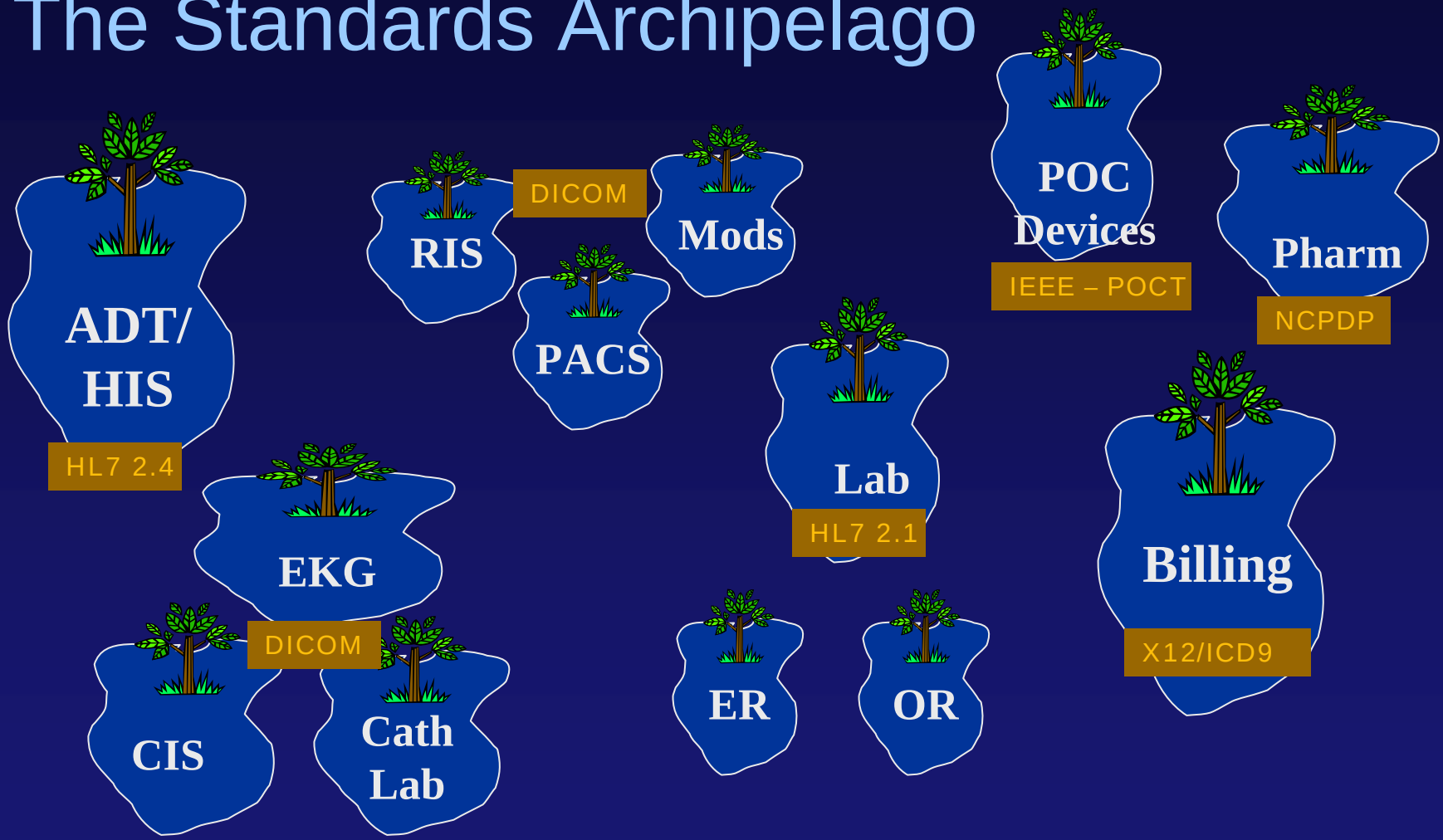
ATC AdvancedTechnologyConsortium

Providing support in quality assurance and data management for radiation therapy clinical trials

IHE grew from DICOM experience

- Integrating the Healthcare Enterprise:
  - an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information
  - promotes the coordinated use of established standards such as HL7 and DICOM to address specific clinical needs
  - leads to systems that communicate better, are easier to implement, and enable care providers to use information more effectively

The Standards Archipelago



Islands of data across the healthcare enterprise

IHERO Participants

- Societies Representing Healthcare Segments
  - RSNA, HIMSS, ASTRO, AAPM, ACR, ESTRO, ….
- Users
  - Radiation Oncologists, Medical Physicists, Radiation Therapists, Administrators, …
- NCI, ATC
- Treatment Planning System Vendors
- Facility Management Systems Vendors
- Therapy Delivery Systems Vendors
- Standards Development Organizations (SDOs)
  - NEMA, DICOM, HL7, ISO …

IHERO Process

- Users identify desired functionalities that require coordination and communication among multiple systems
  - E.g., radiotherapy workflow, single registration, cross-device sharing of data
  - Find and document standards-based transactions among systems to achieve desired functionality
  - Apply necessary constraints to eliminate useless wiggle room
- Provide process and tools to encourage vendors to implement
  - software test tools (for example, tools such as MESA)
  - Connectathon interoperability testing event
- Provide tools and education to help users acquire and integrate systems using these solutions
  - Connectathon results and public demonstrations
  - Integration statements

IHERO Planning Committee (Cooper, La Plain; Co-Chair)

Develop Clinical Use Cases

Connectathons and Public Demonstration

IHERO Technical Committee (Curran, Swerdloff; Co-Chair)

Appoints Co-Chairs

supervises

Establishes Integration Profiles and identifies standards

IHERO Task Force

Tripuraneni, Palta; Co-Chair

ASTRO Initiative

IHERO Domain-related Technical Working Group

contribute

Users

Global Development:
Radiation Oncology Planning and Delivery Systems, IT Infrastructure, etc.

Global

Interoperability

IHERO Organizational Structure

IHERO Deliverables

- Integration Profiles
  - Describe clinical need and use cases
  - provide a more precise definition of how standards are implemented
- Technical Framework
  - Provides implementation specification for each transaction by specific reference to Standards
- Connectathon
  - Vendors implement these profiles and test their systems with software tools and at a face-to-face Connectathon, where they test interoperability with other vendors' systems.
- Public Demonstrations
  - Vendors publish IHE Integration Statements to document the integration profiles supported by their products

IHERO Clinical Use Case #1

A patient arrives in the clinic and is registered into the Facility Management System (FMS)

The patient is registered on the CT scanner using exactly the same Medical Record Number (one to one mapping) as used in the FMS. A CT study is obtained and transferred to the contouring workstation (only if CT unit is not a dedicated CT-Sim)…… (Tests DICOM image export from CT scanner to Sim software, and both DICOM image and RT structure export to RTPS)

The patient is registered on the Radiation Therapy Treatment Planning System (RTPS) using exactly the same Medical Record Number (one to one mapping) as used in the FMS. The patient CT and contours are then transferred to the RTPS. …… (Tests DICOM image and RT structure import)

A treatment is generated on the RTPS including all DRRs.

The patient treatment plan (which includes all treatment delivery parameters, treatment schedule, dose and dose per fraction, and DRRs) is transferred to the FMS. …… (Tests DICOM image, RT structure, and RT plan export from RTPS to FMS)

On the first day of treatment, the patient is setup and filmed on the treatment delivery system using electronically transferred parameters in the FMS. . …… (Tests RT plan and RT dose import from FMS to Treatment Delivery System)

Images are compared with the planning system DRRs. Films are approved and treatment commences.

Alternate, films are incorrect, corrections made, and the information transferred back to the planning system for corrected dose calculation. . … (Tests RT plan import from FMS to RTPS)

Cancer Experts Corps (CEC)

An initiative originating from the NCI and supported by the Foundation for the National Institute of Health (FNIH), a Non-Government Organization

- It is designed to offer international assistance to cancer facilities and organizations in underserved parts of the world with the ultimate goal of promoting clinical cancer research and clinical trials
- The CEC arises on the background of a domestic program, the Cancer Disparity Partnership
- The international support for CEC is currently being sought

The NCI vision as articulated by Dr. Coleman is to use parts of ATC infrastructure (WebSys/Rapid Review) for remote proactive QA of target and critical structure delineation and peer-review

Summary of RCET Activities

- The RCET team is continuing its effort in making ATC Method 2 for data archive and retrieval more robust through “bug” fixes and extending its capability to handle different flavors of DICOM-RT objects
- RCET Data Server has been replicated at NCIC to accrue MA20 clinical trial data using ATC Method 3. The RCET staff is working towards transferring day-to-day responsibilities of managing the Data Server to the NCIC IT staff.
- The RCET team is continuing its effort to add new modules to the NetSys and WebSys

Summary of RCET Activities

- The research and development of data mining tools and data compression for storage and transmission using Wavelet Transforms is on-going. A prototype of these developments will be demonstrated at the next ATC meeting
  - A research abstract has been submitted to the 2005 BIROW meeting and two abstracts are planned for submission to the 2005 AAPM meeting. The manuscripts to peer-review journal will follow.
- An integration of RCET infrastructure, IMPAC database, and UF Outcome database is under way at UF for outcome studies.
  - A research abstract for submission to the ASTRO 2005 and a manuscript in the Red Journal is planned

Summary of RCET Activities

- The ITC and RCET team members are continuing to play an important role in the development of IHE-RO initiative.
  - This endeavor is likely to accelerate the implementation of common DICOM and DICOM-RT standards.
- The Rapid-Review Applets are being redesigned to facilitate peer-review of DICOM images and RT-Structures.
  - This enhancement will facilitate remote peer-review, which is one of the key requirements for the CEC initiative.

RCET System Architecture