Welcome!

Informatics Systems Overview

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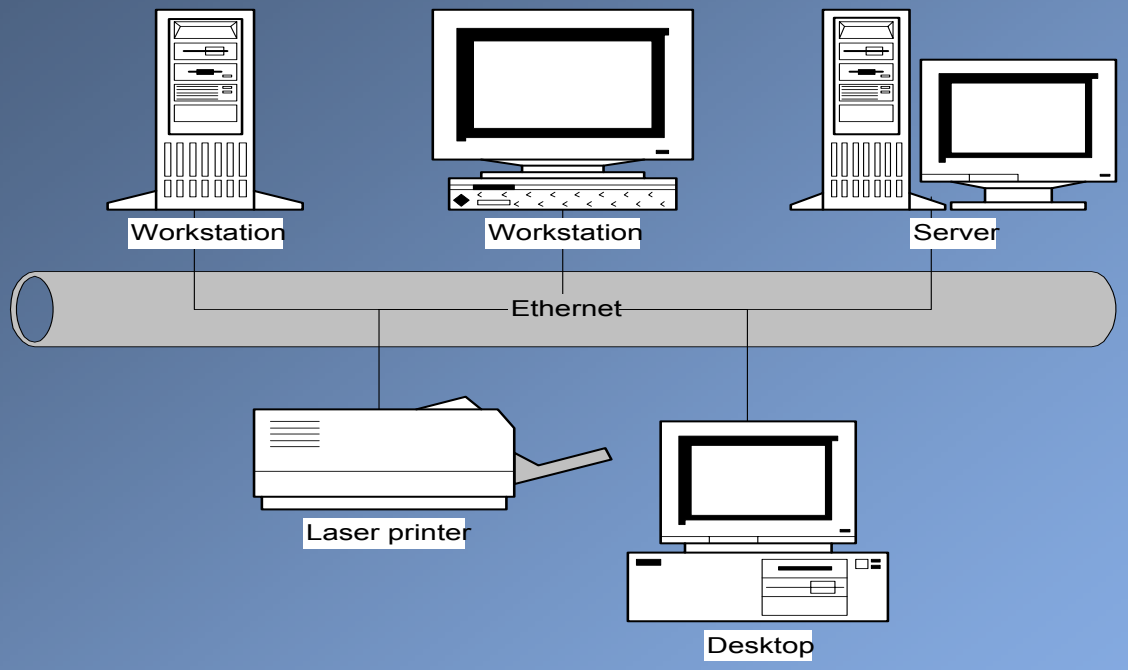
Objectives

- Understand basic network infrastructure for both LAN's and WAN's
- Understand interfaces to both hospital IS systems and radiation oncology devices
- Understand network requirements for single and multi-department institutions

Objectives con't

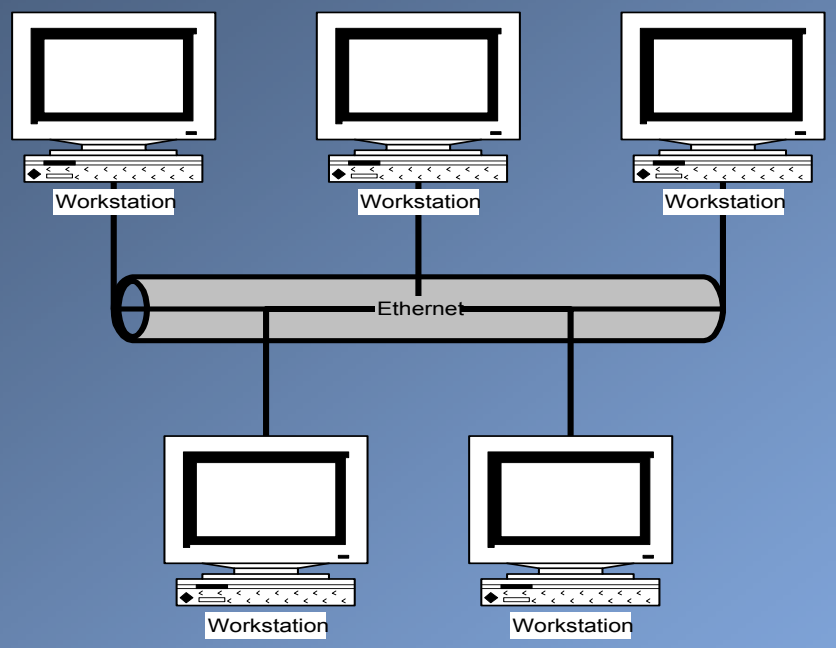
- Understand what is needed for migration from a paper to an electronic treatment record
- Generate specifications for an information system
- Personnel requirements for implementing and maintaining an information system
- Review basic specifications of available Treatment Management systems

Local Ethernet Network

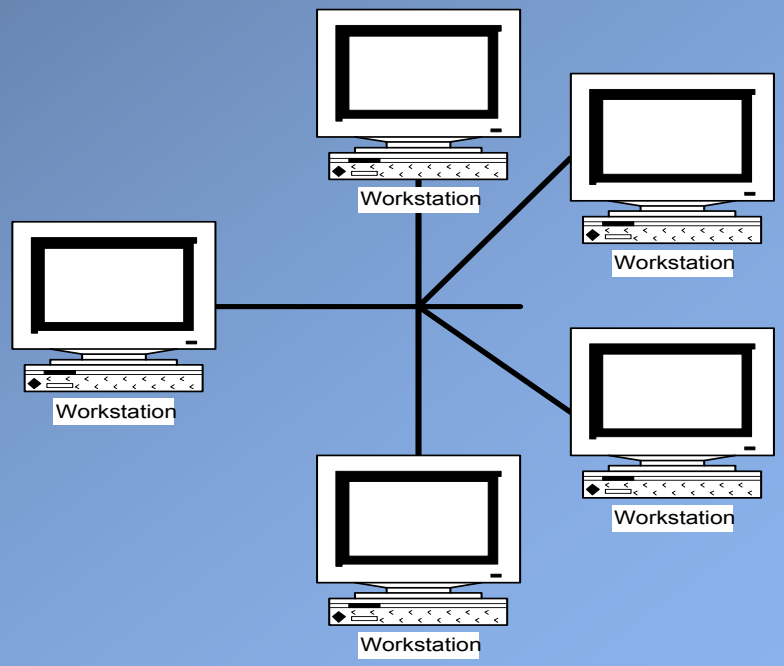


Most common type of network
IEEE 802.3 standard

Bus topology

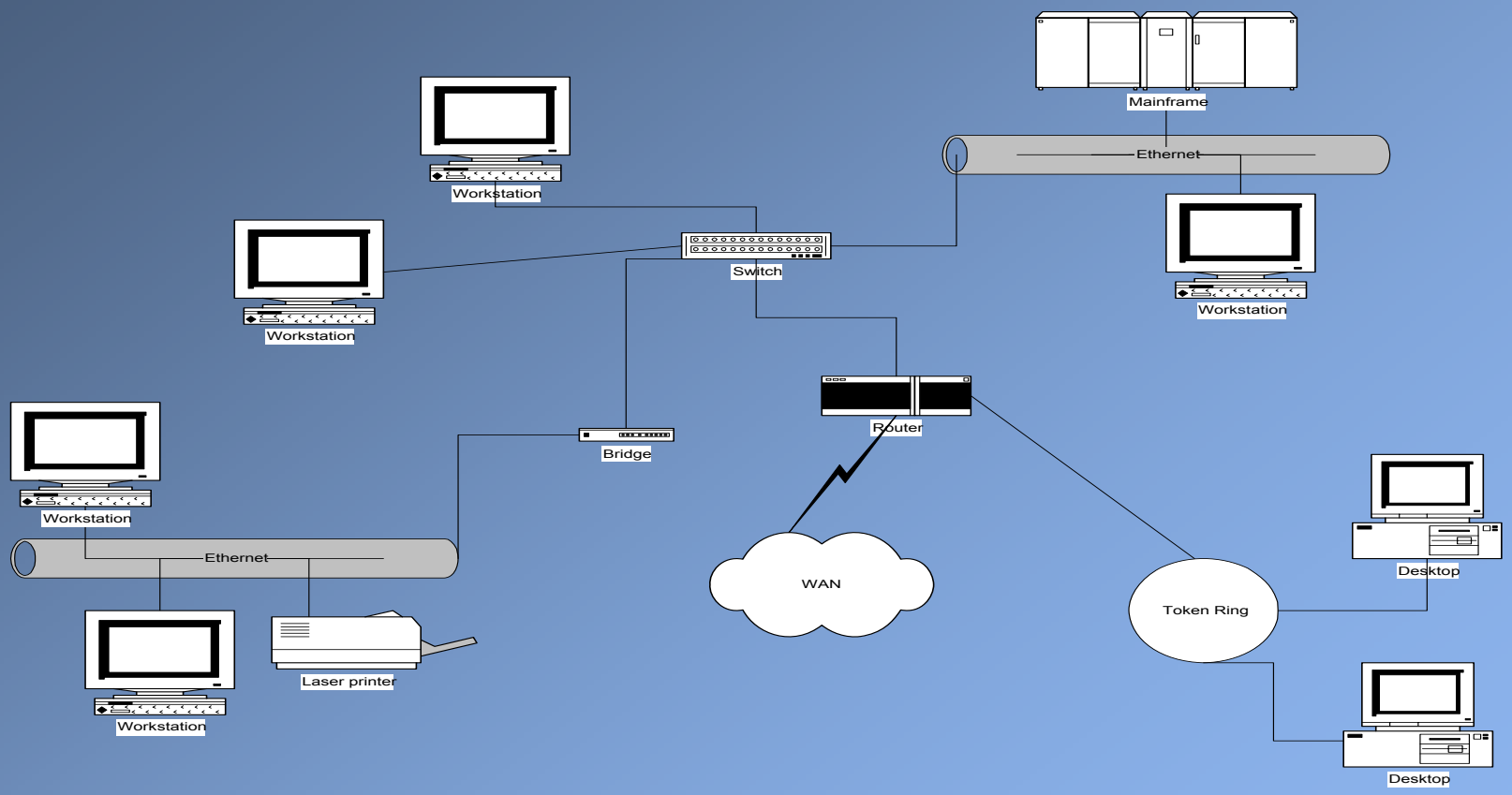


Star topology



Reference (4)

Multiple Networks

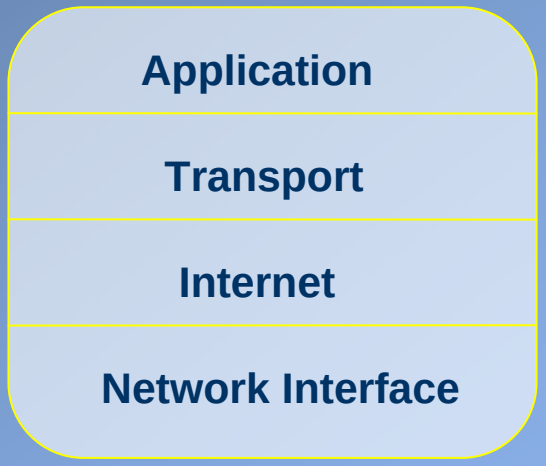


Protocols

- TCP/IP – Transmission Control Protocol/Internet Protocol
- IPX/SPX – Novell protocol (current Netware supports TCP/IP)
- NetBEUI / NetBIOS (old protocols)

TCP/IP

- Most common network protocol
- Based on a suite of protocols
- Is routable
- Supports DHCP and WINS



WAN Connections

- Different types of communication connections available
  - T1 (1.536 Mbps)
  - T3 (44 Mbps)
  - SDSL, HDSL (1.544 Mbps)
  - Cable Modem
  - Satellite

WAN Communications

- “Thick” client
  - Standard desktop computer, application loaded on computer
  - Reduces network traffic by not having to load application over Net
  - Increases software maintenance by having to upgrade applications on each computer

- “Thin” client
  - Application is loaded over the network
  - Increases network traffic
  - Reduces software maintenance time

WAN Solutions

- Software with web forms based interface
  - Specific application not needed on workstation
  - Reduced network traffic – only loads requested data
  - Can be run from any computer with a web browser

- Thin client using Citrix® Metaframe™ or Windows Terminal Server
  - Software maintenance reduced
  - Network traffic reduced
  - Need at least one more server depending on client load
  - Configuration more difficult

Citrix® Metaframe™

- Software that runs as an extension to Terminal Server
- ICA (Independent Computing Architecture) client
- Can have Citrix Server Farms to load balance across multiple servers
- Multiple clients available – Windows, McIntosh, UNIX, DOS
- Supports multiple communication protocols

Citrix con't

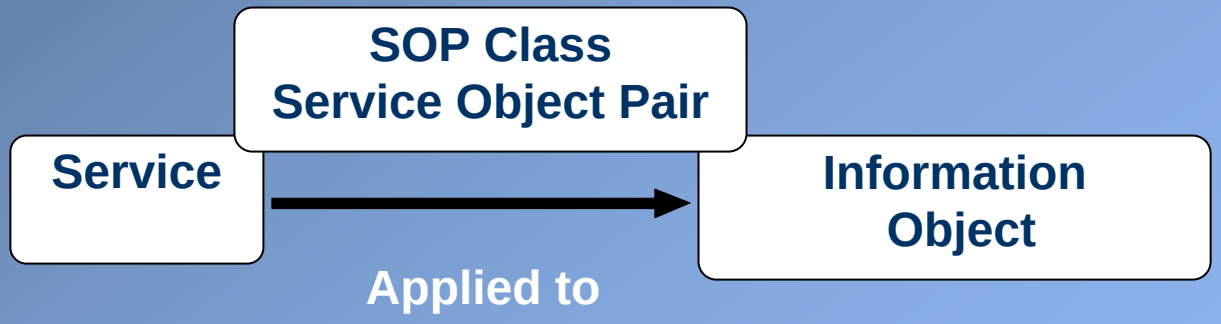
- Application actually runs on the Citrix server
- Video and keyboard/mouse information are transferred over the network
- Printer configuration can be difficult
- Solution for multi-site departments

DICOM

- Digital Image Communication in Medicine
- Standards designed for image communication
- DICOM-RT Extensions added to the standard to support radiation therapy objects

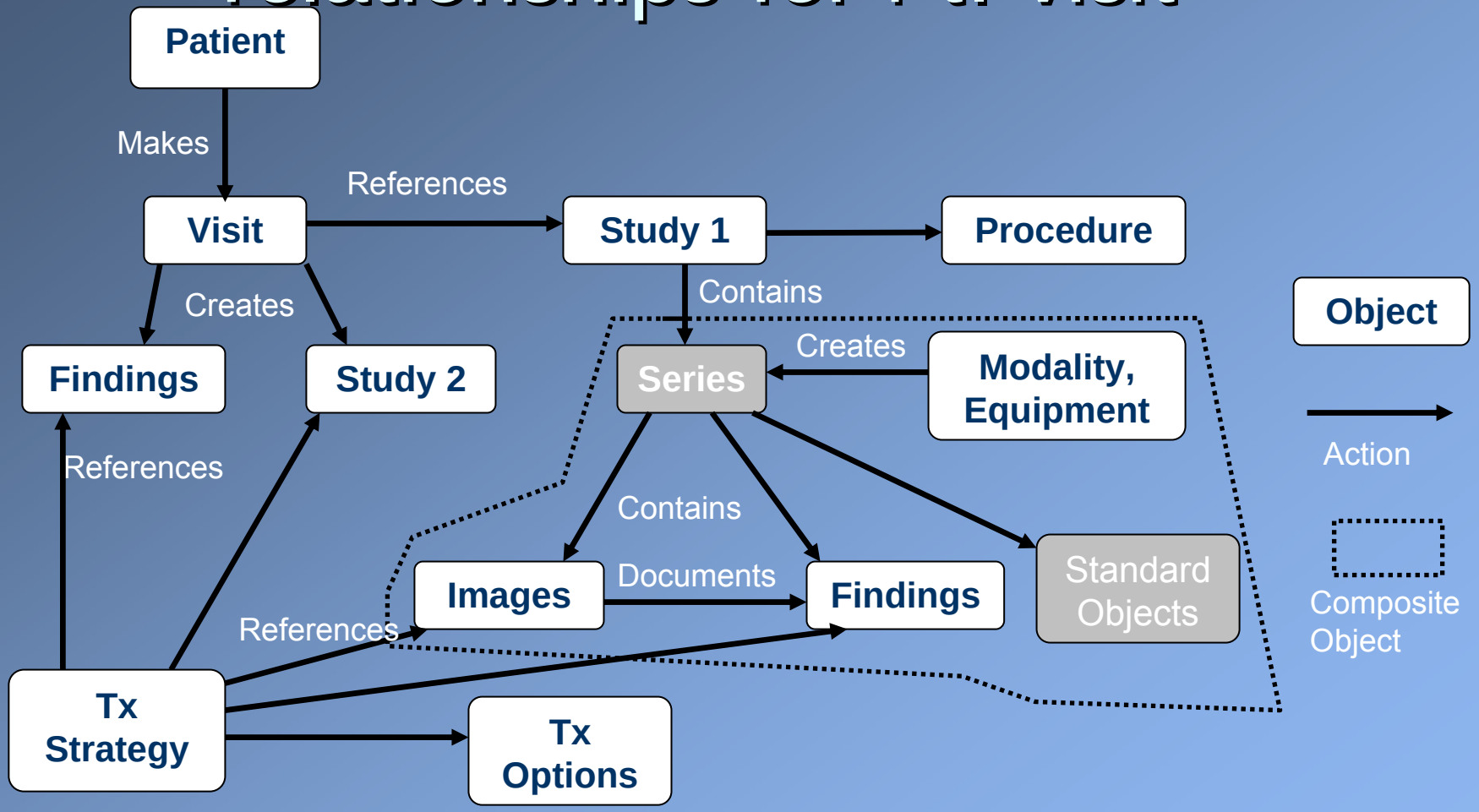
DICOM con't

- Service Object Pair (SOP) is the basic unit of communication
- An action or service is performed on an information object
- Example



Reference (4)

Example - Information objects and relationships for Pt. visit



Reference (4)

DICOM-RT information objects and definitions

DICOM RT modality (Information Object)	Object Definition
RT Image	RT specific images, such as DRR, EPID digital simulation capture, digitized film.
RT Structure Set	Curves or points representing patient contours and structures.
RT Dose	2 and 3D isodose curves or surfaces, point doses, dose volume histograms
RT Plan	Detailed planned data, beams, applicators, fractionation scheme
RT Beams Tx Record	Record/Verify data, as treated for external beam
RT Brachy Record	Record/Verify data, as treated for brachytherapy
RT Summary Record	Summary, cumulative data for entire course/patient

Compatibility example

- Application can be a service class user (SCU) or service class provider (SCP)

App 1	SOP	App 2	Compatible?	Comment
A	Store RT-Plan to	B	YES	A is an SCU and B is an SCP for RT-Plan
A	Store RT-Image to	B	NO	A is an SCU, but B does not support RT-Image
B	Store RT-Plan to	A	NO	A is an SCP, but B is not an SCU for RT-Plan
B	Store RT-Structure to	A	NO	A is not an SCP and B is not an SCU for RT-Structures

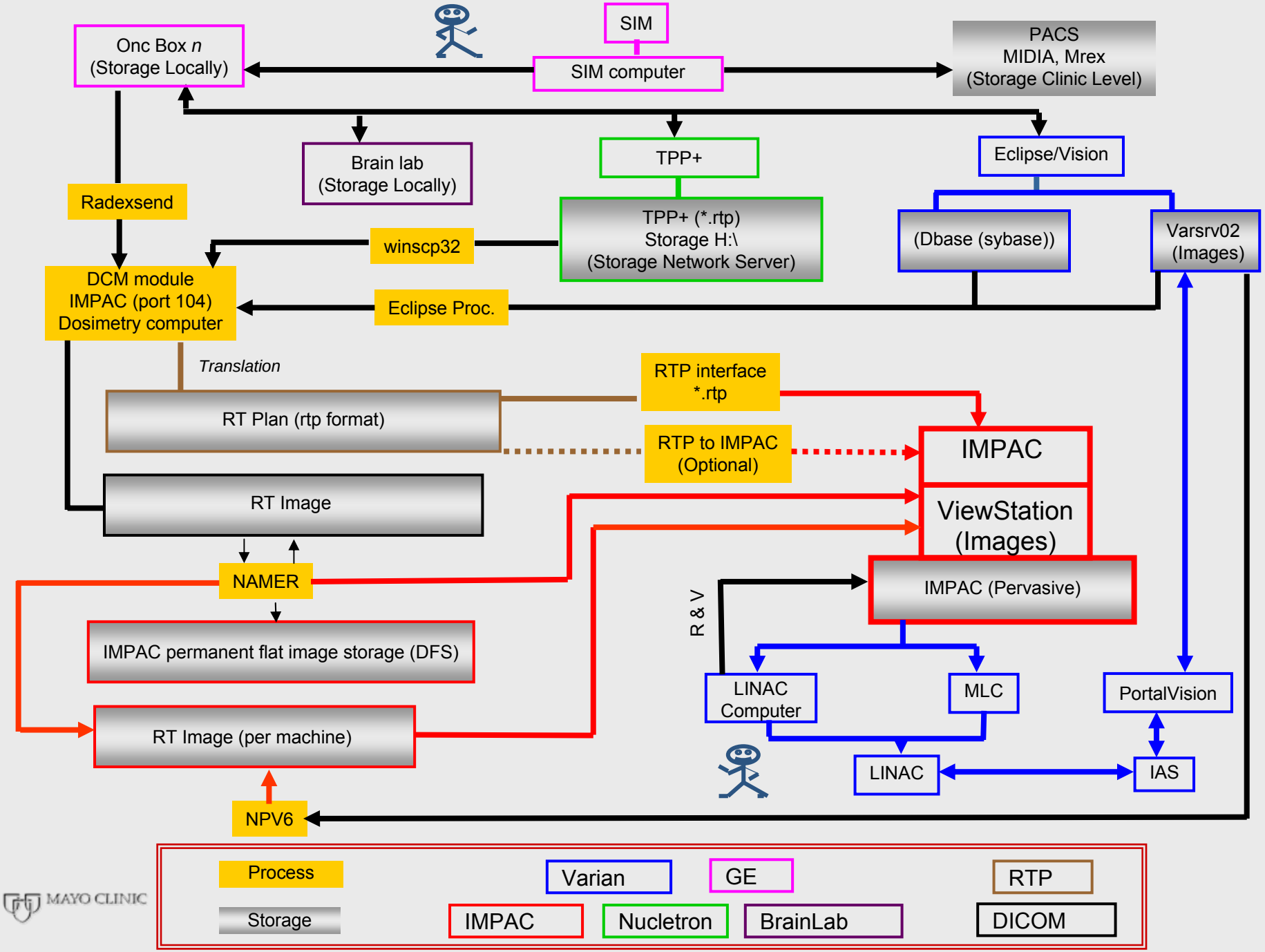
Reference (4)

Dataflow

- Knowledge of departmental dataflow is required for any information system
- Examples of dataflow, connectivity, and equipment interfaces

Interconnections

- Analyze computer information flow within the department
- Determine the method of communication between each component
- Examine the type of data sent between each component


SIM
Onc Box n
(Storage Locally)
SIM computer
PACS
MIDIA, Mrex
(Storage Clinic Level)
Brain lab
(Storage Locally)
TPP+
Eclipse/Vision
Radexsend
TPP+ (*.rtp)
Storage H:\
(Storage Network Server)
winscp32
(Dbase (sybase))
Varsrv02
(Images)
DCM module
IMPAC (port 104)
Dosimetry computer
Eclipse Proc.
Translation
RTP interface
*.rtp
RT Plan (rtp format)
RTP to IMPAC
(Optional)
IMPAC
RT Image
ViewStation
(Images)
NAMER
IMPAC (Pervasive)
R & V
IMPAC permanent flat image storage (DFS)
LINAC
Computer
MLC
PortalVision
RT Image (per machine)
LINAC
IAS
NPV6
Process
Storage
Varian
GE
RTP
IMPAC
Nucletron
BrainLab
DICOM
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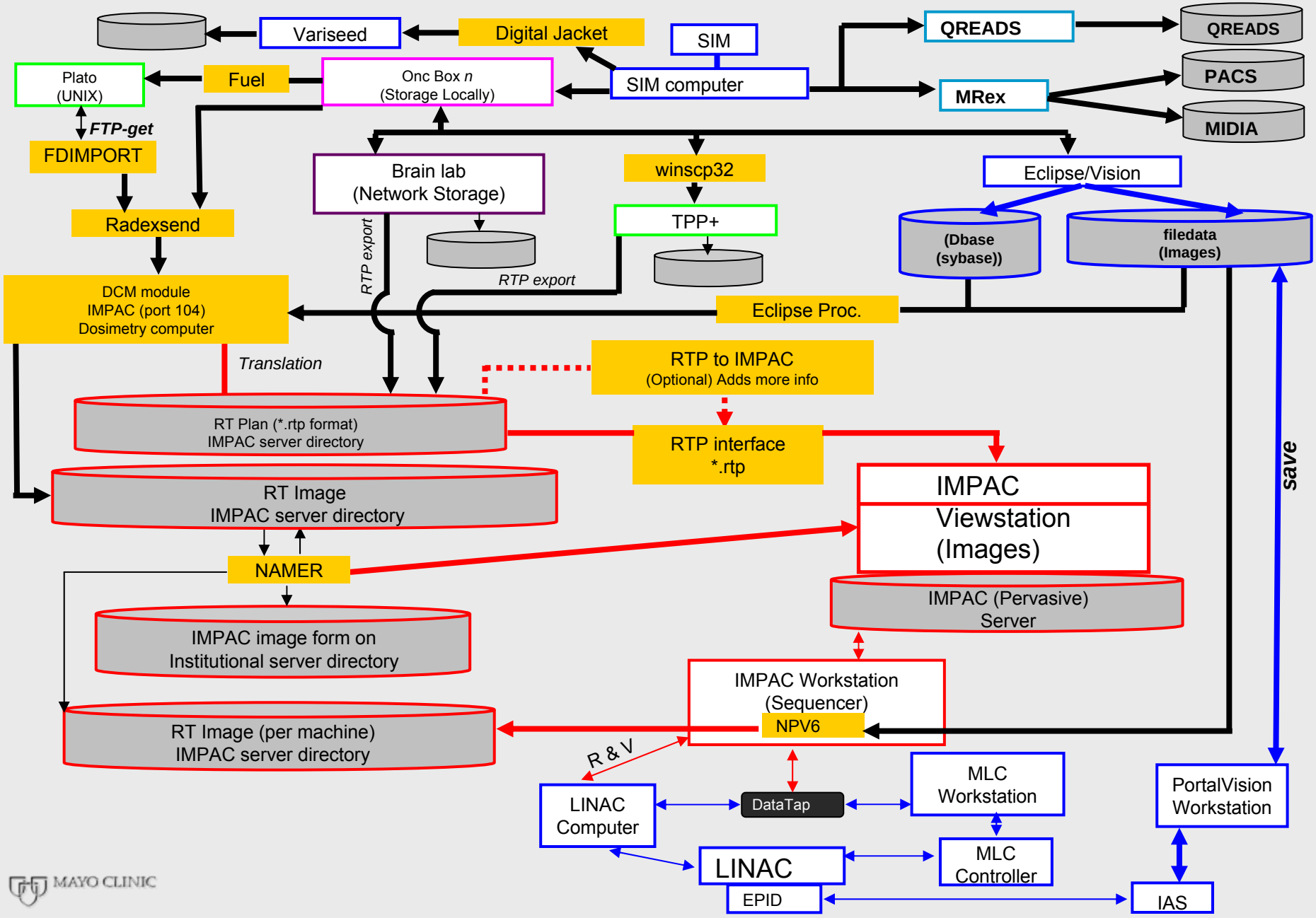
Non-4DITC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RTP to IMPAC
(Optional) Adds more info
RT Plan (*.rtp format)
IMPAC server directory
RTP interface
*.rtp
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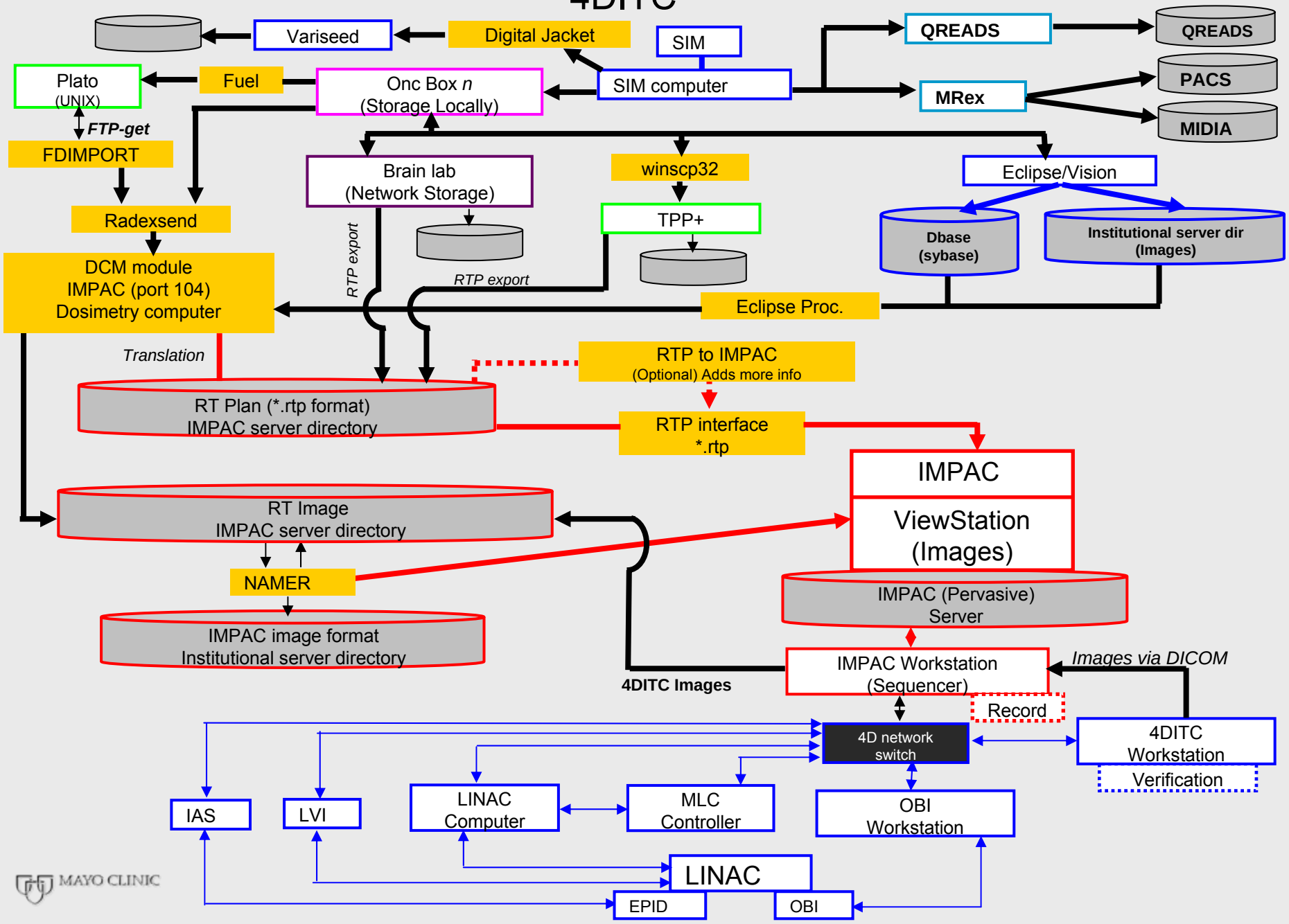
RT Image
IMPAC server directory
IMPAC
Viewstation
(Images)
NAMER
IMPAC (Pervasive)
Server
IMPAC image form on
Institutional server directory
IMPAC Workstation
(Sequencer)
NPV6
RT Image (per machine)
IMPAC server directory
R & V
LINAC
Computer
DataTap
MLC
Workstation
PortalVision
Workstation
LINAC
MLC
Controller
EPID
IAS
MAYO CLINIC

4DITC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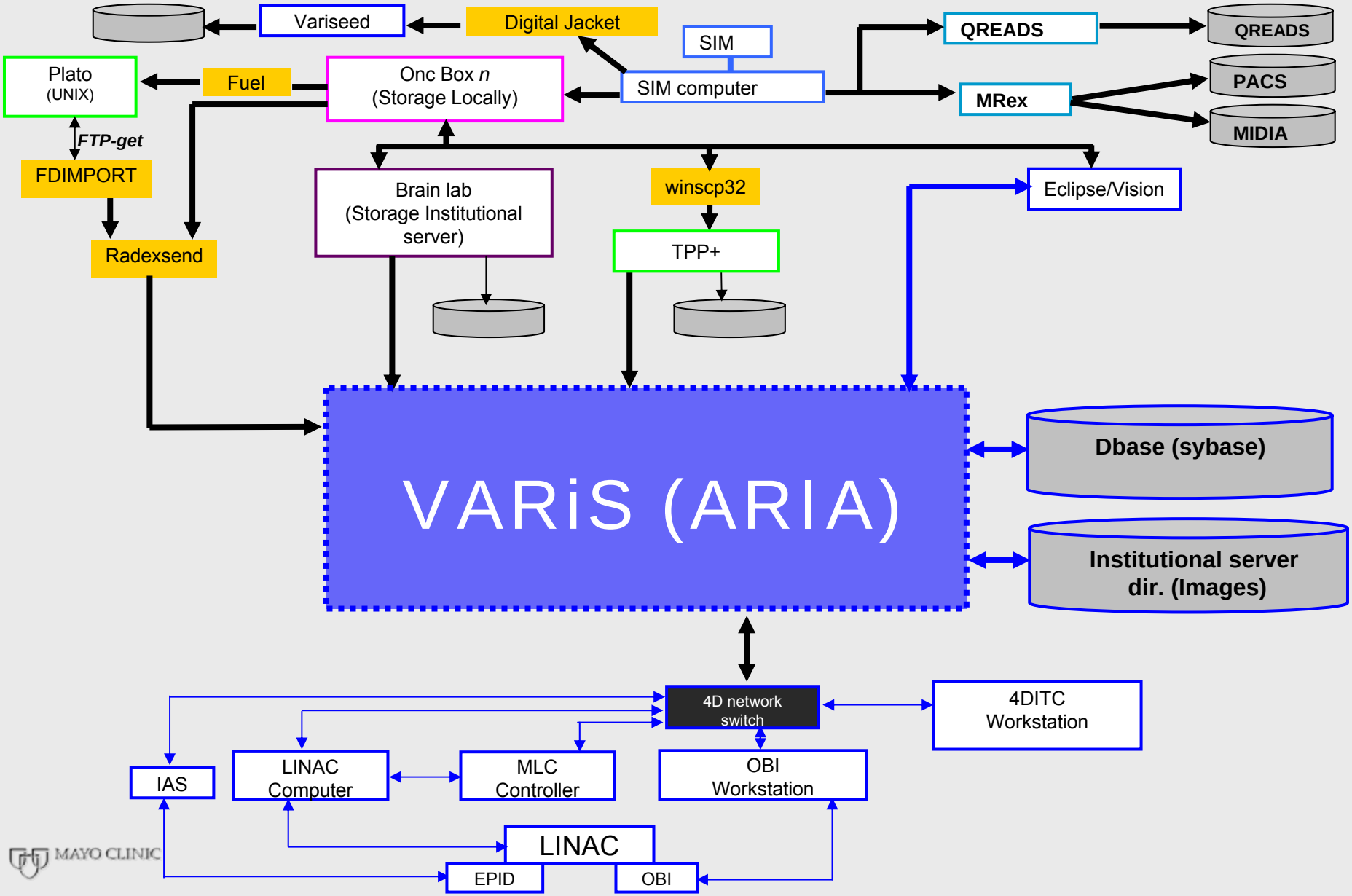
Server
IMPAC image format
Institutional server directory
4DITC Images
IMPAC Workstation
(Sequencer)
Images via DICOM
Record
4D network
switch
4DITC
Workstation
Verification
IAS
LVI
LINAC
Computer
MLC
Controller
OBI
Workstation
LINAC
EPID
OBI
MAYO CLINIC

4DITC
Tentative



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Color Code:

Multivendors:

- Varian
- IMPAC
- Nucletron
- GE
- BrainLab
- In-house

Processes

DICOM Transfer
(in black)

TMIS Specifications

- The Treatment Management Information System (TMIS) ties together the various sources of information
- Ideally – Information goes directly to TMIS with no user intervention
- Ideally - Conversion programs are not needed
- Ideally - Redundant entry of data is avoided

Developing TMIS Specifications

- Complete a process map of information flow
- Cover all areas including nurses, doctors and secretaries
- Who enters what data, how many times is it entered
- How many times is the same data entered?

- ***Major Components***

  - **Users:**
  - Physicians
  - Physicists
  - Therapists
  - Dosimetrists
  - IS team
  - Administrative Staff

- **Clinical Operations:***

I. Patient Registration Process
II. Patient Consultation Process
III. Departmental Scheduling Process
IV. Departmental Patient Charting Process
V. Patient Treatment Sim Process
VI. Patient Treatment Process
VII. Administrative Services

** Van Dyk J. The Modern Technology of Radiation Oncology. Chapter 14 by Brooks K.W.*

- **Technological Innovations:**

I. New imaging modalities (Cone Beam CT, EPID-MV, OBI-kV, kV – MV)
II. Image-guided stereotactic treatments
III. New Image-Guided Radiation Therapy modalities
IV. Etc.

- **IS Infrastructure management:**

I. Archiving & Data mining
II. Database Technology (Sybase vs. MS SQL)
III. Interface capabilities (i.e. HL7, DICOM, other)
IV. Vendor support
V. IS/ITPerformance.

Flow Types
1. Pretreatment Plan complete
2. Patient starts Tx prior to Plan complete
3. No plan needed, but not emergent
4. Emergent
5. Pt Under Tx- M.D. Change
6. Pt. Not setting up, e.g. SSD >1.5cm

Data Flow
07/26/06

1.

SIM 1: Orthogonal Pair contour or CT(Ch2) Rx, Dx, Pt Data, Default Beams → contour or CT(Ch2) to M.D. for volumes → Data to (Team) Dosimetrist Do Plan → M.D. Review, Visual Approval, **Sign CAX** → Paper Work, R&V Data Entry, BEV, print films, **MUCalc** → (Plan), R&V, Calc, BEV double check

SIM 2: M.D. for Virtual Sim volumes, +- fields → contour or CT(Ch2) to M.D. for volumes

A: Requires new Plan? — Yes → M.D. Review, Visual Approval, **Sign CAX**; No → Paper Work, R&V Data Entry, BEV, print films, **MUCalc**

3.

SIM 2: Print Tx Iso Wksheet → M.D. -Volumes/Fields Print Worksheet → <24 hrs to start?

SIM 1: Sim Films with Blocks R&V Data Entry → <24 hrs to start?

<24 hrs to start? — No → Paper Work, R&V Data Entry, BEV, print films, **MUCalc**; Yes → Shop

Block Check? — No → Films & BEV to Shop → Treatment Machine; Yes → Sim Before Shop?

Sim Before Shop? — Yes → Simulator → Treatment Machine; No → Films & BEV to Shop → Simulator → Treatment Machine

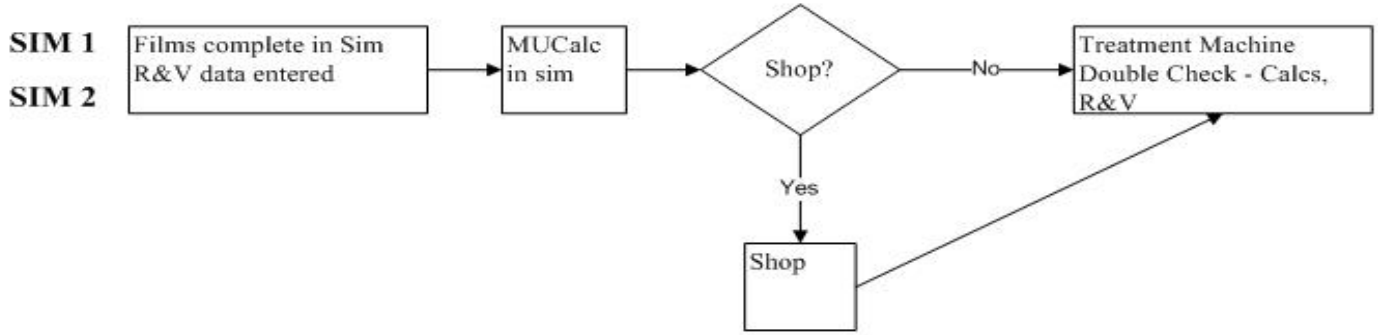
2.= 3 + 1

Shop → MUCalc → R&V, Calc, (BEV) double check → Treatment Machine

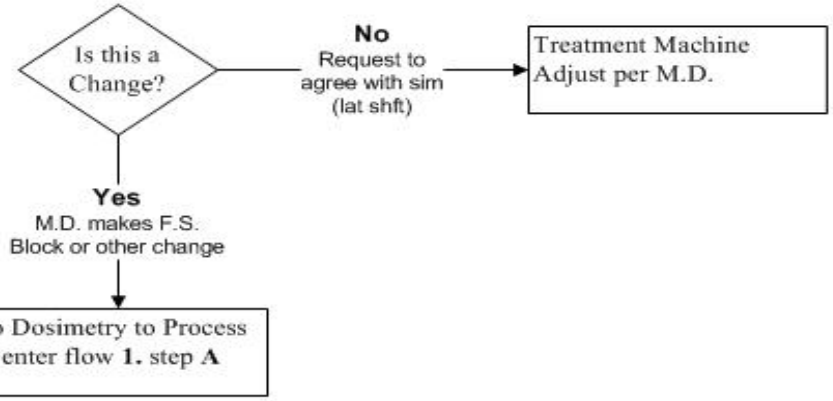
At Machine

Goal: In all cases the material will be completed and double checked 4 hours prior to Patient treatment

4.

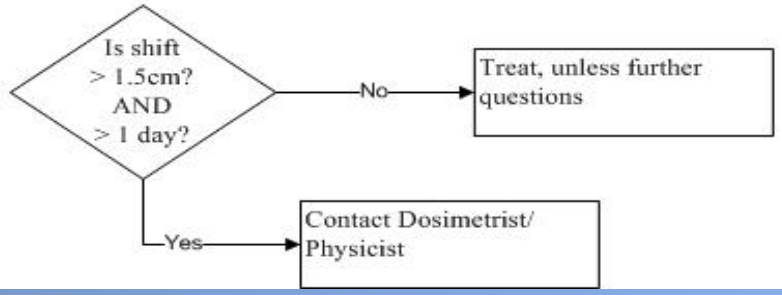


5.



6.

Setup problems



Example Specifications

- Physics / Dosimetry

  ACCESS TO DEPARTMENT AND INSTITUITIONAL SCHEDULES

  1. **Auto- notification to appropriate physicist when special procedures are scheduled or changed.**
  2. **Access to all Rad Onc physician, simulator, treatment machine, shop and patient schedules**
  3. **Ability to attach info or appointments to patients treatment, simulation and block room schedules in TMIS.....**

Physics / Dosimetry con't

INFORMATION TRANSFER

1. **All patient treatment information available in digital format must follow the latest**
2. **DICOM-RT standards to allow for seam-less transfer of data**
3. **Sectional image based treatment port design should not produce multiple data sets**
4. **Transfer of data should be done without "patched network software" or programs**
5. **Information should be able to be imported into the TMIS from normal page scanners or digital cameras……..**

Electronic Treatment Record

- The use on an electronic treatment record has numerous advantages over a paper record
  - Available for viewing at any time
  - It can be viewed simultaneously by several people
  - No physical transport of record needed
  - Data more easily available for analysis

Electronic Treatment Record con't

- There are disadvantages
  - Paper record has evolved over many years
  - Electronic treatment records are not as flexible – vendor specific
  - More computer resources are required

Electronic Treatment Record con't

- Will probably not result in reduction in personnel
- May need 1 FTE to manage the system
- If dedicated IS personnel are not available will need a computer guru
- May need to hire computer consultants to manage network

Major Available TMIS Systems

- IMPAC MOSAIQ
- Varian ARIA
- Nucletron Oncentra
- Siemens Lantis

Server Operating Systems / HW

	O.S.	HW Small	HW Large
MOSAIQ	Windows 2003 Server	ZEON, 3+ GHz, 3 GB RAM, 18 – 146 GB Storage	Quad ZEON, 3+ GHz, 4 GB RAM, 72 – 146 GB Storage
ARIA	Windows 2003 Server	ZEON, 3+ GHz, 2 GB RAM, 6x73 GB RAID 5 Storage	
Oncentra	Windows 2000 Server	ZEON, 3+ GHz, 1 GB RAM, 6x73 GB RAID 5 Storage	
Lantis	Windows 2003 Server	P4, 3+ GHz, 1 GB RAM, 2x36 GB RAID 1 Storage	ZEON, 3+ GHz, 2 GB RAM, 3x70 GB RAID 5 Storage

Database Engine

MOSAIQ	Microsoft SQL
ARIA	Sybase 12.5
Oncentra	Oracle
Lantis	Pervasive 8

Conclusion

- Complexity of Rad. Tx. are increasing every year
- Computers are a vital part of the treatment process
- A electronic TMIS and Tx. Record will be needed to handle the large amount of information
- Medical physicist will (does) play an important role in the operation of a TMIS

References

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Thanks!