Welcome!
Informatics Systems
Overview

R Dahl*, M Herman Mayo
Foundation
Rochester, MN
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
Example - Information objects and relationships for Pt. visit

- Patient
  - Makes Visit
  - Contains Visit
  - References Findings, Study 1, Procedure

- Visit
  - Makes Visit
  - Creates Study 1, Study 2
  - References Findings, Study 1, Procedure, Images

- Study 1
  - Contains Series
  - Creates Study 1
  - References Images, Procedures

- Series
  - Contains Images, Documents, Findings
  - Creates Series
  - References Findings, Standard Objects

- Findings
  - Creates Findings
  - References Findings, Standard Objects

- Images
  - Contains Images
  - Creates Images
  - References Images, Documents

- Procedure
  - Contains Procedure
  - Creates Procedure
  - References Procedure

- Procedure
  - Contains Procedure
  - Creates Procedure
  - References Procedure

- Tx Strategy
  - Creates Tx Strategy
  - References Tx Strategy

- Tx Options
  - Creates Tx Options
  - References Tx Options

- Standard Objects
  - Contains Standard Objects
  - Creates Standard Objects
  - References Standard Objects

- Composite Object
  - Action

Reference (4)
## DICOM-RT information objects and definitions

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

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

<table>
<thead>
<tr>
<th>App 1</th>
<th>SOP</th>
<th>App 2</th>
<th>Compatible?</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Store RT-Plan to</td>
<td>B</td>
<td>YES</td>
<td>A is an SCU and B is an SCP for RT-Plan</td>
</tr>
<tr>
<td>A</td>
<td>Store RT-Image to</td>
<td>B</td>
<td>NO</td>
<td>A is an SCU, but B does not support RT-Image</td>
</tr>
<tr>
<td>B</td>
<td>Store RT-Plan to</td>
<td>A</td>
<td>NO</td>
<td>A is an SCP, but B is not an SCU for RT-Plan</td>
</tr>
<tr>
<td>B</td>
<td>Store RT-Structure</td>
<td>A</td>
<td>NO</td>
<td>A is not an SCP and B is not an SCU for RT-Structures</td>
</tr>
</tbody>
</table>

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
Color Code:

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

Processes

Storage Location

DICOM Transfer (in black)
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

  ■ **Technological Innovations:**
  1. New imaging modalities (Cone Beam CT, EPID-MV, OBI-kV, kV – MV)
  2. Image-guided stereotactic treatments
  3. New Image-Guided Radiation Therapy modalities
  4. Etc.

  ■ **Clinical Operations:**
  1. Patient Registration Process
  2. Patient Consultation Process
  3. Departmental Scheduling Process
  4. Departmental Patient Charting Process
  5. Patient Treatment Sim Process
  6. Patient Treatment Process
  7. Administrative Services

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

  ■ **IS Infrastructure management:**
  1. Archiving & Data mining
  2. Database Technology (Sybase vs. MS SQL)
  3. Interface capabilities (i.e. HL7, DICOM, other)
  4. Vendor support
  5. IS/IT Performance.
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

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
   - 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
   - Films & BEV to Shop

2. SIM 2
   - M.D. for Virtual Sim volumes, +/- fields
   - Print Tx Iso Wksheet
   - M.D. -Volumes/Fields Print Worksheet
   - ~24 hrs to start?

3. SIM 2
   - Sim Films with Blocks R&V Data Entry
   - At Machine MUCalc
   - Shop
   - R&V, Calc, (BEV) double check
   - Treatment Machine
   - Simulator
   - Films & BEV to Shop

2. = 3 + 1

Goal: In all cases the material will be completed and double checked 4 hours prior to Patient treatment
4. SIM 1
   Films complete in Sim R&V data entered → MUCalc in sim → Shop?
   No → Treatment Machine Double Check - Cals, R&V
   Yes → Shop

5. Is this a Change?
   No → Request to agree with sim (lat shift) → Treatment Machine Adjust per M.D.
   Yes → M.D. makes F.S. Block or other change → To Dosimetry to Process & enter flow 1. step A

6. Setup problems
   Is shift > 1.5cm? AND > 1 day?
   No → Treat, unless further questions
   Yes → Contact Dosimetrist/Physicist
Example Specifications

Physics / Dosimetry

ACCESS TO DEPARTMENT AND INSTITUTIONAL 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 TMI S…
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 seamless 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
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
<table>
<thead>
<tr>
<th>O.S.</th>
<th>HW Small</th>
<th>HW Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOSAIQ</td>
<td>Windows 2003 Server, ZEON, 3+ GHz, 3 GB RAM, 18 – 146 GB Storage</td>
<td>Quad ZEON, 3+ GHz, 4 GB RAM, 72 – 146 GB Storage</td>
</tr>
<tr>
<td>ARIA</td>
<td>Windows 2003 Server, ZEON, 3+ GHz, 2 GB RAM, 6x73 GB RAID 5 Storage</td>
<td></td>
</tr>
<tr>
<td>Oncentra</td>
<td>Windows 2000 Server, ZEON, 3+ GHz, 1 GB RAM, 6x73 GB RAID 5 Storage</td>
<td></td>
</tr>
<tr>
<td>Lantis</td>
<td>Windows 2003 Server, P4, 3+ GHz, 1 GB RAM, 2x36 GB RAID 1 Storage</td>
<td>ZEON, 3+ GHz, 2 GB RAM, 3x70 GB RAID 5 Storage</td>
</tr>
<tr>
<td>MOSAIQ</td>
<td>Microsoft SQL</td>
<td></td>
</tr>
<tr>
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<td></td>
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<tr>
<td>ARIA</td>
<td>Sybase 12.5</td>
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<tr>
<td>Oncentra</td>
<td>Oracle</td>
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<tr>
<td>Lantis</td>
<td>Pervasive 8</td>
<td></td>
</tr>
</tbody>
</table>
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

Thanks!