Introduction to DICOM

How to teach yourself this skill



About the Presenter

- Biomed since 1996
- Worked in Imaging support since 96
- First Implemented Merge systems / DICOM 2.0
- Instructed DICOM for College credit – 2 schools
- Currently Working in the field of Imaging - VA Imaging BESS

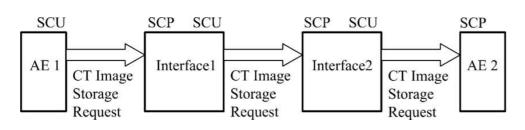
What is DICOM?

- Digital Image and Communications in Medicine. (DICOM)
- Public Use, Open-Source Communication Protocol
- A technique for transmitting, storing, and displaying medical images
- Expanded to processing, overlaying, and reporting changes
- Creates a unique folder and file that does not have name conflicts if transferred anywhere.
- Allows for Private data OEM "Trade Secrets"
- Continually added to and updated.



How Does DICOM work?

- Server, Workstation, Modality
- <u>AE title, IP address, Port</u>
- Requirements found in a Conformance Statement
- Users vs Provider Roles (SCU vs SCP)
- Accession Numbers
- A Header and an Image



| Dicom Con | nections | | GE Healthcare Austria | |
|---|-----------|------------|---|--|
| | 1 | | DICOM [®] | |
| Server Name | | | Conformance Statement | |
| | | | | |
| AE-Title | DCMROUTER | | Direction DOC1130332 | |
| | | | Revision 3.0 | |
| IP Address | | | | |
| | | | | |
| Port | 1024 | | VOLUSON [*] S10 spc310 VOLUSON [*] S6/S8 11.xx/12.xx/14.xx/15.xx/SPC310 | |
| | | | VOLUSON" P6/P8 13.x.x/14.x.x/15.x.x/SPC310 | |
| | | | C€0123 | |
| | | | | |
| | Cancel | Done | Copyright (2) 2006-2015 by Growed Electric Co. DECOM is the regimered trademark of the | National Flat |
| | | Done | total Hamiltonian Americation for his standards publications which is digital remaindents information. | test of andical |
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| _ | nt | | ContrastFlowDuration Contrast, BolusingredientConcentration ReconstructionDiameter DistanceSourcetoDetector DistanceSourcetoPatient | 0018,10 0018,10 0018,11 0018,11 0018,11 |
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Accession No:

SeriesInstanceUID

AcquisitionNumbe

ImagePositionPatient ImageOrientationPatient

FrameofReferenceUID

InstanceNumbe

StudyID

SeriesNumbe

0020.000e 1.3

0020.0010

0020,0011

0020.0013

0020.0032

0020,0037

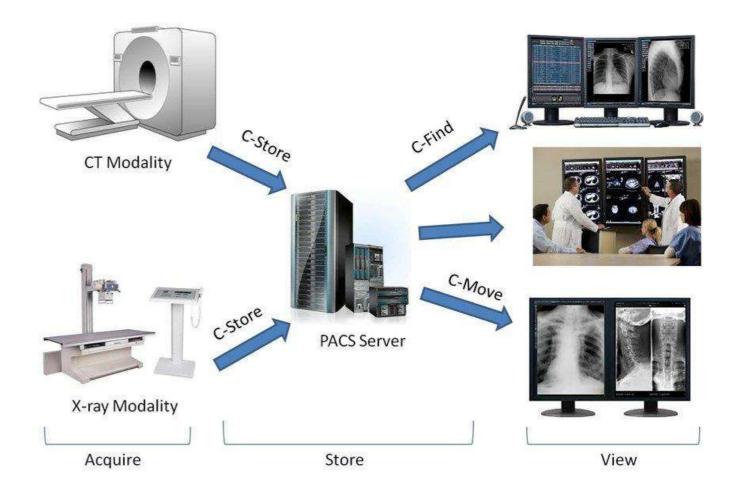
0020,0052 1.3

-76

1\0

What Does a DICOM Network look like?

- A modality takes an image (SCU)
- It stores the image on a server (SCU / SCP)
- A workstation finds and copies the image (SCU / SCP)
- A radiologist "reads" the image



What are we going to do today?

Let's build a DICOM network

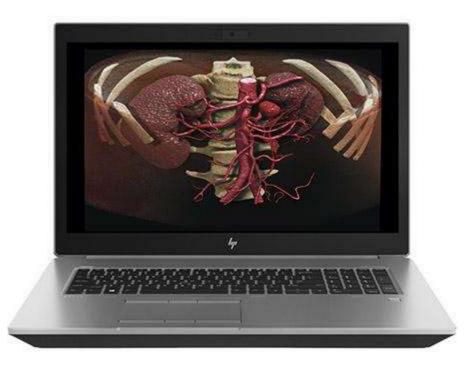
On one Laptop....

Using the same login....

With the software already installed...

Ok.. We are just walking through the setup...

Deep breath... let's dive in!



Setting up a test DICOM server – Use ConQuest

| ConQuest DICOM server 1.4.16beta - CONQUESTSRV1 | | ConQuest DICOM server 1.5.0 - CONQUESTSRV1 - 🗆 🔀 |
|--|--------------------------------|---|
| Configuration Installation Maintenance Known DICOM providers Browse database Server status Query / Move | | Configuration Installation Maintenance Known DICOM providers Browse database Server status Query / Move |
| This screen contains essential parameters for operation of the ConQuest DICOM server. Local unique name of this DICOM server (application entity, AE) : CONQUESTSRV1 | Save configuration | /* *********************************** |
| TCP/IP port to use (other DICOM systems must know this number) : 5678 | Restore original configuration | <pre>* AE name, (IP adress or hostname) and port number. The * * first entry is the Conquest server itself. The last ones * * with * show wildcard mechanism. Add new entries above. * *</pre> |
| Local disk directory to store DICOM images : E c: [softpedia] | | <pre>* The syntax for each entry is : * * AE <ip adress host="" name=""> port number compression * * * For compression see manual. Values are un=uncompressed; *</ip></pre> |
| Enable JPEG(2000) support Images on disk are stored: | Install server as NT service | <pre>* ul=littleendianexplicit,ub=bigendianexplicit,ue=both * * j2=lossless jpeg;j3j6=lossy jpeg;n1n4=nki private * * js =lossless jpegLS; j7=lossy jpegLS * * jk =lossless jpeg2000;j1=lossy jpeg2000 * * J3NNj6NN, JLNN or J7NN overrides quality factor to NN% *</pre> |
| Uncompressed NKI compressed O JPEG or NKI | Uninstall server as NT service | * J3NNj6NN. JLNN or J7NN overrides quality factor to NN% * * * * * * * * * * * * * * * * * * * |
| C Lossless JPEG C Lossy JPEG C Lossless JP2000 C Lossy JP2000 C JPEG or Uncompressed | | CONQUESTSRV1 127.0.0.1 5678 un V* * 1234 un |
| Images on disk are named: | | V = 1234 un V = 4666 un S = 5678 un |
| C DCM (standard format) Cleanup disk below: (MB) | Hide the server (as tray icon) | Hide the server (as tray icon) |
| Cleanup nightly below: (MB) | About this server | About this server |
| Below 0 MB, move to: Image: C:\\dicomserver1416beta\Data Image: Keep Server Alive Free disk space: 26112 megabyte | Close the server | Close the server |

https://image-systems.biz/products/free-dicom-pacs-tools/conquest/

Warning : Install this DICOM software in a folder on the root of your hard drive (c:\)

In "Known Providers" – Always Use the keyboard Tab and Enter Keys

Setting Up a test DICOM Workstation – GinkGo CAD

| File Edit View Series Tools Help Image: Show history Alt+h Image: Show history Alt+h Image: Open file Alt+f Image: Open file Alt+d Image: Open file Alt+d | Settings | DICOM Node DICOM Node Workli | |
|---|--|---------------------------------|--------------|
| Open file Open folder Open folder Alt+d Open folder | ⊡- Ginkgo CADx General | | |
| Open removable unit Open Ginkgo Cloud link Acquire a DICOM study from PACS Search Ginkgo Cloud Dicomize Close Alt+w Close all | General | DICOM Node Workli | st Advanced |
| Search Ginkgo Cloud Dicomize Close Alt+w Close all | workstation | 100 M | st Playancea |
| x Close Alt+w Close all | Local database Electronic health record | Settings | |
| Close all | DICOM nodes Smart retrieve | Id | Softpedia |
| All+s history Acquire Decimize TACS of N Search Ginkgo cloud | Profiles Modality settings | AET | Softpedia |
| | Hanging protocols Locations | Host | Softpedia |
| | | Port | 12312 |
| | General tab and | PDU (KB) | 16384 |
| http://ginkgo-cadx.com Remember that when you buy Ginkgo CADx Pro, you are Powered by MetaEmotion Healthcare | DICOM Nodes are | Retrieve method | Move 🖌 |
| | most important | WADO URL | |
| 🥘 0 running tasks. 🥵 👘 | | Retrieve mode | Series 🗸 |

Reuse connection

Test connection

Accept

Cancel

https://ginkgo-cadx.com/en/

Set AE title, IP and Port for the Workstation into the server "Known Providers" tab and server AE title, IP and Port into the workstation "DICOM Node".

Adding a Modality – Usually in the field

| General | Store | C-Store | Worklist | MPPS | Print | |
|--------------|---------|--------------|-------------|-------------|--------------|---------|
| Peripheral | Service | List D | oicomStore | | | |
| Comment | | Ľ | | | Add | Delet |
| Bodymark | | COM Image | storage _ | | | |
| Measure | Remo | ote HostNam | ne Die | comStore | | |
| DICOM | IP Ad | ldress | 19 | 2.168.254.1 | .04 | Ping |
| Load Default | | | | | | |
| About | DICO | OM AE Title | AF | Ξ | | Echo |
| | Port | Number | 10 | 4 | | |
| | Conn | ect Timeout | (sec) 10 | Re | peat Count | 2 |
| Exit | Dims | e Timeout (s | sec) 10 | Ac | se Timeout (| sec) 30 |
| | | Send After I | Every Image | Stored | | |
| | | Send At End | d of Exam | | | Appl |

- Set up like a Workstation
- Usually works just as an SCU
- May have special requirements check the Conformance Statements
- May do a storage, or other functions like Storage Commitment (STC), Worklist (most common), printing, and Modality Performed Procedure Step (MPPS).

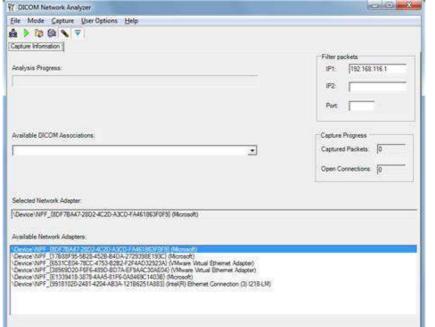
Troubleshooting DICOM

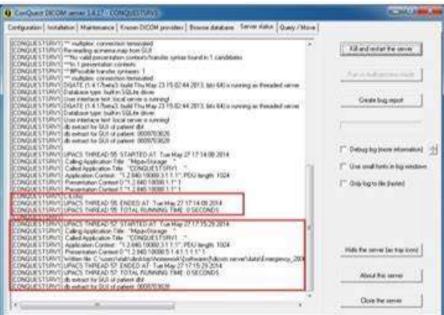
Ping

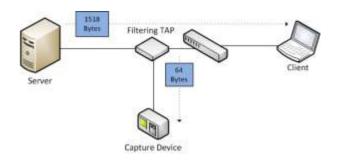
Echo

- TCP/IP Ping
- DICOM Echo
- Server Status in ConQuest
- Debug Logs
- DVTk Network Analyzer
- WireShark
- Conformance Statements https://www.dvtk.org/downloads/

| Command Prompt | - | \times |
|--|-----|----------|
| Microsoft Windows [Version 10.0.18362.900] (c) 2019 Microsoft Corporation. All rights reserved. | | ^ |
| C:\Users\gabri>ping 192.168.1.1 | | |
| Pinging 192.168.1.1 with 32 bytes of data Reply from 192.168.1.1: bytes=32 time=2ms TTL=64 Reply from 192.168.1.1: bytes=32 time=3ms TTL=64 Reply from 192.168.1.1: bytes=32 time=3ms TTL=64 Reply from 192.168.1.1: bytes=32 time=2ms TTL=64 Ping statistics for 102.168.1.1: Packets: Sent = 4, Received = 4, Lost = 0 (0% los Approximate and the state and the stat | s), | |
| C:\Users\gabri> | | |







| No | Tate | Source | Destination | Protocol | Src. | 0st | bylo |
|------|-----------|-------------------|------------------|----------|------|--------|---|
| - 43 | 15,267502 | 192,168,222,1 | 197.168.222.129 | DICOM | 2550 | 104 // | A-ASSOCIATE request SCU ++> SCP |
| -48 | 15.269415 | 192,168,222,129 | 192,168,222,1 | DICOM | 104 | 1550 | A-ASSOCIATE accept SCU 4++ SCP |
| 49 | 15,485986 | 192,168,222,1 | 192,168,222,129 | DICOM | 1550 | 104 | P-DATA, C-ECHO-RO |
| 53 | 15,486850 | 192.168.222.129 | 192,168,222,1 | DICOM | 2.04 | 1550 | P-DATA, C-ECHO-RSP |
| 55 | 15,704683 | 192.168.222.1 | 197.168.222.129 | DICOM | 1550 | 104 | A-RELEASE request |
| 50 | 15,704890 | 192,168,222,129 | 192,168,222,1 | DICOM | 104 | 1550 | A-RELEASE response |
| -105 | 37.712700 | 192.168.222.1 | 192.168.222.129 | DICOM | 1553 | 104 | A-ASSOCIATE request SCU> SCP |
| | | 10220100522220200 | 10200 CONTRACTOR | DICOM | 104 | 1553 | A-ASSOCIATES ACCEPTED OUT CONTRACTOR |
| 108 | 37.851629 | 192.168.222.1 | 192,168,222,129 | DICOM | 3553 | 104 | P-DATA, C-STORE-RO |
| 121 | 37.852550 | 192.168.222.1 | 192.168.222.129 | DICOM | 2553 | 104 | P-DATA, RT Plan Storage (more fragments |
| 134 | 37.853069 | 192.168.222.1 | 192.168.222.129 | DICOM | 1559 | 104 | P-DATA, RT Plan Storage (more fragments |
| 146 | 37.853750 | 192.168.222.1 | 192.168.222.129 | DICOM | 1553 | 104 | P-DATA, RT Plan Storage (more fragments |
| 158 | 37.854285 | 192.168.222.1 | 192.168.222.129 | DICOM | 1553 | 105 | P-DATA; RT Plan Storage (more fragments |
| 171 | 37,854730 | 192,168,222,1 | 192,168,222,129 | DICOM | 1553 | 104 | P-DATA, RT Plan Storage (more fragments |

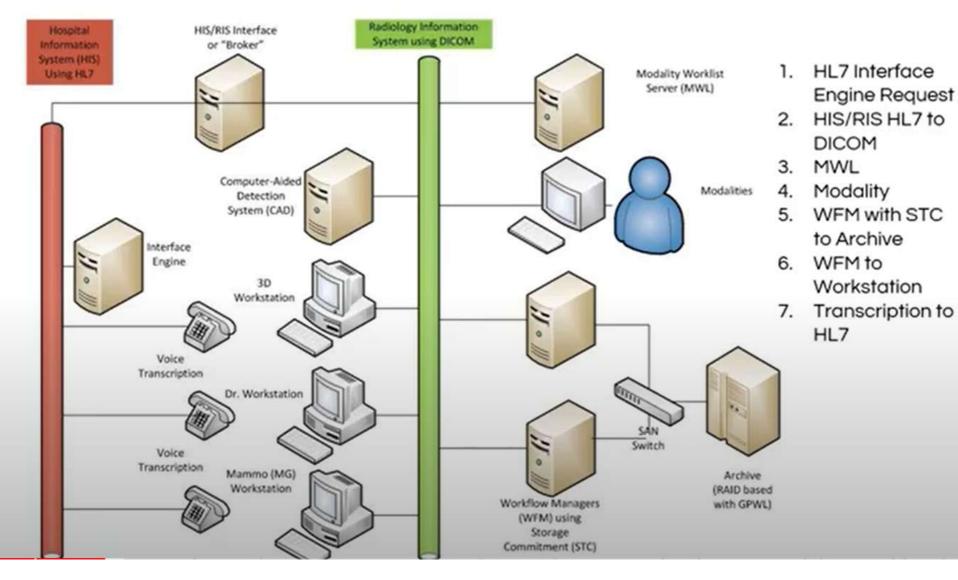
Transmission control Protocol, Src Port: 104 (104), Ost Port: 1553 (1553), Seg: 1, Ack: 287, Len: 223 DICON

PDU Type 0x2 (ASSOC Accept) POU Length: 217

OPDU Detail: A-ASSOCIATE accept SCU <-- SCP # Application context: DICOM Application Context Name (1.2.840.10008.3.1.1.1)

8 Presentation Context: 10 0x01, Accept, Explicit vR Big Endian, RT Plan Storage a presentation Context: 10 0x01, Accept, Explicit vR Little Endian, et Plan Storage 8 user Info: Max POU Length 16384, implementation UB 1.2,2766.03200013.03.35, NewSion OFFIS_DOMM_353

What does a full DICOM network really look like?



- <u>Additional</u> <u>Functions:</u>
 - HIS/RIS Integration
 - Worklist
 - STC
 - Transcription
 - MPPS
 - Cloud / Teleradiology
 - CAD
 - SR
 - Printing
 - Video

Who Doesn't Have Questions?