

# 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

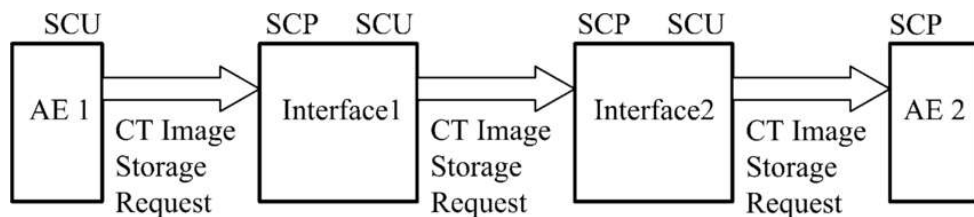
# What is DICOM?

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



**Dicom Nodes**

**Dicom Connections**

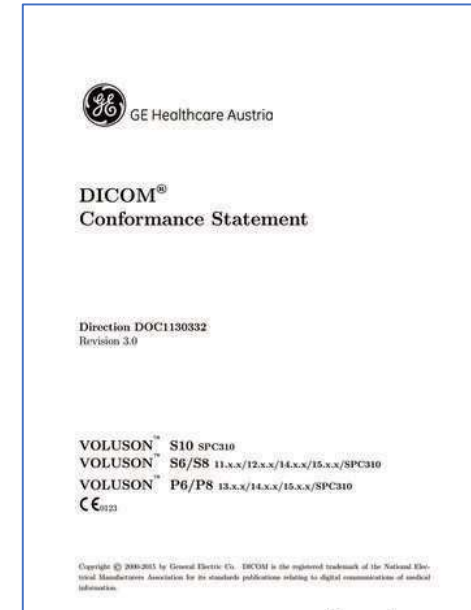
Server Name:

AE-Title: **DCMROUTER**

IP Address:

Port: **1024**

Buttons: **Cancel** **Done**



**DICOM: Patient**

Last name:

First name:

Date of birth:

Patient ID:

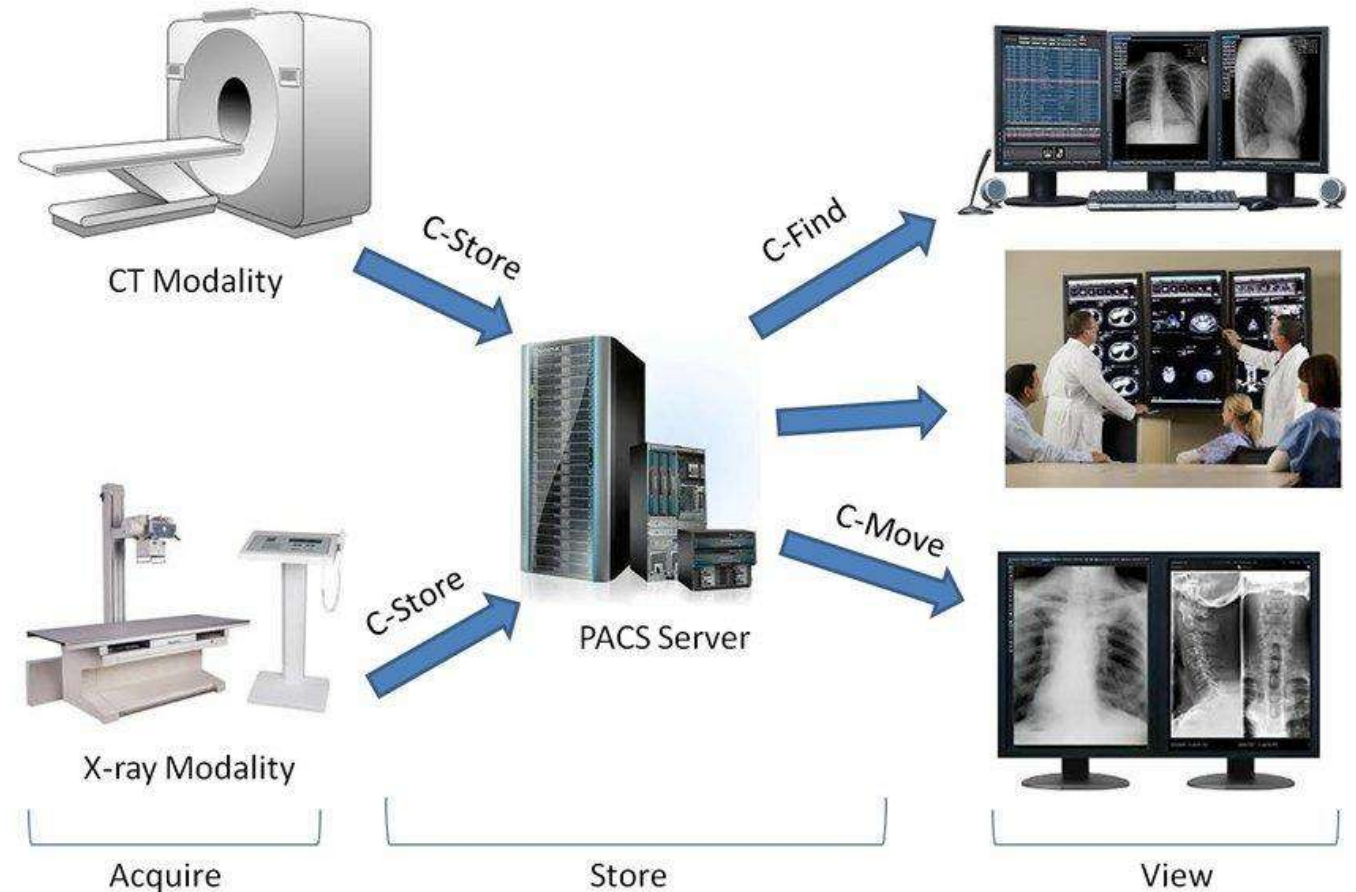
Accession No:



ContrastFlowDuration	0018,1047	0
Contrast_BolusIngredientConcentration	0018,1049	0
ReconstructionDiameter	0018,1100	200
DistanceSourceToDetector	0018,1110	104
DistanceSourceToPatient	0018,1111	570
Gantry_DetectorTilt	0018,1120	0
TableHeight	0018,1130	183
RotationDirection	0018,1140	CW
ExposureTime	0018,1150	238
X-rayTubeCurrent	0018,1151	260
Exposure	0018,1152	425
FilterType	0018,1160	0
GeneratorPower	0018,1170	58
FocalSpots	0018,1190	1.2
DateofLastCalibration	0018,1200	200
TimeofLastCalibration	0018,1201	085
ConvolutionKernel	0018,1210	B25
PatientPosition	0018,5100	FFS
Unknown	0019,0010	
Unknown	0019,1080	
StudyInstanceUID	0020,000d	1.2
SeriesInstanceUID	0020,000e	1.3
StudyID	0020,0010	200
SeriesNumber	0020,0011	5
AcquisitionNumber	0020,0012	11
InstanceNumber	0020,0013	553
ImagePositionPatient	0020,0032	-76
ImageOrientationPatient	0020,0037	110
FrameofReferenceUID	0020,0052	1.3

# 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

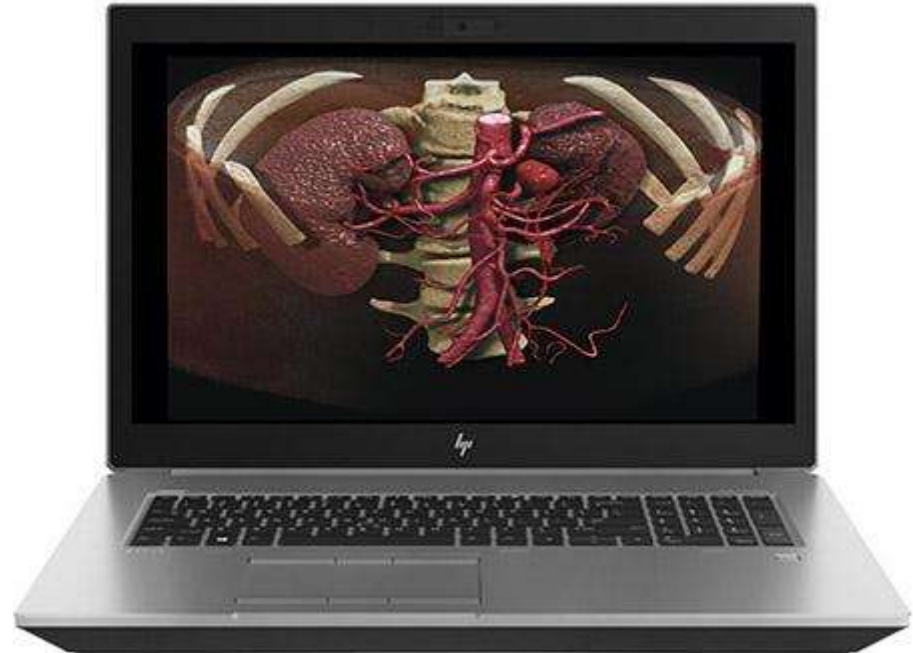
On one Laptop....

Using the same login....

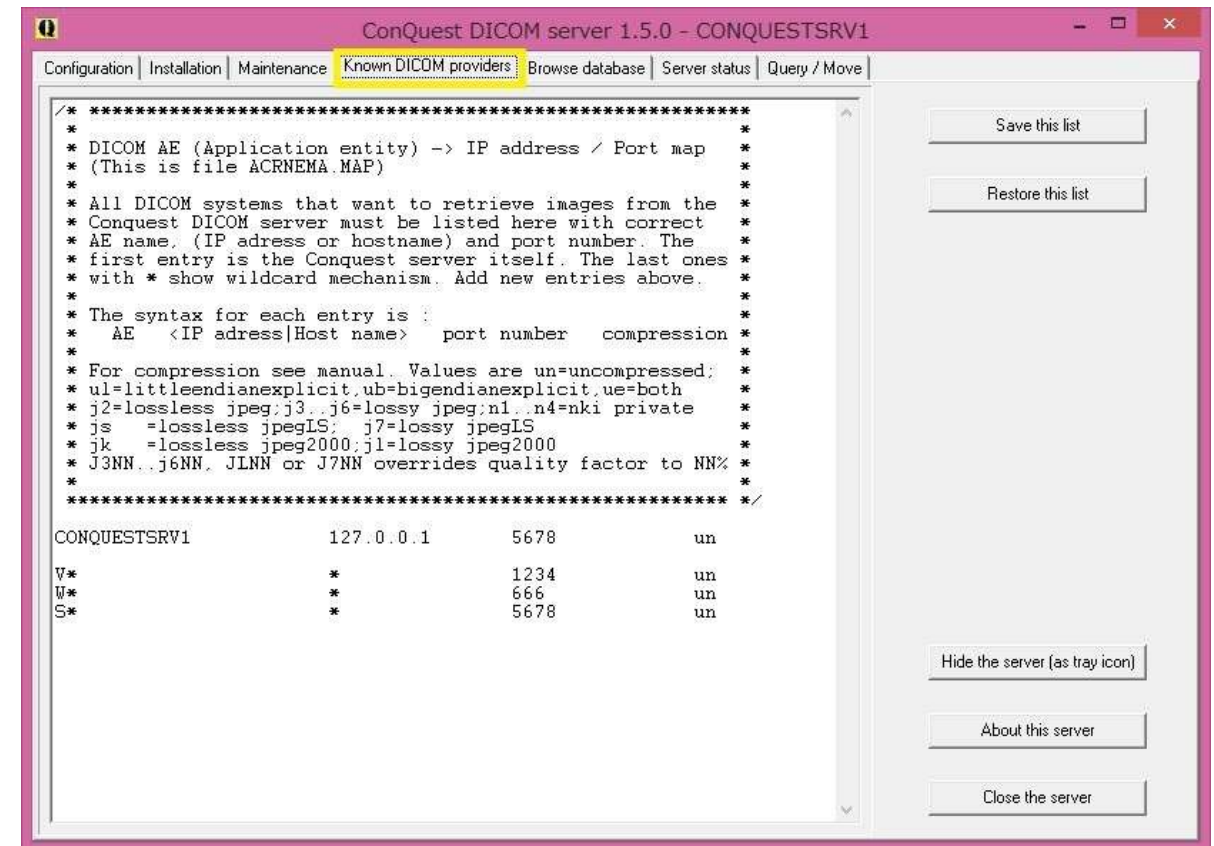
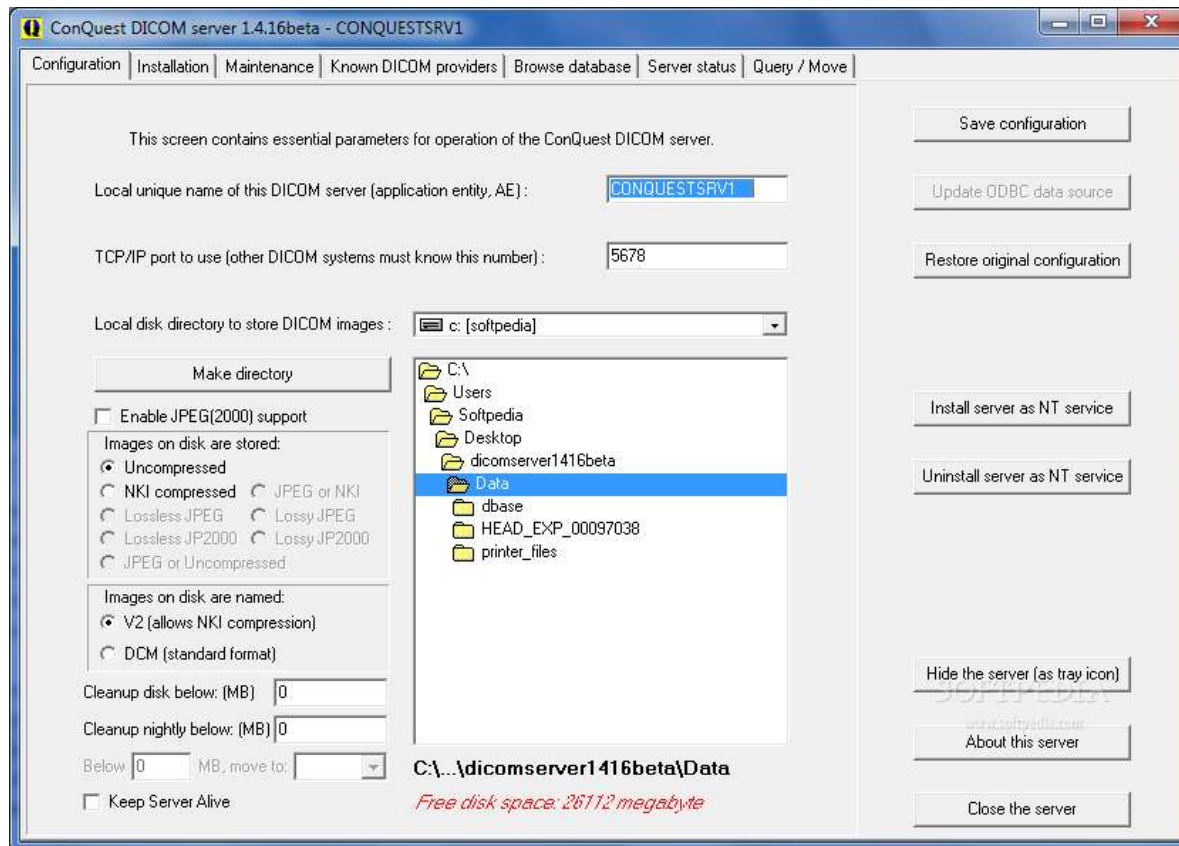
With the software  
already installed...

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

Deep breath...  
let's dive in!



# Setting up a test DICOM server – Use ConQuest

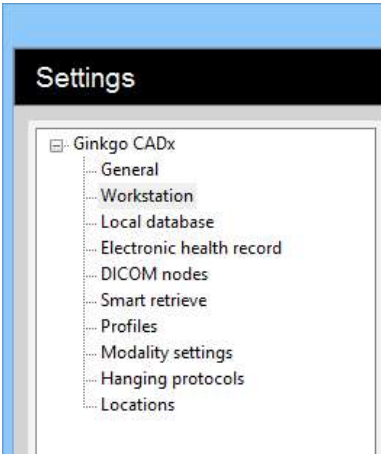
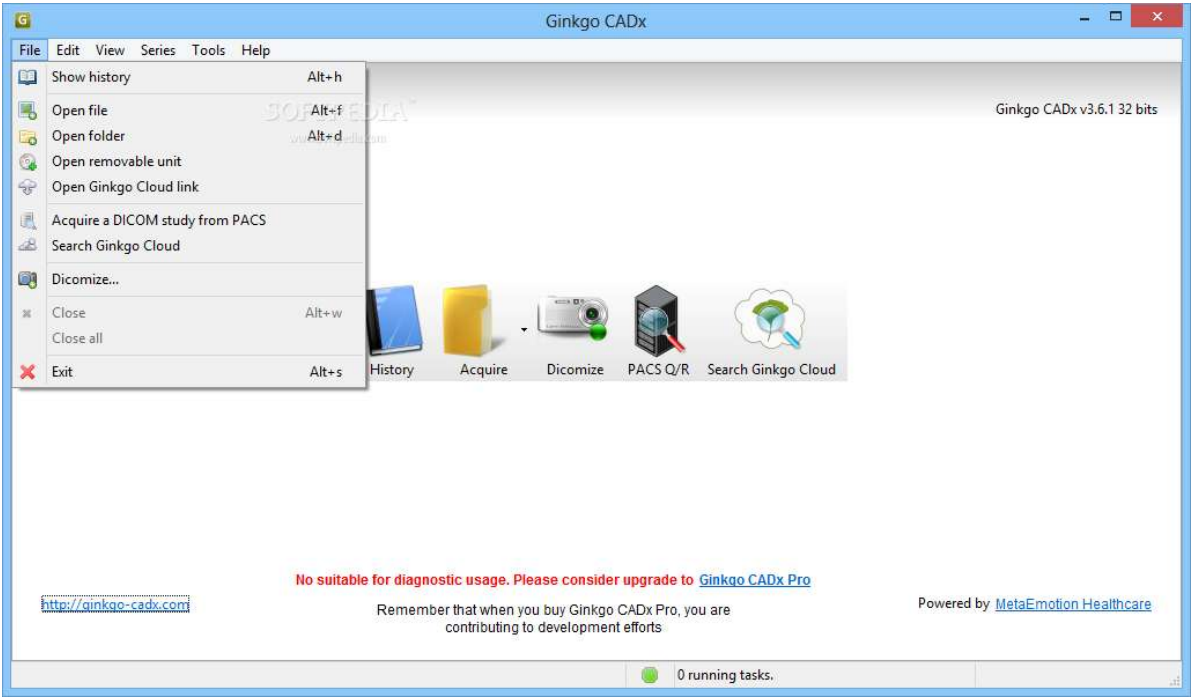


<https://image-systems.biz/products/free-dicom-pacs-tools/conquest/>

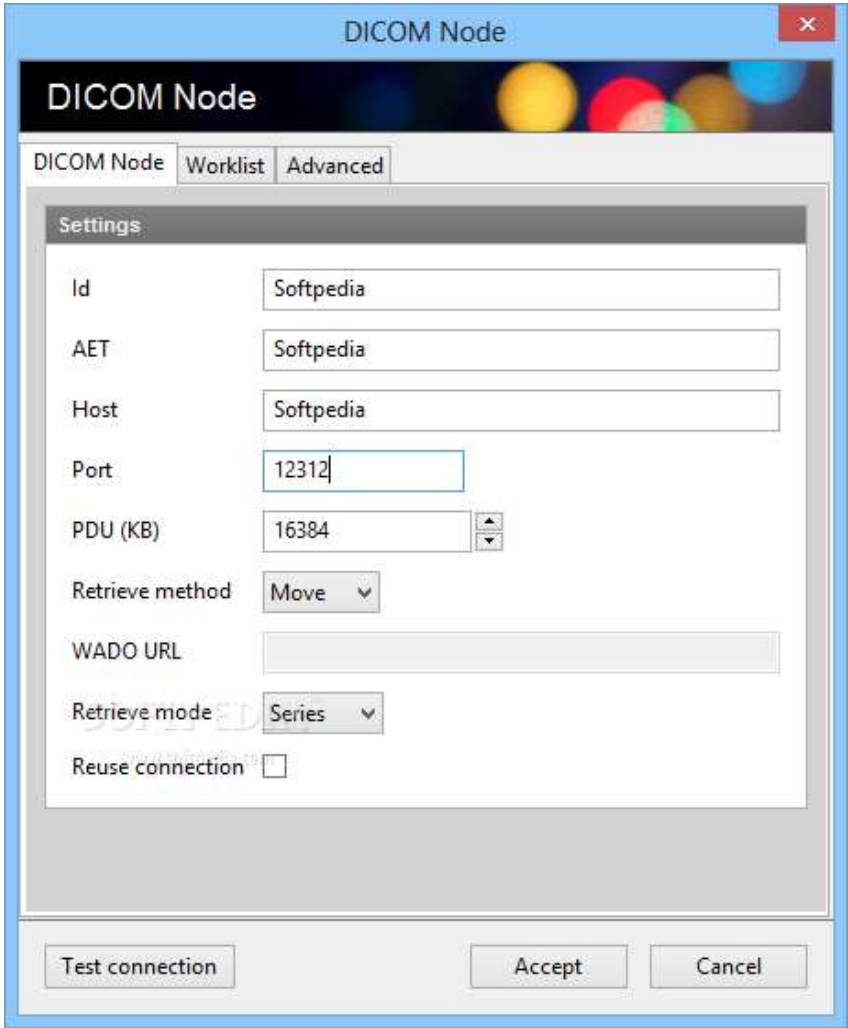
Warning : Install this DICOM software in a folder on the root of your hard drive (c:\)

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

# Setting Up a test DICOM Workstation – GinkGo CAD



General tab and DICOM Nodes are most important



<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

System Setting

General Store C-Store Worklist MPPS Print

Peripheral

Comment

Bodymark

Measure

DICOM

Load Default

About

Service List DicomStore Add Delete

DICOM Image Storage

Remote HostName DicomStore

IP Address 192.168.254.104 Ping

DICOM AE Title AE Echo

Port Number 104

Connect Timeout(sec) 10 Repeat Count 2

Dimse Timeout (sec) 10 Acse Timeout (sec) 30

Send After Every Image Stored

Send At End of Exam

Exit Apply

- 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

- TCP/IP Ping
- DICOM Echo
- Server Status in ConQuest
- Debug Logs
- DVTk Network Analyzer
- Wireshark
- Conformance Statements

<https://www.dvtk.org/downloads/>

] Ping

] Echo

```

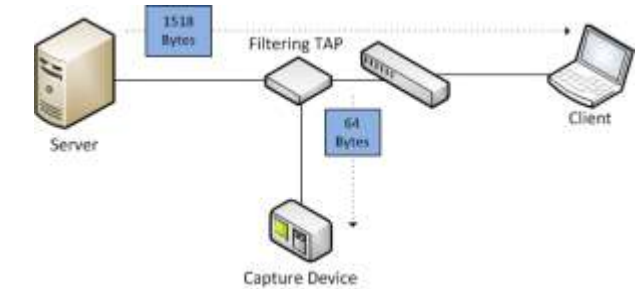
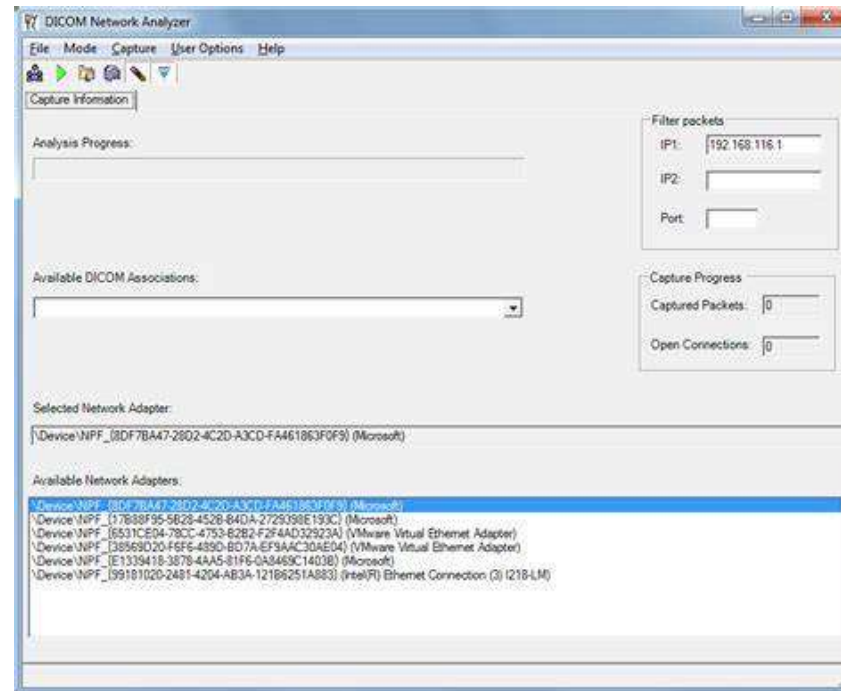
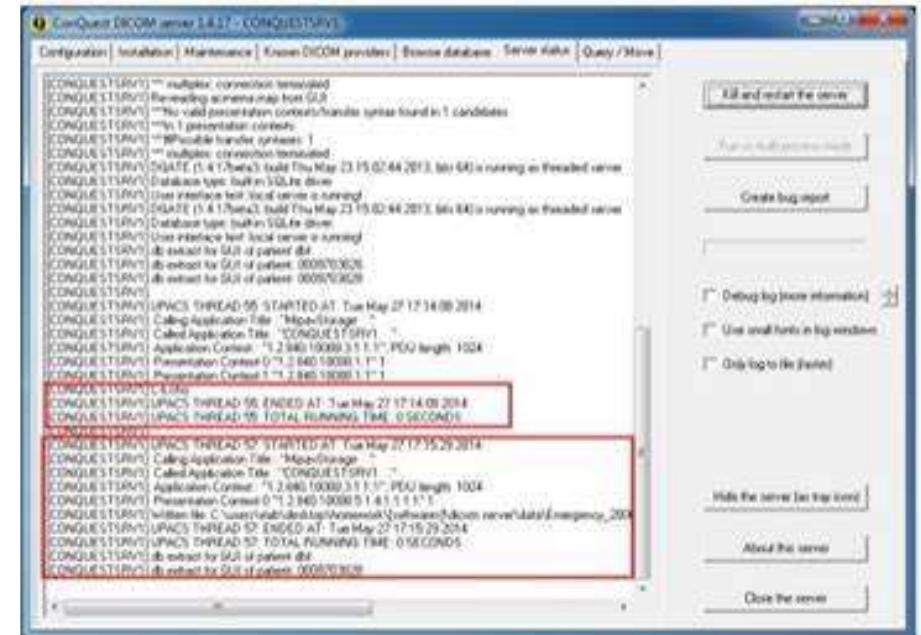
Microsoft Windows [Version 10.0.18362.900]
(c) 2019 Microsoft Corporation. All rights reserved.

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 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
        Minimum = 2ms, Maximum = 3ms, Average = 2ms

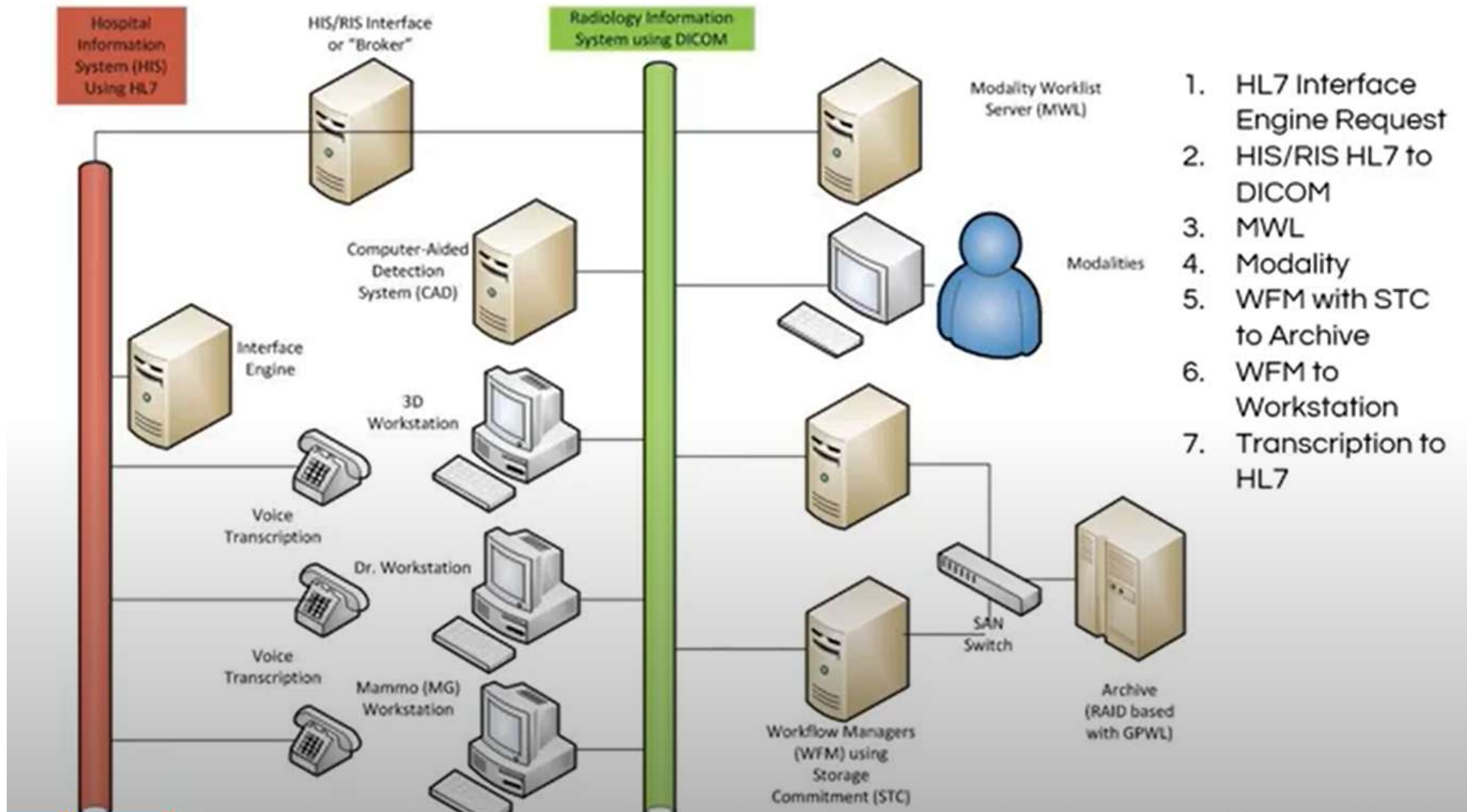
C:\Users\gabri>
    
```



No.	Time	Source	Destination	Protocol	Src. Port	Dst. Port	Info
45	15.267502	192.168.222.1	192.168.222.129	DICOM	1550	104	A-ASSOCIATE request SCU -> SCP
46	15.269415	192.168.222.129	192.168.222.1	DICOM	104	1550	A-ASSOCIATE accept SCU <-> SCP
49	15.485986	192.168.222.1	192.168.222.129	DICOM	1550	104	P-DATA, C-ECHO-RQ
55	15.488850	192.168.222.129	192.168.222.1	DICOM	104	1550	P-DATA, C-ECHO-RSP
55	15.704683	192.168.222.1	192.168.222.129	DICOM	1550	104	A-RELEASE request
56	15.704890	192.168.222.129	192.168.222.1	DICOM	104	1550	A-RELEASE response
105	37.722700	192.168.222.1	192.168.222.129	DICOM	1553	104	A-ASSOCIATE request SCU -> SCP
106	37.851629	192.168.222.1	192.168.222.129	DICOM	104	1553	A-ASSOCIATE accept SCU <-> SCP
128	37.851550	192.168.222.1	192.168.222.129	DICOM	1553	104	P-DATA, RT PLAN Storage (more Fragments)
134	37.851609	192.168.222.1	192.168.222.129	DICOM	1553	104	P-DATA, RT PLAN Storage (more Fragments)
246	37.853750	192.168.222.1	192.168.222.129	DICOM	1553	104	P-DATA, RT PLAN Storage (more Fragments)
358	37.854285	192.168.222.1	192.168.222.129	DICOM	1553	104	P-DATA, RT PLAN Storage (more Fragments)
375	37.854750	192.168.222.1	192.168.222.129	DICOM	1553	104	P-DATA, RT PLAN Storage (more Fragments)

# Frame 106 (277 bytes on wire (277 bytes captured) on interface 11, Src: VMware-Foxit64 (00:10:27:FE:96:84), Dst: VMware-00:10:00:00:00:00  
 # Internet Protocol, Src: 192.168.222.129 (192.168.222.129), Dst: 192.168.222.1 (192.168.222.1)  
 # Transmission control protocol, Src Port: 104 (104), Dst Port: 1553 (1553), Seq: 1, Ack: 287, Len: 223  
 # DICOM  
 # PDU Type: 0x3 (Assoc Accept)  
 # PDU Length: 217  
 # PDU Details: A-ASSOCIATE accept SCU <-> SCP  
 # Application context: DICOM Application Context Name (3.2.840.10008.1.1.1.1)  
 # Presentation context: ID 0x03, Accept, Explicit vs Big Endian, RT PLAN Storage  
 # Presentation context: ID 0x03, Accept, Explicit vs Little Endian, RT PLAN Storage  
 # User Info: Max PDU Length 16384, Implementation UID 1.2.276.0.7200010.3.0.3.1.3, Version OFFIS\_DICOM\_353

# What does a full DICOM network really look like?



1. HL7 Interface Engine Request
2. HIS/RIS HL7 to DICOM
3. MWL
4. Modality
5. WFM with STC to Archive
6. WFM to Workstation
7. Transcription to HL7

## Additional Functions:

- HIS/RIS Integration
- Worklist
- STC
- Transcription
- MPPS
- Cloud / Teleradiology
- CAD
- SR
- Printing
- Video

**Who Doesn't Have Questions?**