# Medical Infomatics Introduction

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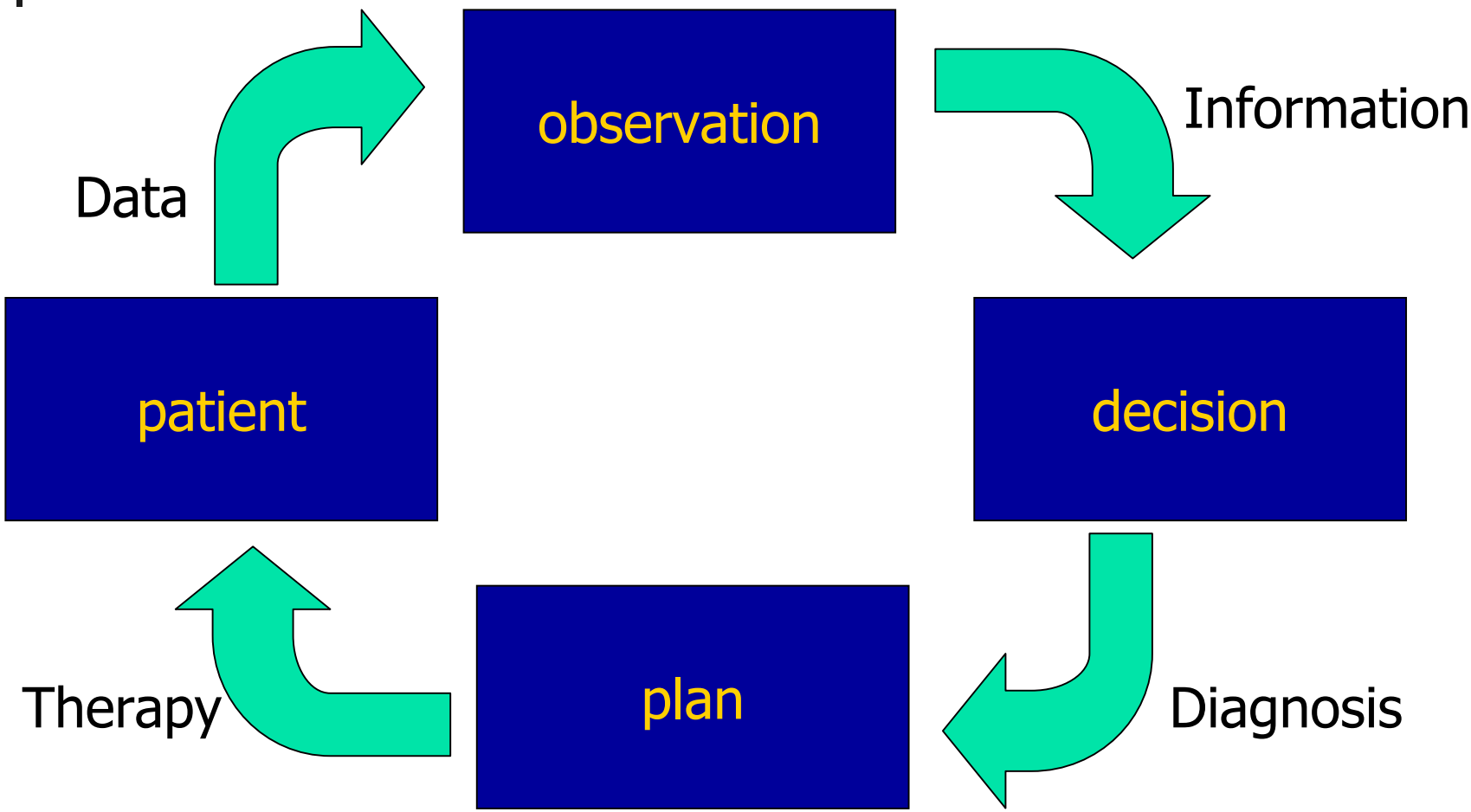
# Medical Information

- MI can’t and should not replace thought processes in human brain but should amplify the brain’s capabilities
- The objective and scientifically based part of the diagnosis may be left to the computer. Those elements of the individual problems of patient can’t be handled over a machine

# Diagnostic – therapeutic cycle




*Source handbook of Medical Informatics*

# Data in computer

# Medical data elements

- The *patient* in question
- The *parameter* being observed
  - Liver size, History, PE, Images, Bio-signal
- The *value* of parameter in question
- The *time* of the observation

# What are the types of medical data

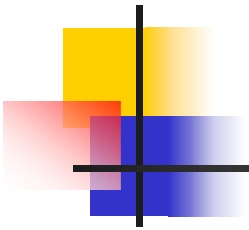
- Narrative data
  - Chief complain
- Numeric data
  - Blood pressure, weight, temperature
- Analog data
  - ECG, EEG
- Visual images
  - X ray, CT, MR
- Hand-draw sketches

# The history of Patient Record

- Time - Oriented Medical Record
  - Mar 4,2003 : Shortness of breath…..
- Source – Oriented Medical Record
  - Mar 4, 2003 : Visit
  - Mar 4, 2003 : Lab, X-ray….
- Problem –Oriented Medical Record
  - S (Subjective)
  - O (Objective)
  - A (Assessment)
  - P (Plan)

# The issue of patient monitory data

- Data Quality and Validation
- Continuous versus intermittent Monitory
- Data Recording frequency
- Integration of multiple kinds of data



# The history of MI architecture

- 1960 - 1970 Central Systems
- 1970 - 1980 Modular Systems
- 1980 - 1990 Client / Server Systems
- 1990 - now  Web-based Systems

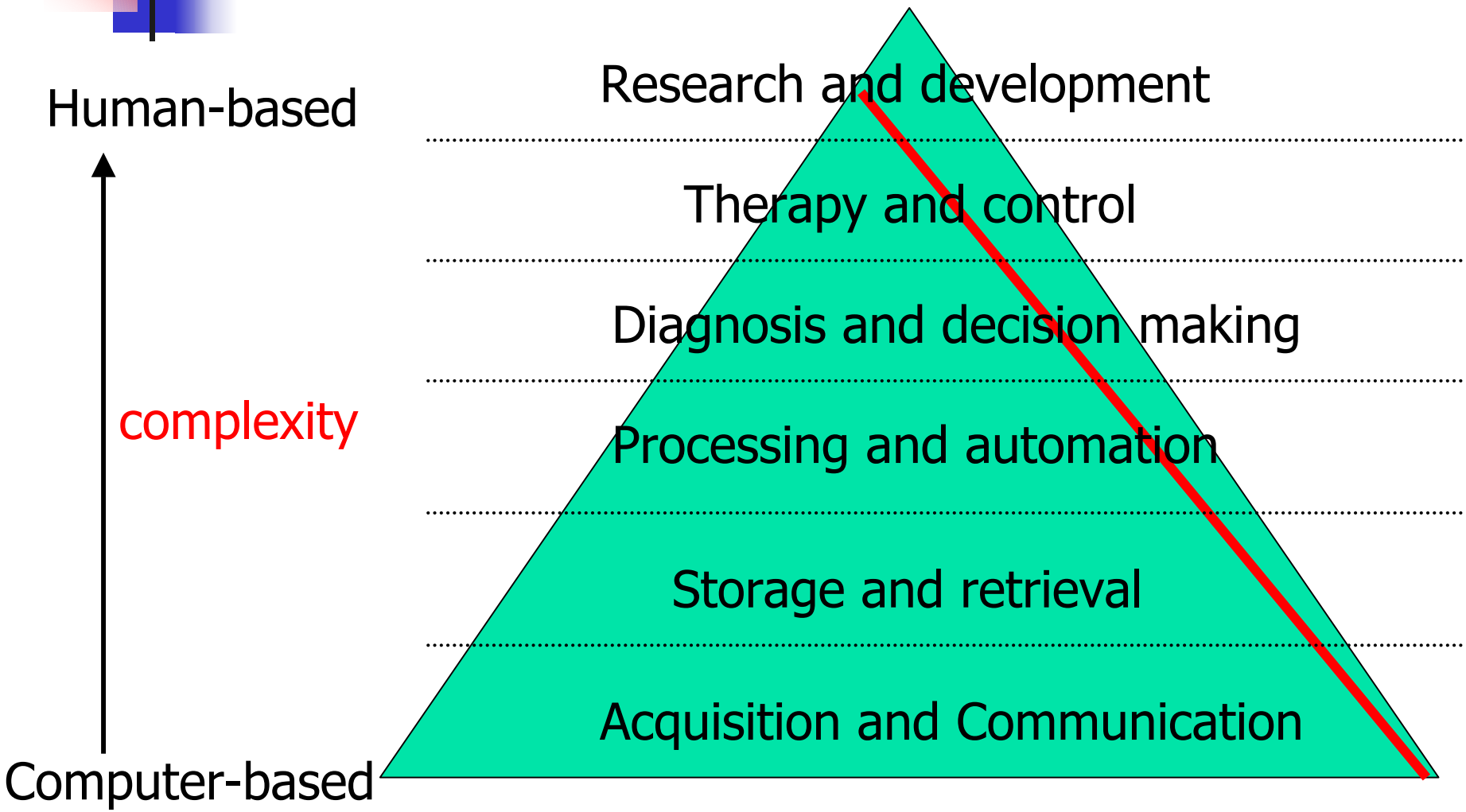
# The basic element of MI system

- Standard
  - Data
  - Coding
- Database
  - Relational DB
  - Object-Oriented DB
- Network
  - LAN,WAN
  - Wireless Communication
- Viewing Station
  - Input Device
  - Processing Units
  - Output Monitor
- Storage
  - HD,DVD,Tape

# How to use medical data

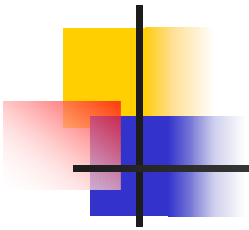
- Create the basis for the history record
  - Evidence : problem, symptom, examination, treatment
- Support communication among providers
- Anticipate future health problems
  - Screen high risk factor
  - Record standard preventive record
  - Identify deviations from expected trend
- Provide a legal record
- Support clinical research
- Cost management

# Level of complexity of MI



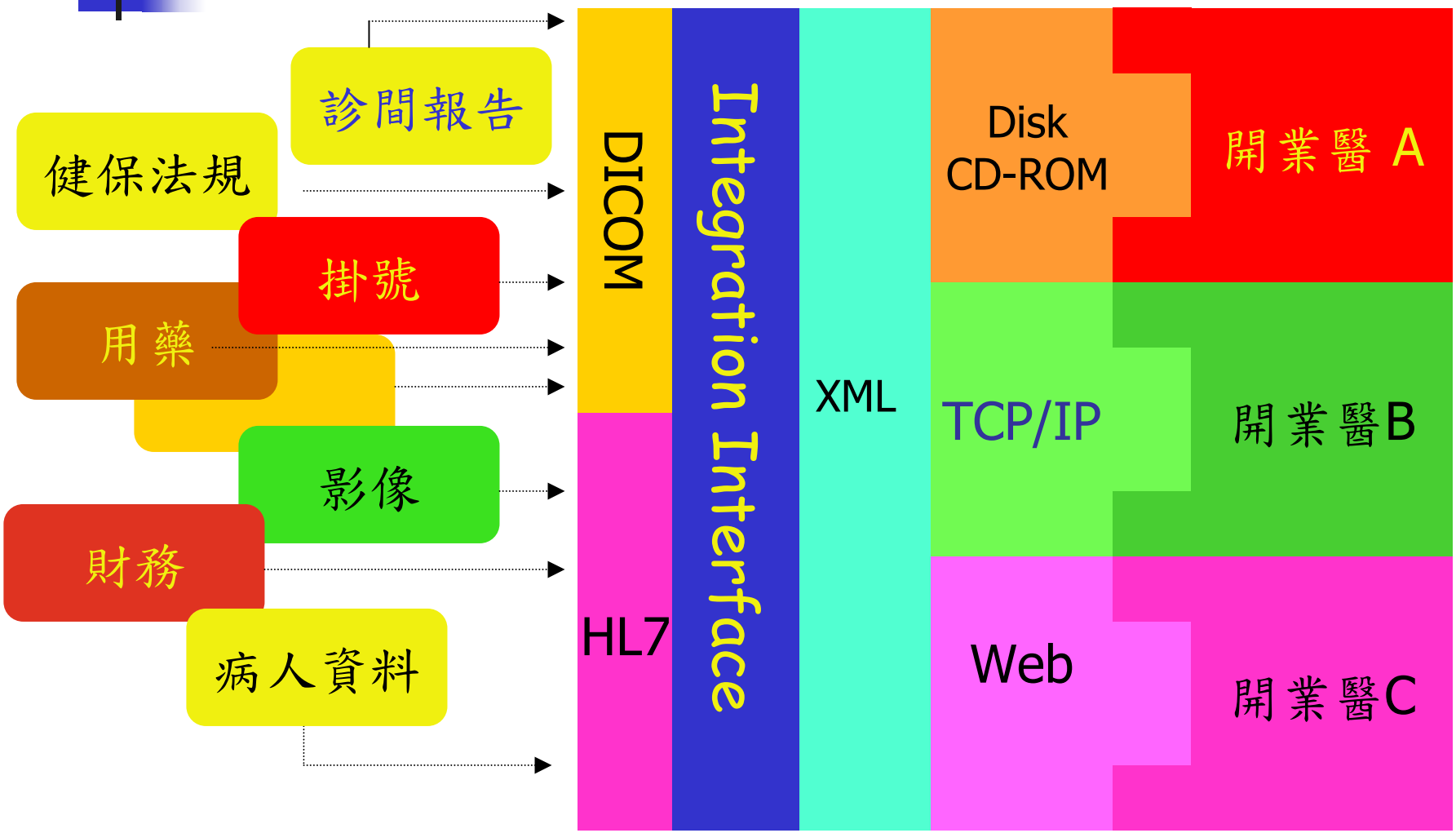
# MI Trend

- Research
  - Formulate rules
  - Discover laws
  - Structure model
- Application
  - Control and stabilize the cost of health care
  - Shift from hospital care to primary (home) care
    - Shared care
    - Electronic data interchange
    - Telemedicine



# Understand DICOM

# 數位式病歷系統


診間報告
健保法規
掛號
用藥
影像
財務
病人資料
DICOM
HL7
Integration Interface
XML
Disk
CD-ROM
TCP/IP
Web
開業醫 A
開業醫B
開業醫C

# Digital Imaging and Communications in Medicine (DICOM)

# Why DICOM?

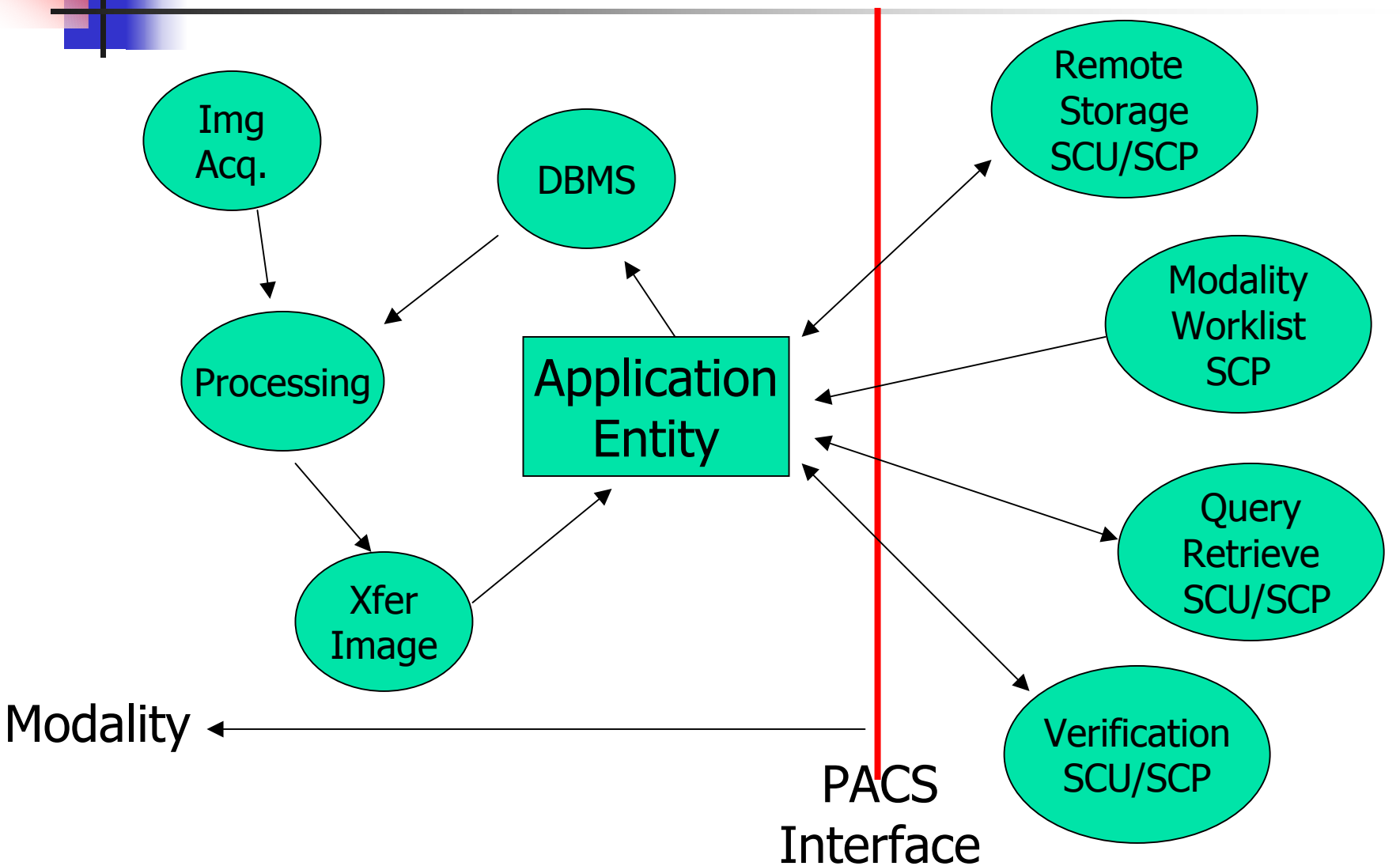
- DICOM Standard
  - Image File Format
    - Object Tag
    - Raw Data of Image
  - Exchange Information Protocol
    - OSI、TCP/IP
    - Information Object
    - Services Class

DICOM Part 1: Introduction and Overview
DICOM Part 2: Conformance
DICOM Part 3: Information Object Definitions
DICOM Part 4: Service Class Specifications
DICOM Part 5: Data Structure and Semantics
DICOM Part 6: Data Dictionary
DICOM Part 7: Message Exchange
DICOM Part 8: Network Communication Support for Message Exchange
DICOM Part 10: Media Storage and File Format for Media Interchange
DICOM Part 11: Media Storage Application Profiles
DICOM Part 12: Media Formats and Physical Media for Media Interchange
DICOM Part 13: Print Management Point-to-Point Communication Support
DICOM Part 14: Grayscale Standard Display Function
DICOM Part 15: Security Profiles

# Comparing DICOM conformance statements

- Check and compare the application descriptions
- Match up the DICOM service object pairs
- Match up the User/Provider roles
- Check the number of simultaneous associations
- Compare the presentation contexts
- Compare the communication profiles
- Check for any special object attribute requirements

# Application Entities and bubble diagrams

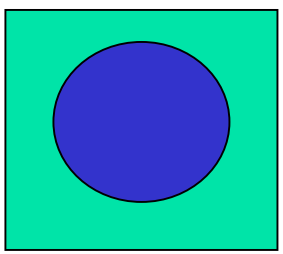


# DICOM Service

- Composite
  - DICOM C_Store
  - DICOM C_Find
  - DICOM C_Move
  - DICOM C_Get
  - DICOM C_Echo
- Normalized
  - DICOM N_Action
  - DICOM N_Eventrep
  - DICOM N_Create/Set
  - DICOM N_Delete

# DICOM C_Store

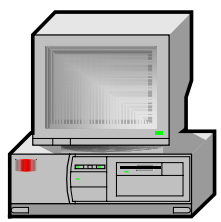
- Requirement
  - The modality shall send images for soft copy display



CT / MR

Modality Push

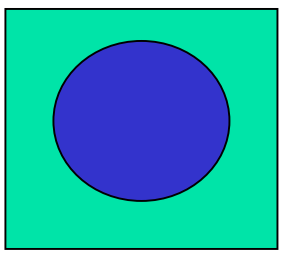
DICOM C_Store



Computer

# DICOM C_Store

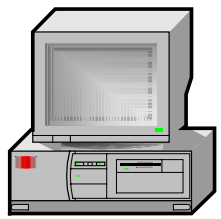
- Requirement
  - Old images shall be available to the technologist at the modality console when comparing study



CT / MR

PACS Push

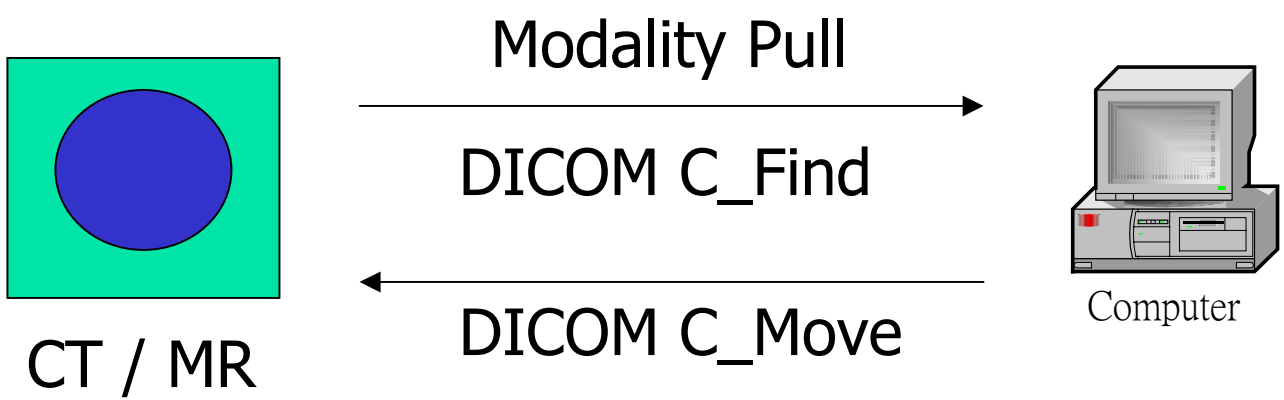
DICOM C_Store



Computer

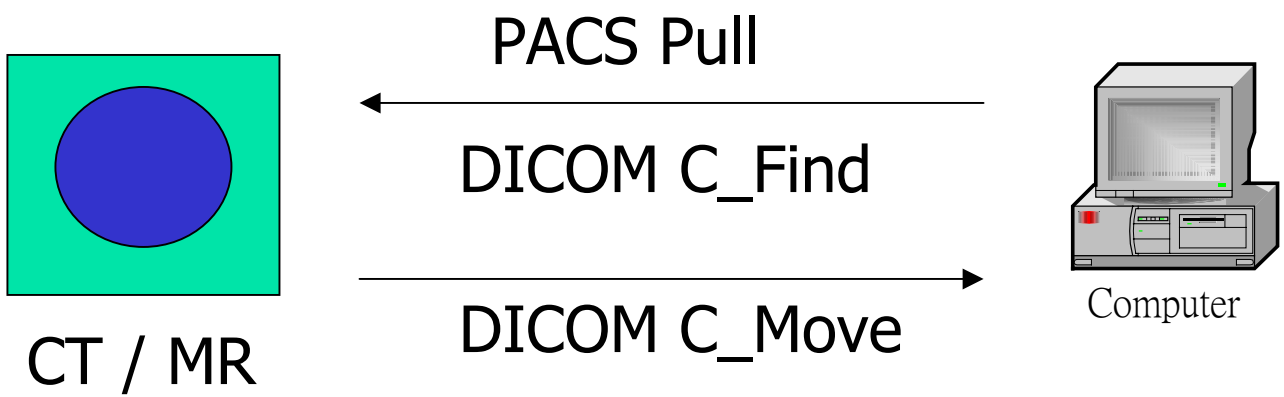
# DICOM C_Find /C_Move

- Requirement : modality query the PACS to get patient's images
- Modality : SCU of Query/Retrieve Service



# DICOM C_Find /C_Move

- Requirement : PACS get additional studies, series, images
- Modality : SCP of Query/Retrieve Service
- PACS : SCU of Query/Retrieve Service



# Match up the DICOM service object pairs

- Service Object Pairs : SOP
  - SOP Class
    - The functionality of a device
  - SOP Instances
    - The identifying the individual object
- SOP Class like as template

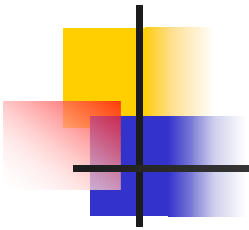
# Match up the DICOM service object pairs

- SOP Class
  - Service element
    - Store, Find, Move, …
  - Object define
    - CT Image
- SOP is identified with a Unique Identifier (UID)

# UID Examples - Storage Service

| SOP Class Name | SOP Class UID |
|---|---|
| Computed Radiology Image Storage | 1.2.840.10008.5.1.4.1.1.1 |
| CT Image Storage | 1.2.840.10008.5.1.4.1.1.2 |
| MR Image Storage | 1.2.840.10008.5.1.4.1.1.4 |
| Nuclear Medicine Image Storage (Retired) | 1.2.840.10008.5.1.4.1.1.5 |
| Nuclear Medicine Image Storage | 1.2.840.10008.5.1.4.1.1.20 |
| Ultrasound Image Storage (Retired) | 1.2.840.10008.5.1.4.1.1.6 |
| Ultrasound Image Storage | 1.2.840.10008.5.1.4.1.1.6.1 |

# Match up the User/Provider roles



- DICOM is based on two way communication
  - A device that sends, the other one that receives
  - DICOM terminology : Invokes, Performs
- DICOM roles
  - SCU (Service Class User)
  - SCP (Service Class Provide)

# SCU/SCP Example

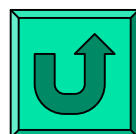
- Scenario
  - MRI, radiology workstation, physician workstation, Printer server
  - MRI send image to workstation
  - Radiology receive image from MRI, send image to physician for consultation, send image to printer for printer service
  - Physician query old image, view image,
  - Printer Service

# SCU/SCP Role

- MRI :
  - SCU of the storage SOP Class
- Radiology :
  - SCU/SCP of the storage SOP class
  - SCP of the query service
  - SCU of the printer service

# SCU/SCP Role

- Physician
  - SCP of the storage SOP class
  - SCU of the query service
- Printer
  - SCP of the printer service



# Check the number of simultaneous associations

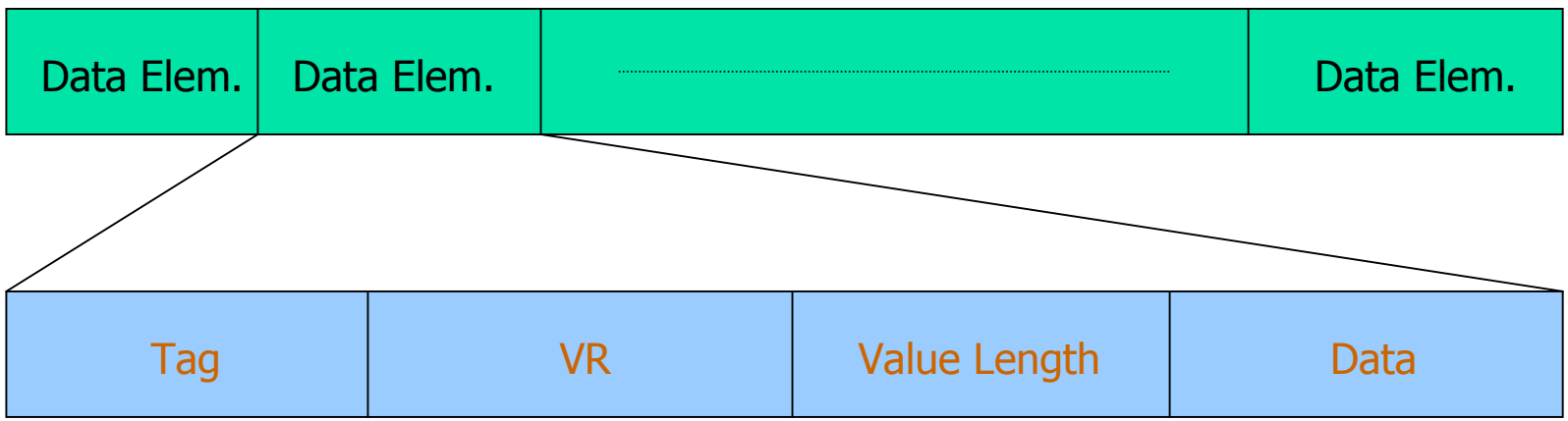
- How many “DICOM Conversations” can handle simultaneous?
- Purpose:
  - SCP : a separate device is required
  - Can handle the potential impact on performance
- How long does an association stay open?

# Compare the presentation contexts

- Also called :Transfer syntax
- Not all PC use the same byte ordering
- How the information is encoded for each SOP class
- Ex.
  - Implicit / Explicit VR, Little/ Big  Endian
  - JPEG compression

# Implicit / Explicit VR

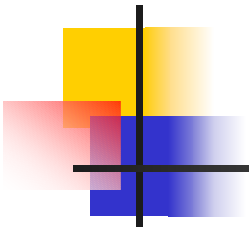
- DICOM part 5:define Value Representation (VR)
- DICOM part 6 (Dictionary): attributes



# DIOCM Data Element

- Tag : 16 bit unsigned integer representing the Group Number and Element Number
- Ex.
  - (0008,0020) Study date
  - (0008,0060) Modality
  - (0010,0010) Patient's name
  - (0010,0020) Patient ID
  - (0028,0010) Number of pixel rows in the image
  - (0038,001A) Scheduled admission date

- Value Representation : two-byte character string containing a code which describes the data type for that element
- Value length : an unsigned integer which give the length of value field in bytes
- Value filed : this is the actual value being sent. The value field must always contain an even number of bytes.

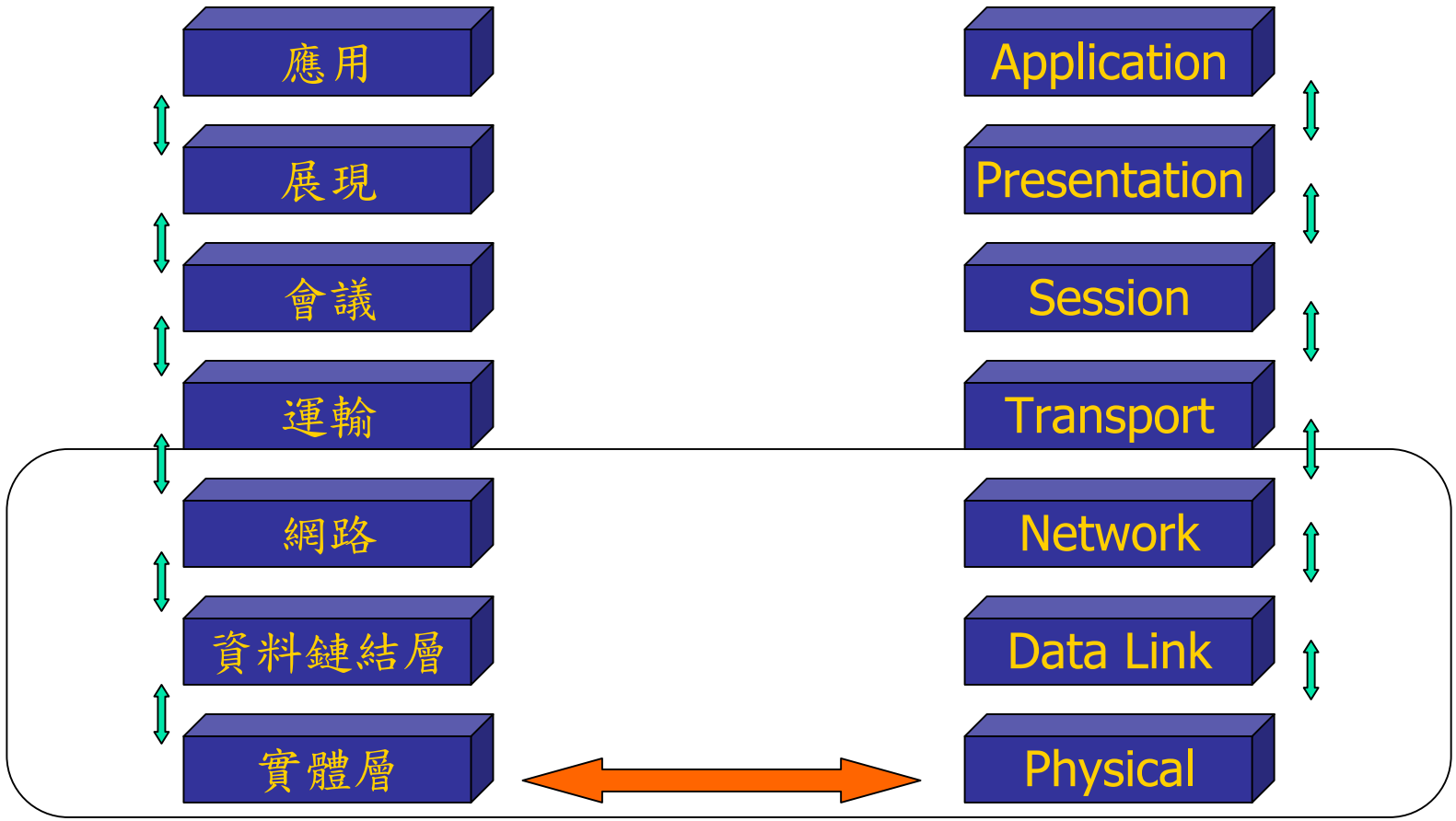


- Little / Big Endian
  - Little : the Least Significant Byte come first
  - Big : the most Significant Byte come first
- Data compression
  - Require reason
    - Reduce storage space, certain application, WAN
  - Trade – off using image compression

# Compare the communication profiles

- DICOM follow OSI-7 layer communication model.
- There are three communication options
  - OSI
  - 50 pin point-to-point
  - TCP/IP ->Transport Layer
- Physical connection is not define

# OSI 通訊協定七層架構



# Check for any special object attribute

- Check for additional and/or unusual attribute requirements
- Attribute
  - The smallest component of DICOM Object
  - Ex. : Patient Name
- Failure to properly match attributes can break a system

# Picture Archiving and Communication System

# PACS

# 目前健保申報模式

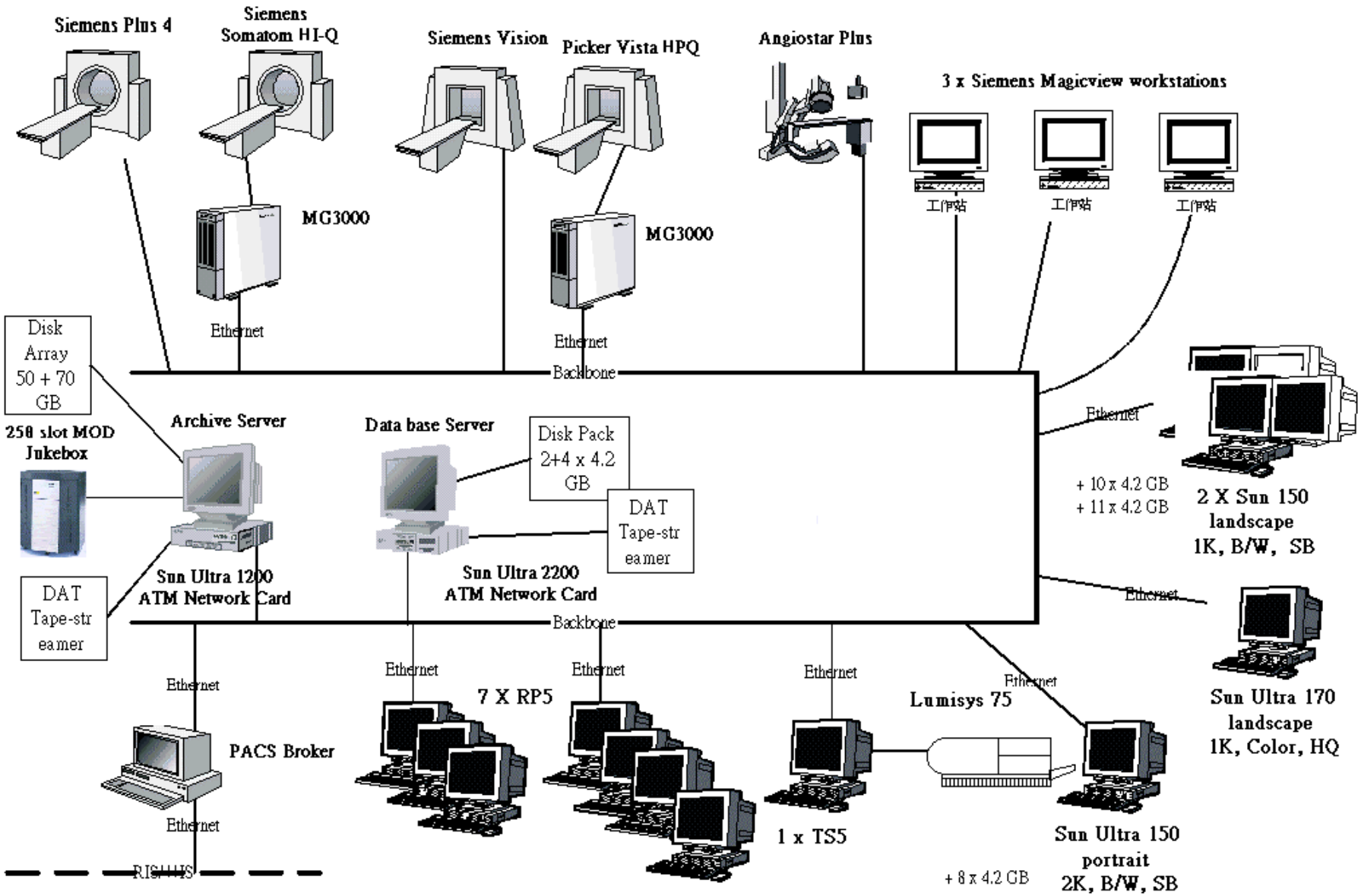
- 健保局在抽審時會要求診所將病人病歷以及在該次治療時所拍攝之片子全部送至健保局備審，待健保局審完之後再將影像連同複印的病歷寄回診所
- 缺點
  - 往返時間過長
  - 影像送審後診所沒有留存，因此健保局像若是沒將影像送回診所將無法調閱該影像
  - 影像在寄送時容易發生遺失的情形，沒有備份影像可以調閱。健保局會因此無法審查

# 傳統片子缺點

- 一般診所並無此翻拍設備進行資料備份
- 需沖洗，環保問題
- 保存不易
- 調閱不易
- 無法資源共享

# 數位化影像特色

- 便於資料的儲存與管理
- 可用電腦輔助分析軟體來提升醫療品質
- 可透過網路傳輸提供會診達到資源分享
- 減低人工作業, 增進調閱速度


Siemens Plus 4
Siemens Somatom HI-Q
Siemens Vision
Picker Vista HPQ
Angiostar Plus
3 x Siemens Magicview workstations
MG3000
MG3000
Ethernet
Ethernet
Backbone
Disk Array 50 + 70 GB
250 slot MOD Jukebox
Archive Server
Data base Server
Disk Pack 2+4 x 4.2 GB
DAT Tape-str eamer
Sun Ultra 1200 ATM Network Card
Sun Ultra 2200 ATM Network Card
DAT Tape-str eamer
Ethernet
+ 10 x 4.2 GB
+ 11 x 4.2 GB
2 X Sun 150 landscape 1K, B/W, SB
Ethernet
Backbone
Ethernet
Sun Ultra 170 landscape 1K, Color, HQ
Ethernet
PACS Broker
Ethernet
RIS/HIS
Ethernet
7 X RP5
Ethernet
Ethernet
1 x TS5
Ethernet
Lumisys 75
+ 8 x 4.2 GB
Sun Ultra 150 portrait 2K, B/W, SB

# Main Component of PACS

- Archiving Server
- Application Client
- Network
- Storage
- Database
- Printer

# Main Component of PACS

- Archiving Server
  - Image Import/Export
  - Image Information Management
  - Image Data Backup/Restore
  - Image Data Flow Control
  - Error Message Control

# Main Component of PACS

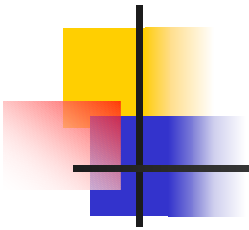
- Application Client
  - Image Display
  - Image Process
  - Image Report
  - Template Storage
    - DICOMDIR
    - DATABASE

# Main Component of PACS

- Network
  - Internet
    - Analog Modem, ADSL
    - ISDN, Cable
    - ATM
  - Intranet
    - Giga Bit
    - Fast Ethernet
    - FDDI

# Main Component of PACS

- Storage
  - Huge Capacity Hard Disk
  - Disk Array(Mirror, RAID5)
  - Juke Boxes：MO、Tape、DVD、CD-RW、CR-R

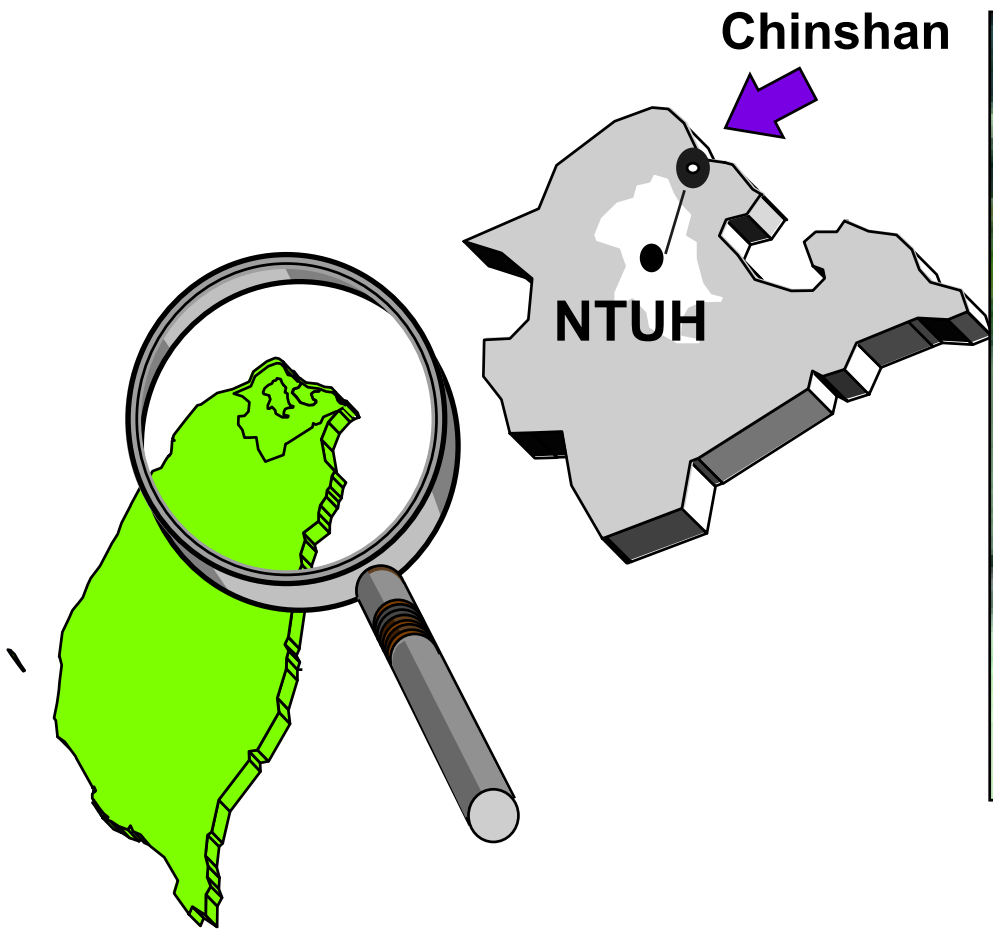


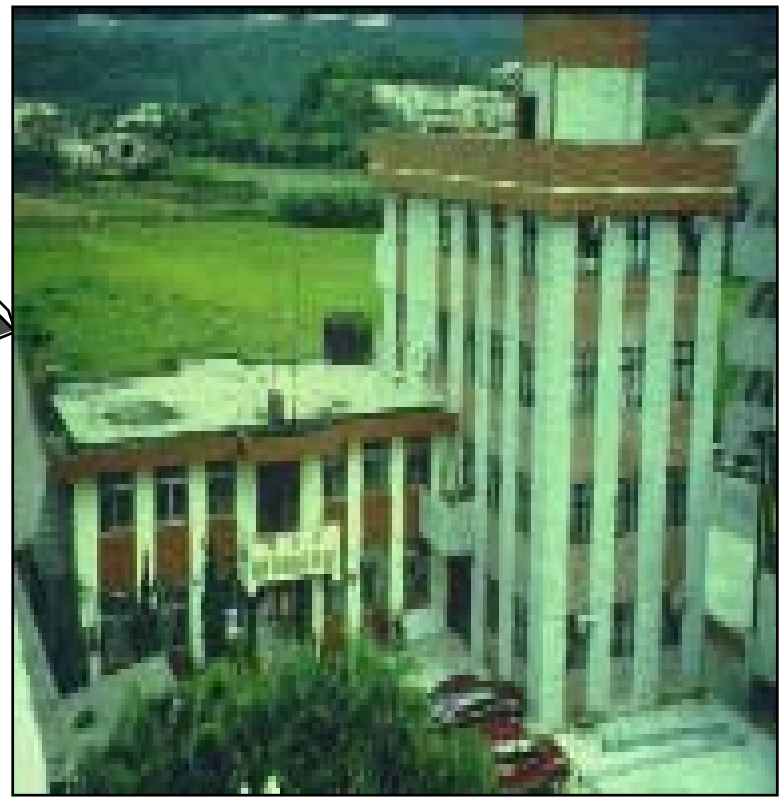
# How to implement ?

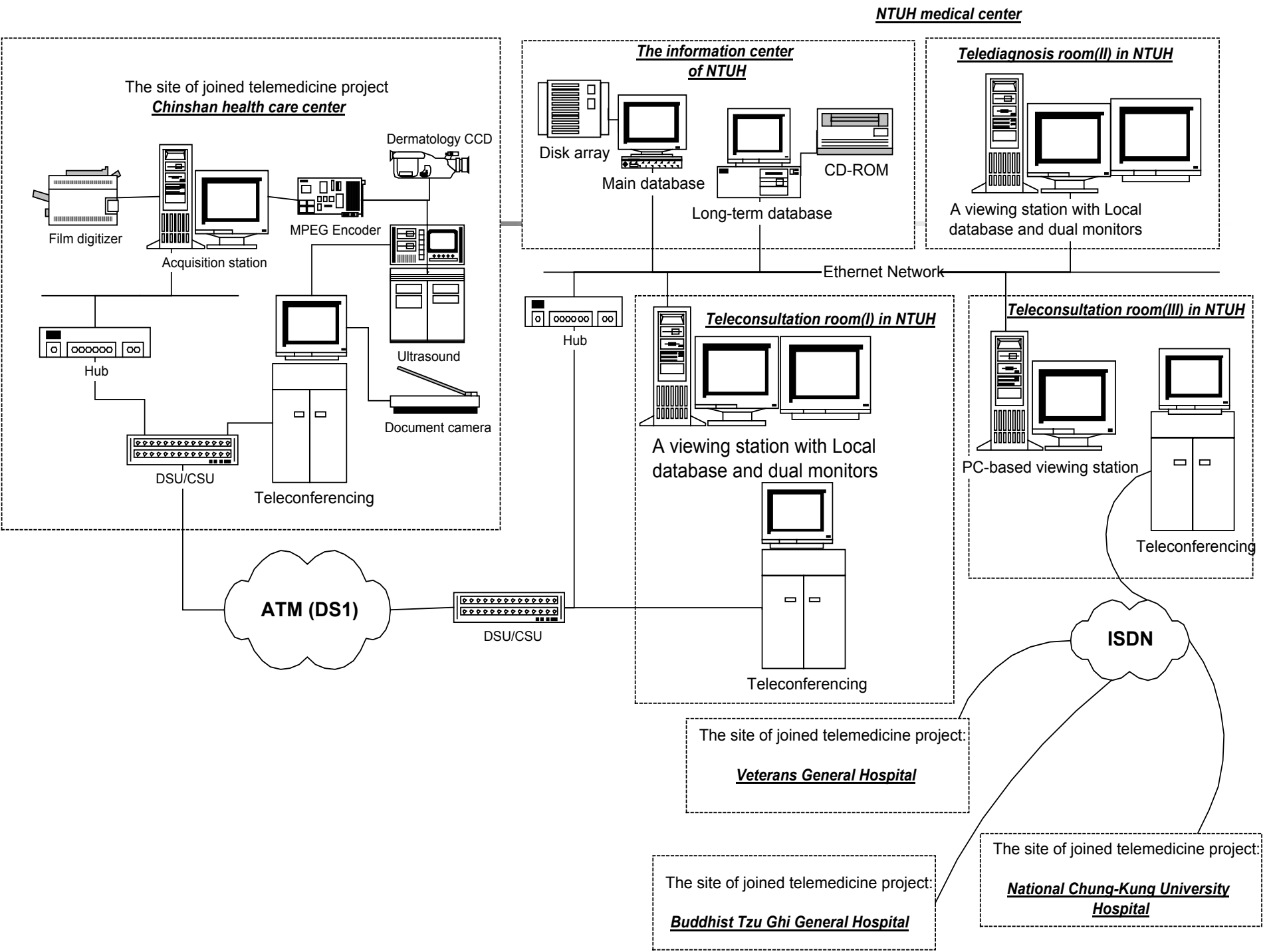
- Working Model
- Data exchange
  - Standard
- System upgrade
  - Easy migration
  - Cost
  - Time
- Network
  - Bandwidth
  - Protocol

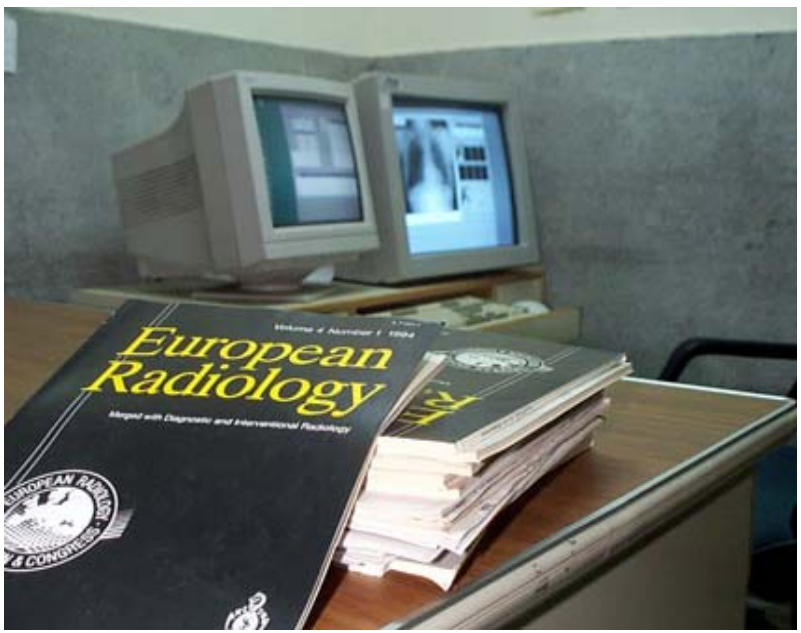
# 台大遠距醫療系統

# 金山衛生所



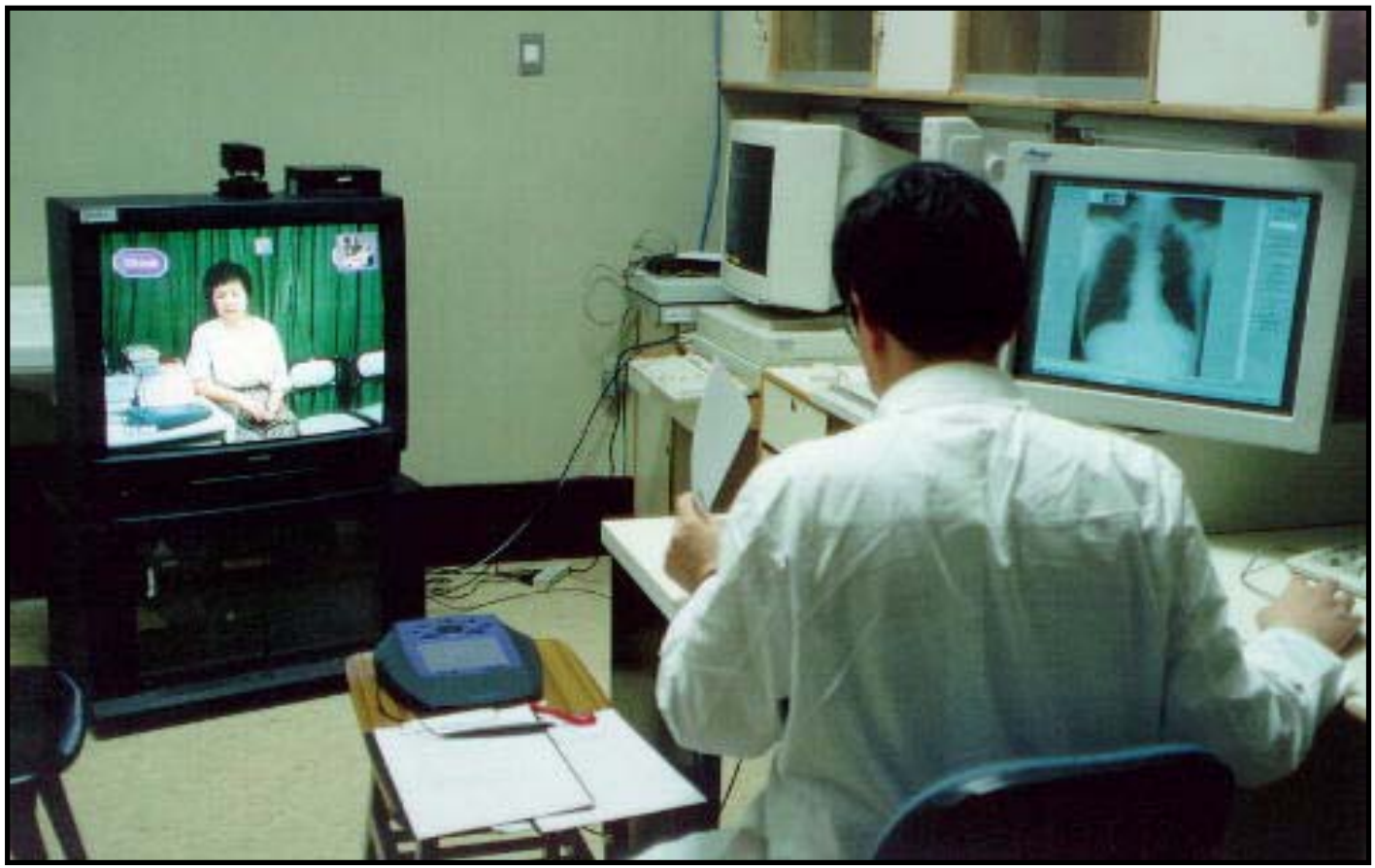




NTUH medical center
The site of joined telemedicine project
Chinshan health care center
Dermatology CCD
Film digitizer
Acquisition station
MPEG Encoder
Hub
Ultrasound
Document camera
DSU/CSU
Teleconferencing
The information center of NTUH
Disk array
Main database
CD-ROM
Long-term database
Telediagnosis room(II) in NTUH
A viewing station with Local database and dual monitors
Ethernet Network
Hub
Teleconsultation room(I) in NTUH
A viewing station with Local database and dual monitors
Teleconferencing
Teleconsultation room(III) in NTUH
PC-based viewing station
Teleconferencing
ATM (DS1)
DSU/CSU
ISDN
The site of joined telemedicine project:
Veterans General Hospital
The site of joined telemedicine project:
Buddhist Tzu Ghi General Hospital
The site of joined telemedicine project:
National Chung-Kung University Hospital


European Radiology

# 雙螢幕會診系統

# 遠距X片 會診



# 超音波診斷

Chinshan Health Care Center

NTUH

# Thank you for your attention