

PACS

**PICTURE ARCHIVING
& COMMUNICATIONS
SYSTEM**

DEFINITION

- **A picture archiving and communications system (PACS) is a medical imaging technology which provides economical storage of, and convenient access to, images from multiple modalities.**

HISTORICAL DEVELOPMENT

- Concept began with Albert Jutras in Canada in the 1950s.
- Early **PACS** systems were developed by the military to send images between Veterans Administration hospitals in the 1980s.
- Development was encouraged and supported by the U.S. government.

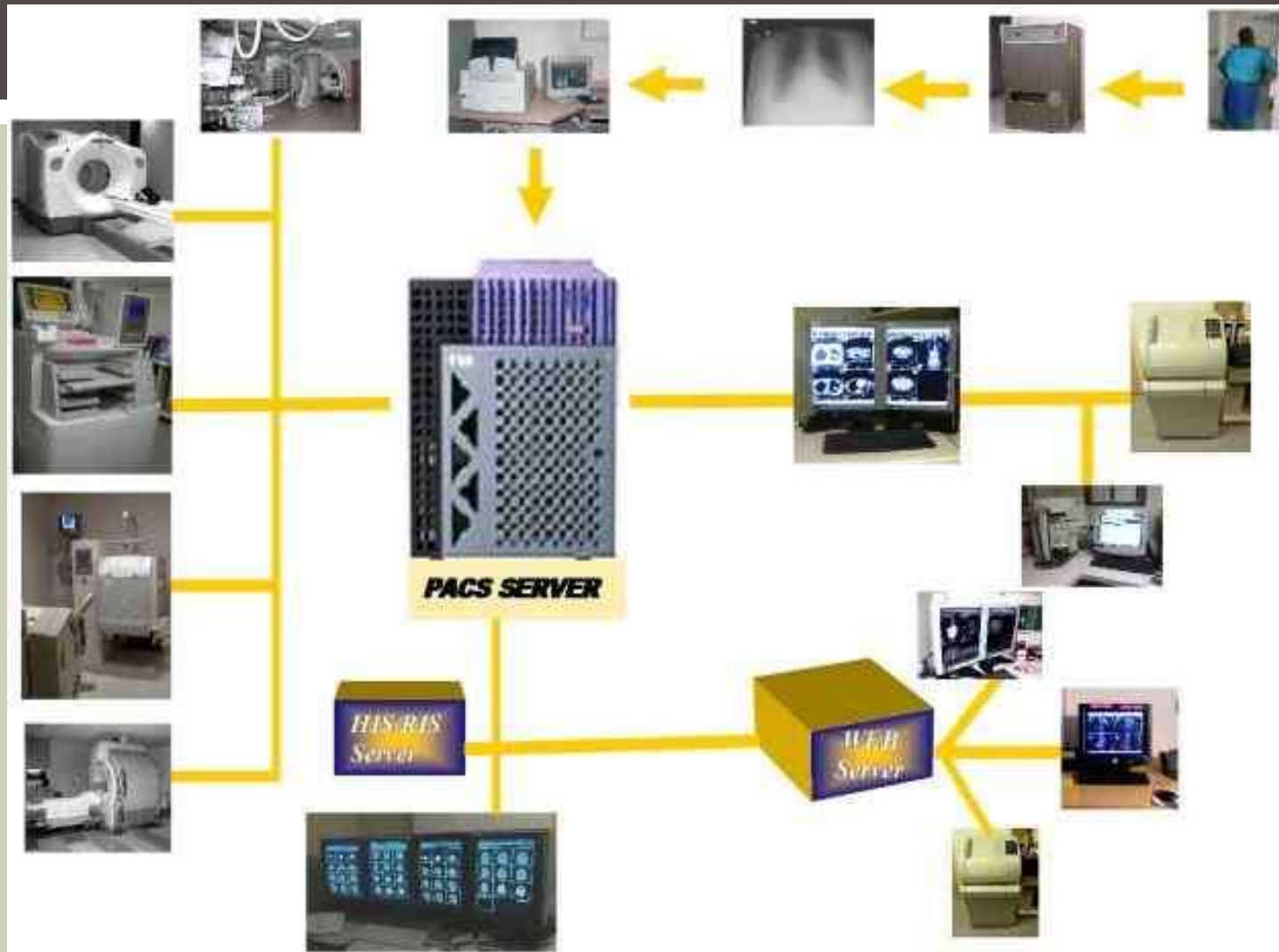
- Early process involved scanning radiographs into the computer and sending them from computer to computer.
- Images were then stored in PACS.
- Computed and **digital radiography** followed.

PACS

- **A network of computers used by radiology departments that replaces film with electronically stored & displayed digital images.**
- **It provides archives for storage of multimodality images, integrates images with patient database information, facilitates laser printing of images & displays both images & patient information at work stations throughout the network.**
- **It also allows viewing of images in remote locations.**

PACS

- Can accept any image that is in **DICOM** format
- Custom designed for each facility
- Components/features can vary based on the following:
 - Volume of patients
 - Number of interpretation areas
 - Viewing locations
 - Funding



DICOM

- DICOM (**Digital Imaging and Communications in Medicine**) is the universal format for PACS image storage and transfer.
- Non-image data, such as scanned documents, may be incorporated using consumer industry standard formats like PDF (Portable Document Format), once encapsulated in DICOM.

Industry Standard Integration



INITIAL PROBLEMS

- Early systems did not have standardized image formats.
- Matching up systems was difficult.
- Vendors kept systems proprietary and did not share information.
- DICOM standards helped change this by allowing communication between vendors' products.

COMPONENTS

- Made up of **4** major components:
 - 1.** Imaging modalities- such as X-ray plain film (PF), CT and MRI.
 - 2.** A secured network for the transmission of patient information.
 - 3.** Workstations for interpreting and reviewing images.
 - 4.** Archives for the storage and retrieval of images and reports.

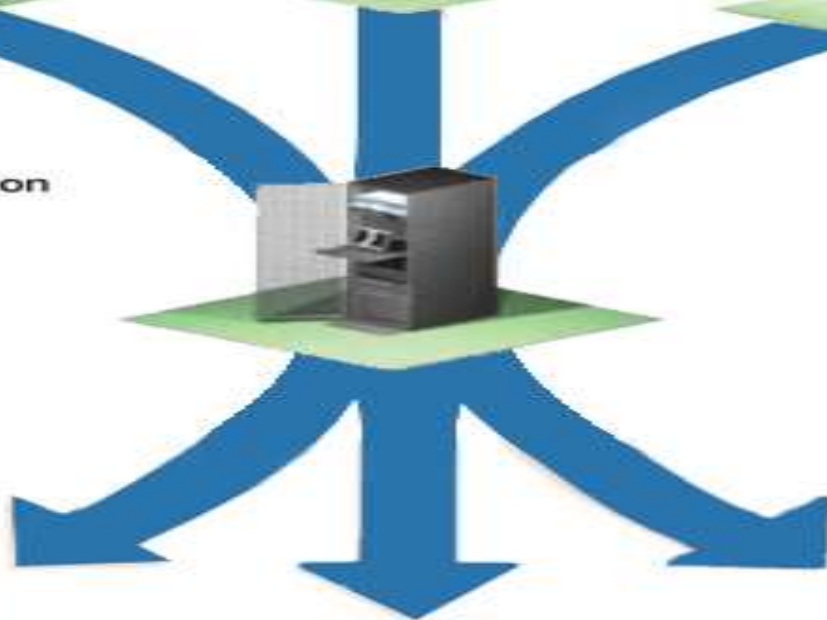
IMAGE ACQUISITION COMPONENT

- Images of a PACS are produced by several radiologic imaging modalities.
- Images of CT, U/S, MRI & nuclear medicine imaging (PET/SPECT) are digitally captured.
- Images of X-ray scanners have to be digitalized first.
- The images can be transmitted from the modalities using a specified interface.
- DICOM interface is most frequently used.

Acquisition Devices



Storage and Transmission



Viewing



ARCHITECTURE

- **The architecture is the physical implementation of required functionality, or what one sees from the outside.**
- **A radiologist typically sees a viewing station.**
- **A technologist present at a QA workstation.**
- **While a PACS administrator spend most of their time in computer room.**

ARCHITECTURE CONTINUED...

- QA workstation is a checkpoint to make sure patient demographics are correct.
- If study information is correct, images are passed to archive for storage.
- The central storage device (archive) stores images & may also store reports, measurements & other information present with images.
- Next step is the reading workstations.
- Reading workstation is where radiologist reviews patient's study and formulates their diagnosis.

ARCHITECTURE CONTINUED...

- Normally attached to a reading workstation is a reporting package assisting with final report.
- Reporting software is optional.
- CD/DVD authoring software may also be annexed, used to burn patient studies for distribution to patients or referring physicians



CT Modality



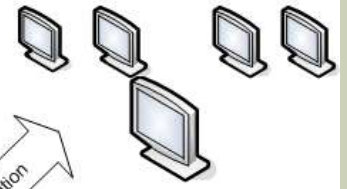
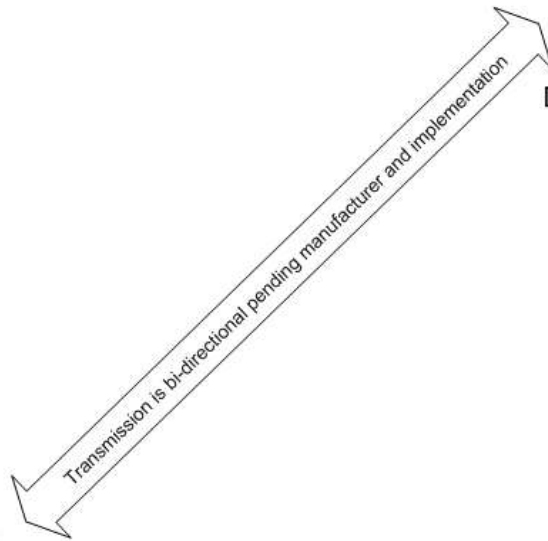
MR Modality



US



Archive



Doctors Reading Workstation

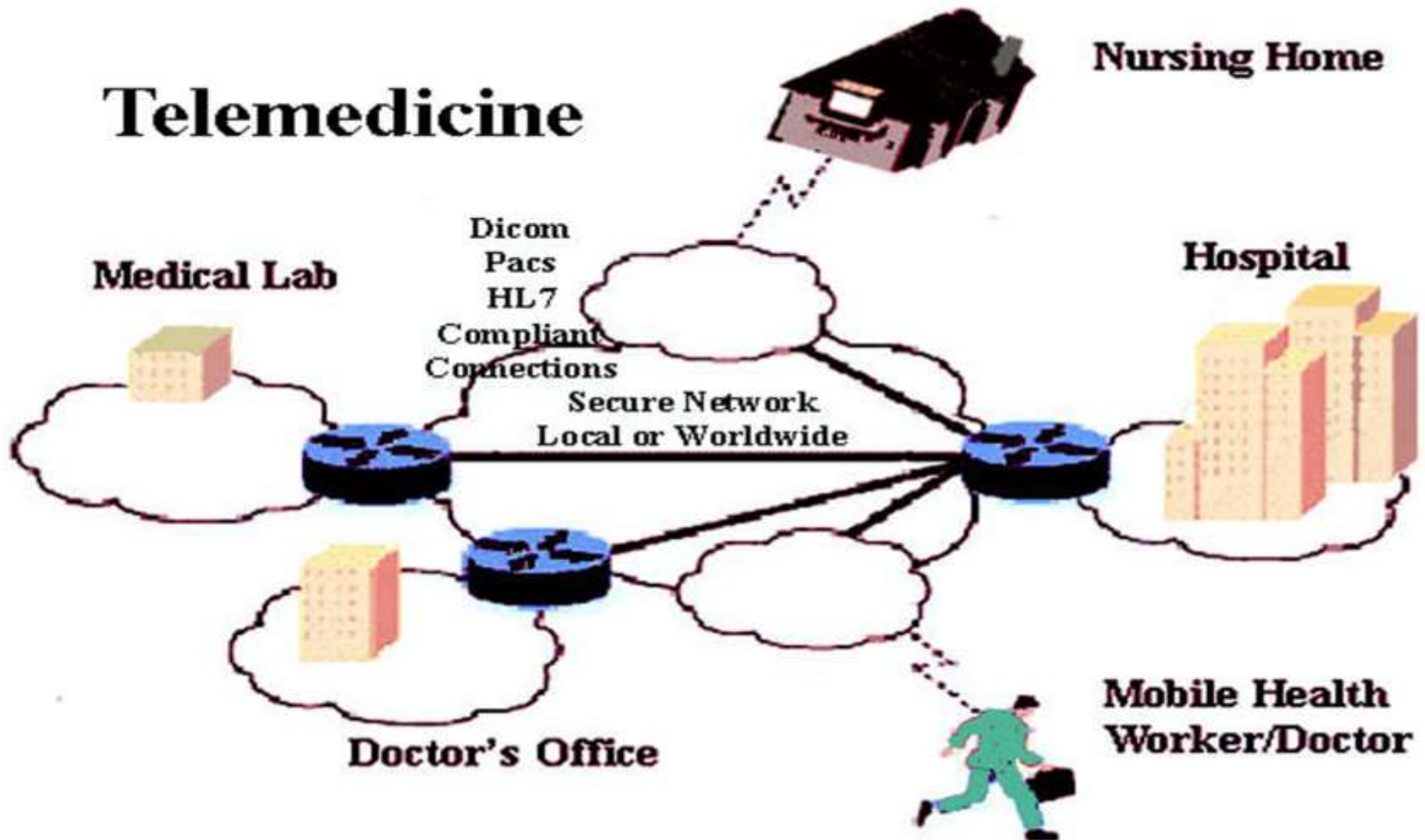
USES

- PACS has four main **uses**:
- **Hard copy replacement:** PACS replaces hard-copy storage.
- **Remote access:** Provides capabilities of off-site viewing and reporting (distance education, telediagnosis)
- **Radiology Workflow Management:** Used by radiology personnel to manage workflow of patient exams.

USES CONTINUED..

- **Electronic image integration platform:**
Provides electronic platform for radiology images interfacing with other medical automation systems such as Hospital Information System (HIS), Radiology Information System (RIS).

Telemedicine



ADDITIONAL USES

- **Early PACS seen only in radiology & some cardiology departments.**
- **Now can be used in multiple departments.**
- **Archive space can be shared among departments.**
- **PACS breaks down the physical & time barriers associated with traditional film-based image retrieval, distribution, and display.**
- **PACS allows radiologists to reconstruct & stitch images in their offices.**



USES

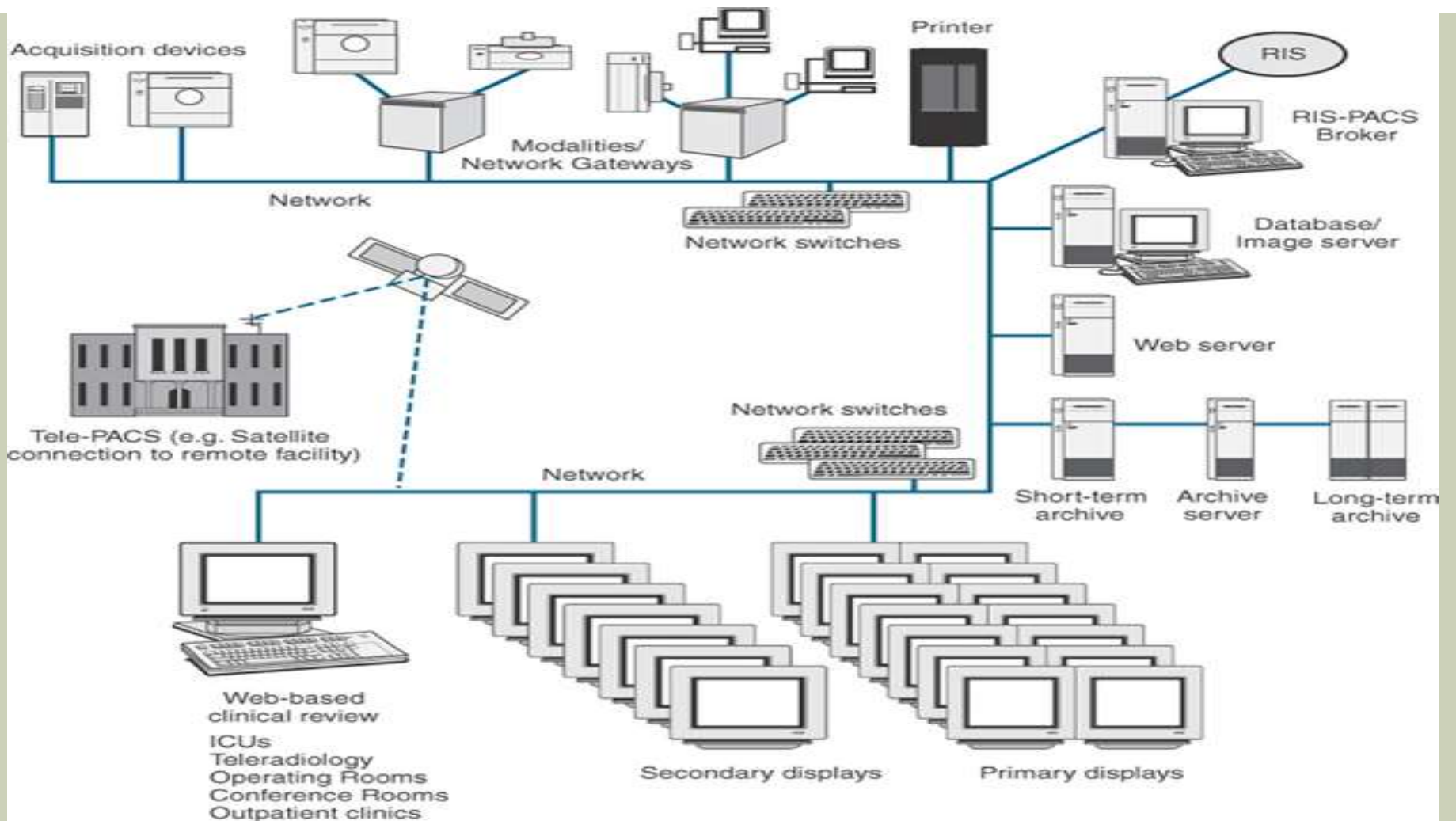
- PACS reading stations may also have image processing capabilities.
- Orthopedic workstations are available for the following:
 - Surgeons can plan joint replacement surgery.
 - Specialized software allows matching of best replacement for patient with patient anatomy.
 - System saves time and provides better fit.

DISADVANTAGES

- Firstly, implementing a PACS is an **expensive** project.
- The change in workflow could be frightening for conservative radiologists & physicians.
- Most of staff will need introduction & additional trainings to work with PACS software.
- No archive can guarantee a total fault-tolerance as a result images can be lost or deleted.
- Computer engineer availability required, to serve daily faults and problems.
- Confidentiality can be a problem.

CONCLUSION

- To put things in a nutshell, the benefits of PACS are clearly visible, but there are some reasonable doubts left.
- To improve the number of PACS installations, the vendors and developers of PACS systems should, besides the technical advancement, focus in helping the end users to remove the last doubts.
- This could be reached with easier introductions into the topic, even better adjustable systems to the clinical workflows and reliable archiving and backup solutions.



THANK YOU