

Large-Scale PACS: Seven Months of Clinical Experience

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Introduction

Samsung Medical Center (SMC) is a new tertiary care center with approximately 1050 inpatient beds and a large outpatient clinic facility. The hospital is a 22-story building complex and is located at the southern part of Seoul, Korea. When fully operational (mid 1995), the hospital is expected to have more than one million outpatient visits and perform more than 290,000 radiological procedures. Installed in the Department of Diagnostic Imaging are 2 MRI, 2 CT, 7 CR, 3 DSA, 3 fluoro units, 8 US and 1 mammo unit.

We have completed the installation of a PACS system that is designed to handle approximately 35% of the conventional film load in the Department of Diagnostic Imaging. We expect to go totally film-independent before the end of this decade. In September 1994, the hospital opened for limited general admission and PACS is used in daily clinical operation.

Implementation Schedule

1992-1993	Planning and Budget
March '93	Request for Proposal
July '93	Benchmark Testing
Dec. '93	PACS Contract
Dec. '93	Start Network Cabling

July '94	MRI and CT I/F
August '94	FCR 9000 I/F
Sept. '94	PACS Installation Completed and FAT
Sept. '94	Started Clinical Operation using PACS

System Overview

PACS at SMC includes interfaces to 3 CR (Fuji FCR9000), 2 MRI (GE Signa Advantage 5.4), 2 CT (GE HiSpeed 1.2), 1 DSA (GE Advantx), 1 film digitizer (Lumisys Lumiscan) and 1 laser film printer (Kodak 2180). Images are stored on a 40 Gbytes short term storage unit (Loral WSU) with roughly 10,000 images storage capacity with bit preserving 2:1 compression and are archived on an optical juke box (Kodak 6800) with 1 Terabytes, more than 2 years storage capacity with non-bit preserving 10:1 compression. Patient images are concurrently accessed by any of the 27 workstations (4 quad-monitors, 10 dual-monitors and 13 single-monitor workstations) distributed throughout the hospital (see Figure 1).

The two MRI, two CT, one MR independent console and one CT independent console are interconnected via thin ethernet network using a bus topology. For connectivity between the modality network and SMC's PACS, two "store and forward" PC-based image gateways were used to accept

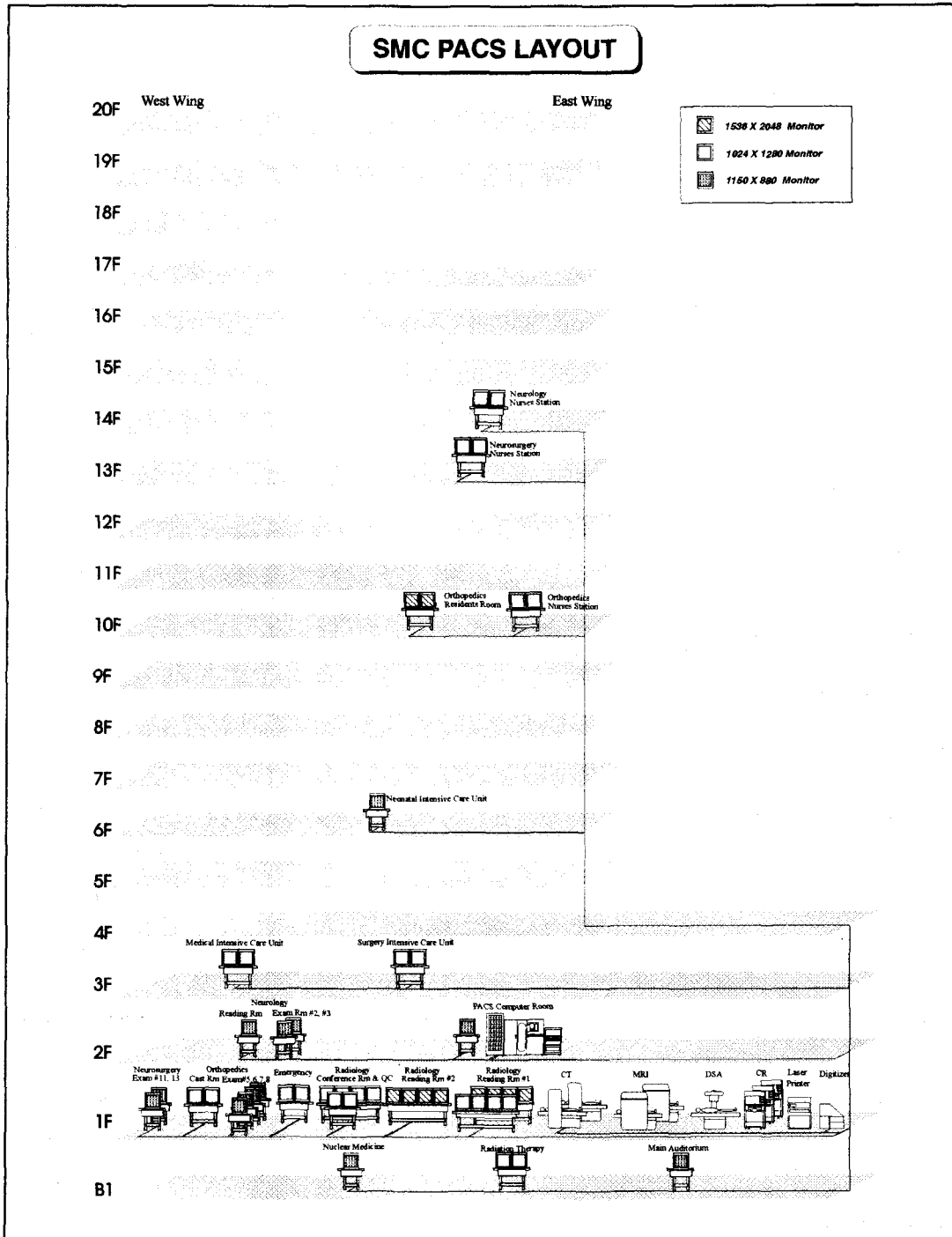


Figure 1

data in DICOM protocols and forward to the PACS.

The interconnection between modalities allows ease of access to both MR and CT image series for on-the-fly comparison studies on any of the 6 attached consoles via import and export of image series between consoles. More

importantly, radiologists and clinicians have on-line access to a vast array of patient studies for CPU-intensive post image processing such as 3-D visualization of CT and MRI volume data set. Newly acquired MR and CT image series may be transmitted to PACS automatically or manually through either

of the two gateways. To distribute the gateway load, each gateway is assigned to a modality. To test the integrity of the gateway's performance, a network load test was performed by sending 25,000 MR images and 7,000 CT images to PACS over a 4 day period. We have cross checked images sent and received, and found no loss of images on PACS storage unit [1].

Clinical Operation

At present, clinical staffs in both outpatient and inpatient areas in orthopedics surgery, neurosurgery, neurology, emergency room, surgical ICU, medical ICU, pediatric ICU and neonatal ICU use softcopies only. Although hardcopies from imaging modalities are generated, they are not distributed and serve as backup purposes only. We plan to stop generating hardcopies in the near future. Between September 1994 and March 1995, a total of 15,200 patients have been registered into the PACS system. The total number of exams residing in the archiving unit (ODJ) is over 42,000 exams representing approximately 365,000 images.

Although it has been only seven months since our hospital has used PACS in clinical situation, the radiologists and clinicians in general are immensely satisfied using the system and using softcopy for primary reading. The customization of the PACS database [2] that fit the needs of our hospital and staffs still is an ongoing process and will take an additional few more months.

Conclusion

A PACS system in clinical operation covering the departments of orthopedics surgery, neurosurgery, neurology, emergency room, surgical ICU, medical ICU, pediatric ICU and neonatal ICU is presented. On average 6,000 radiological exams per month are carried out on various imaging modalities and images sent to PACS. The number of

exams will increase when the hospital opens up the remainder of inpatient wards beginning May 1995. By early 1996, the rest of imaging modalities in the Department of Diagnostic Imaging will be interfaced, additional workstations installed on all inpatient wards and all exams ordered from the inpatient wards will be read on softcopies. It is expected then PACS will cover over 75% of all radiological exam load.

References

- [1] D. W. Ro, H. S. Choi and J. H. Lim, "Image networking of MRI and CT modalities to SMC's PACSnet", 1994 Fall Symposium of The Korean Radiological Society, pp.148, 1994.
- [2] A. H. Rowberg and G. L. Zick, "PACS - clinical evaluation and future conceptual design", Integrated Diagnostic Imaging - Digital PACS in Medicine, Chap 5, Ed. by J.P.J. De Valk, Elsevier Sci. Pub., Netherlands, 1992.