HISTORY OF DICOM, PACS & U-HOSPITAL IN KOREA

Hee-Joung Kim, Ph. D
Dept. of Radiation Convergence Engineering
College of Health Science
Yonsei University

Medical Physics & Imaging Lab. | Wonju-LINC, Yonsei University

DICOM
Digital Imaging and Communications in Medicine

CONTENTS

Medical Physics & Imaging Lab. | Wonju-LINC, Yonsei UniversitY | DICOM

THE HISTORY OF DICOM CONFERENCE

Conference at Baltimore, MD in 2003

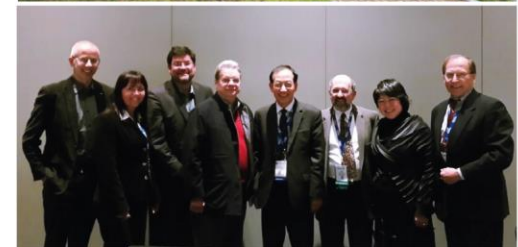Conference at Budapest in 2005

Conference at Chengdu in 2008, 2014

Conference at Rio de Janerio in 2010

Conference at Bangalore in 2013

2015 CONFERENCE AT YONSEI UNIV. WONJU IN KOREA
August 27,2015

DICOM conference at yonsei university

DICOM Workshop 2015
Wonju, Korea
August 27, 2015
www.dicomconference.org

Start Aug. 27	Minutes	Title	Presenter
08:15	45	Registration	
09:00	20	Welcome to the DICOM Workshop and to Yonsei University	Yonsei Univ.(TBA), KSIIM(President), WMIT (President), INFINITT (President), Harry Solomon
09:20	5	Overview of the Program	Harry Solomon
09:25	25	History of DICOM, PACS, and u-Hospital in Korea	Hee-Joung Kim, Ph.D, Yonsei Univ.
09:50	25	DICOM Overview: Stability and Evolution	Kevin O'Donnell, Toshiba
10:15	30	Open Source DICOM Projects in Korea	Samual Choi, Ph.D, IRM Inc.
10:45	30	BREAK	
11:15	30	Radiologist's Digital Workspot today and tomorrow	John Carrino, MD, American College of Radiology
11:45	20	Reporting Workflow in Radiology using DICOM SR integration	John Carrino, MD, American College of Radiology
12:05	70	LUNCH	
13:15	20	Analytic Workflow: From Images to Reports	Kevin O'Donnell, Toshiba
13:35	30	Capturing Analysis: Measurement, CAD, Segmentation and more	Harry Solomon, GE Healthcare
14:05	30	Nuclear Medicine PACS and DICOM application	Tae-Sung Kim, M.D, National Cancer Center
14:35	30	Development and use of next generation PACS	Jung Bin (Ben) Kim, INFINITT Healthcare
15:05	20	BREAK	
15:25	30	Deploying It [DICOM] effectively: Some Assembly Required	Kevin O'Donnell, Toshiba
15:55	30	DICOMweb™ and interoperability	Harry Solomon, GE, DICOM Co-Chair
16:25	20	Summary, Q&A, wrap-up	
16:45		Adjournment	

Homepage http://www.dicomconference.org/   E-Mail svastagh@medicalimaging.org

DICOM Digital Imaging and Communications in Medicine

Digital Imaging and Communications in Medicine

2015 DICOM Workshop in Korea

August 25, 2015 – WG-10&WG-29 meetings
August 26, 2015 – DICOM Standards Committee meeting
August 27, 2015 – DICOM Workshop

Host and organizers

Hosted by: Yonsei University, Wonju-campus

Organized by:
- Wonju-LINC(Leaders in INdustry-university Cooperation),Yonsei University
- DICOM Standards Committee

Sponsors
- KSIIM(Korea Society of Imaging Informatics in Medicine)
- INFINITT Healthcare Co., Ltd.
- Wonju Medical Industry Techno Valley
- Korea Research Institute of Standards and Science
- GE Healthcare Korea
- BK21+

KSIIM 대한의학영상정보학회
KRISS 한국표준과학연구원
INFINITT   GE Healthcare   BK21+

LINC
DICOM Digital Imaging and Communications in Medicine

Location
The Workshop and meetings will be held at:
Sanhakkwan & Miraekwan, Yonsei University Wonju-campus, Yonseidaegil 1, Wonju, Gangwon, South Korea
http://www.yonsei.ac.kr/wonju/

Specific location
August 25-27 – Office of Local Organizing Committee
Office Room #505 Sanhakkwan

August 25 – WG-10&WG-29 meetings
August 26 – DICOM Standards Committee meeting
To be held at:
International-Conference Room, #503 Medical Industry Venture Center

August 27 – DICOM Workshop
To be held at:
Lecture hall, #437 Miraekwan

Opportunity for sponsoring
The Workshop will be free to attendees; all companies and organizations are invited to join in sponsoring the Workshop by joining the sponsors already committed

To discuss sponsorship, please contact:

Hee-Joung Kim, Professor, Yonsei University
Tel: 033-760-5270
Email: hjk1@yonsei.ac.kr

ACR-NEMA 300-1985 standard

ACR-NEMA 300-1985 standard published

DICOM 3.0 standard

(Part 1~8)

Current

107 supplements + 617 change proposal

1983   1985   1988   1991   1993

ACR
(American College of Radiology)

NEMA
(National Electrical Manufacturers Association)

ACR-NEMA 300-1988 standard published

ACR-NEMA 300-1988 standard

DICOM 3.0 standard

(Part 9~15)
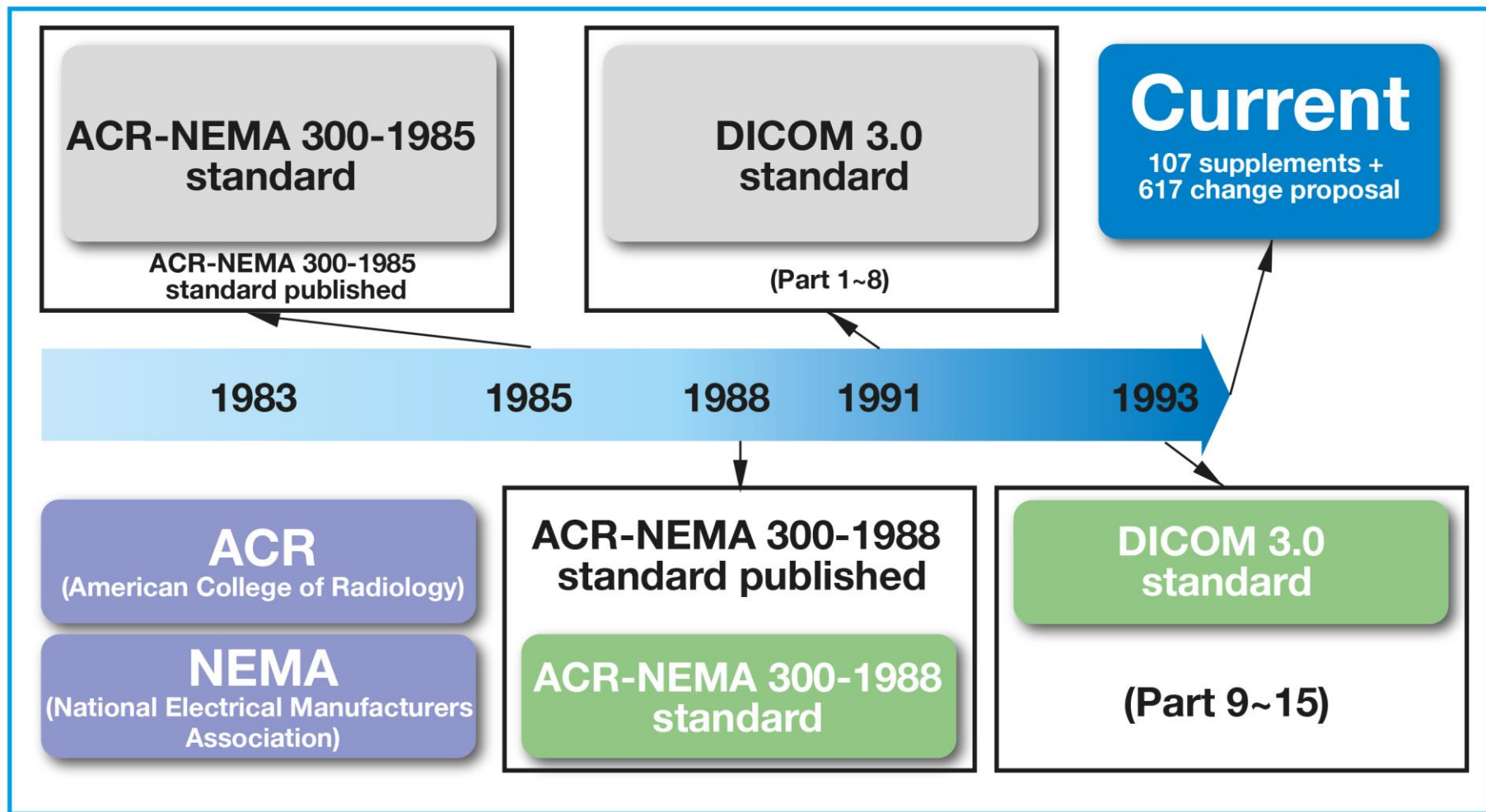
The goals of DICOM...

are to achieve compatibility and to improve workflow efficiency between imaging systems and other information systems in healthcare environments worldwide.

- PACS installation ⬆
- CD/DVD usage ⬆
- Compatibility necessity ⬆
- Teleradiology, Telemedicine ⬆

➡ DICOM 3.0 Standard Necessity

Home   Travel   WWW.

Secondary Capture

Hospital

MRI

DICOM Server

RX

NM   US   CT   XA

- **1993-Society of Korean PACS**
- **1995-1999-G7 PACS project : SNUH, KAIST, Marotech-J.H.Kim**
- **G7 PACS project in 1997**
  - Standardization of PACS Spec in Korea
  - Translate English DICOM into korean
  - Develop Hangul code
  - Cost analysis of PACS installation
  - Develop test station for PACS
- **Fast growing PACS installation**

- **Formed October 22, 1998**
- **Objectives**
  - Exchange DICOM and PACS related information
  - Collaboration w/ international DICOM Committee
  - Continuous efforts for DICOM after G7 project
- **May 5-7, 2002: International DICOM Meeting in Korea**
- **July, 2006: DICOM validation tool kits-KFDA-by H.J. Kim**

대 한 **P A C S** 학 회

THE KOREAN SOCIETY OF PICTURE ARCHIVING AND COMMUNICATIONS SYSTEM

서울특별시 송파구 풍납동 388-1
서울중앙병원 방사선과
138-736
TEL   02-3010-4400/4399
FAX   02-476-4719

Department of Radiology
Asan Medical Center
388-1 Pungnap-dong, Songpa-gu
Seoul 138-736
Korea

대한 **PACS** 학회 **2002** 년 춘계학술대회 및 **DICOM seminar** 일정
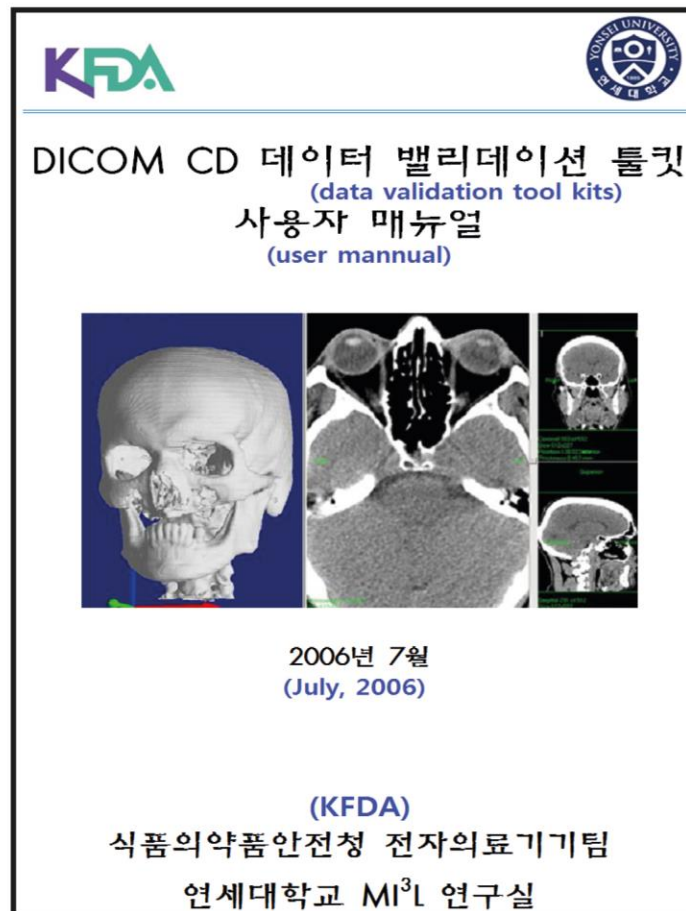
일시 : 2002 년 5 월 5 일(일)
장소 : 코엑스 인터컨티넨탈호텔 비바체 룸

DICOM seminar   09:00 – 12:00

09:00-09:30	Current status of DICOM	Clunie
09:30-09:50	DICOM and ISO	Shinoda
09:50-10:30	MR Multi-frame object	Parisot
10:30-11:00	DICOM and IHE	Loef
11:00-11:30	DICOM and the Web	Cordonnier
11:30-12:00	directions in Structured Reporting	Heaney

춘계학술대회   13:30 – 17:00

Vendors	Name	Tel	Email / Fax
Mediface	HS Choi	365-3323	hschoi@mediface.com
Marotech	HS Lee	765-7687	leehh@aol.com
Siemens	WK Lee	532-7100	med.seoul@sgm.siemens.co.kr
Taewon	JS Jeong	578-0338	jsjeoung@unitel.co.kr
Samsung-GE	YC Choi	0342-40-6045	young_chul.choi@korea.med.ge.com
SDS	SR Hong	3429-5333	srhong@sds.samsung.co.kr
Philips	YJ Kim	3445-5333	pmskorea@chollian.net
Shinkisa	SK Lee	573-8778	shinkisa@bora.dacom.co.kr
Hyundai HIT	SH Lee	224-7951	lsh@aminet.co.kr :Secretary
Hospitals	Name	Tel	Email
HanyangUH	SI Kim	290-8280	sunkim@email.hanyang.ac.kr :Chairman
AMC	KS Song	224-4369	kssong@www.amc.seoul.kr
YUMC	HJ Kim	361-5753	hjkim@yumc.yonsei.ac.kr :Secretary
SNUH	JH Kim	760-3677	kimjh@radcom.snu.ac.kr
Jes-aeng H	TJ Chun	0342-779-0039	tchun@DMC.or.kr
Paik H	SJ Chja	950-1188	chasj@chollian.dacom.co.kr
SMC	CW Paik	3410-2507	chpaik@smc.Samsung.co.kr

- **Define PACS Spec in Korea**
- **Develop DICOM Hangul Code**
- **K-DICOM, JIRA/DICOM, and CTN Collaboration will help to implement and use multi-byte characters with DICOM in real world**
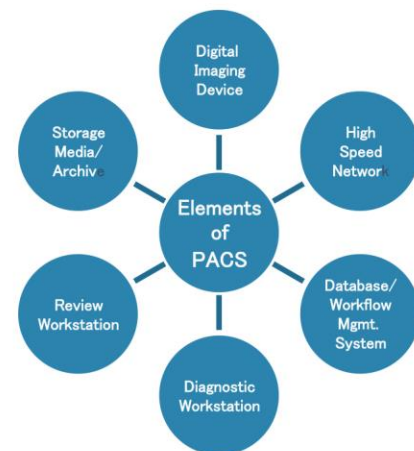- **K-DICOM committee plays an important role for promoting PACS as well as K-DICOM**

"Picture Archiving and Communication System"

P: Picture, Images & Reports

A: Archive, Online, Near line, Offline

C: Communication, Networking, Transfer Protocols

S: System, Components & Architecture

Elements of PACS
- Digital Imaging Device
- High Speed Network
- Database/ Workflow Mgmt. System
- Diagnostic Workstation
- Review Workstation
- Storage Media/ Archive

PACS : for storage and distribution of images and information when necessary

Imaging Modality   Archiving   Communication   Computer Reading

US Army teleradiology poject starts
1983

Siemens/Philips start develo ping PACS concepts. EuroPACS starts annual meetings.
1984

Baumann and Gell follow up survey – 177 large PACS identified worldwide.
2000

Original concepts: Dr. T. Iinuma, "Image processing in clinical medicine – considerations of a system", Bull., Tokyo Women Med. 44, 152 (in Japanese).
1974

US – Baltimore Veterans Hospital PACS.
UK – Hammersmith and Conquest PACS projects.
1992

US National Cancer Institute funds UCLA group under Professor Bernie Huang.
1985

Multiple regional and national projects initiated. Worldwide mass adoption begins in earnest
2002

1970's 1980's 1990's 2000's

Dr. Samuel J. Dwyer III describes PACS ideas at a Seminar at the University of Iowa. Dr. Judith M. Prewitt introduces the term PACS. Cardiovascular radiologist Dr. Andre Duerinckx describes the far reaching future benefits of PACS for a hospital.
1981

Roger Baumann and Gunther Gell identify 23 large PACS worldwide with over 100 PACS projects
1995

Berlin BERKOM project started
1986

NATO conference in France includes topic on Imaging Networks SCAR celebrates 10th annual meeting.
1990

1st International Conference on the PACS, Newport Beach, California.
1982

PRIMIS created at VUB Brussels – to study applications of digital imaging
1987

Major Events in PACS history in Korea

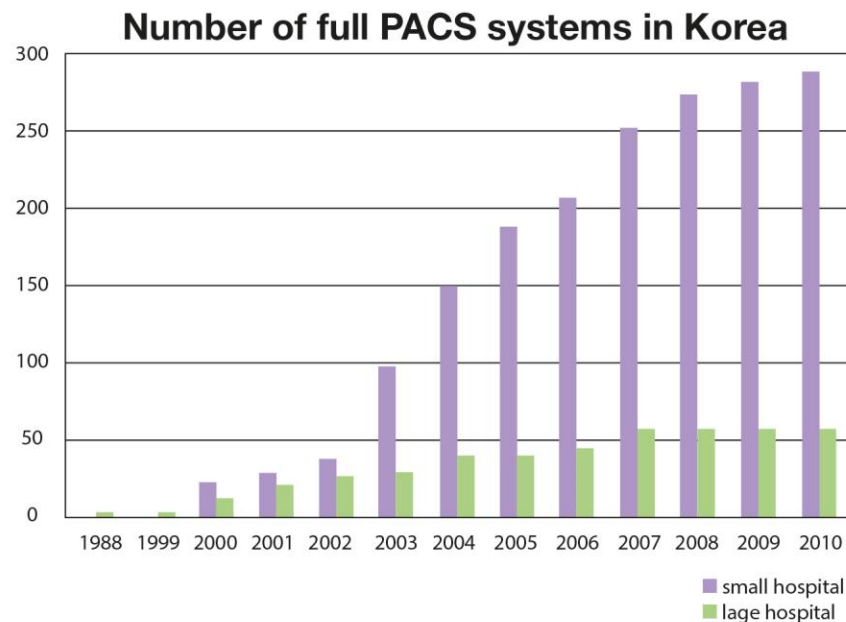| Year	Events
1986	The first pilot PACS in Seoul National University
1994	The Korean PACS Society was established
1994	Samsung Medical Center launched a partial scale PACS
1999	PACS reimbursement act approved by Korean government
1999	Full scale filmless hospitals by domestic companies
2001	HL-7 based interface between HIS-PACS in Seoul National University
2004	The IHE Korea was established

Only 4 years later from 1982 when the 1st word of PACS appeared in USA, the 1st PACS in Korea was tried in SNU in 1986

K. Inamura, J.H. Kim, European Journal of Radiology, 2011

Medical Physics & Imaging Lab. | Wonju–LINC, Yonsei UniversitY | DICOM

Major Events in PACS history in Korea

Number of full PACS systems in Korea

- ■ small hospital
- ■ lage hospital

The number of full PACS systems installed in Korea

K. Inamura, J.H. Kim, European Journal of Radiology, 2011

Medical Physics & Imaging Lab. | Wonju-LINC, Yonsei UniversitY | DICOM

Major Events in PACS history in Korea

No.	Hospital	Number of beds	Number of connected modalities	Number of terminals	Annual generation of image data (TB)	Implementation
1	Seoul National University Hospital	1500	250	3000	27	Cooperative development with a domestic company since 1995
2	Samsung Medical Center	1200	190	3000	25	Purchase from a foreign company in 1994
3	Asan Medical Center	2200	250	3500	24	Cooperative development with a domestic company since 1995

Large number of connected modalities and display terminals reflects their complete filmless PACS operation covering all imaging modalities across the hospital

K. Inamura, J.H. Kim, European Journal of Radiology, 2011

Timeline diagram:

Phases: Introductory (R&D) → Early Growing (Partial PACS) → Growing (Radiology PACS) → Maturing (Film-less) → Integrated PACS → Ubiquitous PACS

Years: 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007

- 1994: Samsung Hospital Partial PACS (Loral); Establishment of Society of PACS
- 1996: IMF Economic Crisis
- 1997: Samsung Hospital Full PACS (GE); Bundang Jesaeng Hospital (KCC)
- 1998: PACS Insurance started
- 1999: Ilsan Paik Hospital (Marotech)
- 2000: Small Hospital PACS
- 2001: Asan Medical Center HIT; OCS/PACS Interface HL7 Standardization
- 2002: YONSEI UNIVERSITY HEALTH SYSTEM; Seoul National University Hospital; Web PACS Service
- 2003: IHE North America Year 5
- 2004: EMR; Korean HL7 Standardization; CAD Orthopedic
- 2005: Security Solutions
- 2006: Tele PACS reading
- 2007: KSIIM

The chronological change of PACS diffusion from 1987 to 2002 in Japan
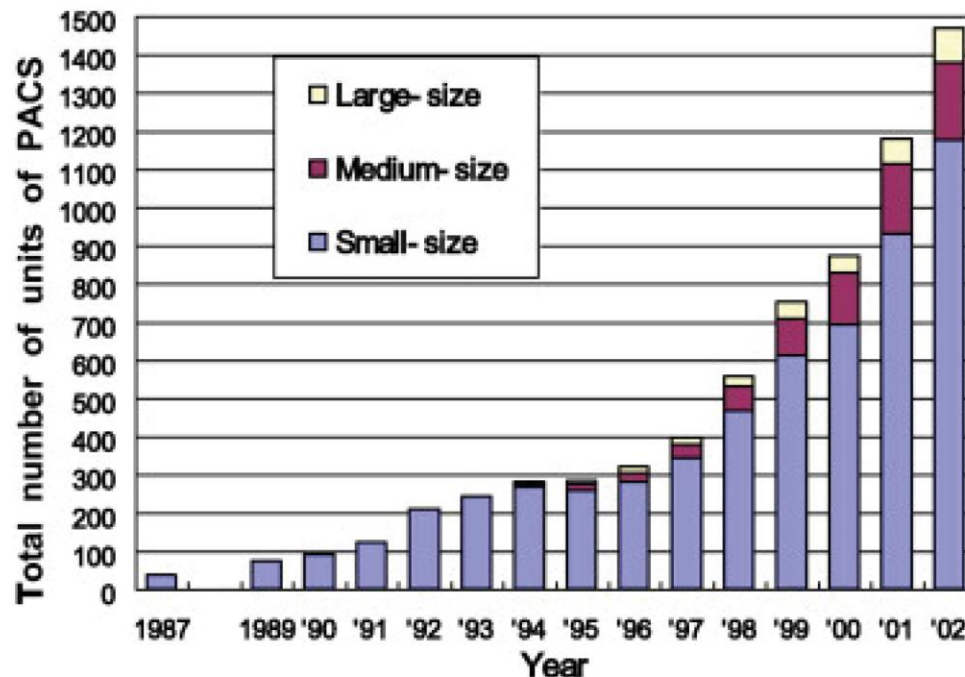
Progress of PACS diffusion in Japan during years 1987–2002. Even small-size PACS of 1173 units in 2002 had function for image collection, storage, image processing, display, hard copy and image transmission through network

K. Inamura, J.H. Kim, European Journal of Radiology, 2011

Medical Physics & Imaging Lab. | Wonju–LINC, Yonsei UniversitY | DICOM

History of PACS in Japan during years 1984–2002

Year	Events
Small size and medium size PACS	
1984	MedFile series (NEC), NEPACS Enterprise (NEC)
1988	TDS-File (Toshiba)
1984	Film digitizer by CCD (NEC)
1986	Image compression hardware (NEC)
Large size PACS	
1984	Experimental PACS in Osaka University (NEC)
1989	Clinical PACS in Hokkaido University (NEC)
1989	Experimental PACS in Kyoto University and Nagoya University
Teleradiology	
1984	Experiment in Nagasaki Pref. (NEC)
1987	Experiment by satellite communication in Harumi (Toshiba)
1989	Commercial teleradiology (SECOM)
Standardization activities	
1984	Standardization by JIRA following ACR-NEMA
1984	IS&C (Image Save and Carry) started
1985	DICOM in Japanese version
2002	IHE-J demonstration (JIRA, JRS, JSRT, JAHIS)

Only 2 years and 4 years later from 1982 when first terminology of PACS appeared in Newport Beach in USA, dedicated hardware for film digitizing and image data compression were commercialized by a domestic manufacturer in 1984 and 1986 in Japan, respectively.

1989 — Hokkaido University Hospital-wide PACS

1989 — MIPS-89 = ACR-NEMA v1

1994 — IS&C turns to DICOM

1995 — DICOM demo at JMCP

1996 — Samsung Medical Center PACS on DICOM

2002 – IHE-J demo at JMCP (now JRC)
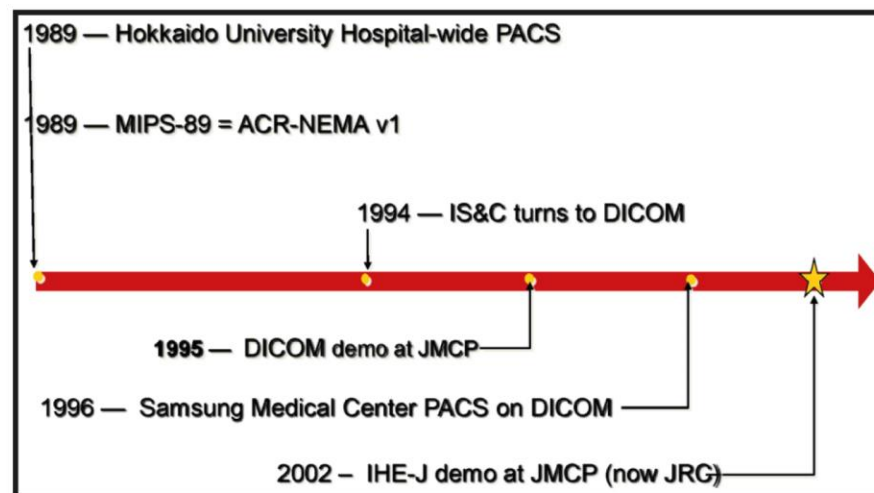
Standardization activity at early stage in Japan until 2002

K. Inamura, J.H. Kim, European Journal of Radiology, 2011

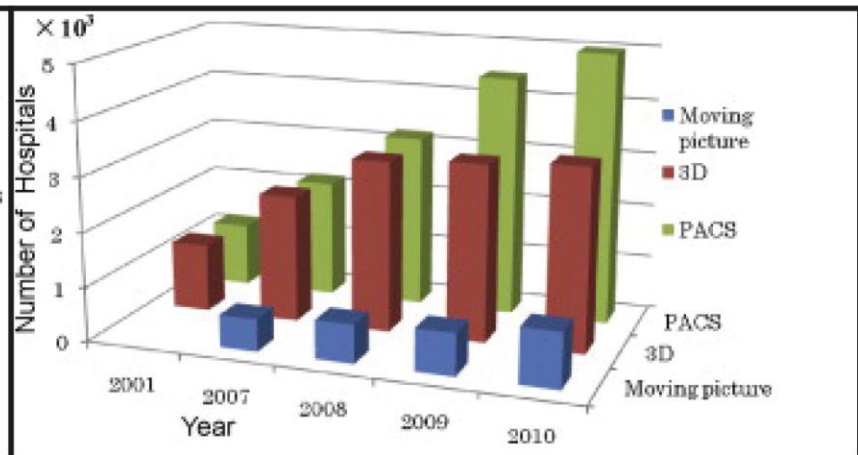Medical Physics & Imaging Lab. | Wonju–LINC, Yonsei University | DICOM

PACS with HIS, EPR, RIS   PACS with Moving Picture, 3D
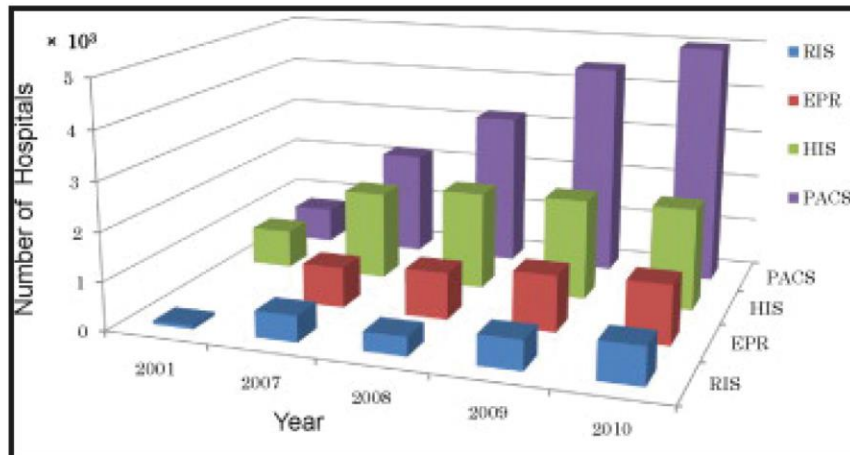
The number of hospitals equipped with PACS, EPR, RIS and HIS

The number of hospitals equipped with moving picture and 3D

K. Inamura, J.H. Kim, European Journal of Radiology, 2011

The history of PACS in China

Year	Events
1994	The first mini-PACS in Beijing Union Medical College Hospital
1996	The first DICOM 3.0 compatible PACS in affiliated hospital of West China. Medical University
1997–1998	PACS was growing slowly because of only UNIX workstation, DICOM software package only for UNIX, the less of DICOM imaging modalities and Asia Financial Crises
1998	The academic community summarized the experience in the practice of PACS
1999	The Ministry of Health in China approved integrated and applicable PACS
1999–2001	Eleven hospitals imported MiniPACS from abroad
2000	Shangai Jiao Tong University developed their own image archive sever of low cost
2001–2002	Eight hospitals purchased whole hospital PACS systems. Among them 4 systems were from Chinese domestic vendors

Year	Events
2003	Affiliated Hospital, Guiyang Medical College reported construction and cabling of PACS and the equipment which formed the necessary platform to run PACS and HIS. There were more than 50 terminals. All components were from manufacturers outside China
	A boom of PACS adoption by SARS crisis
	National projects started to develop health IT standards unique to China
2004	Healthcare professionals established a relationship with the U.S. IHE organization, with a view to launching IHE-China
2005	A draft of DICOM 3.0 compliant PACS with Chinese characteristics
2007	Shenyang city Hospital of 2300 beds replaced their CRT monitors by LCD technology
	The first Connectathon by IHE-China. Five vendors participated
2008	The functionality of IHE workflow profiles in RIS/PACS installations
2009	The Sun Yat-sen University in Guangzhou, decided to convert completely to digital radiology
2010	Hong Kong Sanatorium and Hospital linked an agreement of PACS monitoring, database-driven reporting and HIPAA/audit log management.

In spite of slow start of PACS installation in Chinese hospitals, very acute build-up to catch up with global level is observed

K. Inamura, J.H. Kim, European Journal of Radiology, 2011

Medical Physics & Imaging Lab. | Wonju–LINC, Yonsei UniversitY | DICOM

Before & After Introducing PACS system

STPA

CURRENT

From PACS to EMR/EHR

Convenience

Feedback to OCS

HIS
(OCS)
EMR/EHR

Fast result
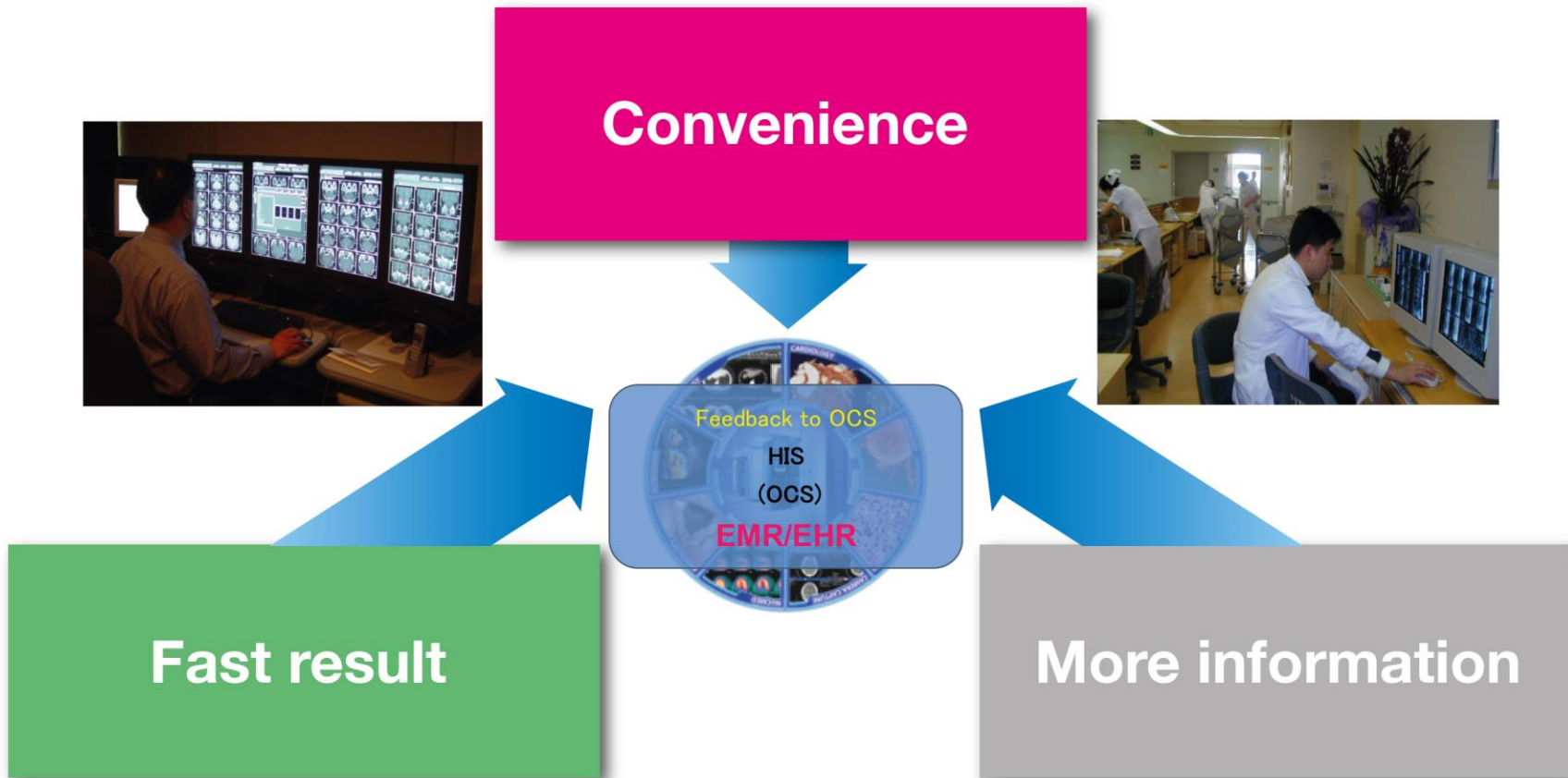
More information

PACS served as [Microsoft Windows XP] **to the hospital administrators to see "Digital Hospital"**

Imaging Informatics will serve as [Windows Vista] **to the "ubiquitous Hospital" in next generation**

Pursuing history of PACS in Severance (2000 ~ 2005)

| 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |

YONSEI UNIVERSITY HEALTH SYSTEM

RUNS COST MANAGEMENT SYSTEM

YONGIN SEVERANCE HOSPITAL

RUNS OCS (Order Communication System)

GANGNAM SEVERANCE HOSPITAL

COMPLETELY OPERATES FULL-PACS

SEVERANCE MENTAL HEALTH HOSPITAL

RUNS PW/PA (PATIENT MANAGEMENT PATIENT ACCOUNT) SYSTEM

SEVERANCE HOSPITAL

COMPLETELY OPERATES FULL-PACS

GE PACS

SEVERANCE DENTAL HOSPITAL

OPERATES PACS

SEVERANCE CARDIOVASCULAR HOSPITAL

OPERATES PACS

Infinitt PACS

Medcon PACS

YONSEI UNIVERSITY HEALTH SYSTEM

PROGRESS u-HOSPITAL PROJECT

NEW HOSPITAL PACS PROJECT

KSIIM (Korean Society of Imaging Informatics in Medicine)

2015 KSIIM annual meeting
Yonsei university Wonju-Campus

KSIIM (Korean Society of Imaging Informatics in Medicine)

IHE Beginnings

- **1982-1992: ACR-NEMA Image Standards**
: **Despite ten years of developments, standards were not widely implemented.**

- **1992: Birth of DICOM marked with public demonstration at RSNA annual meeting**
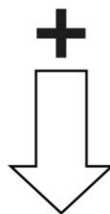: **Galvanizes imaging community and industry support of standard**

Connect(ivity + Mar)athon
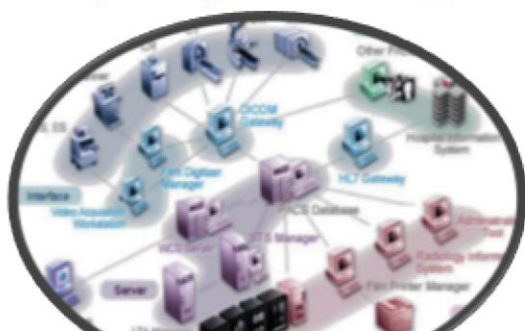
Connectivity + Marathon

Connectathon
A series of tests with multiple vendors walking through use cases derived from the Technical Framework.

- Founded in June 25th 2004 with support of both KSIIM and KSOMI
- Many activities including education, workshop, panel discussion, demonstration, connectathon, and show case demonstration

IHE KOREA 2004 - 2005 Demonstrations

2004 PACS and KSMP conference

2005 KOSMI conference

Medical Physics & Imaging Lab. | Wonju-LINC, Yonsei UniversitY

DICOM

- IHE GDC committee meeting
- Report: 2014-activities of IHE Korea
- Plan: 2015-activities of IHE Korea
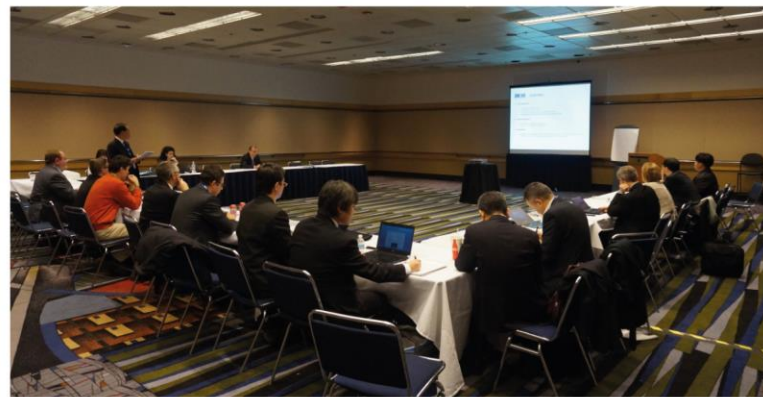
Ubiquitous

- From Latin ubique: 『Being everywhere at once: omnipresent』,
  『Seeming to appear everywhere at the same time』

- Evolution of Computing Paradigm
: Mobile Computing - "anytime, anywhere"
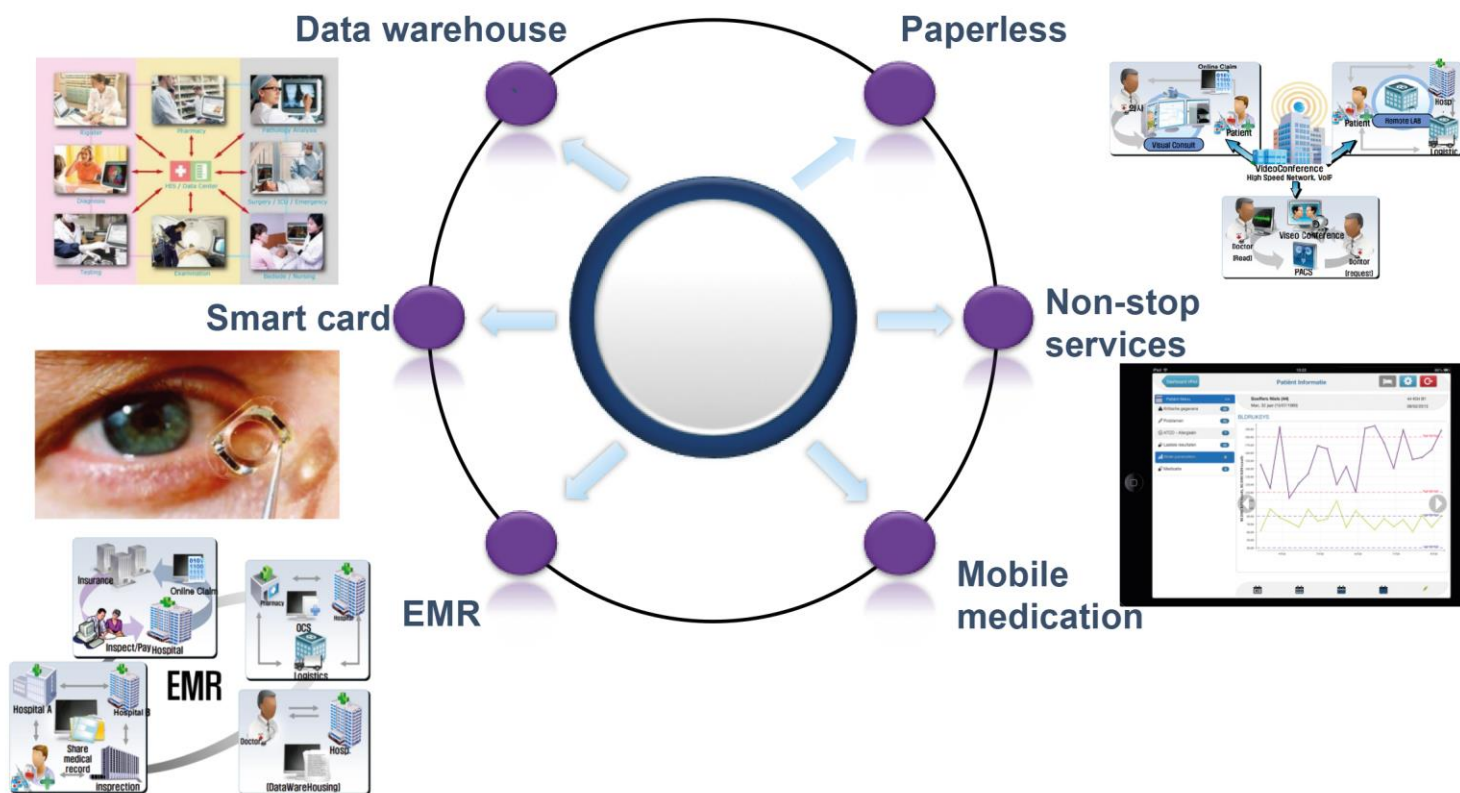: Ubiquitous Computing – "all the time, everywhere"

Ubiquitous

Healthcare   E-Health   U-Health

U-Hospital

Data warehouse

Paperless

Smart card

Non-stop services

EMR

Mobile medication

Medical Physics & Imaging Lab. | Wonju–LINC, Yonsei UniversitY | DICOM

U-Severance Hospital System

Integration by Standard (DICOM, HL7) IHE
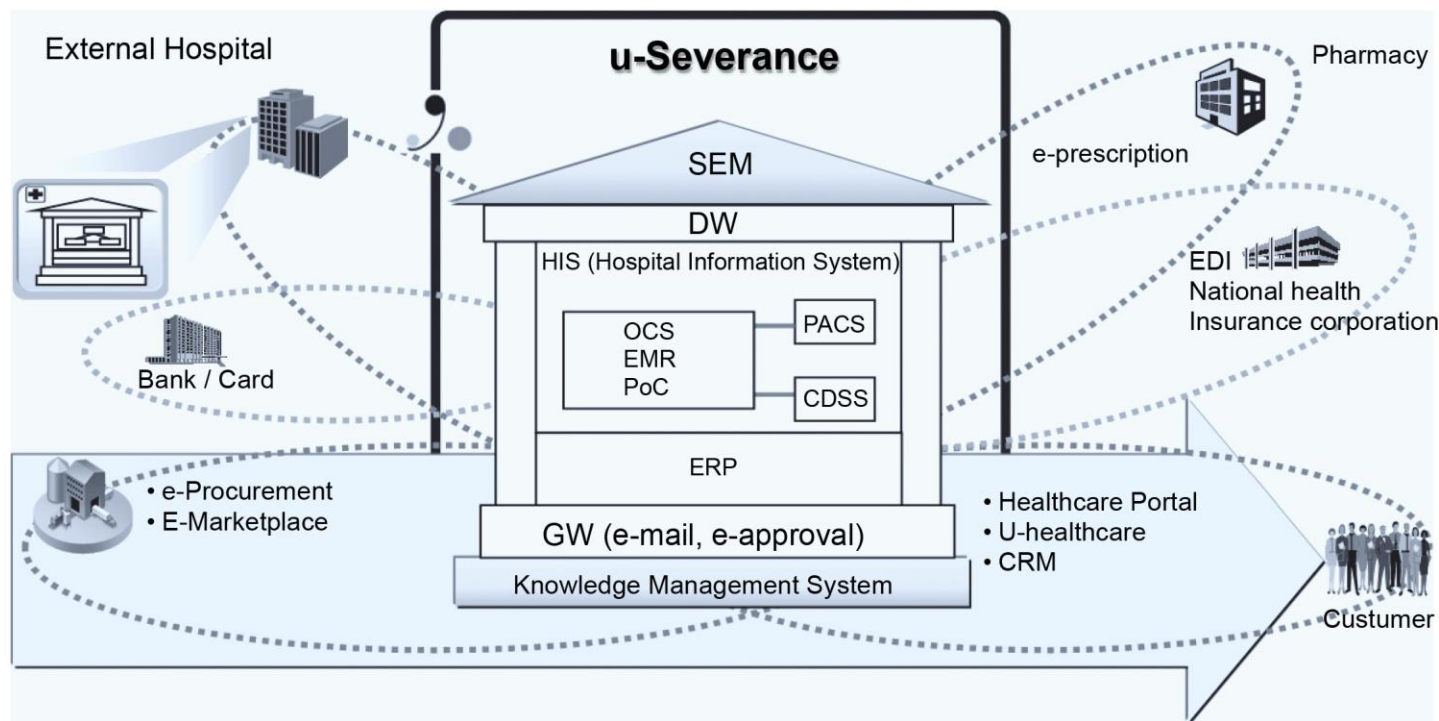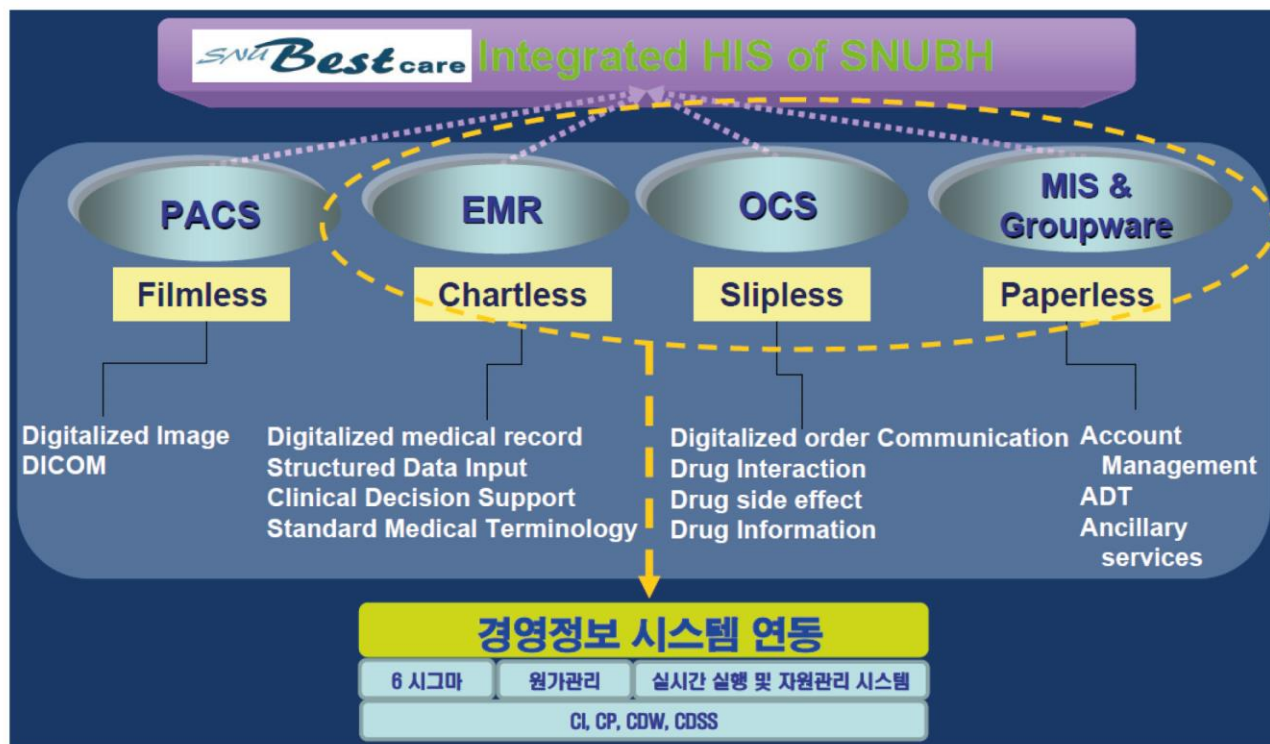
Courtesy of SNUBH

HIS-EMR, OCS, PACS

Point of Care

OR

PACS

Medical Physics & Imaging Lab. | Wonju–LINC, Yonsei UniversitY | DICOM Digital Imaging and Communications in Medicine
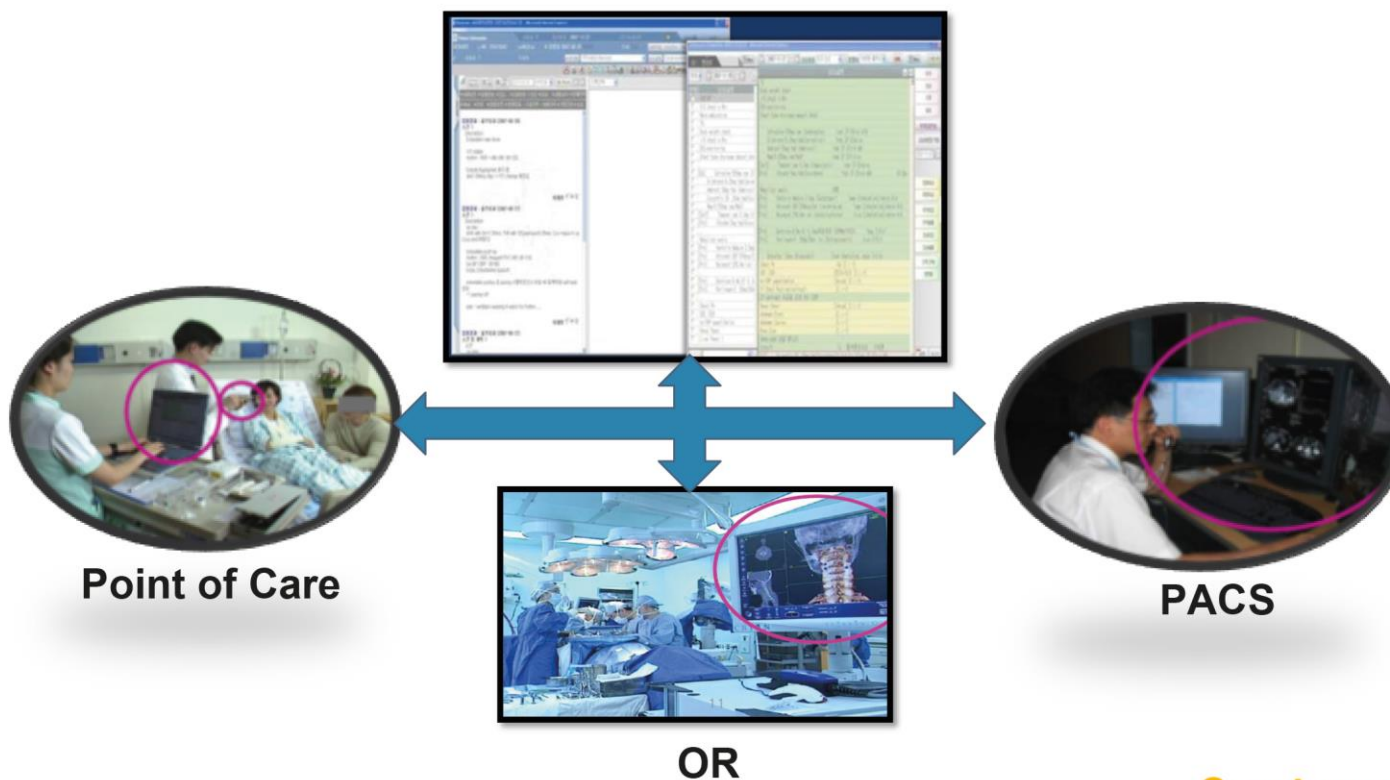
- **DICOM plays an important role of PACS development**
- **Success of PACS plays a window to EMR development**
- **Dream of u-Hospital project becomes reality of HIS w/ slipless, filmless, chartless paperless**
- **4less-HIS requires continuous efforts of DICOM, HL7, IHE societies**

Thank you for your attention

MEDICAL PHYSICS AND IMAGING LAB

Medical Physics & Imaging Lab. | Wonju-LINC, Yonsei UniversitY