

Scandinavian Japanese Radiological Society

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Development of PACS using the DICOM and IHE specification

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Chairman, IHE-Japan

Index

- Background
- Activity of IHE-Japan
- Implementation of NIRS hospital
- Discussion

Purpose of Standardization

- Shortening of preparation and test for connection
- Easy replacement of systems
- Simple documentation for RFP
- Increasing connectivity of Hospital Information System and PACS

How to implement PACS

We used the DICOM standard
and IHE Integration Profiles.

What is IHE?

- IHE is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information.
- IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical need in support of optimal patient care.
- IHE defines many Integration Profiles. Integration Profile describes use cases, actors and transactions.

IHE - Japan

Supported by
METI,
MHLW

- Established in July 2001.
- Initial participating organizations:

- **JRS**: Japan Radiological Society
- **JSRT**: Japanese Society of Radiological Technology
- **JAMI**: Japan Association of Medical Informatics
- **JIRA**: Japan Industries Association of Radiological Systems
- **JAHIS**: Japanese Association of Healthcare Information Systems Industry
- **MEDIS**: Medical Information System Development Center

METI: Ministry of Economy, Trade and Industry

MHLW: Ministry of Health, Labour and Welfare

Activities of IHE-J

- Technical assessment of IHE documents
- Investigation into Japanese extension
- Interoperability-testing event called Connectathon was held From 2002.
- Demonstration of IHE for users
- Publicity activities to medical staff and users (Workshop)
- Publication: book / DVD



Connectathon (Interoperability-testing)

■ Connectathon:

- Feb. 2004 (First official Connectathon)

- Feb. 2005

- Jan. 2006

- Feb. 2007

- Feb. 2008

- Oct. 2008

- Oct. 2009

- Oct. 2010

Connectathon
2006.1.30-2.3



IHE implementations in Japan (Success Story)

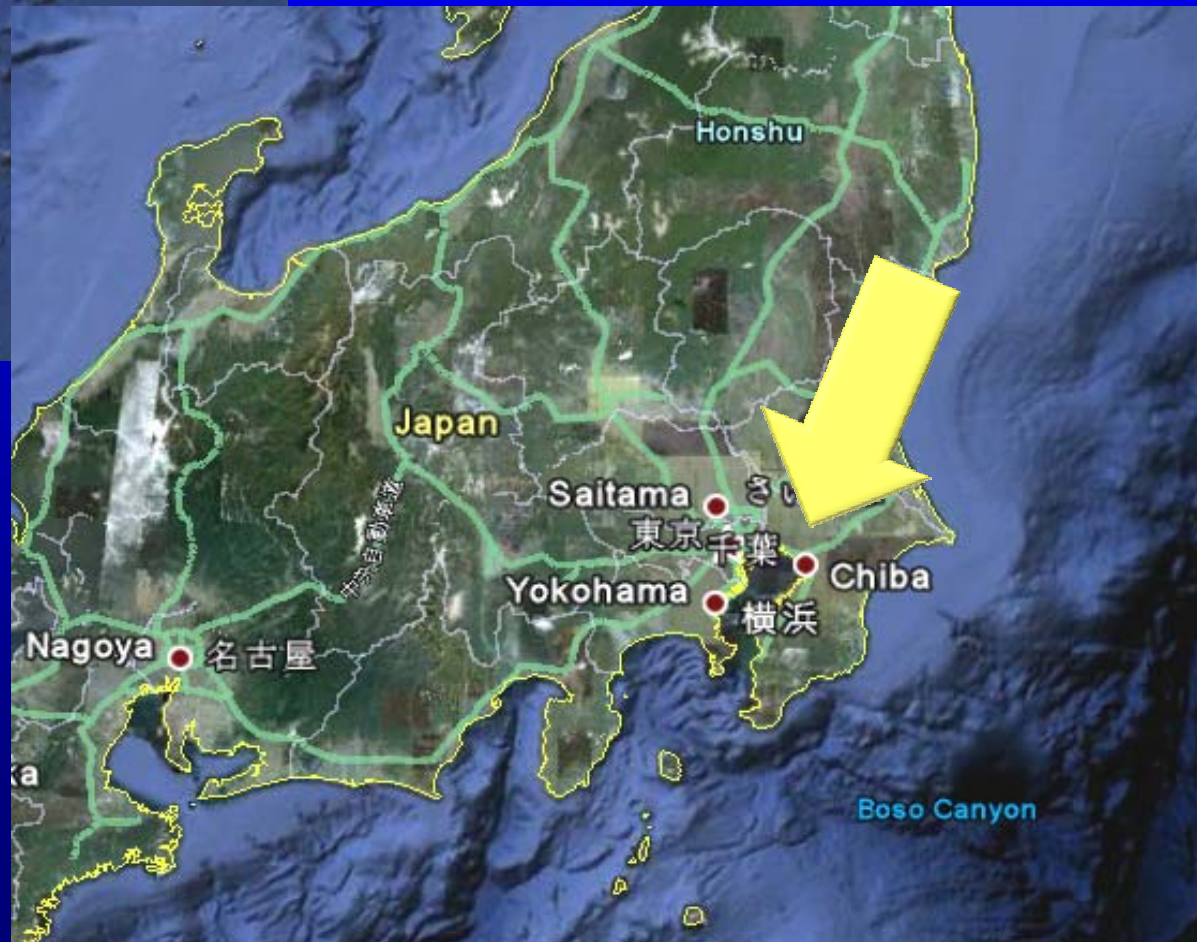
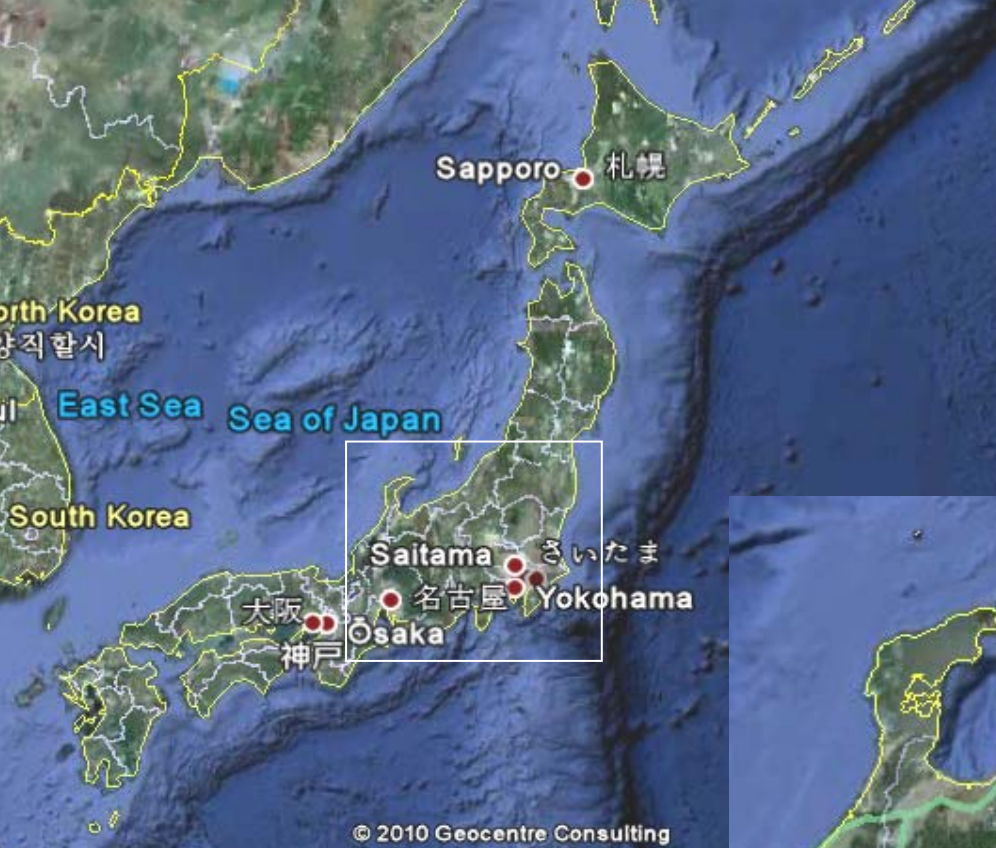
- Saitama Medical Center: March 2005
- Fujita Health University Hospital: April 2005
- Okazaki City Hospital: January 2006
- National Institute of Radiological Sciences (NIRS) Hospital: April 2006
- Takayama Red Cross Hospital
- Hamamatsu Medical University
- Fukui University Hospital

Now go back to
NIRS Hospital

NIRS Hospital

- Our hospital is specially designed for the heavy particle radiation therapy. Systems (EMR, PACS, clinical database and oncology RIS) are working. Some systems were adopted for standards. We made a modification to use the IHE profiles.
- We plan to study the effectiveness and availability of IHE Radiology and IT-Infrastructure profiles in the Japanese environment.

NIRS is located in Chiba



National Institute of Radiological Sciences Hospital

- Located at Inage, Chiba
- Beds for inpatients: 100 beds
- Outpatients: 70-100 patients/day
- Specialized for a radiation therapy with carbon ion particle
- Film-less PACS (August 2005-)
- Electronic Medical Record (EMR) (Oct. 2006-)

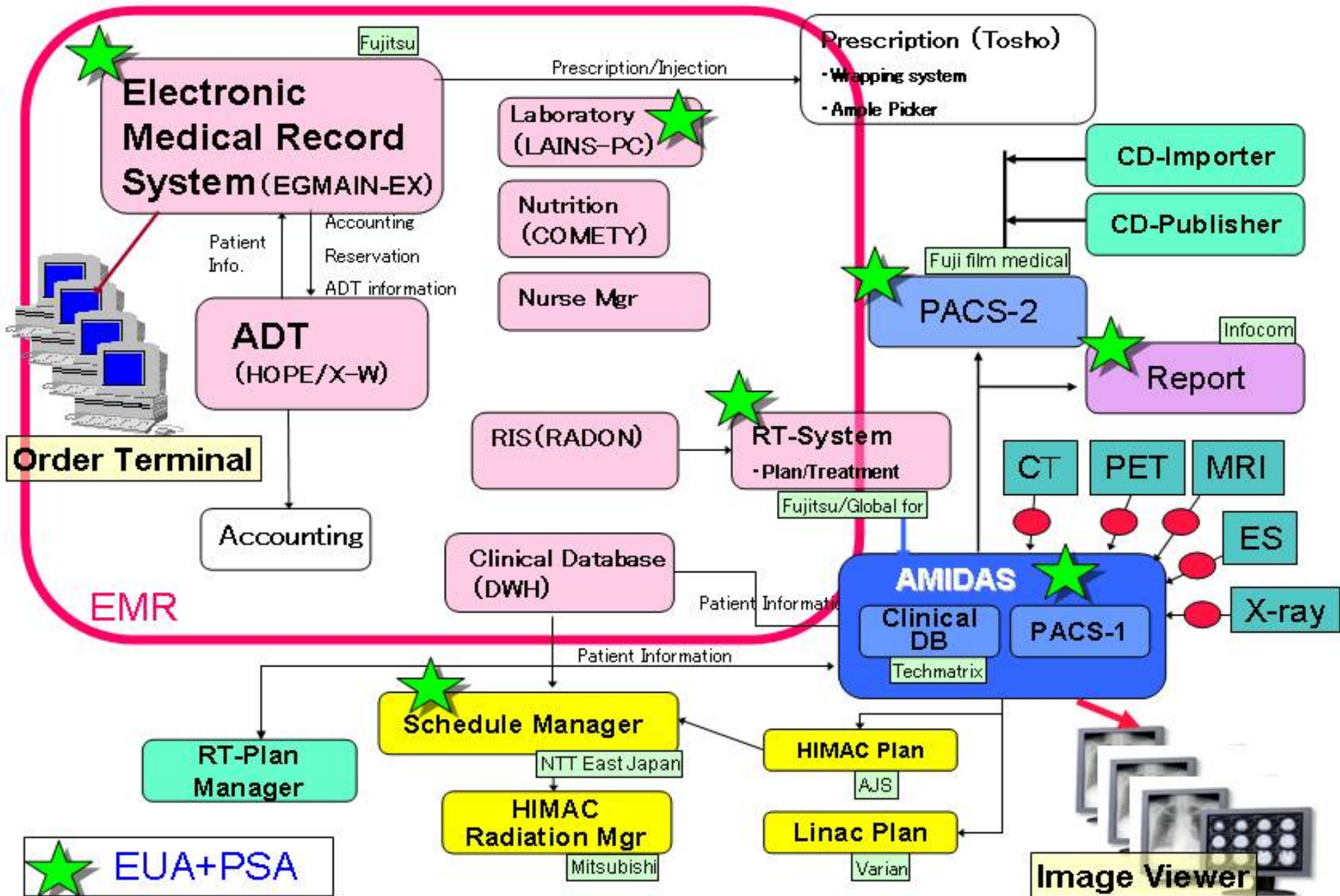
IHE Integration Profile in NIRS Hospital

- Radiology and Laboratory Domain (From October 2006)
 - Scheduled Workflow (SWF)/Laboratory Testing Workflow (LTW)
 - Patient Information Reconciliation (PIR)/Laboratory Information Reconciliation (LIR)
 - Report Workflow (RWF)
- IT Infrastructure Domain (From April 2005)
 - Enterprise user authentication (EUA) : Single sign-on
 - Patient synchronized applications (PSA) : Coordination of patient
 - Consistent time (CT) : Time synchronization

Integration Profile In NIRS Hospital-2

- Radiology Domain (From September 2009)
 - PDI (Portable Data for Imaging)
 - IRWF (Import Reconciliation Workflow)

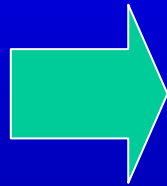
Hospital Information System in NIRS May 2010



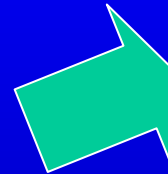
Dual PACS



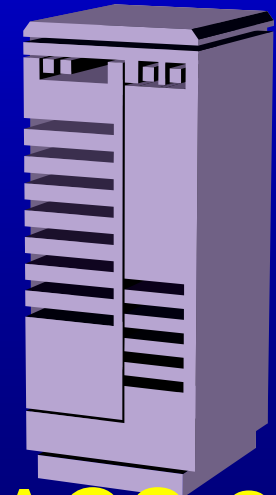
Modality



Gateway



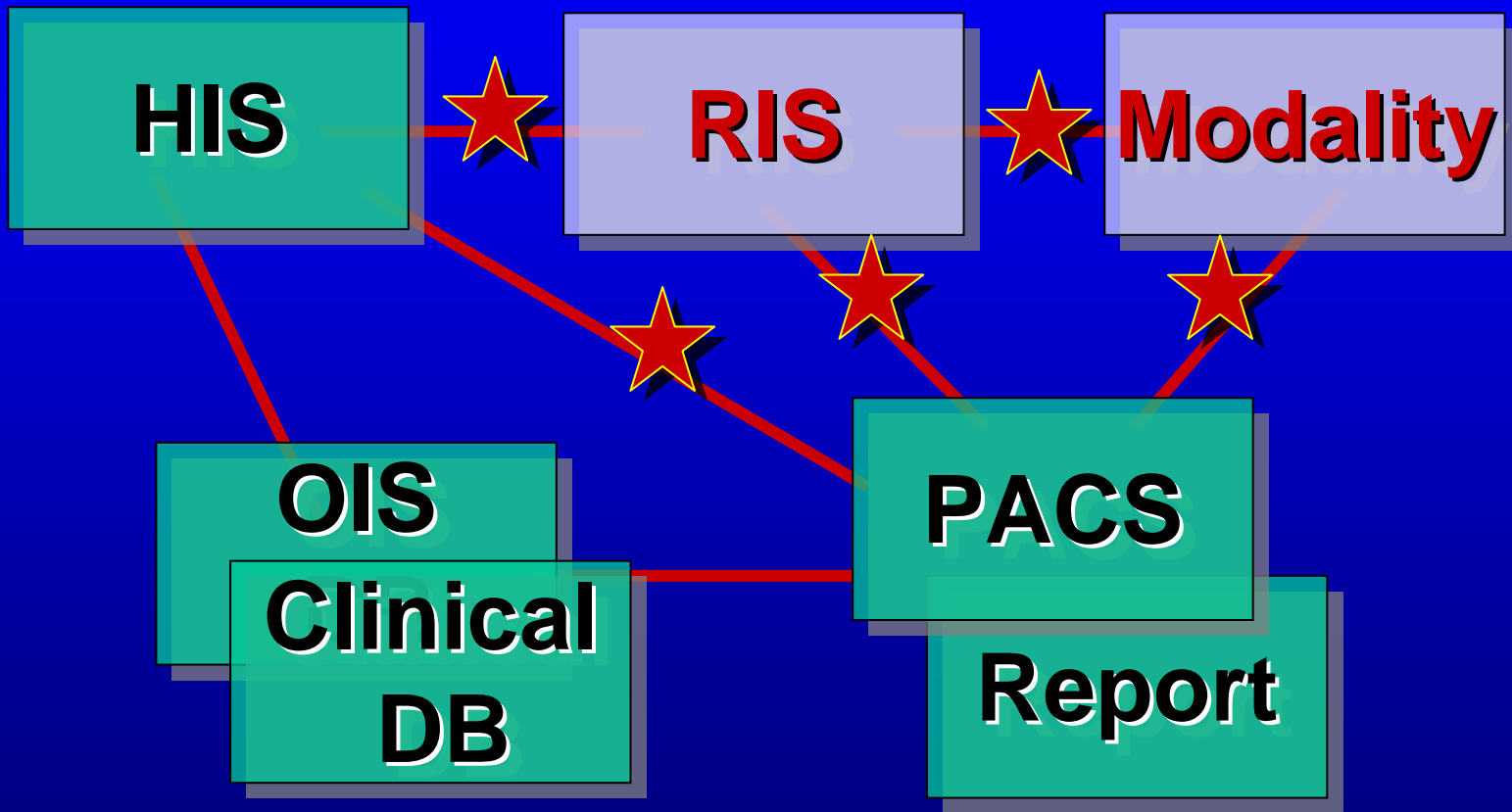
PACS-1



PACS-2

For high availability

Configuration of Hospital Information System



OIS: Oncology Information System



Communicated by IHE Integration Profile

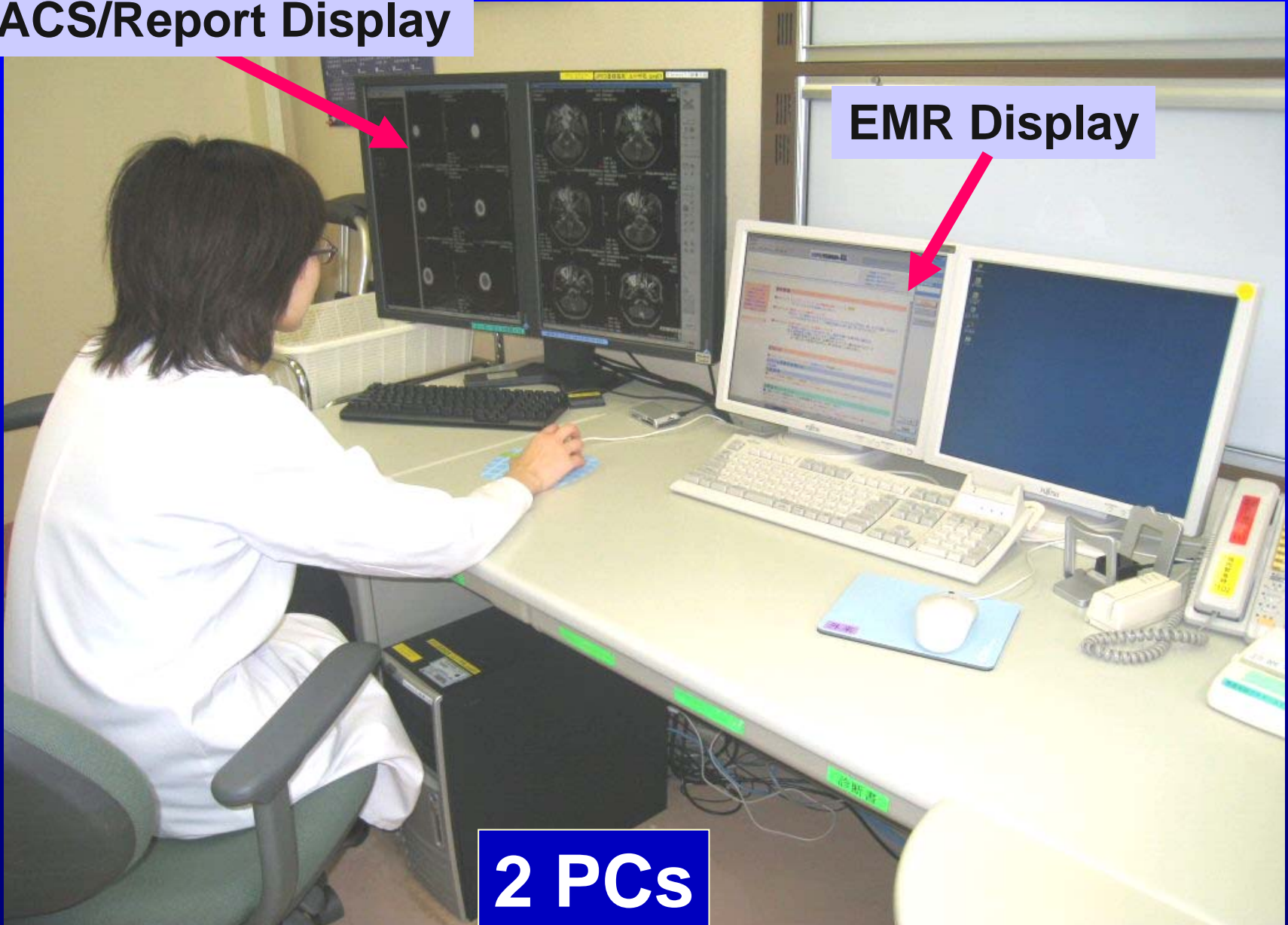
EUA/PSA

Outpatient Clinic

PACS/Report Display

EMR Display

2 PCs



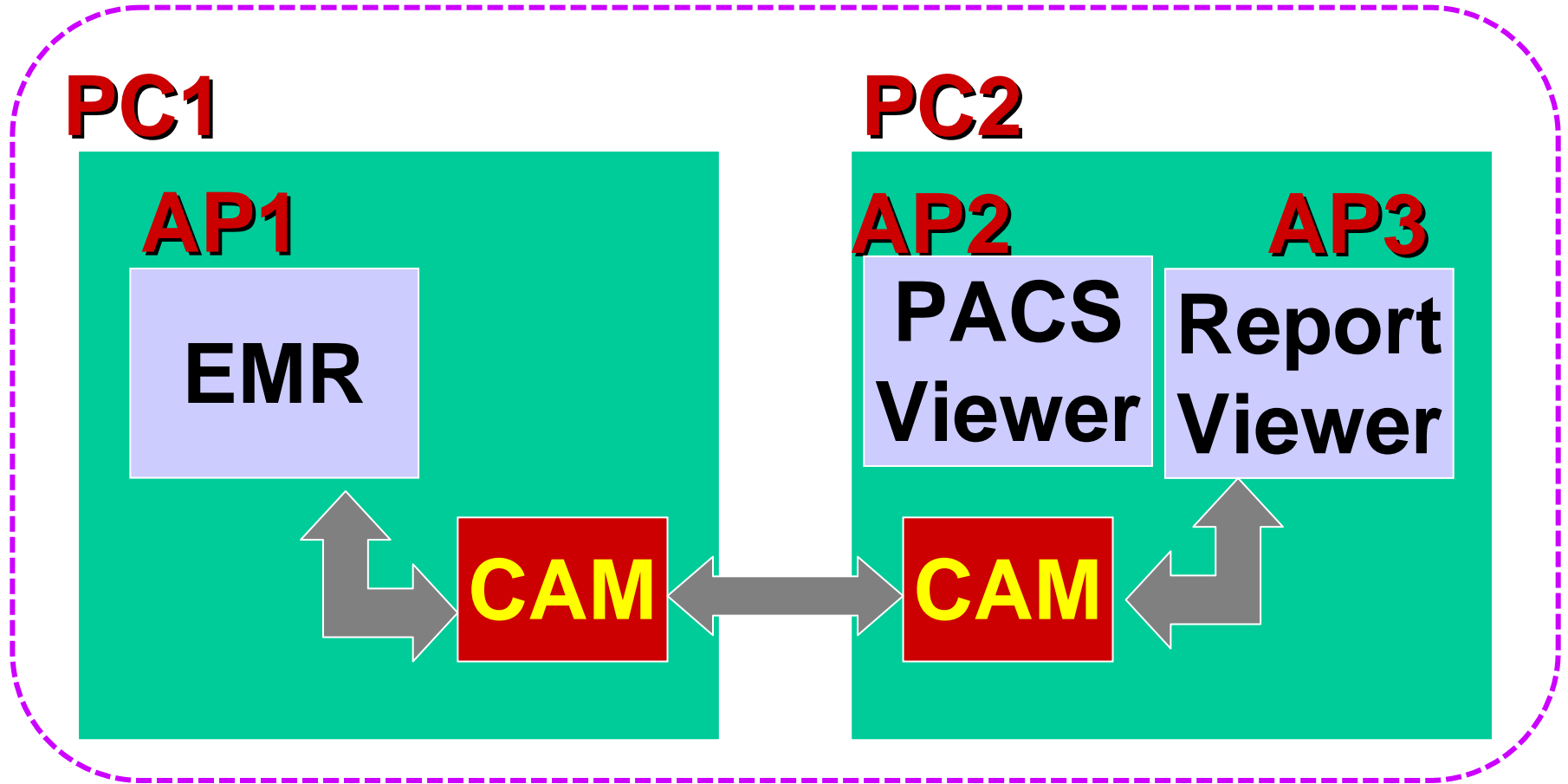
Special Consideration for radiation therapy

- Radiotherapy needs various images (CT, MRI, PET, Dose Distribution) for precise radiation planning. To corroborate EMR and PACS-Viewer is necessary.
- Physicians want to use EMR, PACS-Viewer, Report-Viewer, Oncology RIS simultaneously in clinical practice.

Single Sign On and Patient Synchronization

- To evaluate IHE IT Infrastructure Integration Profile (EUA, PSA)
- To adapt the EUA and PSA to the Japanese clinical environment
- Used IHE IT Infrastructure Profile:
 - EUA: Enterprise user authentication
 - PSA: Patient synchronized applications

Context Area

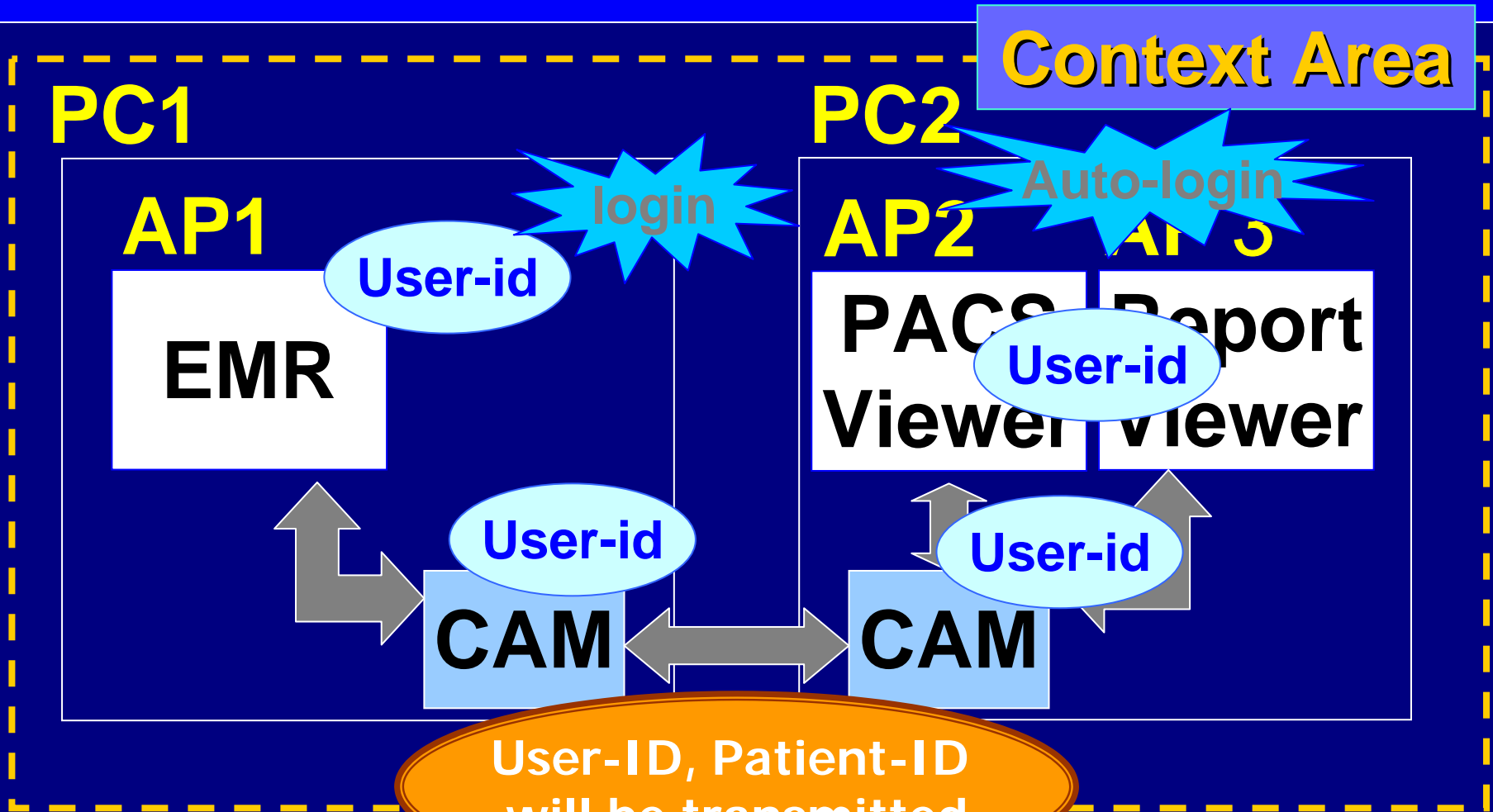


CAM: Context Area Manager

AP: Application 1,2 ...

PC: Personal Computer

Function of EUA



CAM: Content Manager

AP: Application 1,2 ...

PC: Personal Computer 1,2 ...

Use Case

- User-A logs in to EMR at PC1
- User-A also logs in to PACS viewer without login procedure at PC2
- User-A selects Patient-1 by EMR at PC1
- PACS viewer selects to Patient-1 automatically at PC2
-
- User-A logs off from EMR at PC1
- PACS viewer is automatically logged off at PC2
- User-B logs in to EMR
- PACS viewer automatically logs in

EUA/PSA Module

- We made the middle-ware library to communicate the context area manager each other. We analyzed the flow of the applications. We implemented the function of the EUA and PSA into the existing applications.
- We evaluate the functionality of the EUA and PSA by using the each application. We find that the user interface is very important.
- If we build the application insufficiently, the function of the EUA/PSA may disturb the application by excessive dialogs.

Problems

- Scope of Context manager
 - Context manager function is limited to a single workstation by HL7. We expand the function to multiple workstations.
 - Lack of the study/series information.
- Complexity of implementation
 - web application (applet, servlet)
 - client application (active-X, java)
- Access control is out of scope

Problems

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Merit

- The EUA and PSA function increased the convenience in user interface
 - Only one input of user-ID and patient-ID
 - When physician logs off, he can quit every application by one procedure.
- We expect that the each applications can be easily implemented by using the EUA and PSA library and we can shorten the period of the development.

Demerit

- Cost
- Education/Propaganda
 - User
 - Vender
- Development of EUA/PSA Middle ware
- Incomplete of Implementation
 - Incomplete RFP and/or insufficient understanding
 - Difficulty of implementing all IHE functions

Discussion

- Profit of IHE in installing the PACS
- Is the IHE technical framework easily used for the RFP ?
- Cost saving or Cost consuming ?
- Promotion of the Standardization is necessary.

Conclusion

- We developed Hospital Information System and PACS by using IHE specification and confirmed the effectiveness.
- We improved existing systems when the systems were renewed.
- We had to encourage to promote the standardization for cost and time saving.
- Our middle-ware for EUA/PSA are now open source software and open to the public.

Thank you for your attention.

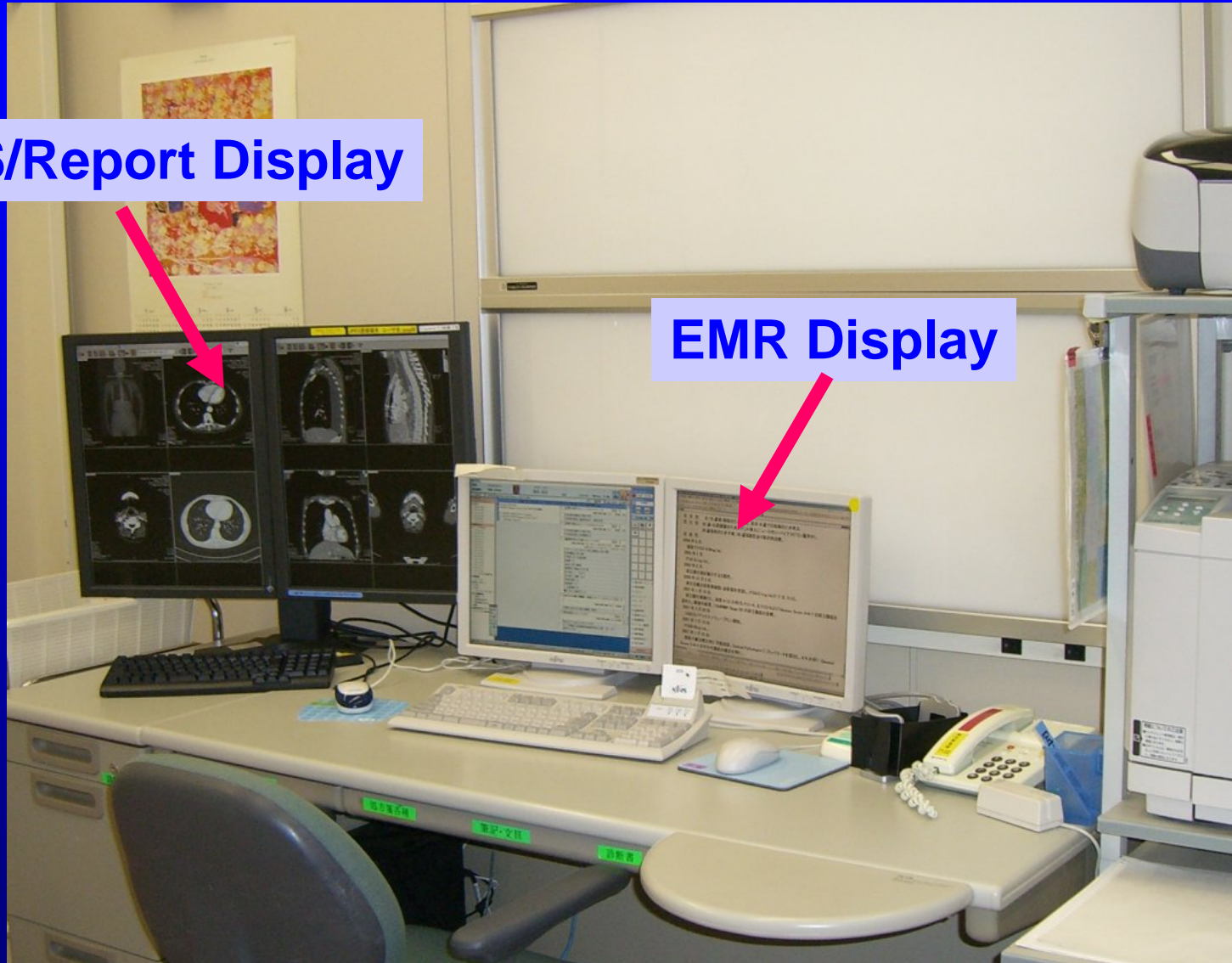
Result

- The IHE-ITI EUA and PSA function were implemented into four systems (EMR, PACS-viewer, Report-viewer and Oncology RIS).
- These functions were merged into an application by using the middle-ware.
 - The PACS viewer is based on the java client program.
 - The Oncology RIS is based on a php script and apache server. The EUA and PSA function were realized in an applet method.

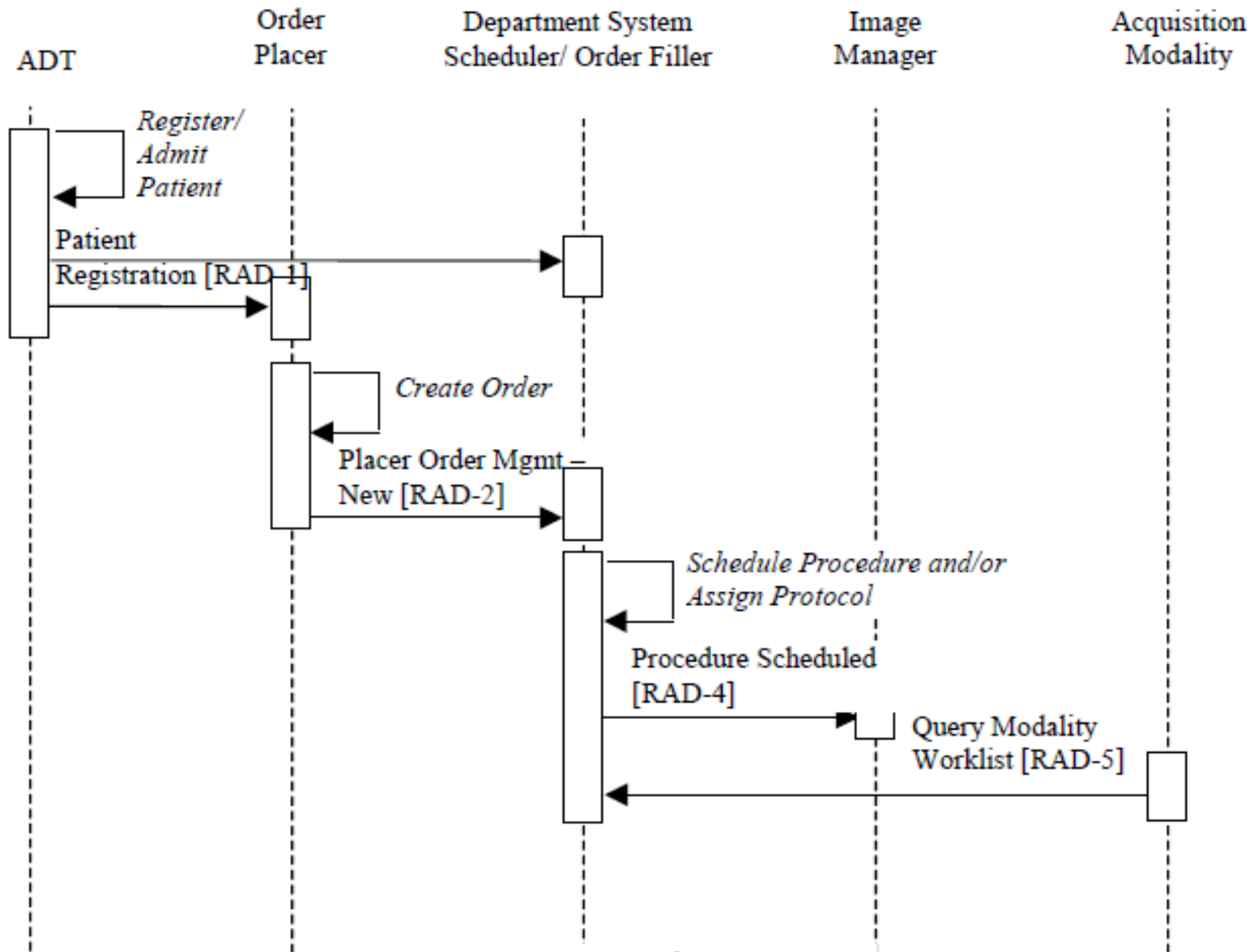
Out-Patient Clinic

PACS/Report Display

EMR Display



SWF (Scheduled Workflow)



Continued in Figure 3.3-2

Figure 3.3-1. Administrative Process Flow

**SWF
(Scheduled
Workflow)**

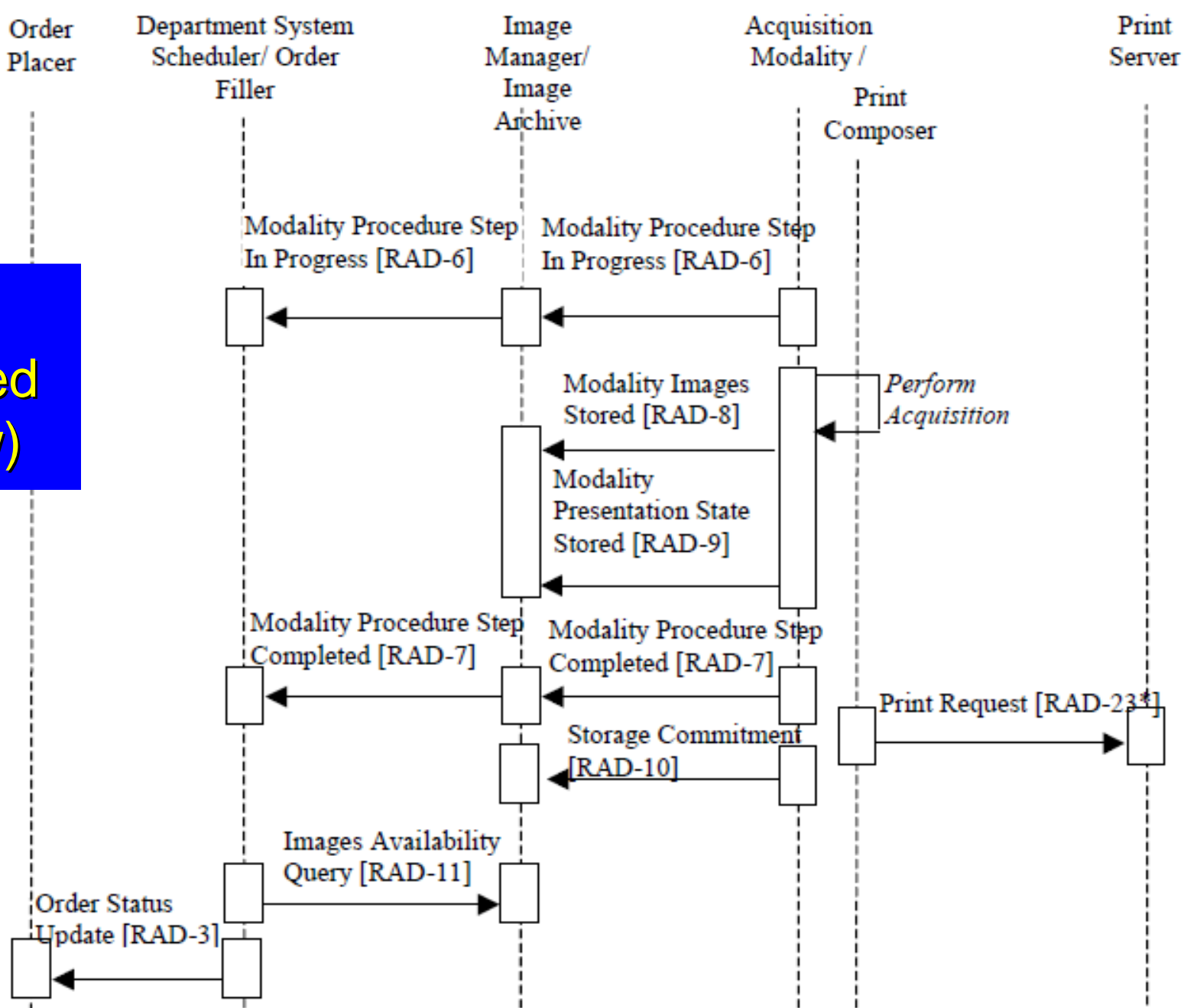


Figure 3.3-2. Procedure Performance Process Flow

PAM (Patient Administration Management)

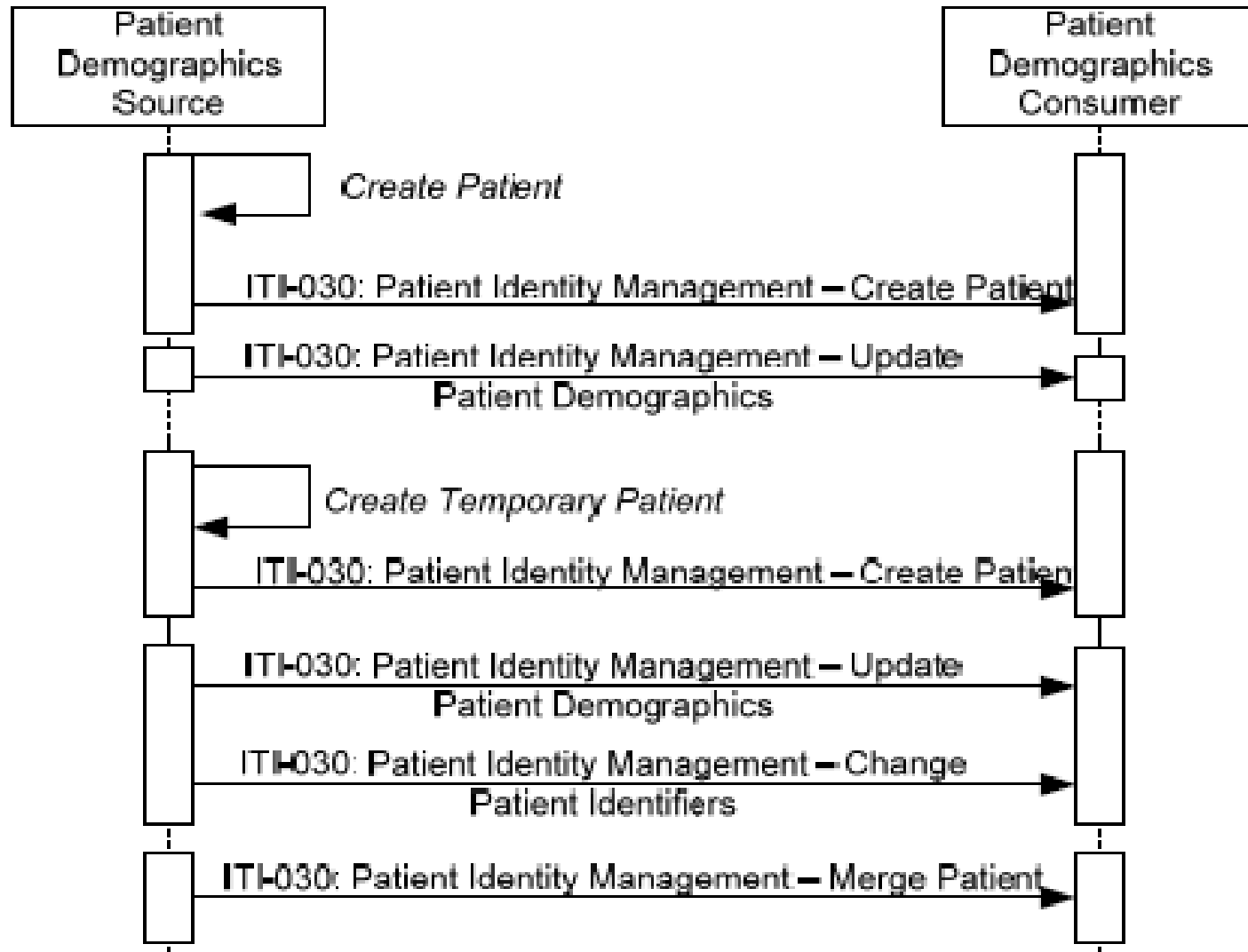


Figure 14.5-1 Patient Identity Management Process Flow in PAM Profile 9

PDI (Portable Data for Imaging)

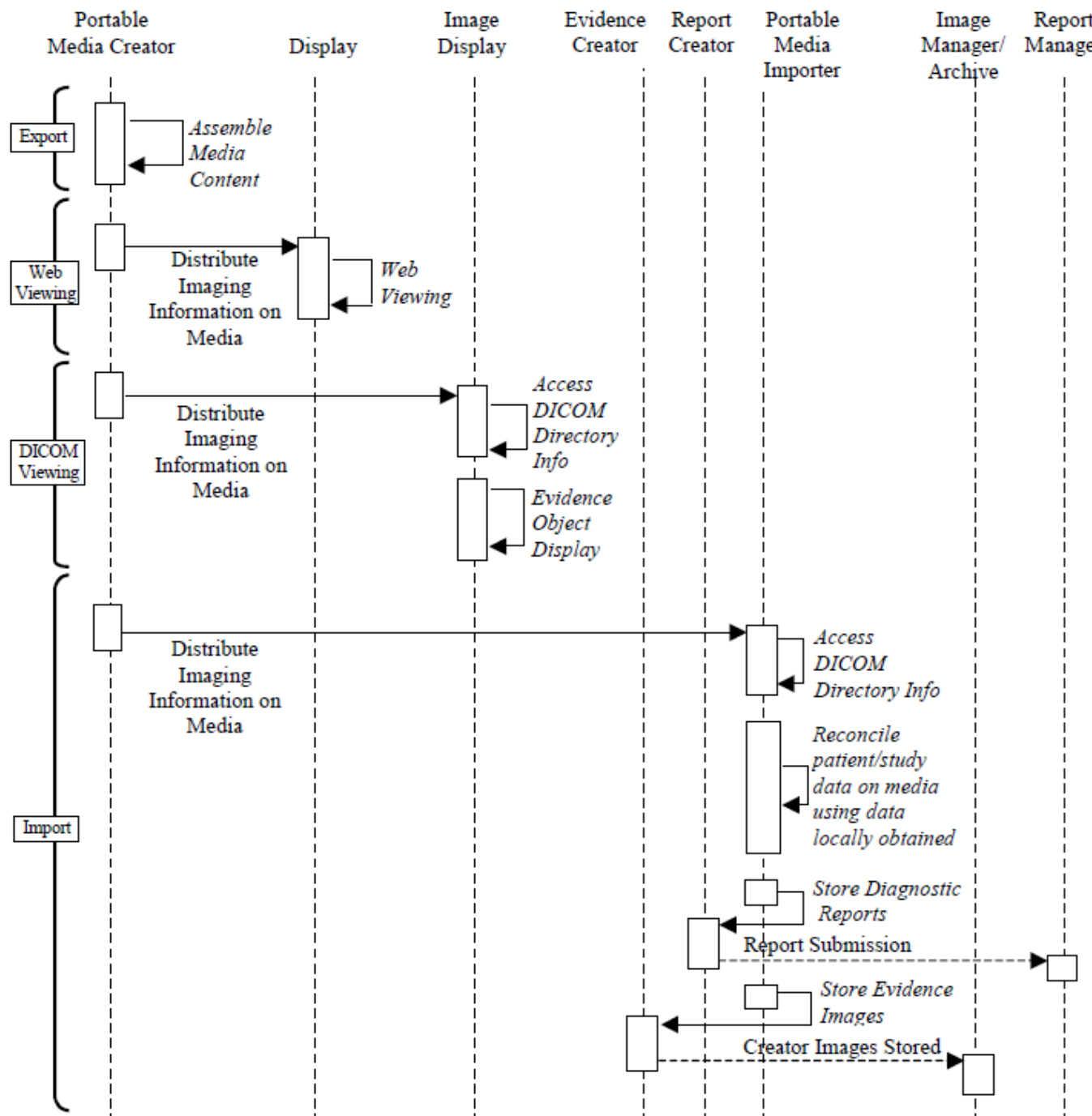


Figure 15.3.2-1. Portable Data for Imaging Process Flow

IRWF (Import Reconciliation Workflow)

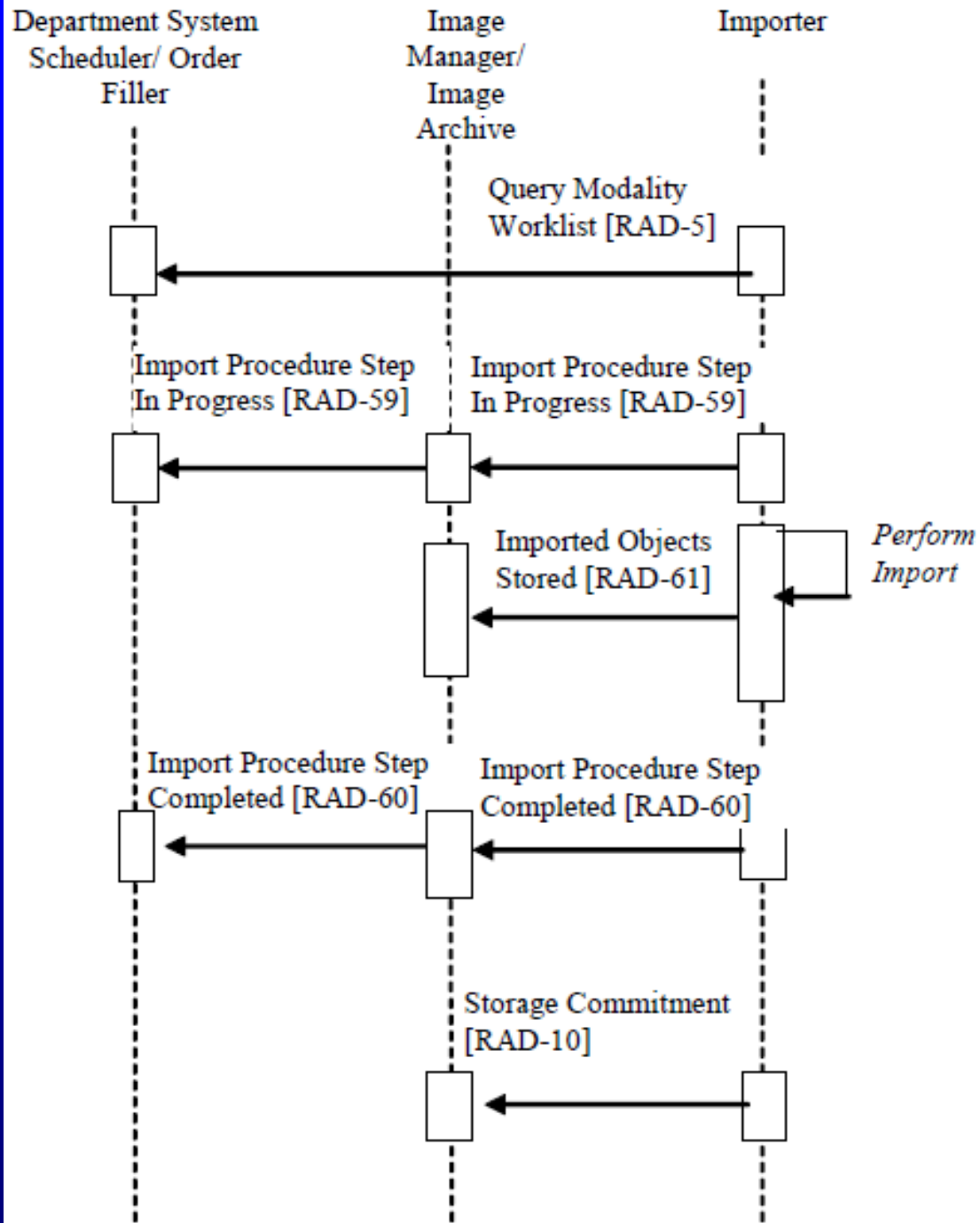


Figure 21.3.1-1. Scheduled Import Reconciliation Work

EUA (Enterprise User Authentication)

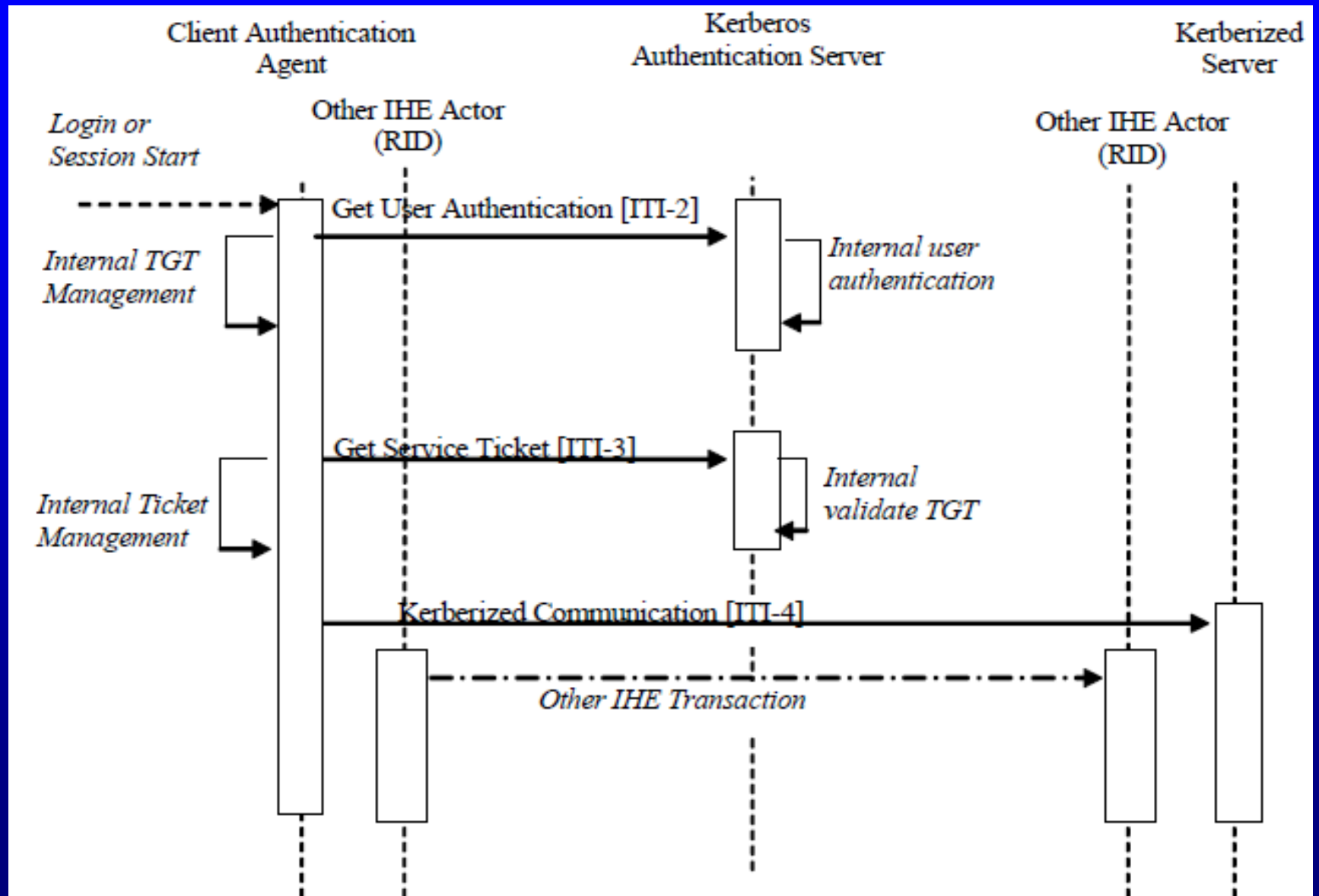


Figure 4.3.1-1. Basic Process Flow in Enterprise User Authentication Profile

EUA+PSA

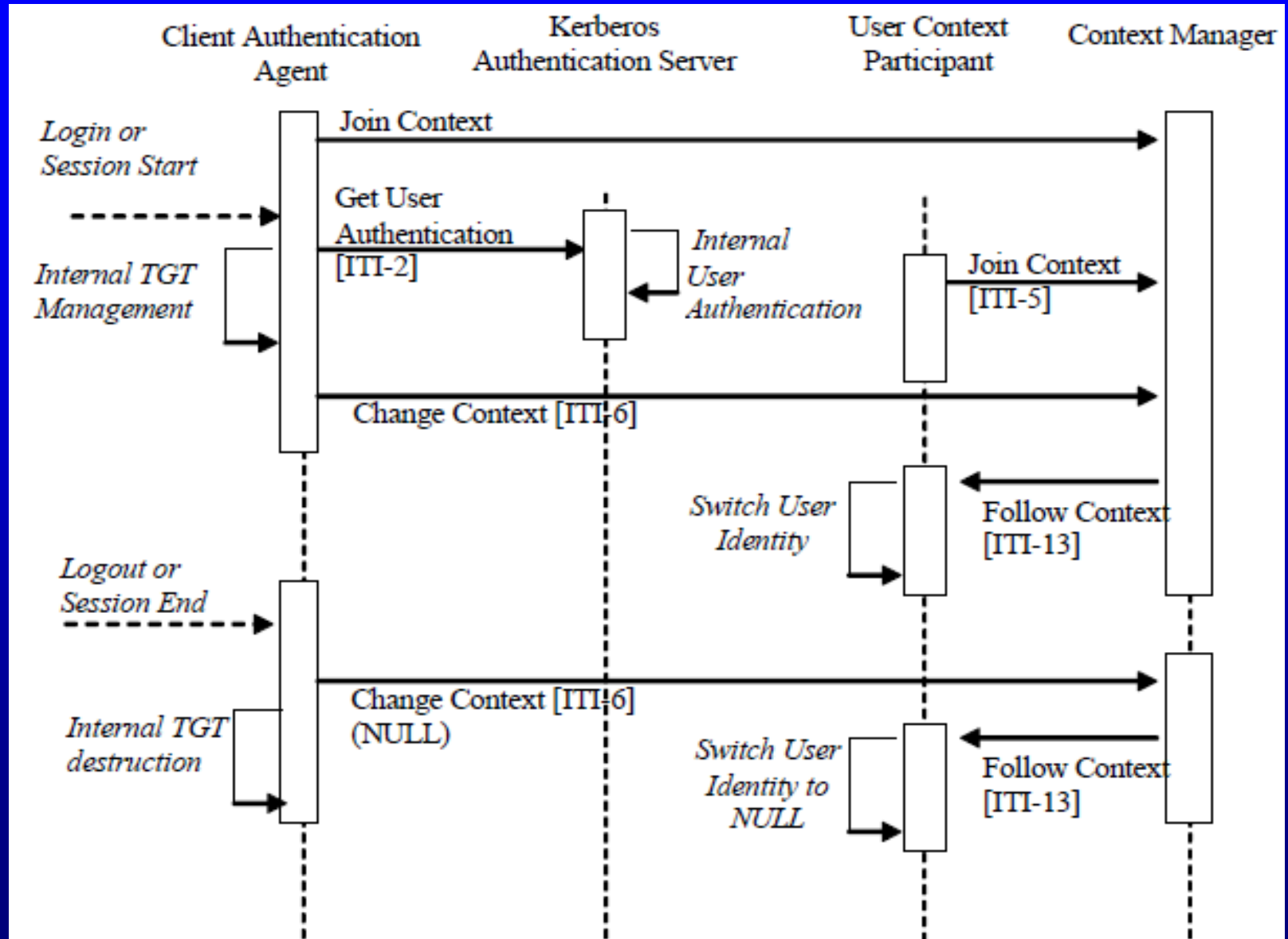
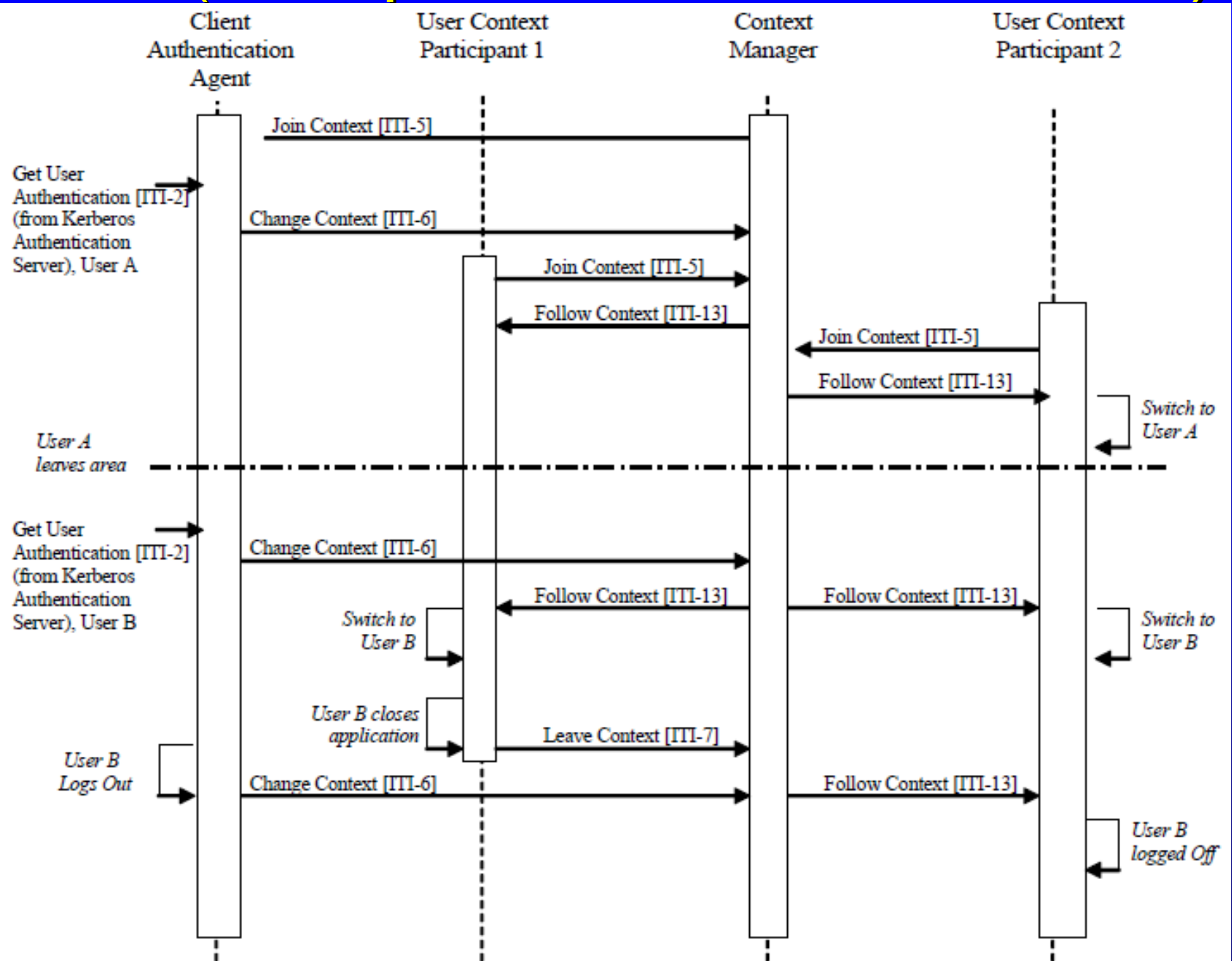


Figure 4.3.2-1 Process Flow with User Synchronized Applications

EUA (Enterprise User Authentication)



PSA (Patient Synchronized Applications)

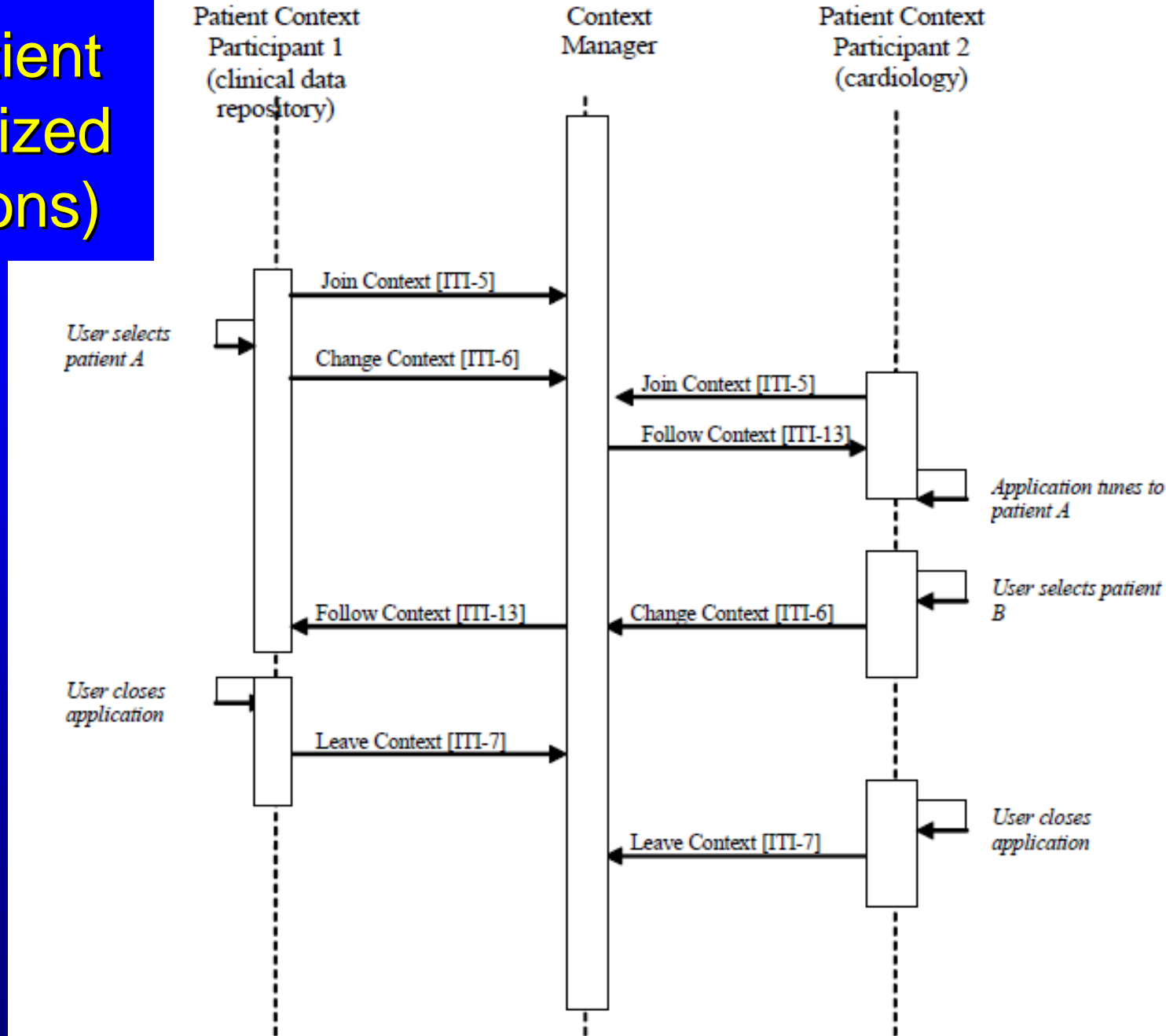


Figure 6.3-1 Simple Patient Switching Process Flow

CT (Consistent Time)

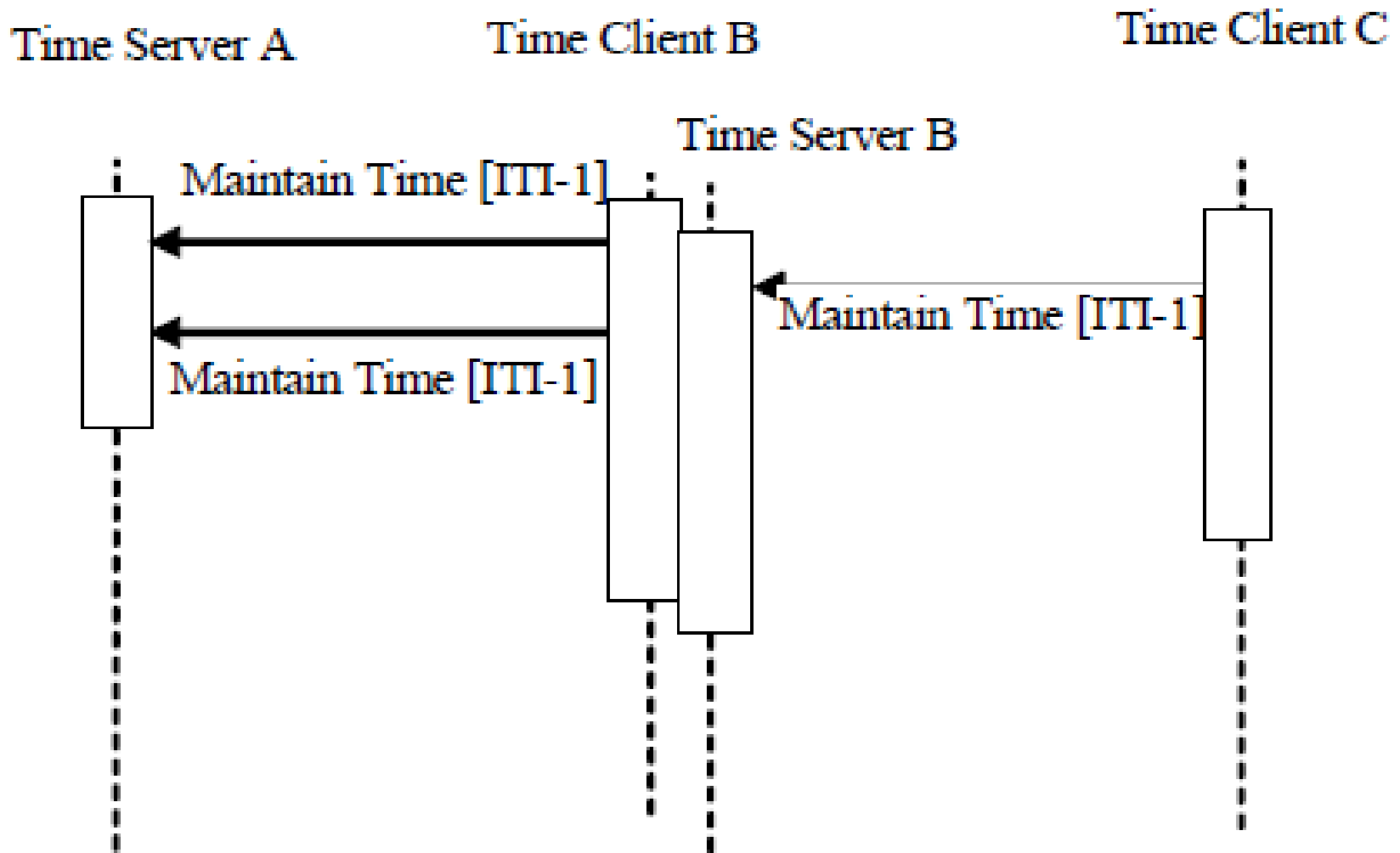
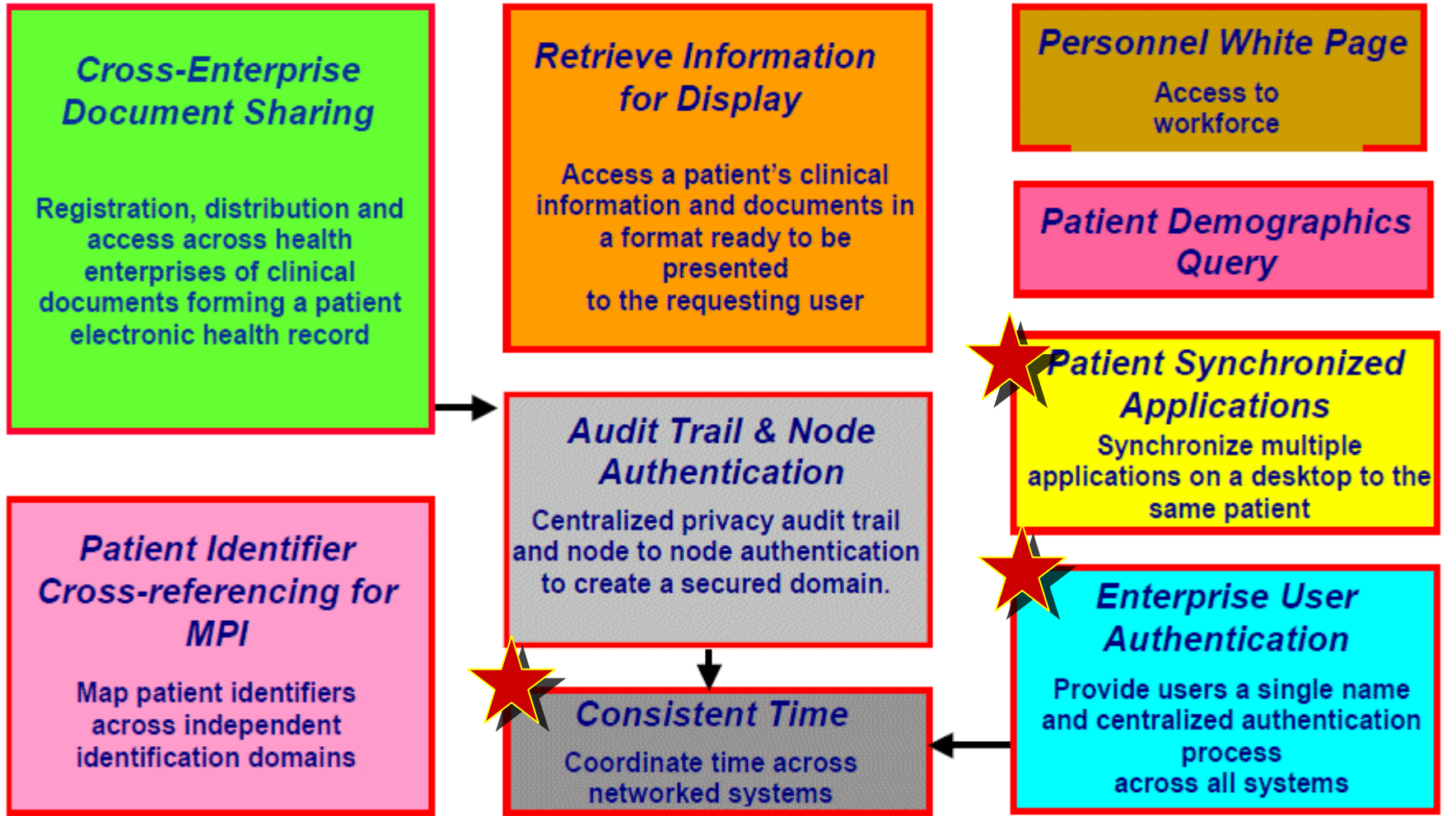


Figure 7.3-1 Basic Process Flow in Consistent Time Profile

Reference

- [1] IHE Integrating the Healthcare Enterprise, <http://www.ihe.net/>
- [2] IHE-Japan website. <http://www.ihe-j.org/>
- [3] Clinical Context Management Specification Version 1.4, The Health Level Seven, ANSI/CMS V1.4-2002

IHE ITI Integration Profiles



 **Implemented at NIRS**

EUA (シングルサインオン)

- HISにユーザAがログイン (PC1)
- PACSに同一ユーザで参加 (ログイン不要) (PC2)
-
- HISからユーザAがログアウト
- PACSも連動して、ログアウトし終了
- HISにユーザBがログイン
- PACSに同一ユーザで参加 (ログイン不要)

PSA (患者選択連動機能)

- HISにログインしている (PC1)
- HISで患者Aを選択
- PACSにログイン (PC2)
- PACSは患者Aで連動 (患者選択が不要)
- PACSで患者Bに変更
- HISは、連動して患者Bに切り替わる
- 他のアプリケーションにログイン
- このアプリケーションでも患者が連動する

まとめ

- IHE-ITI (EUA, PSA) を導入するについて、実装上の問題点を検討した。
- システムを更新するのに合わせて、機能を追加するが、既存のシステムの改造が必要となり、手間が煩雑であった。
- PSAで画像検査・シリーズの連携が不足している。
- 将来の普及のために、Open なソフトが必要。→公開を検討中

IHE-ITI 実装のメリット

- EUA, PSAの導入により、ユーザ・サイドの利便性が確保される。
 - ログインや患者ID入力の低減
 - 共通のログインや患者選択画面の採用
- 各アプリケーションは、患者連動機能をライブラリーとして提供されるので、今後、開発期間の短縮やコストダウンが期待できる。

稼働中のシステム

- Hospital Information System (HIS)
- Radiology system
 - RIS
 - PACS
 - Report system
- Clinical database for radiation therapy
- Schedule management system