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The First Japanese Implementation of IHE-ITI EUA/PSA and the Impact of Visual Integration

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Abstract

In Japan, two PCs (for example: EMR and PACS viewer) are commonly used for the Hospital Information System in one clinical unit. Many physicians have to enter a user ID and password to login to these systems. To solve the troublesome manipulation, we developed the function of the IHE-ITI Enterprise User Authentication (EUA) and Patient Synchronized Applications (PSA). We developed middle-ware for the EUA/PSA to reduce the implementation load among the EMR, PACS-viewer, report-viewer, radiation scheduling system and radiation information system. The EUA/PSA was based on the HL7 CCOW standard and did not support multi PCs. So we enhanced the EUA/PSA mechanism for use with several PCs. We realized that EUA/PSA were essential in a multi-system environment. Our middle-ware resolved the complexities of the application implementation. The established guideline was useful to unify the user interfaces of each application. We found that the EUA/PSA function will be inevitable for visual integration.

Keywords:

IHE IT Infrastructure,
Enterprise User Authentication (EUA),
Patient Synchronized Applications (PSA),
Context Area Manager

Introduction

In Japan, many large-scale hospitals have Computerized Physician Entry Systems. Recently, PACSs (Picture Archiving and Communication Systems) have also been rapidly spreading in the clinical environment. In the hospital physicians have to simultaneously manipulate these systems in out-patient clinics and wards. To reduce operation time, the concept of visual integration is necessary. Some methods of visual integration have been proposed, for example, the HL7 CCOW (Clinical Context Management Specification) [1]. By the definition of CCOW, the context manager is limited to one workstation or personal computer, which is not suitable for Japanese institutions. We analyzed the physicians' workflow and found that multiple workstations and/or personal computers should belong to the same context unit. We expanded the context unit to a "context area", which can cover several workstations and/or personal computers in one clinical unit.

For the implementation of visual integration, we adopted the EUA (Enterprise User Authentication) and PSA (Patient Synchronized Applications) integration profiles [2] that IHE (Integrating the Healthcare Enterprise) IT-Infrastructure [3] defined. To simplify the implementation we developed middle-ware that enables the EUA/PSA mechanism and modified our existing six systems. Our hospital specializes in particle radiation research and the hospital information system consists of the EMR, PACS, a reporting system (Report), radiation oncology-RIS (RO-RIS) and radiation schedule system (RSS). We thought that these systems should adopt the EUA/PSA.

The aims of this paper are (1) analysis of the effectiveness of the EUA/PSA, (2) the usefulness of the EUA/PSA middle-ware and (3) verification of the expanded function of the context manager defined by HL7 CCOW.

To study the effectiveness we counted the number of physicians' operations. We prepared middle-ware conforming to the EUA/PSA integration profile, developing several actor functions that the IHE ITI technical framework defined. We developed four types of libraries to satisfy the application's running environments. In this process we aim to know the validity of the library's algorithm.

The last purpose was to investigate the concept of the "context area" enhanced from the CCOW definition. The mechanism of the context area is the same as the context unit defined by CCOW. The management space was expanded to multiple computers from one computer.

Materials and methods

The CCOW Standard defines the specification of implementation only for a single desktop, one workstation or one PC. In the standard, there is one "Context", which is data set for the shared information between applications, and one "Context Manager", which is the process that controls the context information. A number of applications maintain information synchronized by the CCOW mechanism. IHE/ITI has defined the Integration Profile as the EUA and PSA with CCOW. EUA is an integration profile that recognized a single sign on by using shared user information, and PSA is an integration profile that maintains patient information among a number of applications by using shared patient information.

EUA that supports a single sign on is implemented by using "CCOW User Subject". First, each application joins the Context to send some messages to the Context Manager when an application starts. If the Context already has user information, the application retrieves the user information and then starts under the scope of authority of the user information. If not, the application presents a dialog box for the user to obtain the required information by user authentication, for example, user ID, password and so on. IHE has requested the Kerberos Authentication for the EUA. The authorized user information is sent to the Context Manager and then the information is set to the Context, after which other applications will use the information. This is the mechanism of the single sign on in IHE and CCOW.

The PSA that supports synchronized patient information is implemented by using "CCOW Patient Subject". When each application joins the Context and the user selects one patient in one application, that patient information is sent to the Context Manager and then set the patient information to the Context, after which the Context Manager send a message that one patient has been selected by other applications. This is a trigger that requests setting the patient for applications. When a user changes the patient, the same procedure is applied. All other applications then know that new patient information should be set. This is the mechanism of synchronized patient information.

Context Area Manager

We developed a new synchronized mechanism adapted to a number of desktop environments with Hitachi Medical Corporation. We expanded the mechanism of IHE and CCOW specifications, because it is useful and is easily understandable to use a standard procedure that has been already defined, so transactions and related information items in the new mechanism are the same as the specification and guide of CCOW and IHE. From an application point of view, some standardized functions or methods should be called up only when needed. The application is not concerned with the environments, whether a single desktop or a number of desktops. The developed environment supports such features.

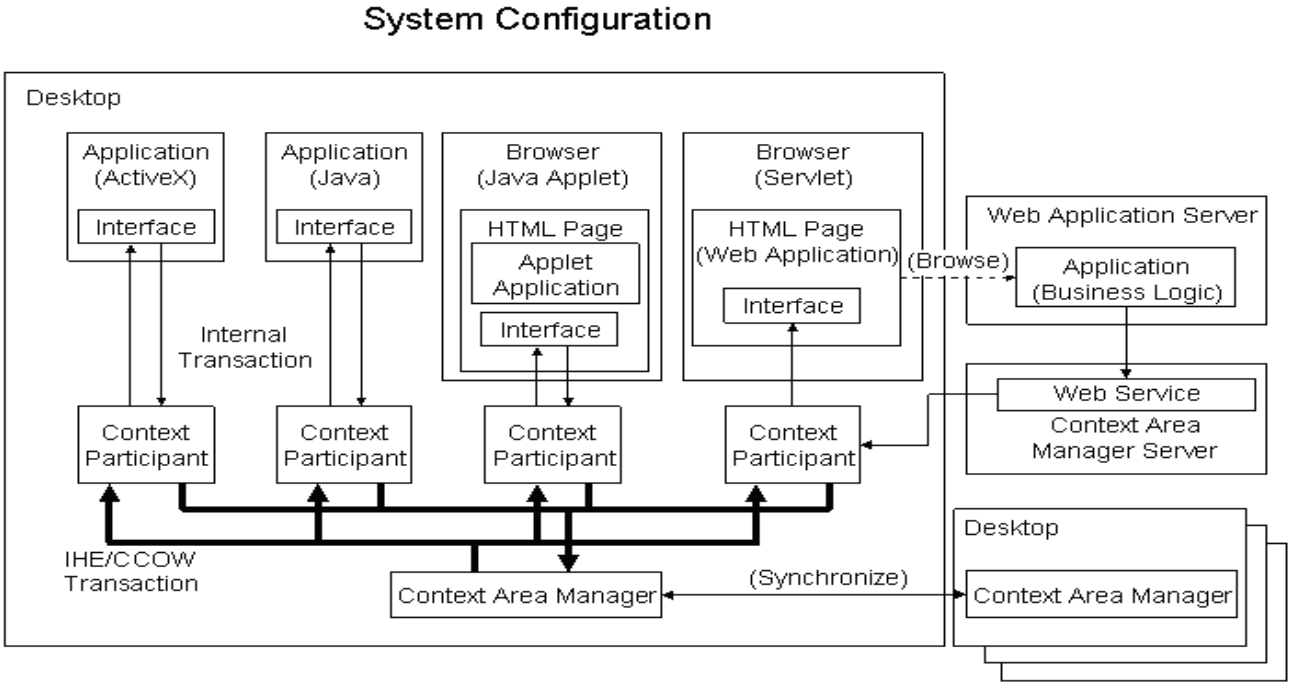

Figure 1 - Configuration of the context area manager and the relationship between the context area manager and applications

As shown in Figure 1, we defined "the Context Area Manager" and "the Context Participant" for a multi-desktop environment. The Context Area Manager is a new process that has expanded functions compared with the Context Manager specification. The Context Area Manager has the same functions as the Context Manager. The expanded function of the Context Area Manager is for communication with the Context Area Manager on other desktops (workstation and PC). If an application requests to change the Context, the Context Area Manager would broadcast that information to other Context Area Managers to synchronize the Context on all desktops. This mechanism allows synchronization of the Context on a number of desktops. From a user viewpoint, the information handled on a number of desktops remains synchronized.

The Context Participant is a special process that receives messages from the Context Area Manager and sends them to an application which receives messages from an application and sends them to the Context Area Manager. The Context Participant would be generated for each application. The relationship between the application and the Context Participant is one to one.

An application sends messages to the Context Participant by using libraries or methods or Java scripts. It is dependent on the implementation of an application. There are 4 types of implementations: ActiveX application, Java application, Java applet and Servlet. A library that sends and receives messages from/to the Context Participant for ActiveX application and for Java application has been developed. Also, for the Java applet, some Java scripts are written as applets to enable communication from/to the Context Participant. In the case of the Servlet system, the logic that allows the communication from/to the Context Participant is implemented on the server side. There are various complicated configurations for the Servlet system, but all systems have a basic configuration, the Context Participant and the Context Area Manager, and all applications communicate from/to the Context Participant to send messages from/to the Context Area Manager. The Context Area Manager enables communication to the Context Area Managers on other desktops to synchronize information in the Context Area.

Next we established guidelines for the implementation of the EUA/PSA. Table 1 shows the guidelines. The venders of the existing systems modified their applications according these guidelines.

Table 1 - Guidelines for implementation of the EUA/PSA

NO	Items
1.	To manipulate a context manager, unified procedures and man-machine interfaces are used.
2.	The conditions according to participation and breakaway from the context manager did not depend on the applications.
3.	We can confirm the participation/breakaway visually.
4.	When an application works with context manager, the application checks that the context manager is running correctly.
5.	When the context is changed, each participating application with un-saved data will ask the user to save the data.
6.	The displayed terms regarding the context manager are decided. Every application uses the same words and icons that show the status of participation.
7.	The dialog: Each application is set to default maneuvers: (1) always permit, (2) ask a user with a dialog box and (3) always refuse to change the context.

Target systems

The target systems were (1) EMR, (2) PACS, (3) report system, (4) RO-RIS and (5) RSS. The EMR is the HOPE/EGMAIN-EX C/S Edition, HOPE/DrABLE-EX and HOPE/LAINS-PC by Fujitsu. The EMR can open six patients simultaneously. We decided the synchronization using the PSA. The first patient is opened by the Context Area Manager, whereas, the last patient was synchronized by another application.

Our PACS consists of two systems, SDS-DicomViewer (PACS-1) by TechMatrix, and the SYNAPSE (PACS-2) by Fujifilm. The Report is F-REPORT by INFOCOM. The RO-RIS is RIGIA by Global-for. The RSS is the Particle Radiation Schedule Management System by Nippon Telegraph and Telephone East. Figure 2 shows the configuration of the NIRS Hospital Information system. When the EUA/PSA library was installed in all applications, the most suitable library was carefully selected from the four types (ActiveX application, Java application, Java applet and Servlet).

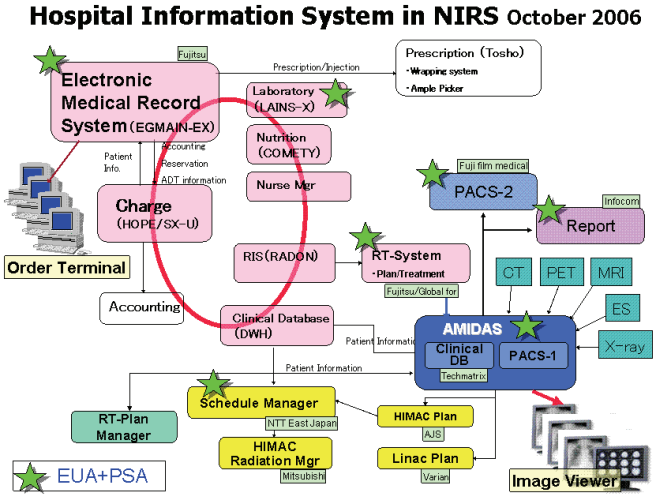

Figure 2 - Existing Hospital Information Systems. The star sign denotes the function of the EUA/PSA

Results

Our EMR has been running since October 2006 and uses the ActiveX module. PACS-1 uses the Java module. PACS-2 uses the ActiveX module. The Report uses ActiveX. The RSS uses the Java applet. RO-RIS uses the ActiveX. No system uses the Servlet module.

We set up the context area in our hospital. There are 23 context areas in the out-patient clinic and wards. Each context area covers several applications (EMR, PACS-1, PACS-2, Report, RSS and RO-RIS). Each context area consists of 2 personal computers, one which is used mainly for EMR and the other which is used mainly for the PACS/Report application and RSS application.

We examined the number of actions for the login and the selection of patients in each application. Table 2 shows the differences between operation with and without the EUA/PSA function. Each application can omit 2-3 operations by using the EUA/PSA mechanism.

Table 2 - The number of the actions we can omit during Login and Patient Selection by the EUA/PSA function

Application	Login	Patient Selection
EMR	2	2-3
PACS-1	2	3
PACS-2	2	2
Report	2	2
RSS	2	3
RO-RIS	2	3

(We count one for a mouse click and/or a consecutive keyboard input.)

The enhanced Context Area Manager is working with no serious problems, but if the number of participants in the same context area increases, the response time of the Context Area Manager also increases. We found that with two participants in the same context area, the response time was less than one second.

Discussion

Our hospital has six existing information systems. We wanted to reduce implementation problems and to unify the application interfaces: middle-ware could resolve these problems. We prepared guidelines for modification of the workflow. These guidelines include icons that indicate the status of an application, as shown in Figure 3. We developed two types of icons (small and large), which are useful for physicians to understand the status of the context manager. The "Participating" status means that each application communicates with a context manager and all applications cooperate. In this status, all applications are coordinated for the same log-in user and the same patient ID.

Figure 3 - The left two icons show "Participating", the right two icons show "Non-Participating"

The validity of the enhanced context area was confirmed. Our hospital information system consists of six systems (EMR, PACS-1, PACS-2, Report, RSS, RO-RIS). In the future, the necessity of t visual integration will increase, and implementation of the IHE ITI EUA/PSA will be popular among medical institutions and hospitals. The unified procedure for visual integration is very important, and we developed guidelines and icons. We consider that hospital information staff should prepare guidelines and rules to utilize the visual integration effectively.

The context manger function of the patient subject is limited to the patient ID. In future, integration of the patient ID should be enhanced to details of patient information such as the examination ID or image ID, especially for PACS/Report applications. The EUA/PSA defined by IHE ITI uses CCOW version 1.4, which defines the patient subject as the patient ID. CCOW version 1.5 defines detailed information about a patient such as DICOM objects. In future we want to improve the function of the PSA to support DICOM objects.

It is natural to be afraid of malpractice in clinical procedures. With a multi-vender information system it is troublesome for physicians to enter a user ID and a patient ID or to select a patient. The EUA/PSA mechanism will

solve such onerous problems, but if the Context Area Manager is down, the implications will become serious. We made the related applications foolproof and robust to eliminate malpractice. Each application can be executed without the EUA/PSA function and will ignore the Context Area Manager when the manager will not respond to a participant.

Conclusion

We developed four types of EUA/PSA middle-ware. Each application used suitable middle-ware for running environments and also enabled the simple implementation of a single sign on and patient selection. We modified six existing information systems to use the EUA/PSA middle-ware. These modifications require the considerable effort, but otherwise we achieved good seamless operation by the EUA/PSA functions. We believe that the EUA/PSA function will be indispensable for multi-vender information systems and useful for clinical safety.

References

[1] Clinical Context Management Specification Version 1.4, The Health Level Seven, ANSI/CMS, V1.4-2002.
[2] EUA/PSA integration profile, Integrating the Healthcare Enterprise. website http://www.ihe.net/Technical_Framework/index.cfm#IT
[3] ITI Integration Profile, website http://www.ihe.net/Tecnical_ Framework/index.cfm#IT.

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