Archive Selection for the MICAS, a Multi-Vendor Incremental Approach to PACS

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THE MEDICAL INFORMATION, Communications and Archive System (MICAS) is a multi-modality integrated image management system which incorporates the Radiology Information System (RIS) and Radiology Image Database (RID). It will be integrated in the future via a Graphical User Interface (GUI) with the Hospital Information System (HIS), Clinical Information System (CIS) and other related databases by the Information Systems Division (ISD) of the University of Rochester Medical Center (URMC).

MICAS is being implemented over five to seven years using multiple vendors with Radiology as the systems integrator. This approach requires that each component of the Picture Archiving and Communication System (PACS) be individually selected contrasted to the single-vendor (turn-key) approach in which one vendor provides the entire system.

The key to the long-term successful implementation of MICAS is interoperability of all components. This requires that all MICAS vendors strictly adhere to the Digital Imaging and Communications in Medicine (DICOM) Ver. 3.0 and Health Level 7 (HL7) standards and that no proprietary interfaces between components supplied by a single vendor are permitted, such as between the archive and workstation. In addition all vendors, including the modality vendors, must document the content of all fields required, optional and private in the DICOM header.

MICAS OVERVIEW

The Department of Radiology had investigated PACS for several years and in June 1995, the MICAS task group was formed and given the directive to implement a staged implementation of PACS capability with a first year budget of approximately \$400,000.

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Additional monies would follow based on the project demonstrating its clinical utility and cost effectiveness. The task group had the constraint that IDXrad, the current RIS, had to be seamlessly integrated with the PACS. Functional specifications were developed over a nine-month period. Turn-key and individual component vendors were asked to respond to the Request For Quotation (RFQ).

No turn-key system vendor offered a sufficiently versatile and cost-effective solution that was within our budget. Therefore, it was decided to assemble the system from components. Digital Equipment Corp. (DEC) was selected as the vendor and integrator of the hardware, ImageLabs for viewer software and IDX for the acquisition engines, RIS interface, query and retrieve and temporary archive manager. The Department of Radiology was responsible for the network infrastructure.

MICAS installation commenced the third week of February 1997. As to be expected with any complex hardware and software installation, especially with multiple vendors, numerous problem areas were uncovered. The DEC hardware and ImageLabs viewer software has been accepted, but the image acquisition and related software from IDX has not been accepted. In the meantime, MICAS is currently being used as a clinical review system.

A detailed description of the architecture and infrastructure for MICAS is described elsewhere.^{1,2} The MICAS architecture is configured around a Cabletron Systems SmartSwitch 6000 (throughput exceeding 2M packets/sec and bandwidth exceeding 3.2 Gbps) with all devices connected directly with the switch. The switch is programmed such that the imaging devices and workstations for each modality are segmented to maximize data throughput. Each modality segment is designed to operate at 100 Mb/s except where limited by the modality and includes its own temporary RAID 5 archive. All clinical devices within Radiology including the RIS are connected to the switch. A seamless interface is provided between the RIS and RID with all image pointers residing in the RIS.

The images are currently acquired using the DICOM standard, but subsequently are not transmitted and stored using DICOM standards. A perma-

nent archive was not initially part of MICAS. Security for the system is currently provided by a firewall that will be enhanced in the future. Studies will be transmitted to clients outside the Radiology LAN via a clinical image server. Provisions will also be made for off-site acquisition and transmission of studies. The next major components to be purchased for MICAS are the archive with associated hardware and software and clinical image server. The archive vendor will be responsible for the functionality currently provided by IDX.

METHOD

A Request For Information (RFI) was sent to 16 archive vendors and responses have been received from 14. The two that did not respond did not want to participate in a multi-vendor PACS. A detailed Request For Quotation (RFQ) for a DICOM compliant archive with related hardware and software has been sent to 16 vendors. The RFQ was based on the vendors' responses to the RFI, a thorough review of the archives and related hardware and software demonstrated at the 1997 RSNA, site visits and discussions with the vendors and staff. The selection of vendor(s) and awarding of the purchase order(s) is planned to be completed by the end of March 1998 with installation planned for June 1998.

The components included in the RFQ were a HIS/RIS interface (PACS broker) to the RIS, modality acquisition engines and work list managers for all modalities, the archive with related hardware and software, hardware for the initial phase of system redundancy, backup and fault tolerant operation, a DICOM compliant diagnostic workstation and clinical image server. In addition, ImageLabs, the vendor of the viewer software will be asked to upgrade the viewer software to full DICOM compliance and provide software for the operation of a DICOM compliant temporary archive (study cache) that will interact seamlessly with the archive to be purchased.

THE SELECTION PROCESS

Selecting the archive vendor for a multi-vendor PACS is crucial to the long-term success of the MICAS and requires making decisions that will impact the Radiology Department for an indefinite period of time. Among the many considerations that will impact vendor selection:

- DICOM compliancy between all components of the archive as well as all external connections and interoperability
- Documentation for Year 2000 compliance
- Vendor to perform an on-site facility inspection to evaluate existing infrastructure, modalities to be interfaced to archive, interoperability of current hardware and software with that of the prospective vendor
- The interoperability of the vendor's HIS/RIS interface (PACS broker) with the existing RIS, modalities, ImageLabs DICOM viewer and the ability for other DICOM devices to query
- Validation and documentation that the vendor has successfully interfaced with the imaging modalities to be interfaced with MICAS
- Can the vendor provide a bi-directional modality work list manager?
- Available software tools to correct studies that are not validated, yet make them available for interpretation prior to correction and provide an audit trail for the corrections, this would include handling patients with no available demographic information such as from the emergency department
- Flexibility, scalability and user configurability of the administrative and workflow software of the archive manager
- Vendor providing an object-oriented database
- Database(s) to store full DICOM header information for all objects at patient, study, series and overlay levels and ability to access this information from a DICOM client without directing the query to a specific database
- Archive must be able to manage multiple jukeboxes and multiple media storage technologies
- Archive must support storage, query and retrieve color and multi-frame DICOM images as well as non-radiologic images that may or may not adhere to the DICOM standards
- Availability of rules engines for fetching, routing, compression and study management with user defined algorithms
- Archive must communicate with ImageLabs DICOM viewer and other vendor's DICOM viewers with the same functionality and speed as it would with its own viewer
- Archive must have backup, redundancy and fault tolerance capabilities and provide required security for patient confidentiality and privacy as well as adequate safeguards against hacking
- Manage multiple servers, such as the clinical image server, outside the radiology LAN including database, routing and security

- Vendor willingness to provide only a portion of the PACS solution and work with the existing MICAS vendors

SUMMARY

From the time a decision was made to purchase an archive until a purchase order was issued took approximately 10 months. During this period an RFI was developed, issued and the results analyzed. Technical discussions were held and site visits were made. To ensure that current information was available, a complete review of available multi-modality DICOM compliant archives were made at the 1997 RSNA. With this information

in-hand and the future development path for MICAS specified, a detailed RFQ was developed, responses were received and evaluated. A purchase order was to be issued by the end of the first quarter 1998.

The archive vendor will have been selected by the time this paper appears in print. The oral presentation of this work will review the responses of the archive vendors and present the basis for selection. It is planned to publish our findings.

The archive is the heart and brains of PACS. It controls information acquisition, distribution and storage plus work flow. It is critical that DICOM compliance and interoperability between all components of the PACS be an absolute requirement, especially for the archive.

REFERENCES

1. Smith EM, Fontaine MT, O'Brien C, et al: Implementation of the Medical Information, Communication, and Archive System (MICAS). *J Digit Imaging* 10:153-157, 1997 (suppl 1)

2. Smith EM, Robinson A, Fontaine MT, et al: Project MICAS—Medical Information, Communication and Archive System: PACS Implementation at the University of Rochester Medical Center. *J Digit Imaging* 10:228, 1997 (suppl 1)