

Through advances in technology and developments in the application of Information Technology to radiographic imaging, Picture Archive and Communication Systems (PACS) are becoming increasingly attractive as the image management solution for radiology departments. Radiographic images in digital form can be acquired from a variety of modalities, stored in an archive and communicated to any remote location where they are required. The user interaction with a PACS takes place at the workstation. This is commonly a PC connected to the PACS network and running PACS software. Normally after typing a username and password at the workstation, the user is able to view and manipulate examinations of different patients. Comments and annotations can be added to examinations, and examination reports can be created, edited and viewed. Traditionally, there have been a number of different PACS workstation types, each dedicated to the task performed at the workstation. However, because of the increased processing power of the modern PC, the PACS workstation has become a multifunctional tool. Apart from the need for a high resolution display on the diagnostic workstation, the remaining hardware making up diagnostic and review workstations is very similar. A consequence of this trend is that a review workstation on a ward can offer the same functionality that until now has been reserved for radiologists in a reporting environment. Also, because of the development of treatment planning tools, for example orthopaedic templating, a review workstation may now have greater functionality than a reporting workstation.

## Workstation Types

- Diagnostic – for primary diagnosis and reporting
- Review – for viewing of reported images
- Analysis – for specialised processing and measurement
- Digitizing and Printing
- Teaching

## Applet vs. Application

At present, there are two different routes that a software developer can follow in the production of PACS software. One is an application which is installed on the workstation; the other is a JAVA applet. A JAVA applet is a small program that can be sent to the user's computer with a web page. The web page is viewed in a standard web browser, and the applet which can perform interactive animations, immediate calculations and some other simple tasks is displayed in the web page. A combination of application and applet can also be used for different workstations within the same PACS solution e.g. the application could be installed on a reporting room workstation, while a clinician using a PC may use the web browser to view images and reports on the ward.

The main advantage of using a PACS application is that the workstation may continue to be used to view images from local acquisition modalities even if the PACS network stops functioning, subject to local connections to acquisition modalities. With the JAVA applet, if the web server stops functioning, or the network connection fails, access to the applet and image data may no longer be possible.

However, the JAVA applet can be used on any PC with a standard web browser, at any location, without the need for pre-loading special PACS software. A further advantage of the applet is that upgrades to the software need only be put on the web server, whereas upgrades to the application software, may require visiting each workstation and installing the software from disk.

An applet and an application are capable of performing similar functional tasks, however most vendors who supply both provide an application for the reporting workstations and a less functional applet for image viewing on wards or clinics unless, for example orthopaedic templating is required.

### APPLET

- Delivered to workstation with images
- Network dependent
- Easy to upgrade

### APPLICATION

- Exists on local workstation
- Network independent
- Harder to upgrade

## Functionality

Most of the tasks performed at a PACS workstation will involve viewing images of patient examinations and creating, editing or viewing examination reports. This image and text data is stored on the PACS archive and the location of this information on the archive is stored in a database. The workstation software queries the database depending on criteria defined by the worklist functions (see below) or user defined searches. The results are displayed on the workstation as a patient list and the user then selects the patient or examination to view.

On the reporting workstation, most vendors provide worklist functions which simplify the method of opening examinations for reporting. The list contains examinations yet to be reported. The radiologist may filter the list by acquisition modality, examination type or referral type. Less common filtering options are patient type (e.g. paediatric, geriatric) and by priority (set by radiographer or referring clinician). The user can choose the filtering method most appropriate to their role or speciality and normally open examinations for reporting in the order they appear on the list, normally chronological. When the report for an examination is complete, the examination information is automatically removed from the worklist. For each user, default filters to be applied can normally be customised so that that manipulation of the patient list is not required before beginning a reporting session

## Tools available on the workstation

Once an examination has been opened, there are a number of tools provided by most PACS workstation software for the manipulation of the displayed image. As the data in the displayed image is a copy of the original data stored on the archive, manipulating the display of this data does not affect the original image information. Manipulation of the image is useful as it can allow the user to make more accurate decisions with greater confidence:

"Window width/level" controls the range of image pixel values displayed on the monitor. The size of this range is defined by the window width, and the centre of the range is defined by the window level. "Magnifying tool" creates a small magnifying window on the image. The position of the magnifying window is determined by the user; the size of the window and amount of magnification can normally be varied.

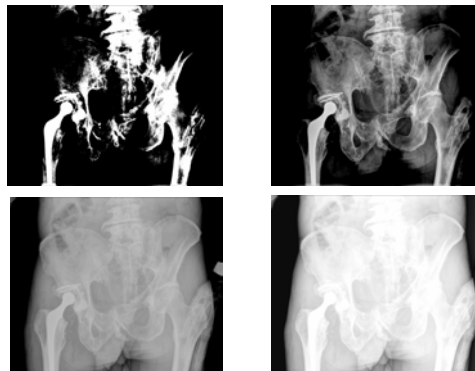
"Pan/Zoom" magnifies the entire selected image instead of creating a magnifying window. This zoomed image can then be moved around by using the pan tool.

"Measurement Tools" allow the user to make measurements and extract statistical information from the image data. Measurements are normally made by drawing on the image using the selected measurement tool.

"Orthopaedic Templating" is a method of orthopaedic treatment planning prior to surgery. Suppliers of orthopaedic prosthetics provide template images of their range of products. An orthopaedic surgeon can then overlay these templates onto radiographic images at the workstation.

## Window Width/Level

Allows for different anatomical detail to be visualised



## Magnify Tool

Allows for different anatomical detail to be visualised



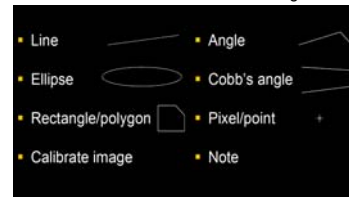
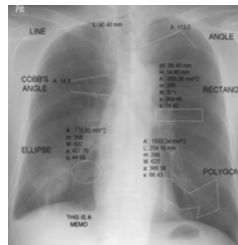
## Pan / Zoom

Magnifies the whole image and allows movement around the magnified image



## Measurement Tools

Tools to make measurements and extract statistical information from the image data



## Orthopaedic Templating

Overlay templates onto images to determine required size and shape of prostheses



A fuller version of the content of this poster is contained in the PACSnet Technology Update No. 1, "PACS Workstation Software", available from the MHRA (www.mhra.gov.uk; 020 7972 8181). Please contact PACSnet (www.pacsnet.org.uk) for further information.