SECTION C
STATEMENT OF WORK

DIGITAL IMAGING NETWORK - PICTURE ARCHIVING AND COMMUNICATIONS SYSTEM (DIN-PACS)

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1. Summary of Work

1.1 Introduction

The Digital Imaging Network - Picture Archiving and Communications System (DIN-PACS) shall be an open systems network of digital devices designed for the effective acquisition, transmission, display and management of diagnostic imaging studies. This network is primarily based on two international standards, Digital Imaging and Communications in Medicine (DICOM, see Appendix C)) and Health Level 7 (HL7, version 2.4), a standard for electronic data interchange in the healthcare environment. The specifications herein define the performance and functional requirements for a DIN-PACS installed, made operational and maintained at the medical treatment facilities identified in Appendix A as well other Department of Defense (DoD) and federal installations. Appendix D provides a Glossary of Acronyms used in this document. Appendix E provides an overview of the annual imaging workload. Appendix I provides clinical scenarios and Appendix J provides generic site configurations.

The ultimate objective of this Request for Proposals is to support business process changes throughout the Military Health Services System (MHSS) and, especially, within the practice of military radiology. The vision for radiology is to create a "virtual" radiology department by eliminating multiple "place" constraints that arise both within and between diagnostic centers. Within facilities the DIN-PACS system is intended to eliminate the necessity of creating film and allow access to images by multiple users at any place and anytime. Between facilities the system is intended to create opportunities to dynamically shift workload at anytime and to any location where clinical expertise is available.

1.2 System Description

The following paragraphs provide an overview of the system contemplated by this statement of work and provide the conceptual framework against which proposals shall be evaluated. The DIN-PACS system shall include the installation and configuration of all hardware and software necessary to operationalize the concepts and the technical performance requirements defined throughout the statement of work.

1.2.1 System Architecture

PACS system architectures are categorized based upon how they distribute and store images. For the purposes of this statement of work, these categories are centralized, distributed, and hybrid. Choice of architecture shall be proposed by the vendor and may vary by type of site, or "generic site configuration", as defined in Appendix J.

This statement of work contains the requirements for the components which comprise the DIN-PACS system. DICOM standards and associated information object definitions (IODs) and services are used extensively as a reference model in the definition of technical requirements. For example, the system will be required to support DICOM Patient and Study Management Services in order to support management of patients, visits, imaging studies, etc. as independent objects within both the PACS and a radiology information system. The statement of work does not require that the proposed system be internally based upon this and other DICOM standards; however, the system will be required to utilize DICOM and HL7 standards in its communications with external systems and components. To the maximum extent possible, the government will evaluate system performance against these standards.

The Government strongly favors standards-based, open architecture systems. Accordingly, the level of compliance with the DICOM and HL7 standards shall be an important factor in evaluation of the system. In addition, internal level of compliance shall be a factor in the evaluation of the system and preference will be given to vendors whose system maintains the required level of performance with minimum reliance upon proprietary devices and dedicated subsystems and components. It is the Government's desire that, to the maximum extent possible, the DIN-PACS system share infrastructure resources (e.g., LAN and workstations) with other clinical information systems. Vendors are encouraged describe in their proposals components and subsystems which may be used to support other clinical applications not described within this request for proposal.

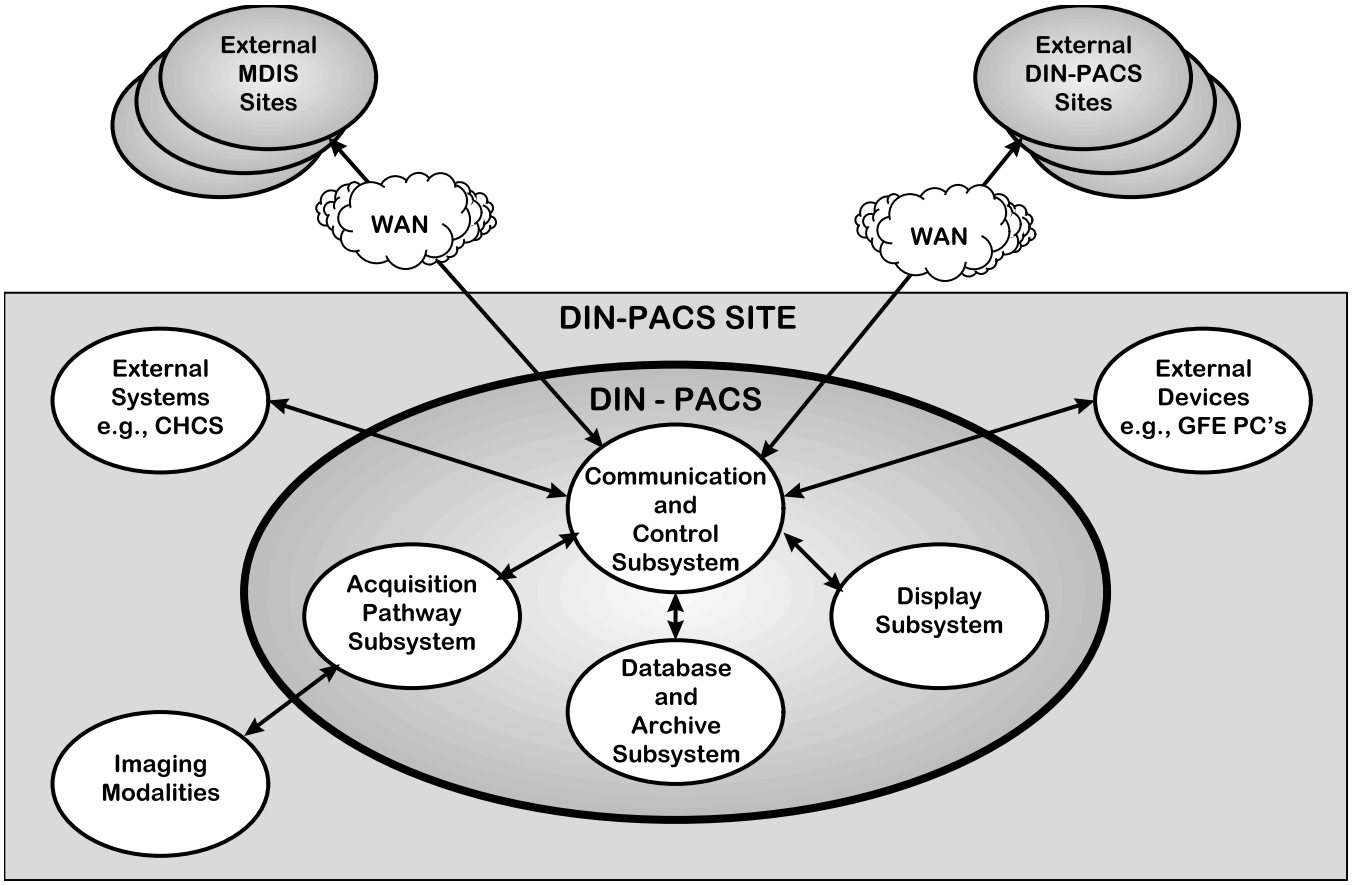
1.2.2 Logical Organization

The system shall accept, store, display, and communicate images and associated information. For the purposes of this Request for Proposal, the system is considered to contain four major functional subsystems: Acquisition Pathway, Display, Database and Archive, and Communication and Control.

Figure 1.2.1 below depicts relationships between subsystems and external devices and systems. This construct of DIN-PACS reflects logical concepts and does not necessarily represent physical entities within the system. Physical components and

their organization will be based upon the vendor's proposed system architecture and the minimum requirements contained in this statement of work.

Figure 1.2.1 - DIN-PACS Subsystem Overview



The organization and integration of components within the vendor's proposed system shall support a logically unified view of all exams and associated information across multiple domains. A user shall be able to access any examination stored on-line in the system from any display workstation integral to the system at any time without knowledge of where the images and related data are physically stored. The vendor's presentations on system architecture, components, and performance shall provide a thorough description of their system's capacity to provide this level of performance. Vendors are encouraged to utilize the conceptual models found throughout the Statement of Work (e.g., Figures 1.2.1 and 7.1) in their descriptions of system architecture, system operation, integrated performance, etc.

1.2.2.1 Acquisition Pathway Subsystem

The image acquisition pathway subsystem is defined as the physical and logical pathway from the image acquisition gateway to the safe storage of the image, and shall include:

- Network Interfaces to DICOM Devices: to interface and integrate DICOM conforming equipment (both Government and Contractor furnished) with the DIN-PACS network. The Network interface shall accept all required DICOM associations.
- Interface to Non-DICOM Devices: to accept images from non-DICOM compliant modalities and to provide DICOM services (e.g., worklist management) via a user workstation in the physical vicinity of the modality.
- DICOM Modality Worklist Management Provider services to support scheduling and patient demographic information at the modality (Modality Worklist Management as specified in DICOM Supplement 10).

- Network Failover Protection and Recovery: for all Image Acquisition Network Interfaces. The system shall provide pathways and methods to bypass failing segments, nodes, and devices, in order to continue clinical operations and ensure safe image and data storage.
- Compliance with acquisition pathway requirements defined in appendix C.

1.2.2.2 Display Subsystem

The image display subsystem shall include:

- Soft Copy Image and Report Display Workstations: to display and manipulate digital images (gray-scale and color where applicable) and associated overlays (i.e., textual and graphical annotations) and reports. This capability shall be defined for three classes of display workstations, one for primary image interpretation, the "diagnostic workstation", one for secondary clinical review, the "review workstation", and finally one for Government furnished personal computers (PC's).
- Video Projector System: to project images onto a larger format backdrop for viewing in conference and teaching environments.
- Large Screen Monitor: to display images in a conferencing and teaching environment.
- Laser imagers: to print images to film in multiple formats for translumination. At the option of the Government, the vendor shall provide integrated laser imagers for both wet and dry process printing. In addition, the vendor shall provide DICOM-compliant interfaces to government-furnished laser imaging devices which may be connected as dedicated DIN-PACS network devices or as components of modality equipment groups (e.g., mini-PACS). Compliance with the provisions of NEMA Gray-Scale Display Function Standard (Working Draft Version 0.8 - Wed, Oct 23, 1996), or most current adopted version in effect not less than six months prior to issuance of each delivery order, is required.

1.2.2.3 Database and Archive Subsystem

The image database and archive subsystem shall support all DICOM services specified in Appendix C, and shall include:

- Database Management System: to maintain the information integrity of the system ensuring the proper transfer of images and data into, within, and out of, the imaging network and DIN-PACS.
- Image Examination Storage: to provide configurable, seamless, and autonomous, temporary short-term storage, temporary intermediate storage and permanent long-term archive of images as well as associated overlays and reports.
- Interface to the Composite Health Care System (CHCS): to provide a two way bi-directional interface to CHCS to facilitate the efficient retrieval and transmission of patient demographic data, patient examination data, and reports. A subset of this information is exchanged between the DIN-PACS and the modalities in the form of modality worklists. Appendix F contains a listing of data elements and data transfers required. CHCS is the Department of Defense's computerized healthcare information system that is deployed world-wide, across all levels of medical treatment facilities both on land and at sea.

1.2.2.4 Communication and Control Subsystem

The Communication and Control Subsystem is conceptually defined as those devices that support and control the communication of images and associated information. The physical arrangement and functioning of the devices is dependent upon the vendor's proposed architecture. The control component of this subsystem provides the intelligence needed to configure and manage system components, operation, and flow of information, in order to achieve performance requirements stated throughout this request for proposal.

1.2.2.4.1 Communications and Network Interface

The DIN-PACS shall effectively transmit and receive DICOM objects such as images and associated overlays and reports, to and from locations inside and outside of the MTF from multiple vendors' DICOM systems, utilizing the Internet, local area networks, and wide area networks. Locations outside of the MTF shall have the option to utilize, but not be limited to: dial-up and fixed standard voice, 56 kilobit/second, ISDN, DS1, and ATM services. The communications network interface shall also support the use of the Internet for teleradiology. Internet access shall comply with the security requirements for the system as specified in paragraph 1.4 and elsewhere in this statement of work.

1.2.2.4.2 Control

The vendor shall supply with the proposal a thorough description of the control mechanisms and configuration options used by their proposed system. This description should be integrated with a full description of the proposed system architecture.

If the system relies on routing of images and associated information to fulfil performance requirements, it shall be clearly stated, and the routing model shall be documented. If the system relies on auto-routing, then it shall be based on a configurable algorithm which executes a set of selection criteria according to a set of rules. All criteria, rules, and limitations of autorouting shall be described in detail in the vendor's proposal. Throughout this RFP the term "autorouting" is used in a generic sense acknowledging that centralized image storage architecture may not require physical autorouting/preplacement of images to meet performance requirements.

Monitoring and management of the DIN-PACS, its communications network, and its components shall be possible from systems management applications having a graphical user interface. The application(s) shall provide comprehensive functionality for monitoring device status, traffic patterns, network loading, loss of packets/cells, network component failures, re-configuration, etc. A thorough description of the management capabilities shall be supplied with the written proposal.

1.3 Integrated System Performance

The system shall be integrated to ensure the proper overall functioning of the DIN-PACS network based on complete compliance with DICOM standards as specified in Appendix C. The Government shall evaluate proposals on the basis of both local and wide area performance. An important factor in evaluation will be the proposed system's ability to support both a high level of local performance (i.e. within the individual military treatment facility) and at the same time support functionality and performance (e.g., image throughput and seamless operation of DICOM Query/Retrieve) across geographic regions (e.g., between a teleradiology spoke and its archive at a remote military treatment facility).

1.4 Security

Protection of the system and the system's data from unauthorized use shall be accomplished through a variety of methods ranging from passwords to more advanced firewalling techniques designed to isolate information from other networks.

All systems shall meet the C2 minimum level of trust as defined in the most current edition of DOD 5200.28-STD. The US Government's security classification system called Orange Book and "Trusted Network Interpretation Environments Guideline", called Red Book, define a series of divisions for D (Least secure) to A(most secure) and levels within those divisions. Division D (minimal protection) covers systems such as non-networked, free-standing PCs running DOS. Division C, Level 1 (discretionary security protection) applies to most systems (i.e. they have the concept of users, with users having control over objects they own). Division C, level 2 (controlled access protection) adds auditing and increased validations and is applicable to the DIN-PACS system.

1.5 System Redundancy and Reliability

The system shall be designed with reasonable redundancy so that no single point of failure can cause any disruption of radiology services. The system shall prevent any loss of acquired images and data. If a system failure prevents image acquisition, the system shall provide a means to enter the missed images electronically. At a minimum, the system shall be capable of receiving images via removable media. The system shall automatically complete the transmission, or retransmission, of all images not originally transmitted due to system failure. Where appropriate (i.e., at the Government's discretion on a site specific basis), to guarantee against catastrophic failure, loss of image exam information, and interruption of clinical services, the vendor shall supply an Uninterruptible Power Supply (UPS), sufficient to provide a minimum of 15 minutes of continued operation. The vendor's proposal shall include UPS requirements for each level of system included in this statement of work.

The vendor shall provide reliability data for each key component in the system. The vendor shall provide a reliability analysis of the system as a whole. The proposal shall list all assumptions and explain the method of calculating reliability factors.

1.6 Quality Control and Quality Assurance

Quality control for DIN-PACS shall be defined as those procedures performed on a routine basis to assure the clinical quality, data/image integrity, reliability, and operational performance of the system. Quality control shall be a part of the vendor's proposal as required elsewhere in this statement of work. The Government envisions a shared responsibility for

quality control. The quality control program shall be comprehensive and include integration with the periodic tasks of preventive maintenance and calibration, at both the component and system level, contained in the vendor's equipment maintenance program.

Quality assurance for DIN-PACS is defined as those measures and procedures performed to assure the relevance and effectiveness of the quality control program. Quality assurance is an integral part of contract execution and management performed by the Government.

The on-site Government system administrator, biomedical maintenance, medical physicist/s, or other designated personnel shall perform quality assurance of the DIN-PACS quality control program. These on-site Government personnel shall be able to access system logs and imaging acquisition devices' (see Appendix A) quality control data from their desktop or remote computer systems, and use this data to perform qualitative and quantitative analysis to determine image and data quality. The vendor shall provide system administrator, engineer and medical physics support as ordered on a site specific basis. It is the intent of this statement of work that those personnel, when provided by the Contractor, shall perform routine, day-to-day quality control functions necessary to insure that the DIN-PACS performs as specified. The scope and extent to which the Contractor executes a quality control program shall be determined on a site-specific basis consistent with the provisions of the contract and the delivery order for each site.

1.7 System Operation

The vendor's proposal shall include a complete description of the proposed system's theory of operation. This should include descriptions of the key internal processes, e.g., image distribution, automatic image routing, database access, handshaking with external information systems. The vendor shall specifically include descriptions of the system's operation under the scenarios given in Appendix I. The proposal shall include a description of the staff required to operate the system, their necessary qualifications, and the tasks the staff shall perform.

1.8 Turnkey Installation

The DIN-PACS Contractor shall at the option of the Government provide complete turnkey installation of all components of the DIN-PACS network. Turnkey installation may include, but is not limited to, networking, transformers, power runs, uninterruptible power supplies (UPS), disconnects, conduit, electrical wiring, network backbone infrastructure, structural support, accessory office furniture, heating, ventilation and air conditioning (HVAC) and finish work as required to support the DIN-PACS installation and system operation. Contractor shall be responsible for verifying that the existing utilities, including the telecommunications network and infrastructure, are adequate for the proposed system.

1.9 Legacy System Interface

The Department of Defense has an extensive installed base of "legacy" systems acquired under the Medical Diagnostic Imaging Support (MDIS) contract, Contract No. DACA87-91-D-0047, administered by U.S. Army Engineer Center, Huntsville, Alabama. Department of Veterans Affairs operates equivalent systems acquired through various contracts issued by the VA Purchasing Center, Hines, Illinois. These systems vary in scale from small teleradiology spokes to full hospital PACS that operate as major teleradiology hubs. Wide area communication infrastructure is in-place to link these systems and will be extended to support DIN-PACS and other clinical information systems. The DIN-PACS shall interact with existing MDIS sites on varying levels that reflect the operational requirements of the Military Health Services System and the military departments. Technical requirements to support legacy system interface are defined in further detail in later sections of this statement of work.

1.10 System Expansion Capability

The DIN-PACS system shall provide the capability to integrate any or all of the following additional items into the network at future dates during the life of the contract:

- Network Interfaces to DICOM Devices.
- DICOM Standard Upgrades.
- Software Upgrades.
- Display Workstations.
- Quality Control Workstations.
- Expansion of Storage Devices.
- Laser film printer (wet and dry).
- Additional Turnkey Installation.
- Local Workstation removable media support for image transport.

- 35 mm Film Slide Printer.
- Paper Printer.
- Wireless Mouse and Keyboard.
- Video Communications on a workstation to workstation basis.
- Voice Driven Operation.
- Image and report fax capability.
- Systems Integration to non-DICOM devices/systems.

1.11 System Scale

Over time, the system selected for this project shall be required to expand or contract in planned phases. To support flexibility in system scale while protecting the investment made at initial installation, the system must provide a high degree of scaleability in terms of archive size, server capacity, modality support, teleradiology capacity and functionality, database and RIS capacity and functionality, and number of connected user workstations. The system shall be scaleable to handle additional sites and significant increases in image volume via incremental additions of hardware and software without degradation in performance. The Government will develop site-specific and regional system deployment plans based upon readiness requirements, changing clinical practices, workload, and medical equipment technology.

Offerors shall provide an analysis of known upper limits of the architecture with respect to storage capacity, processing capacity, network throughput, input/output throughput, single points of failure, etc. The analysis shall incorporate a detailed description of scaleability options. Descriptions shall include a definition of operating range and optimum component and system configuration based on the architecture and logical organization of the proposed system. For example, if the vendor proposes a distributed architecture system that includes autorouting through a scaleable controller, the controller options shall be described in terms of its loading capacity to support a range and combination of connected devices (e.g., workstations and imaging modalities) and throughput of images across the range.

The proposed system shall be evaluated on the basis of documented system performance at installed sites and technical information describing the scaleability of the architecture. Evaluation may include examination of installed sites and/or benchmark testing.

2. Image Acquisition

2.1 Network Interfaces to DICOM Devices

A. The DIN-PACS Contractor shall be responsible for providing all appropriate hardware and software to interface and integrate DICOM conforming devices to the DIN-PACS network to at least the minimum DICOM functionality specified in Appendix C. The DIN-PACS Contractor shall communicate and work directly with the imaging equipment vendors to ensure proper integration and interface of the imaging devices to the DIN-PACS.

B. All Appendix A, Government furnished equipment shall be purchased and installed under separate contracts by the Government. Specific information on the make, model, software version and system options of each device specified in Appendix A shall be furnished as a part of each delivery order. The DIN-PACS vendor shall be reponsible for communicating with each device vendor to determine and implement DICOM intercompatibility and connectivity between the device and the DIN-PACS. The vendor shall provide firm fixed prices for integration to the specified devices given the information provided in Appendix A.

C. All imaging equipment specified for the generic site configurations in Appendix J shall be purchased and installed under separate contracts by the Government. Specific information on the make, model, software version and system options of each device specified in Appendix J shall be furnished as a part of each specific delivery order. The DIN-PACS vendor shall be reponsible for communicating with each device vendor to determine and implement DICOM intercompatibility and connectivity between the device and the DIN-PACS. The vendor shall provide firm fixed prices for integration to the specified devices given the information provided in Appendix J.

D. For purposes of this proposal, the vendor shall provide as a separately identified item, a quality control workstation to provide all DICOM functionality between the DIN-PACS and the modalities as defined in Appendix C. Connectivity requirements for QC workstations for the three initial installations shall be identified in Appendix A. Locations for these QC workstations shall be identified in Appendix B. Connectivity requirements for these workstations for the generic configurations shall be identified in Appendix J. Functionality for this QC workstation is defined in paragraph 3.7 below.

E. Similarly, the DIN-PACS Contractor shall be responsible for providing all appropriate hardware and software to interface and integrate the DIN-PACS Contractor provided workstations specified in Appendix B to meet the DICOM functionality specified in Appendix C.

F. The Government desires that DICOM interfaces provide similar functionality, reliability, and flexibility, as proprietary interfaces (i.e., worklist management, failover protection via retransmission and removeable media, storage commitment, and bi-directional query and retrieve).

3. Image Display

3.1 General

A. The Contractor shall provide two types of workstations for soft copy image display and analysis: the diagnostic workstation and the review workstation.

B. The Contractor shall provide one ergonomically designed chair and an ergonomically designed mobile console (cart) that can be temporarily fixed in place, for support of each functional workstation. This includes a mobile workstation console specifically designed for Operating Room (OR) use.

C. Contractor shall provide the option of wall and ceiling mounted workstations in areas where desk and/or floor space is not available or convenient (i.e., ICU, OR, ER, etc.).

D. The DIN-PACS system shall support the new NEMA display standard (Working Draft Version 0.8 - Wed, Oct 23,1996 or the current version in effect 6 months prior to issuance of site specific delivery orders) to guarantee image integrity. This means that images shall be displayed at any viewing station or printed on any hardcopy device looking similar to the appearance of the image on the viewing station.

E. Image display on all image display devices shall conform to the concept of "What You See Is What You Get" (WYSIWYG). Specifically, image display at DIN-PACS workstations shall match the display at the initial modality monitor through conformance with the NEMA display standard.

F. Each device shall have a calibration method available that allows differences between the response of the display or hardcopy system and the display curve to be measured, and a method of updating the display device for automatic correction.

G. The vendor shall provide a method of displaying examinations and related data on Government furnished PC's.

3.2 Display Monitors

3.2.1 General

A. Each workstation shall be configurable for one, two, and four, high resolution gray-scale image monitors. As an option, an additional 24 bit (8 bit per primary color) color monitor for color modalities shall be configurable on the same workstation, in addition to the gray-scale monitor(s). For modalities such as ultrasound and nuclear medicine, the addition of color monitors is desired.

B. The diagnostic workstation shall display images in portrait mode. The clinical review workstation shall be configurable in either portrait or landscape mode.

3.2.2 Display Spatial Resolution

A. The diagnostic workstation gray-scale monitors shall have a nominal 2 K x 2.5 K or better, pixel display matrix size (5 mega-pixel).

B. Full data set images shall be displayed without any minification of images, provided that the data set fits within the pixel display matrix of the monitor.

C. The review workstation gray-scale monitor shall have a nominal 1024 x 1280, or better, pixel display matrix size with the image data set being minified to fit on the screen.

D. The viewable raster of the diagnostic and review workstation monitors shall be a minimum of 21 inches diagonally.

3.2.3 Data Sets Available to the Monitors

A. The full data set of acquired images shall be available for viewing at all workstations for all modalities.

B. The review workstation shall maintain full image matrix size and bit depth data set for image manipulation functions (e.g., 2 K x 2.5 K x 12 bit data set for CR image manipulation functions).

C. Display data set for gray-scale monitors shall be 8 bits/pixel at a minimum (proposals with video display gray-scales greater than true 8 bits/pixel are highly desirable).

D. Simultaneous display of image, text and graphics overlays shall not reduce the number of gray levels of an image.

E. The downsampled data image sets shall accurately scale any overlays associated with the image.

3.2.4 Brightness (Luminance) and Veiling Glare Filter

A. The Contractor shall provide a minimum 30% veiling glare filter with every monitor.

B. The brightness (luminance) of all monitors shall be greater than or equal to 70 foot-Lamberts, used in conjunction with the veiling glare filter, as measured at the center of the monitor on the clinical image.

C. Black levels shall be less than 0.2 foot-Lamberts.

3.2.5 Text Window Luminance (Brightness)

A. Text window background luminance (brightness) shall be selectable and adjustable to less than 40 Foot-Lamberts.

B. Design of text windows shall be optimized for maintenance of visual acuity of diagnostic

workstation viewers.

C. Text windows may be provided via an additional color monitor integrated into the workstation.

3.2.6 Text Overlays

A. The Contractor shall provide all text overlays in a black-on-white, white-on-black, light on dark-gray-scale, dark on light-gray-scale, readable, font scaleable, format.

3.2.7 Vertical Refresh Rate

A. All monitors shall have a refresh rate of not less than 72 frames per second, non-interlaced.

B. All monitors shall be flicker free.

3.2.8 Calibration

A. Mapping of pixel values to luminance of all monitors shall be accomplished utilizing centrally stored, digitally created, test images viewed using the clinical display software application.

B. Contrast adjustment ranges of all monitors shall result in calibration of monitors such that monitor gray-scale is linear as defined in the NEMA display standard and shall differ by less than or equal to 5%.

C. Three month drift of monitor brightness and contrast shall be less than 5%.

D. A highly desirable feature is an internal luminance calibration measurement and correction circuitry and/or look up table.

3.2.9 Individual Monitor Uniformity and Distortion

A. Each monitor shall have less than 15% brightness uniformity degradation as defined in the NEMA Standard on Gray-Scale Display Function, working draft version 0.8, 23 Oct 96.

B. Each monitor shall have less than 3% linearity distortion as defined in the NEMA Standard on Gray-Scale Display Function, working draft version 0.8, 23 Oct 96.

C. Each monitor shall have less than 3% geometric distortion as defined in the NEMA Standard on Gray-Scale Display Function, working draft version 0.8, 23 Oct 96.

3.2.10 Cross Monitor Luminance Uniformity

A. All monitors of a given class shall have no more than 5% variance in luminance from each other, as measured in the center of the monitor across all points of the SMPTE test pattern.

3.2.11 Monitor Electron Beam Spot Size

A. The electron beam spot size of each monitor shall vary by less than 50% from the center to each diagonal corner of the monitor. This parameter shall be measured from a viewable area 0.5" inside the perimeter of the monitor. Vendor must specify the spot size and provide a digital test pattern for each monitor type.

3.2.12 Gray-scale Display

A. Diagnostic and review workstation monitors shall display a minimum of 256 shades of gray as specified in the NEMA Standard on Gray-Scale Display Function, working draft version 0.8, 23 Oct 96. Comment: Recent technological developments allow diagnostic workstations the ability

to display of 1024 shades of gray. Such an implementation is highly desirable.

3.2.13 Frame Buffer

A. The pixel data frame buffer shall support the entire diagnostic data set for both gray-scale and color images for diagnostic and review workstation monitors. Larger buffers are highly desirable.

3.2.14 Monitor Life Expectancy

A. All monitors shall be designed to maximize clinical life expectancy of the monitor. "Energy Star" compliance is desirable. Clinical life expectancy is defined as full compliance with all monitor display parameter specifications (contained in section 3.2). Vendor shall specify in the written technical proposal the mean time between failures for each type of monitor proposed.

3.2.15 Monitor Phosphor

A. Type and color of monitor phosphor shall match on all monitors for any workstation (e.g., all monitors on a workstation must appear to be the same color to the trained human eye).

3.2.16 Gamma Correction

A. A Gamma correction look up table (LUT) shall be incorporated into all workstations' monitor calibration tool sets. The gamma correction LUT shall be monitor specific and bring the monitor to the linearly calibrated state (see 3.2.8).

B. User preference look up tables (LUTs) shall be provided on the workstation for all input and output modalities.

3.3 Workstation Functions

3.3.1 Worklist / Composite Exam List

A. The database shall automatically create examination worklists in the DIN-PACS.

B. Listings shall be sorted into worklists and composite examination lists.

C. Worklists/Examination listings shall be configured to display any or all of the DIN-PACS data elements.

D. Worklists/examination listings shall be quickly and easily sortable by any or all of the DIN-PACS data elements as well as on the last four digits of the social security number field.

E. Creation of specific worklists shall be a tool used by both the Government and Contractor system administrator to configure the system to each individual facility using various parameters.

F. All lists shall be updated in the background as new images are generated and entered into the DIN-PACS and as exam status changes (e.g., undictated to dictated, etc.).

G. All update intervals to worklists shall be site configurable.

H. The workstation shall include a "Key Exam" flag on the worklist. The purpose of this flag is to allow the user to indicate key exams within a patient's exam list. This shall be a user privileged function.

3.3.2 Unread Worklists

A. The DIN-PACS database shall automatically generate and display at each workstation a worklist of new, unread exams designated for reading.

B. Unread examination worklists shall be provided only to authorized users based on log-in.

C. These worklists shall be generated and stored centrally to the DIN-PACS network so that a user, logged on to any workstation, may access any worklist from the network and display exams selected from this worklist to his/her current workstation location.

D. The workstation shall allow the user, with a single keystroke, to display the unread exams in sorted order with appropriate prior exams automatically displayed in tandem, and, following dictation, close the exam, mark the exam as read, removing it from all unread worklists, and then open the next exam on the list. Performance of this "Dictated Key" function is critical to clinical acceptance. The vendor shall specify in the written proposal the total time to perform this function and demonstrate such at the product demonstration.

E. The workstation shall include a single keystroke equivalent examination "Review Key" process which allows the user to perform all of the steps as described for the "Dictated Key" except that it does not change the status of the exam nor remove the exam from the worklist.

F. For use in training institutions, a unique keystroke designation shall also be available that shall mark a study as interpreted by a "trainee", awaiting final oversight. This status change shall be reflected in the worklist. This function shall be configurable by the system administrator. However, the study is not removed from the worklist until reviewed and marked dictated by an attending radiologist.

G. The DIN-PACS database shall maintain a site configurable composite exam list of all exams located in the database and storage/archive devices.

H. This composite exam list shall be accessible at all workstations and shall allow the user, through the graphical user interface, to select and retrieve any exam.

I. The composite exam list shall include an indicator of exam location (i.e. intermediate storage, long term archive) so that the user may have some indication of the time required for exam retrieval.

J. An indicator shall be displayed providing an estimate of the time to completion of the retrieval.

K. The displayed indicator shall not interfere with ongoing processes nor overlay the image display area.

L. The system shall include mechanisms for the following: (1) to warn of another radiologist interpreting the exam, and (2) to automatically skip an exam being interpreted by another radiologist.

M. When an exam has been interpreted by a person in training when using the "Dictated Key", as described above, the exam shall be skipped when another trainee is using his "Dictated Key" function, but shall not be skipped when an attending radiologist is using his "Dictated Key" function.

N. Exams interpreted by a person in training shall remain on the worklist until interpreted by an

attending radiologist and shall be displayed on the worklist for the interpreting radiologist.

3.3.3 Access Rights and Privilege Groups

A. Site configurable privileges shall be assigned to control access to functions of the DIN-PACS. Examples of controlled functions include patient merge, exam verification, report dictation, priority fetch, hardcopy production, exam merge, image delete, worklist access, etc.

B. Privilege groups shall include but are not limited to: System administrator, maintenance, quality control, radiologists, technologists, clinical user and transcriptionist

C. These requirements shall include the ability of information system to authenticate the identity of users, limit access to information to authorized users, and logging of access to the data stored in the system. Security requirements apply system-wide.

3.3.3.1 Authentication

A. The system shall support system-wide authentication of users through the use of a unique user-ID and password for each user, to be entered at the keyboard on system workstations. Vendors are encouraged to suggest alternative methods for authentication.

B. The login code shall be written in a modular format and well documented to support the introduction of future security and authentication methods, e.g., PCMCIA Fortezza card, etc. The Government shall initiate such a request for security and authentication modifications to the vendor at a future date. Software coding of future security and authentication methods shall be the responsibility of the vendor. Pricing for such modifications shall be negotiated at the time of the request.

3.3.4 Image Display and Manipulation Features

Each workstation shall include, as a minimum, the following image display and manipulation features. These features shall be available as mouse driven and/or graphical user interface (GUI) applications.

Examples of Image Display and Manipulation for multi-image studies:

- Single exam without comparison studies or multiple sequences - Display all images across all available monitors, page left to right or up and down depending upon number of monitors and users preferences.
- Single exam with multiple sequences (i.e., MR) or multiple exams requiring comparison - The ability to assign specific exams or exam sequences to a specific monitor. The images on each monitor should be viewable in stack mode as a single image or multiple images in tile mode. If the images are seen in single stack mode, they should be scrollable one image at a time up and down through the stack. If the images are seen in tile mode, the screen should be scrollable by pages and lines of images at a time. This scrolling should be up and down.

3.3.4.1 Non-Linear Window and Level by Modality and Body Part

A. The system shall support the use of nonlinear window and level of images through the import and use of processing parameters (such as the Fuji CR parameters) or by the development and use of internal look up tables.

B. These tables shall be modality and body part specific with a minimum of five user programmable hot keys assigned for non-linear window and level settings.

3.3.4.2 Workstation Internal Display of Quality Control Images

A. The system shall provide internal quality control images for the purpose of quality control, calibration, and troubleshooting.

B. These images shall be designed to test the dynamic range of the image transmission paths, display devices and output devices.

C. Spatial resolution, contrast resolution, and dynamic range shall be tested by these images.

D. Display and analysis of test images shall be performed as a function of the operational clinical software application.

E. QC images shall be transmittable over the LAN and WAN to workstations and other output devices.

3.3.4.3 Image Arrangement and Display Capabilities

A. The workstation shall allow display of multiple images and/or multiple exams on a single monitor with a rearrangement capability.

B. Rearrangement of images within an exam and exams between monitors also shall be possible (e.g., through a click and drag mechanism).

C. Workstations shall support a double click to full screen (for images displayed in 2:1 format or greater) and double click to return feature for displayed images.

D. It shall be possible to manually rearrange the sequence of images in a study and save the image sequence for future display sessions.

E. It shall be possible to select multiple image display formats, as a minimum: 1:1, 2:1, 4:1, 6:1, 9:1, 12:1, 15:1 , 20:1, and 40:1 and apply the format to entire examinations.

F. The workstation shall allow for rearrangement of an image display sequence based upon the acquisition sequence from the DICOM header.

G. It shall be possible to hide selected images from view, indicate that the images are hidden, and redisplay if desired.

H. It shall be possible to easily compare images by overlaying two images and providing a simple user interface for shifting between the two images, e.g., a window shade function.

I. Toolbar placement on a monitor shall be user selectable.

J. It is desirable that a subset of a user's image manipulation tools be available by a single mouse click at any point on the monitor.

K. Images shall be automatically presented in an upright as well as correct right/left orientation based upon past header indicators or QC technologists' saved changes to image orientation.

L. The minimum implementation shall allow the user to orient the image in a user selectable presentation.

M. Capability to rearrange across multiple monitors, sets of images that have been separated by series, such as MRI or CT stacks separated by imaging plane and sequence type shall be supported on all workstations.

N. Capability to synchronize image stacks and series from multiple image exams (CT and MRI) for display in cine, page and scroll mode viewing.

O. Capability to display all DICOM header and other information as a configurable overlay and as

an all inclusive header display, including, but not limited to: kVp, mAs, FFD/SID, technologist ID, s-number/exposure index, CR plate number, CHCS Exam number. The system shall display/hide such an overlay or header display at user discretion with a single keystroke.

P. Capability to mask off empty (*i.e.* white) portion of a displayed image with a black mask and save the display.

Q. Overlays for orthopedic hardware and prosthetic devices (commercial software available).

3.3.4.4 Default Display Protocols

A. The images of a patient study shall be displayed using a user-selectable, user-definable protocol, which may be activated each time the individual user logs on a workstation. These protocols define where a new exam shall be displayed and that the number, location and format of the older comparison exams shall be automatically displayed when this function is active during single exam display or during use of the "Dictated Key" process.

B. If no individual protocol exists for a user, the department default protocol shall be utilized.

C. The default display shall be user, modality and body part/exam type specific and shall support a combination of modality and body part/exam type.

D. The display defaults shall be able to be set by the user during a workstation session and saved to the DIN-PACS for future sessions.

E. The user shall be able to modify each set of display defaults at any time at any workstation.

F. Creation/modification of user specific defaults shall not require system administrator intervention.

G. Creation/modification of site-wide defaults shall require system administrator intervention.

H. For multiple image examinations specific image placement and distribution over multiple monitors of the workstation shall be possible for both current and historical examinations. For example: on a four monitor workstation, viewing of two PA/Lateral chest exams could have PA images on monitors 1 and 2 and Lateral images on monitors 3 and 4. The new exam is on monitors 2 and 3. (Note: Automatic sorting based on information not contained in the image header can be supported by pre-sorting as a manual quality control function.)

I. For single image examinations (e.g., serial chest radiographs on ICU patients), three of four monitors may be used to display current and two immediate previous exams while the fourth monitor might display 4 or more minified images of even older exams, any of which could be brought to full size by pointer double click.

J. Orientation of images shall be based upon automatic reading for left (L) and right (R) indicators from the DICOM headers unless overridden by the QC operator.

K. QC operator changes to image orientation shall be saved if requested.

L. Modality specific image format on monitors shall be site and user definable, e.g., CR 1:1, CT 9:1, MRI 12:1, US 6:1, NM 6:1.

M. Default protocols for automatic separation and display of MRI sequences from multiple (at least two) examinations across multiple monitors shall be supported.

N. Site and user specific default protocols shall be supported for the distribution of current and historical examinations across the monitors of a workstation.

3.3.4.5 Image Display, Scrolling, and Paging

A. Quick sequential paging through images of an exam displayable on a single monitor or multiple monitors shall be provided.

B. Both forward and backward scrolling (i.e., one image or row of images at a time) and paging shall be possible utilizing arrow keys or a mouse.

C. If both old and new image series are viewed, it shall be possible to page through the exams independently and synchronously.

D. It shall be possible to display new and old images simultaneously.

E. It shall be possible to jump back to the previous patient or forward to the next patient, with a single keystroke.

F. It shall be possible to jump to the next exam, in a worklist, in a single keystroke.

G. It shall be possible to display both tile and stack mode images simultaneously on the same monitor.

H. The workstation shall provide visible indices for available sequences and allow for manual assignment of sequences to monitor positions for display.

I. Independent manipulation of tagged image subsets. This function is required for MRI, CT and angiography and desirable for other modalities.

3.3.4.6 Cine and Stack Display

A. It shall be possible to arrange groups of related images into a stack (only the top image visible of a series of images) and display them sequentially.

B. For stack-display it shall be possible to couple the selection of the image from the group to the movement of the pointing device. This shall allow the user to move forward and backward through the stack of images, stopping to focus on anything of interest.

C. It shall be possible to link image stacks and move through them simultaneously such that the same anatomic level is displayed in each stack.

D. A cine function with a user selectable, variable frame rate, up to at least 30 frames per second, non-interlaced, for up to a 512 x 512 matrix, shall be provided.

E. Using cine, it shall be possible to display at least two sets of images simultaneously (e.g. new and old CT series).

F. A method shall be provided to designate images to be included and excluded in the stack display.

G. A method of simultaneously relating the active slice display to the overall examination slice positions on the scout image shall be provided.

H. The workstation shall include the capability to display in tile, stack, and cine mode 2D reconstruction constructs of 3D image data sets and any other modality specific workstation image reconstruction.

I. All image manipulation tools and display attributes available in tile mode shall be available in stack mode and display attributes shall apply during cine mode.

J. Stack and sequential (cine) display modes, with synchronization by slice position. These shall include within a single study, between modalities and between current and old studies. Two stacks are minimum, four are desirable. Image manipulation tools shall be functional within the stacks and cines.

3.3.4.7 Interactive Gray-scale Operations (Window Width and Level)

A. The workstation shall provide dynamic window and level through the entire image gray-scale data set on all workstations, in accordance with NEMA Standard on Gray-Scale Display Function, working draft version 0.8, 23 Oct 96.

B. Frame buffers shall accomodate full image pixel image resolution from all modalities in both gray-scale and color.

C. This function shall be provided for images on all monitors, a single monitor, or a specified region of interest on a single monitor.

D. Window and level values shall be displayed in Hounsfield units for CT images and pixel values for all other images.

E. The user interface shall support both the window width and level approach and the Top/Bottom (min/max window width) approach (e.g. for Nuclear Medicine images).

F. Activation of dynamic window and level changes shall be accomplished by single keystroke or mouse function. Ease of use of this function is critical due to its frequency of use.

G. Display of the inverse video of any selected image and region of interest shall be supported.

3.3.4.8 CT and MRI Scout View Display

A. The workstation shall have the capability to display scout images with the slice position lines overlaid on the image.

B. These slice position lines must be displayable whether the positions are received in the form of overlays to the scout view or as vector information for each individual slice.

3.3.4.9 Image Enhancement Defaults

A. The user interface shall include multiple user-selectable image enhancement defaults for gray-scale windowing and levelling, variable degrees of edge enhancement, and inverse video, available to the user each time the individual user logs on the workstation.

B. Image enhancement defaults shall be user, modality and organ specific.

C. Activation of the user defined image enhancement defaults shall be by a single keystroke equivalent.

D. A single key stroke method to select between default window/level values shall be provided. The purpose of this feature is to jump between bone windows and soft tissue windows in CT, for example.

E. Ten or more user-defined image enhancement presets shall be provided. Function keys are

acceptable for this purpose, but other implementations shall be considered.

F. It shall be possible to preset and change window width and level parameters for each user.

G. If an image is received from a modality along with a window width and level for viewing, the window width and level parameters shall be used for the initial display on the workstation.

H. If an image is displayed for which no window width and level is available, the workstation shall pick a set of values which at least make the image visible as a starting point for subsequent manual changes.

I. If the exam has been saved, the workstation shall use the display parameters from the save operation when displaying the exam.

J. Edge enhancement with user selectable kernel shall be provided, at the option of the Government, on specified diagnostic workstations.

3.3.4.10 Image Orientation, Zoom and Roam (Pan)

A. The workstation shall allow sequential 90 degree clockwise and counter-clockwise rotation of any image as well as 180 degree flip in the horizontal and vertical axes.(e.g., right to left or top to bottom).

B. It shall be possible to rotate one, selected, or all images in a study in one operation in less than one second.

C. Workstations shall be capable of continuously enlarging an image up to at least 4X by replication of pixel values in less than 0.25 seconds.

D. The workstations shall also be capable of enlarging an image up to at least 4X by interpolation.

E. Use of interpolation shall allow a “repaint” of a 2 K x 2.5 K image in less than 2 seconds.

F. Use of the zoom function on any image which is currently displayed in a minified fashion shall utilize the true acquisition data to enlarge prior to replication or interpolation.

G. It shall be possible to zoom several selected images, not only one by one.

H. If the image matrix size is less than the viewable area matrix available for image display the first zoom shall display the full image in the full available viewing area. However, the first zoom shall be no greater than 2X (e.g., nuclear medicine images).

I. If the image matrix size is greater than the monitor viewable area, the first display of the image shall be a full image displayed in the entire viewable area (i.e., fit to screen).

J. The workstation shall provide a single keystroke equivalent method to set the zoom of any image or selected images to exactly 1.0.

K. When the actual image size is greater than the monitor resolution, or the resolution of the available display window, it shall be possible to dynamically and interactively reposition the image in the window.

L. Zoomed images shall be viewable by the image roam function.

3.3.4.11 Magnifying Glass

A. The workstation shall include a magnifying glass function which supports the options of variable magnification, variable window size, internal window width and level, histogram normalization, edge enhancement, and gray-scale inversion.

B. The magnifying glass function shall be freely mobile and support replicable zoom and/or interpolated zoom.

3.3.4.12 Region of Interest, Distance and Angle Measurements

A. The workstation shall compute point-to-point measurements with automatically calibrated, user-selectable scales (e.g. mm or cm).

B. The workstation shall also support angle measurement, area measurement, and perimeter measurement, based on ellipses, circles, rectangles and squares and pointing device controlled tracing.

C. Unique identifiers must be displayed for multiple measurements on the same image.

D. All measurements shall be calibrated to pixel size if imported from an acquisition modality or based upon a measured image object of known size.

E. It shall be possible to compute and display region of interest statistics and distance/angle values for multiple measurements simultaneously (up to 10).

F. It shall be possible to perform image equalization based on the histogram of a region of interest or the entire image and to obtain statistics on the pixels within an outlined region of interest.

G. The key statistics are area, average pixel value, mean, standard deviation, and number of pixels. To avoid confusion, the statistics function should convert the pixel values to the native units of the modality (for example, Hounsfield units for CT).

3.3.4.13 Text and Graphics Annotation

A. The workstation shall utilize and display user-selectable locations and orientations for graphic symbols and text annotation with simultaneous displays on the same image.

B. A symbol palette shall be provided for common symbols, such as arrowheads, circles, ellipses, squares, rectangles, etc.

C. Symbols shall be moveable and sizeable on the image.

D. It shall be possible to toggle the display of text and annotation data on and off, and save the information for future retrieval and display.

E. Text font shall be selectable from a font palette/library.

F. The workstation shall include a function allowing “return to last used text size” when re-using the text tool.

G. The text font and size shall be a default login feature.

H. The Contractor shall provide all text and graphics annnotations in a black-on-white, white-on-black, light on dark-gray-scale, dark on light-gray-scale, readable, font scaleable, format.

3.3.4.14 Utility Functions

A. The workstation shall be capable of reversing at least the last three commands.

B. In the event that a command is not reversible, the operating system shall give a warning signal issued prior to executing the requested command.

C. The workstation shall also include a command to return the image to its original displayed state.

D. As a privileged function, it shall be possible to save the display state of an exam, including the image arrangement and each individual image's window width and level values, orientation, zoom value and roam position, and any annotations.

E. The user interface shall support the ability to revert back to the original format.

F. The workstation shall include automatic screen blanking and power saving with a user-selectable time default.

3.3.4.15 Workstation Pointing Device

A. All workstations shall include interaction with all monitors, all images, all texts and all menus using a common set of physical commands.

B. Features of the pointing shall include: Quick find feature

C. Window wrap around, horizontal and vertical

D. Cursor across all monitors

E. Wireless mouse and trackball support (at the option of the Government for certain workstations)

F. Quick cursor move from monitor to monitor

3.3.4.16 Image Masking Function

A. Capability shall be provided to mask off empty (*i.e.* white) portion of a displayed image with a black mask and save the display.

3.3.5 Minimum Required Exam Window Identification

A. All exam display windows shall be identified with, at a minimum, the following annotation which shall be continuously displayed: patient name, social security number (SSN) with the family member prefix (FMP), exam date, exam time, CHCS exam number (if available), and exam source (if performed outside of the viewing facility).

B. Additional data elements shall be able to be added to this required listing on a site configurable basis.

C. In any case, none of this displayed information shall cover any portion of the displayed image(s).

3.3.6 Image Deletion

A. If a distributed storage architecture is used, selected users with system security privileges shall be able to delete individual or a range of images stored at a particular workstation.

B. The user shall be able to selectively protect images from such automatic deletion based on user-defined criteria.

C. During technologist image/exam QC activity, images may be permanently deleted from an exam.

D. Images may also be added to an exam after initial acquisition if replacement/additional images are required.

E. After updating status to “interpreted”, images may not be deleted or added.

3.3.7 Hard Copy Image Generation

A. Each workstation shall include a one keystroke equivalent method for image and associated text overlays hard copy generation.

B. Each workstation shall be able to view the status of all available printers on the DIN-PACS network and select a printer for hard copy generation.

C. Output location shall be user selectable.

D. Hard copy image generation shall be a privileged function.

E. The workstation shall include a toggle feature to prevent the text overlay or graphics annotation from printing on the film.

3.3.8 Command Reversal (Undo)

A. Each workstation shall allow the user to reverse the last three command inputs, stack selectable.

B. If a command is not reversible, the system shall indicate so by a warning signal prior to executing the command.

C. The system also shall include a single command to return the image to its original display state as it appeared upon first presentation to the monitor.

3.3.9 Exam Display Hold

The following feature is highly desirable by the Government but is not required as a minimum.

A. A user shall be able to place an exam in a "hold" status in order to read a second case (*i.e.* stat or consultation). Upon completion of review of this second case, the original exam shall be able to be restored to the display identical to how it was displayed at the time of interrupt (*i.e.,* zoom, display parameters, *etc.*) and user defined features shall be restored to the pre-hold state.

3.3.10 CHCS Window

A. Each workstation shall include a window type user interface to allow the user to access and interact with CHCS from a separate overlay window on the DIN-PACS workstation. This overlay window can be a terminal emulation window that allows full telnet functionality (minimally VT320/420) with CHCS.

3.3.11 Support of Commercial Software

A. If supported**,** the vendor shall supply a list of commercial software which may be run on the workstations (e.g., medical database search engines, word processing, graphics analysis, terminal emulators, surgical planning packages, etc). The Government recognizes that support of commercial software on dedicated image display workstations can have an impact on systems performance. If such an impact occurs when supporting commercial software, the performance decrement shall be identified by the vendor.

3.3.12 Reports

A. Each workstation shall display a report sent from CHCS, or generated on the DIN-PACS RIS, simultaneously with its corresponding image exam. This requirement does not mandate display of the images when just the report is desired to be reviewed.

B. Display of the report shall be a toggle feature.

C. All data fields shall be user selectable for display in the report.

3.3.13 Screen Saver

A. Each workstation shall include an automatic screen saver with a moving pattern and a user-selectable time default.

3.3.14 Session Time Out

A. Each workstation shall include an automatic time out function with a user-adjustable time default set by the system administrator which shall log a user off of the system if no workstation activity has occurred within the default time setting.

B. The workstation shall present a visual and audible prompt to the user before logging off and shall allow the user to abort the log off to continue work.

3.3.15 System Is Working

A. User operations that require time delays, for example, certain image processing functions, shall be indicated on the screen (e.g., progress bar or flashing icon) to inform the user that the operation is underway and the system is operating.

3.3.16 Long Operation Cancel Function

A. For any operation requiring longer than ten (10) seconds, the user shall have the ability to cancel the function prior to its completion. This is especially important in the case of certain image processing operations and image retrieval from intermediate and long-term archive.

B. The workstation shall give an indication that the system is working and provide a way to cancel lengthy operations.

C. A progress bar is preferred which shall not overlay the image display area nor interfere with current foreground operations.

D. This cancel operation is System Administrator definable function.

E. Cancellation of a long operation function shall return the user to the point from which they initiated the long operation.

3.3.17 Background Task Capability

A. The workstation shall have the ability to perform background tasks (such as fetch, print, and long image processing tasks) while the user maintains control of current image manipulation features.

B. The user shall be notified of completion of background tasks in passive mode not interfering with current workstation operations or requiring user interaction/response. Background tasking is defined as multiple tasks running with one task running in the foreground at a higher priority than tasks continuing to run in the background.

3.3.18 Consultation

A. Workstation and network shall have the capability to support simultaneous viewing of examinations at multiple workstations on an ad hoc basis.

3.3.19 Whiteboarding

The following feature is highly desirable by the Government but is not required as a minimum.

A. Images displayed simultaneously on remote workstations shall have the option to display interactive cursors and overlays from the remote station. This optional capability shall be available locally over the LAN and remotely via teleradiology.

3.3.20 Type Ahead Capability

A. When a series of commands are issued faster than the workstation can complete them, the workstation shall retain these commands in a keyboard buffer and complete the sequence in the correct order.

3.4 Government Furnished Personal Computer Workstation

3.4.1 General

A. Government furnished personal computers (PC's) running Contractor furnished software shall be able to interface with the DIN-PACS network over level 3 (UTP3) or level 5 (UTP5) Ethernet and dial up communication links depending upon access speed. The minimum hardware and operating system specifications of the Government furnished PC are listed in Appendix A.

3.4.2 Software

A. Two types of software shall be offered. The first shall be software for a PC operating under Windows 95 (32 bit API) and Windows NT 4.0 (or most recent version of Windows NT).

B. The second shall be a web browser type software which shall run under either Netscape 3.0 (or most recent version) or MicroSoft Internet Explorer 3.0 (or most recent version).

C. Contractor shall provide licenses for PC and Web Browser software in units of 25, 100, 500, 1000, and 10,000.

3.4.2.1 PC Software Features

A. The PC client software shall provide for connectivity to the DIN-PACS network via the hospital network or dial-in ISDN or POTS connections with data rate speeds ranging from 28.8 kB/sec to 100 Mbits/sec.

B. At a minimum the provided software shall be a have the ability to query for individual images or patient studies and retrieve and display all associated images and radiographic reports.

C. Software shall support all DICOM requirements as specified in Appendix C, paragraph 7.

D. Image manipulation and display functionality shall include: interactive windowing with a number of user definable pre-set window level buttons

E. Zoom to 4 times, using fixed or flexible settings

F. Zoom magnifying glass

G. Gray-scale invert

H. Interactive panning of zoomed images and adjustable (multiple) cine loops for multiple image series.

I. Measurement capabilities shall include pixel value measurement (Hounsfield or absolute pixel value), angle measurement and distance measurement.

J. Histograms of pixel distribution along given lines and statistics of flexible regions of interest (ROI) shall be provided.

K. Easily user definable configurable layout of windowed views and tool bar positioning is required.

L. Software shall automatically detect the video display card's default display resolution setting and automatically scale the full image to the default display resolution using interpolation and image down sampling.

M. When images are zoomed the software shall utilize the entire image data set in the zoomed display.

N. For image zooms greater than the entire image data set the display image shall be zoomed using pixel replication or interpolation. This method shall be user selectable.

3.4.2.2 Web Browser Software Features.

A. Web Browser plug in software shall have all of the features listed in section 3.4.2.1 PC Software Features.

3.5 Video Projector Systems

A. Contractor shall provide video projector systems equivalent to the "Barco Barcographics 1208/1209 Ultra High Resolution Digitally Controlled Projectors", capable of displaying 1 K x 1.2 K x 12 bit images.

B. As an option, a 2 k x 2.5 k x 12 bit projector system shall also be provided.

C. Contractor shall provide a video switch on one (1) monitor of the diagnostic workstation and associated software/hardware necessary to be connected to a review or diagnostic workstation as a slave monitor to drive the projector system.

3.6 Large Screen Monitor

A. Contractor shall provide large screen monitor (at least 37") equivalent to the Mitsubishi Diamond Pro 37 Model XC-3730C and associated software/hardware necessary to be connected to a review or diagnostic workstation as a slave monitor.

B. Multiple slave monitors (up to four) shall be connectable to one workstation.

3.7 Quality Control Workstation.

3.7.1 Background

The ultimate goal of DICOM connectivity and functionality in the DIN-PACS model is for direct connection of modalities to the DIN-PACS with full DICOM service class support as specified in Appendix C, paragraph 3. The Government realizes that this is not the current state of the art in terms of modality and PACS development event though these DICOM standards exist. In support of this technology lag, the Government requires that DICOM functionality be extended from the DIN-PACS in such a way that the modalities' lack of DICOM features and functionalities is compensated

for. The ultimate goal of this alternate solution is to ensure that examinations and related data are entered into DIN-PACS in a reliable manner and that clinical operations are not unduly hindered in the event of network failures, component failures, or lack of complete data entry at the modality level.

The purpose of the quality control (QC) workstation is to extend DICOM services in the direction of the modalities in order to achieve higher levels of functionality than modalities may currently accommodate. For example, a modality may not support worklist management services but may provide basic DICOM Store. The QC workstation shall provide worklist management type functions which allow stored examinations to be matched to the appropriate examination on the worklist and subsequently passed into DIN-PACS. Similarly, additional DICOM services such as removable media, query/retrieve, and storage commitment shall be provided at the QC workstation. The QC workstation shall also provide standard image manipulation and data entry functionality required for image and examination quality control such as window and level, gray scale invert, image flip and rotate, kVp and mAs technician code entry, etc.

The Government intends to purchase and install QC workstations in support of clustered modalities based on operational work flow in the clinical setting. For example, each work core in a hospital may have a QC workstation installed with input from each work core's acquisition modalities. This may result in multiple modality quality control operations being conducted on one QC workstation (e.g., CR and digital fluoroscopy) or dedicated modality quality control operations on a single workstation (e.g., nuclear medicine). In effect, the QC workstation acts functionally as a mini-PACS workstation.

A. The Contractor shall provide a DICOM functionality or equivalent functionality between the QC workstation and the DIN-PACS shall meet all requirements specified in Appendix C, paragraph 4.

B. The QC workstation shall be based on a one or two monitor, review workstation platform and shall contain all review workstation functionality, as defined in Section C, paragraph 3.

C. The QC workstation shall receive DICOM images from types of modalities and multiple numbers of modalities.

D. The QC workstations shall be scaleable in order to support variable types of modalities to include CR, CT, MRI, NM, U/S, secondary capture, angiography, and digital R/F.

E. The QC workstation shall provide worklists of examinations which are in the "unverified", i.e., newly acquired or scheduled to be acquired, status.

F. The QC workstation shall support the merging of listed examinations with incoming examinations from modalities. Merging shall be performed both manually and automatically with simple point and click type operations.

G. The QC workstation shall provide temporary safe storage of images until passed to the DIN-PACS.

H. The QC workstation shall provide DICOM format removable media storage for both read and write operations in support of failover operations and other contingencies.

I. The QC workstation shall provide retransmission capability into DIN-PACS in support fo failover recovery or image/examination transmission error.

J. The QC workstation shall provide image processing features required for quality control operations on newly acquired images. These features are defined in the general workstation section in Section C, paragraph 3.3.

K. The QC workstation shall have the capability to modify the DICOM examination header with the following information required for QC operations: kVp, mAs, SID, and technician code.

L. The QC workstation shall have the ability to display all worklists generated in the DIN-PACS and

to retrieve selected examinations.

M. The QC workstation shall be able to request print services from the DIN-PACS network laser imagers and other DICOM connected hard copy devices.

N. The QC workstation shall support DICOM Verification Service Class as both a User and a Provider. The function is utilized to verify the existence and status of both modalities and the DIN-PACS and to respond to their status queries.

O. The QC workstation shall perform the above listed functions in an interactive, multiprocessing environment which does not require the termination or suspension of one operation in order to perform another operation. For example, simultaneous image manipulation functions and examination merge operations on the same examination shall be supported.

P. Locations and modality connectivity requirements for these QC workstations are defined in Appendices A and B for the initial three system installations and in Appendix J for generic site configurations.

4. Image Examination Database and Archive.

4.1 Image Examination Database

The image examination database shall provide the following data management functions:

A. Accept and store image examination data. All image data sets shall support the DICOM information objects specified in Appendix C.

B. Transmit archived and newly acquired images across the network on demand or by a logical autorouting algorithm to individual workstations or hard copy devices.

C. Retrieve exams manually and automatically according to predetermined fetch and prefetch requirements provided in paragraph 4.5.

D. Provide information about stored objects.

E. Function through an interface with the DoD's HIS, CHCS.

4.2 Image Storage / Archive

A. The image storage / archive shall be based on either a distributed, centralized, or hybrid architecture.

B. Implementation of image archive hardware shall be designed to support the logical design of the image examination database.

C. Hardware may include magnetic tape drives, Winchester hard drives, erasable and non-erasable optical drives and related magnetic and optical juke boxes.

D. Should the Contractor choose to provide any archive device requiring removable media (*i.e.,* optical disks, magnetic tape cartridges), the Contractor shall provide a two year initial supply of the media delivered in increments of six months usage.

E. The image examination database and archive shall provide automated indexing of all image exams contained on removable media.

F. The image archive shall include the following three (3) basic levels of storage:
- Temporary short-term storage for priority imaging exams with immediate retrieval.
- Temporary intermediate storage for non-priority but "recently" acquired imaging exams with fast retrieval. (It is acknowledged that the requirement for this level of storage may be met through short term storage in some forms of architectural configurations and thus may not be present as a separate physical storage device.)
- Permanent long-term archive for historical record of all imaging exams with slower retrieval.

G. Image archive storage levels may be combined depending upon site specific requirements.

H. The vendor shall provide schematic drawings for the following site types, as further defined in Appendix J, which they intend to support:
- Large Fixed Facility
- Medium Fixed Facility
- Small Fixed Facility
- Teleradiology - Spoke

4.2.1 Image Compression

A. At this time, lossy compression is unacceptable for an uninterpreted image.

B. Lossy compression and/or downsampled images is acceptable for PC workstations and shall be considered on a site configurable basis for image archive.

C. Lossy compression is acceptable for home teleradiology images, referral/consultation images and images on long term storage media but is not acceptable for primary interpretation.

D. DICOM supported compression algorithms shall be fully supported by the system in teleradiology applications for both transmit and receive functions.

E. The compression method and degree of compression shall be locally selectable.

F. Images compressed with lossy compression shall permanently display a notice, “Irreversibly compressed”.

G. Contractor shall provide a description of the compression strategy used within its proposed system. This description shall include an explanation of the relationship between compression and the different levels of storage, as well as the rationale for the Contractor’s specific compression strategy.

H. For performance purposes, favorable consideration shall be given to vendors providing proven hardware based lossless compression greater than 2:1.

4.2.2 Short-term Storage

A. Short-term storage shall include the following image exams:
- Adequate short term storage to support exams awaiting interpretation or review.
- Selected supporting “pre-fetched” historical exams of patients who have had uninterpreted new image exams.
- Exams de-archived for scheduled clinic appointments

B. In a distributed architecture, upon completion of the report approval and following the user-defined protocol (time delay, patient discharge, report availability), the exams and reports shall be automatically purged from short-term storage on a first-in first-out basis to create space for additional exams.

C. This feature shall be site configurable.

D. The user shall be able to selectively protect exams and reports from such automatic deletion.

4.2.3 Intermediate Storage

A. Intermediate storage capacity shall be sufficient to support, at a minimum, all of the following image exams:

- New exams acquired in the period of twice the time of the in-patient length of stay for 90% of the patients.
- Two weeks of outpatient exams.
- Selected supporting "pre-fetched" historical exams of patients who have had uninterpreted new image exams. The historical exams pre-fetched shall be fetched in accordance with Paragraph 4.5.

B. New exams and their associated historical exams in the intermediate storage shall be automatically deleted on: a first-in first-out basis, satisfactory long-term archival, and the exam status (i.e., unread and unreported exams shall not be deleted).

C. Reported exams shall be automatically deleted from the unread worklist and their images released from intermediate storage, if present.

D. All storage shall be scaleable, upgradeable and site configurable.

4.2.4 Long-term Archive

A. The long-term archive shall maintain a permanent record of all image exams acquired and transmitted to the DIN-PACS network.

B. The long-term archive shall be designed with sufficient capacity such that exams acquired within the last three years are on-line.

C. Exams older than three years may be stored off-line.

D. No images shall be deleted from long-term archive media.

E. Images shall be written to the archive in a sequential manner such that the archive media is fully utilized and may be placed in an off-line status that reflects clinical chronological sequence.

F. At the option of the Government, a redundant long term archive capability shall be provided with the system.

G. The database archive, including radiological reports, shall be retained for a period of 30 years.

4.2.5 Operations Between Workstation and Storage Locations

A. All operations between the workstations and the short-term storage, intermediate storage and on-line long-term archive shall be database automatic, *i.e.,* no human intervention shall be required to archive or retrieve an exam between these locations as long as the data is on-line.

B. Multiple select de-archive functionality shall be provided to the workstation. For example, a workstation operator may select more than one series of images from a worklist and request a fetch of all selected series with a single keystroke.

C. Remote fetch for teleradiology sites meeting the above requirements (paragraph 4.2.5 A/B) shall be provided.

4.2.6 Image Storage/Archive Expandability

A. The image storage/archive subsystem shall be expandable while maintaining one contiguous

patient database.

4.3 Folders.

4.3.1 Patient Folders

A. Each patient's image exams shall be managed according to a "folder" concept. A folder contains both interpreted images and corresponding diagnostic reports.

B. The default display of the image exams in the patient folder shall be by date and modality.

C. As an option, the image exams in each patient folder shall be organized into subfolders indexed by exam anatomical region, by acquisition modality (*e.g.,* CT, CR, etc.).

D. Users shall be able to sort and arrange the database by any of the folders/subfolder attributes.

E. Each patient folder shall contain all of the patient's exams available for retrieval from the archive.

F. The system manager or site identified manager shall be able to move folders or their contents to include exams, procedures and images.

4.3.2 Teaching Folders.

A. The system shall allow the user to create teaching folders.

B. These folders shall contain clinically useful exams and reports for medical education and research.

C. Folder organization shall be organizationally based. Folder hierarchy shall be site configurable, e.g., department level, department section level, individual physician level.

D. Retrieval of exams from teaching folders shall be by individual or multiple database elements (*i.e.,* requesting all exams within a particular diagnosis or age range).

E. All case material contained within the teaching folders shall be accessible via a hierarchical ACR code search.

F. The user shall be able to create temporary or permanent conference folders including selected multimodality images from one or more patients' folder.

G. The system shall clearly differentiate teaching folders from patient exam folders.

H. A provision shall be made to enter teaching file type of information into a text window associated with exams having similar findings or diagnoses.

I. This teaching file material shall only be accessible/viewable to personnel with appropriate privileges.

J. A privileged provider shall be able to arrange exams in a teaching folder in user selected order.

K. A text page shall be available, through user login privilege, to enter and access case related material (disease and case management discussion, references/bibliography, etc.).

4.3.3 Consultation Folder

A. The system shall provide the capability to create a folder with virtual pointers to specific images contained within the patient folder.

B. This folder shall be a virtual folder rather than a folder containing copies of the tagged images.

4.3.4 Folder Review

A. The user shall be able to select and simultaneously review various images and reports from different selected exam folders.

4.4 Radiology Information System (RIS)

The Department of Defense has a standard Hospital Information System (HIS), at its medical treatment facilities, the Composite Health Care System (CHCS). CHCS is the Department of Defense's computerized healthcare information system that is deployed world-wide, across all levels of medical treatment facilities both on land and at sea. CHCS has subsystems which provide information system functionality to many departments within a hospital. One of the areas that has this functionality is radiology (CHCS-RAD). CHCS-RAD interactions with CHCS include radiology orders, patient demographics, and admission data. CHCS has modules that allow radiology orders to be entered or modified, appointment scheduling, patient encounter information, film folder record tracking, radiology report generation, and department workload tracking.

A. DIN-PACS requires a separate RIS to be integrated within the DIN-PACS itself. A commercial, off the shelf RIS is preferred.

B. An interface between CHCS and DIN-PACS shall be provided by the DIN-PACS vendor. CHCS does not at this time provide the required bidirectional messaging to support the final goal of DIN-PACS/CHCS system connectivity. The future CHCS II will be based on a distributed client server architecture. Incorporation of an ODBC/HL7 compliant RIS within DIN-PACS will facilitate the transition into this client server environment.

C. The interface transition shall be accomplished in three phases:

D. Phase I shall implement unidirectional data traffic from the CHCS into the DIN-PACS RIS. This functionality is currently in place with the DoD's MDIS system.

E. Phase II shall implement initial bidirectional messaging functionality in support of the following transactions from the DIN-PACS to CHCS: exam orders, exam status update, reports/amendments, reports/amendments status update, master file updates for providers, procedures and hospital locations.

F. Phase III shall implement bidirectional messaging functionality in support of the following additional transactions from the DIN-PACS to CHCS (patient registration and master file updates for patient) and to off board servers. These off board servers shall include:

- Enrollment and Eligibility Rapid Redesign (E2R2) Project. E2R2 is the redesign project for the current DEERS (Defense Enrollment Eligibility Reporting System).
- Master Patient Index Project
- Clinically Relevant Database (CRDB) Project

G. The vendor shall provide and install the DIN-PACS system with a minimum of a Phase II CHCS interface as defined above. The Government may choose to implement only Phase I capability if CHCS II is not available at a site. However, when an installed site obtains bidirectional CHCS II capability, the DIN-PACS Contractor shall immediately implement Phase II functionality at no additional cost to the Government. CHCS II bidirectional functionality is expected to be available in February, 1998.

H. The vendor shall demonstrate Phase II CHCS capability at the Product Demonstration Benchmark

Testing (Reference Section L). The Government benchmark testing will evaluate HL7 input and output messaging and data throughput speed.

The CHCS HL7 Interface Specification for CHCS S/W Version 4.5, submitted in response to Contract DAHC 94-88-D-0005, SAIC/CHCS Doc. TC-4.5-0044, 8 July 1996 is attached to the solicitation.

4.4.1 Minimum RIS Functionality

The required incorporated RIS shall include the following minimum functions:

A. Patient Registration

B. Order Entry

C. Order Scheduling

D. Patient Arrival

E. Radiology Encounter, including:
- ⇒ Image/Exam Association
- ⇒ Accession Number Association (Modality/DIN-PACS/CHCS)

F. Results Entry, including:
- ⇒ Dictation
- ⇒ Transcription
- ⇒ Verification
- ⇒ Amendment

G. Results Distribution

H. Workload / Management Reporting

I. File and Table Building / Editing

Each of the phases of implementation shall support TCP/IP transactions across the local and wide area networks.

4.4.2 Data Elements

The following are functional descriptions and core data elements by system function that shall be provided:

4.4.2.1 Patient Registration

A. In phase I and II, patient registration shall be unidirectional from CHCS into DIN-PACS (Bi-directional functionality for phase I and phase II shall be accomplished using terminal emulation).

B. In phase III, patient registration shall be accomplished in either system.

C. Minimum data elements required to support patient registration are:
- Patient Name
- Patient's SSN
- Patient Family Member Prefix (FMP)
- Other Patient ID
- Date of Birth
- Sex
- Race
- Patient Home Address
- Patient Home Phone

- Medical Record Location
- Inpatient. Reg. Number
- Inpatient. Location
- Patient Category
- Sponsor Data:
  - ⇒ Sponsor Name
  - ⇒ FMP/SSN
  - ⇒ Other ID
  - ⇒ Date of Birth
  - ⇒ Sex
  - ⇒ Race
  - ⇒ Sponsor Home Address
  - ⇒ Sponsor Home Phone
  - ⇒ Military Rank
  - ⇒ Branch of Service
  - ⇒ Unit ID Code
  - ⇒ Patient Category

D. If a DIN-PACS RIS radiology order is attempted, the RIS shall pass a query message to verify patient registration via HL7 to the CHCS host.

E. In the event of a match, CHCS shall provide an unsolicited Patient Identification Data (PID) "push" form CHCS to the DIN-PACS RIS.

F. The remaining Order Entry information shall be entered in the RIS and passed back to CHCS via HL-7 messages.

G. In the event that CHCS returns a message that the "patient is not on file", the DIN-PACS RIS shall collect the data required by CHCS for a minimal registration.

H. The DIN-PACS RIS shall have a John Doe capability to support minimum patient data entry for registration of patients with unknown demographics.

I. After collection and verification at the data entry point, the DIN-PACS RIS shall initiate a VT-320/420 terminal emulation session via TCP/IP to the CHCS host.

J. The terminal emulator shall perform a scripted login to CHCS and continue the scripted action to the CHCS patient registration module.

K. The necessary minimal registration shall be attempted from the script by passing the required key-stroke equivalents via terminal emulation.

L. During the registration process, error trapping must be performed by the script. An example of this error trapping would be the case of the entry of a sponsor Social Security Number that is not on file. If this event were to occur, CHCS will provide a terminal response stating the error. The script shall trap the error and allow for the operator to suspend the script and perform a manual registration of the sponsor.

M. After the sponsor is registered, the vendor shall provide a way of reinitiating the patient data entry script.

4.4.2.2 Order Entry

A. In phase I, order entry shall be unidirectional from CHCS into DIN-PACS.

B. Bidirectional functionality for phase I shall be accomplished using terminal emulation.

C. In phases II and III, order entry shall be accomplished in either system.

D. During the order entry process, error trapping must be performed by the script. If an error occurs in data entry, CHCS will provide a terminal response stating the error. The script shall trap the error and allow for the operator to suspend the script and perform a manual input of the data.

E. Minimum data elements required to support order entry are:

- Patient Name
- FMP/SSN
- Exam Requested
- Coded Procedure Type
- Radiology Procedure CPT Code
- Clinical Reason of Exam
- Requesting Physician Name
- Requesting Physician Unique Identifier
- CHCS Unique Order Identifier
- CHCS Unique Examination Identifier
- Exam Priority
- Requesting Ward/Clinic
- Requesting Facility (Division) Name
- Requesting Facility Identifier
- Requested Date/Time
- Request Status
- Requested Radiology Location

4.4.2.3 Order Scheduling

A. In phase I, order scheduling shall be unidirectional from CHCS into DIN-PACS.

B. Bidirectional functionality for phase I shall be accomplished using terminal emulation.

C. In phases II and III, order scheduling shall be accomplished in either CHCS or DIN-PACS.

D. During the order scheduling process, error trapping must be performed by the script. If an error occurs in data entry, CHCS will provide a terminal response stating the error. The script shall trap the error and allow for the operator to suspend the script and perform a manual input of the data.

E. Minimum data elements required to support order scheduling are:

- Patient Name
- FMP/SSN
- CHCS Unique Examination Identifier
- Radiology Exam Requested
- Radiology Exam Location
- Radiology Modality
- Scheduled Date
- Scheduled Time
- Scheduling Status

4.4.2.4 Patient Arrival

A. In phase I, patient arrival shall be unidirectional from CHCS into DIN-PACS.

B. Bi-directional functionality for phase I shall be accomplished using terminal emulation.

C. In phases II and III, patient arrival shall be accomplished in either CHCS or DIN-PACS.

D. During the patient arrival process, error trapping must be performed by the script. If an error occurs in data entry, CHCS will provide a terminal response stating the error. The script shall trap the error and allow for the operator to suspend the script and perform a manual input of the data.

E. Minimum data elements required to patient arrival are:
- Patient Name
- FMP/SSN
- CHCS Unique Examination Identifier
- Radiology Exam
- Facility (Division) Name
- Radiology Exam Location
- Radiology Examination Status
- Radiology Modality
- Pregnancy Status
- Arrival Date
- Arrival Time

4.4.2.5 Radiology Encounter

A. In phase I, radiology encounters shall be unidirectional from CHCS into DIN-PACS.

B. Bi-directional functionality for phase I shall be accomplished using terminal emulation.

C. In phases II and III, radiology encounter data shall be accomplished in either CHCS or DIN-PACS.

D. During the radiology encounter process, error trapping must be performed by the script. If an error occurs in data entry, CHCS will provide a terminal response stating the error. The script shall trap the error and allow for the operator to suspend the script and perform a manual input of the data.

E. A primary function of the DIN-PACS is to maintain consistency between exam data found in CHCS, exam/image data generated and maintained by the DIN-PACS and exam/image data generated at a modality such as computed tomography. This consistency insures a one to one, unique relationship between these three separate databases. Minimum data elements required to support radiology encounters are:
- Patient Name
- FMP/SSN
- CHCS Unique Examination Identifier
- Radiology Exam
- Facility (Division) Name
- Radiology Exam Location
- Radiology Modality
- Examination Date
- Examination Time
- Radiology Examination Status
- Performing Technologist
- Performing Radiology Room
- Repeat Film Number

- Repeat Film Reason

4.4.2.6 Results Entry

A. In phase I, radiology results transfer shall be unidirectional from CHCS into DIN-PACS.

B. Bi-directional functionality for phase I shall be accomplished using terminal emulation.

C. In phases II and III, radiology results entry shall be accomplished in either CHCS or DIN-PACS.

D. During the results entry process, error trapping must be performed by the script. If an error occurs in data entry, CHCS will provide a terminal response stating the error. The script shall trap the error and allow for the operator to suspend the script and perform a manual input of the data.

E. Minimum data elements required to support radiology results entry are:

- Patient Name
- FMP/SSN
- CHCS Unique Examination Identifier
- Radiology Exam
- Facility (Division) Name
- Radiology Exam Location
- Radiology Modality
- Transcription Date
- Transcription Time
- Transcriptionist Name
- Transcriptionist Facility (Division)
- Report Status
- Report Text
- Interpreting Radiologist
- Supervising Radiologist
- Verifying Radiologist
- Verifying Radiologist Facility (Division)
- Verifying Supervisor
- Verifying Supervisor Facility (Division)
- Date of Verification
- Time of Verification
- Result Code
- Special Interest Code
- Teaching Code (ACR Teaching Codes)
- Amendment Date
- Amendment Time
- Amendment Transcriptionist Name
- Amendment Report Status
- Amendment Report Text
- Amendment Interpreting Radiologist
- Amendment Supervising Radiologist
- Amendment Verifying Radiologist
- Amendment Verifying Radiologist Facility (Division)
- Amendment Supervising Radiologist
- Amendment Supervising Radiologist Facility (Division)
- Amendment Result Code

4.4.2.7 Results Distribution

A. In phase I, radiology results distribution shall be a function of CHCS.

B. CHCS shall send the radiology results to DIN-PACS for further distribution to its workstations, RIS terminals, printers and wide area connections.

C. In Phases II and III, the DIN-PACS shall transfer results to CHCS and CHCS shall perform its usual electronic results distribution as well as DIN-PACS distributing to its workstations, RIS terminals, printers, and WAN connections.

D. The DIN-PACS shall print all the data elements listed in the radiology results section above on any printed hardcopy results.

E. Minimum data elements required to support results distribution are:

- Patient Name
- FMP/SSN
- CHCS Unique Examination Identifier
- Radiology Exam
- Facility (Division) Name
- Radiology Exam Location
- Radiology Modality
- Requesting Physician Name
- Requesting Physician Unique Identifier
- Requesting Ward/Clinic
- Requesting Facility (Division) Name
- Requesting Facility Identifier

4.4.2.8 Workload / Management Reporting

A. Radiology workload/management reporting shall be performed on CHCS.

B. DIN-PACS shall support a Government system administrator privileged ad hoc report capability to provide reports to augment CHCS workload/management reporting to include: clinician exam reviews performed, workstation activity reports, film printing report, site examination acquisition reports, teleradiology workload report, storage activity report, archive activity report, storage status report, archive status report.

C. The DIN-PACS RIS shall generate radiology workload reports for each modality or division in the department.

D. Users shall be able to sort the workload reports by patient status, (inpatient or outpatient), type of exam, CPT code, CPT weighted value, modality, date(s) of exam, date(s) of completion, requesting location, requesting facility, and requesting provider.

E. Sorting categories for these reports should include: work area, imaging modality, time interval, improper positioning, patient motion, insufficient information, artifacts, technologist choice, imaging unit mechnical difficulties, and a miscellaneous category for other causes.

F. In phase I, all necessary data is generated by CHCS.

G. In phases II and III, data elements transferred from the DIN-PACS to CHCS may need to be expanded to accommodate the required data elements for accurate workload/management reporting in CHCS.

4.4.2.9 File and Table Building / Editing

A. In phase I, CHCS shall provide update messages to the DIN-PACS to maintain synchronization

between CHCS and the DIN-PACS. These are for the primary (master) files of the Provider File, the Radiology Procedure File and the Hospital Location File.

B. In phases II and III, when these files are changed in either system, updates shall automatically be made to the other system.

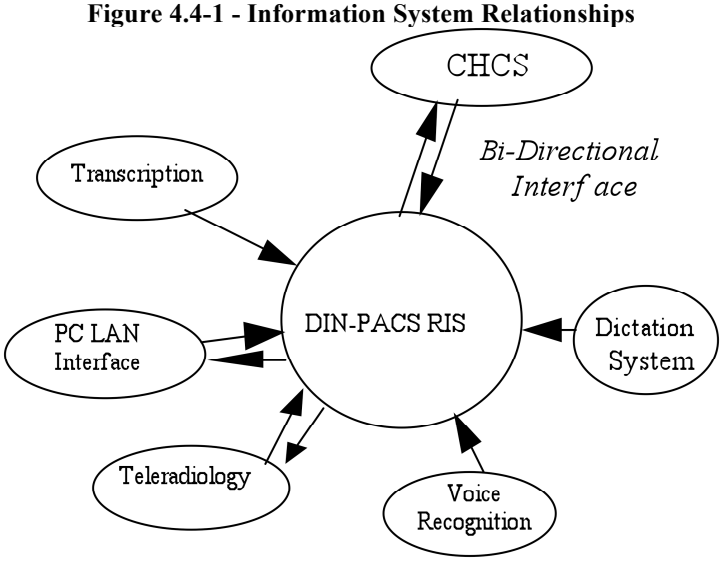
4.4.3 The RIS Interface Approach

A. The DIN-PACS vendor shall provide a bi-directional interface to CHCS as a major part of the DIN-PACS RIS functionality.

B. The interface provided shall have the same reliability and uptime constraints as DIN-PACS.

C. The interface to CHCS shall be a bi-directional HL-7 interface using a commercial RIS integrated into the DIN-PACS. HL7 messages include both standard HL7 and non-standard HL7, to meet the inclusion of the above listed data elements. See Figure 4.4-1.

Figure 4.4-1 - Information System Relationships



4.4.4 RIS Capability

A. Patient care in radiology cannot be affected when CHCS is down. A capability shall exist to allow orders and exam information to be entered into DIN-PACS.

B. The DIN-PACS RIS capability shall automatically update CHCS of RIS activity when CHCS comes back on-line.

C. Additionally, when the DIN-PACS has been down, the DIN-PACS shall be updated by CHCS of any completed Radiology events when the DIN-PACS comes back on-line.

D. Radiology orders in both systems shall allow for multiple exams from all modalities.

E. The diagnostic reports shall be linked to each exam associated with the original order.

4.4.5 Information Integrity and Continuity

A. To maintain consistency between the CHCS and DIN-PACS, use of the following basic principles shall be observed:

- Consistent exam and reporting approach (see appendix I)
- Common data elements that are logically compliant with current DICOM/CHCS/HL7 standards (see appendix F and paragraph 4.5).

4.4.6 Exam/Procedure Database

A. The interface between DIN-PACS and CHCS shall pass data elements that are needed for both systems to operate effectively. Redundant manual entry of common data elements in CHCS and the DIN-PACS databases is not acceptable.

B. The DIN-PACS RIS shall obtain patient demographic data, order entry data, patient appointment data, and patient radiology encounter data and transcribed radiographic reports, from either CHCS or direct entry into the DIN-PACS RIS.

C. The DIN-PACS RIS shall provide patient demographic data, order entry data, and patient radiology encounter data, back to CHCS.

4.4.7 Database Management System

A. The DIN-PACS database management system shall be a relational database that allows multiple users to simultaneously access the same data.

B. The database design strategies shall optimize cost and performance tradeoffs between archiving efficiency and delivery times. Specifically, logical designs are required that feature (a) short-term storage for high demand exams for fast retrieval and (b) long-term archiving for low demand exams for slower retrieval.

C. The vendor shall provide a description of create, modify, read, write and delete rights to files and a method for preventing data writing contentions (i.e., the locking strategies of the database).

4.4.8 Master File Updates, Phase III

A. To reduce system inconsistencies between DIN-PACS and CHCS, master file entries or changes in one system shall automatically update the other.

B. As a minimum the master files that shall be updated are the location files, the procedure files, and the provider files.

4.4.9 Patient Admission, Disposition, and Transfer

A. The DIN-PACS shall support Admission, Disposition, and Transfer (ADT) updates passed from CHCS through the interface.

B. In a distributed network it shall be critical to have DIN-PACS send a patient's images to the workstation on the inpatient ward they are assigned.

C. If a patient is transferred to a different inpatient ward, CHCS shall pass the change to DIN-PACS and DIN-PACS shall autoroute the patient's radiology images to the workstation at the new location.

D. When a patient is discharged, DIN-PACS can delete the images on the inpatient workstation, in a site configurable manner.

4.4.10 Autorouting/Prefetch Support

A. The RIS shall support autorouting and prefetch operations of the DIN-PACS through appropriate message transfer from CHCS, DIN-PACS workstations, teleradiology components, and the DIN-PACS storage system.

4.4.11 Report Generation

A. A radiologist shall be able to review and verify his/her reports once the transcription has been completed.

B. DIN-PACS shall be able to sort an individual radiologist's reports.

C. DIN-PACS shall allow a second signature capability for radiologists to review and verify radiology reports of residents and physicians in training.

D. DIN-PACS shall allow the residents and physicians in training to automatically forward their reports to a staff radiologist for final review and verification.

E. Following a site defined period of time, a resident's report shall be automatically forwarded to a

staff radiologist for approval.

F. A radiologist shall be able to review and verify another radiologist's reports, and DIN-PACS shall attach the verifying radiologist's name to the report.

G. DIN-PACS shall be able to generate user definable and modifiable "canned/boiler plate" radiographic reports in support of a radiologist entering and verifying a report at the time the exam is viewed.

H. The radiographic report shall be attached to the exams in DIN-PACS, so that when an exam is viewed on a workstation, the radiographic report shall be available in a window with the images.

I. The report shall be able to be viewed without requirement for the images to be displayed.

J. DIN-PACS shall be capable of printing hard copies of the reports when they are approved.

K. The reports shall be able to be printed on demand, and/or in batch mode as required.

L. The print batches shall be user sortable so that all, some, or just a single location's reports can be printed.

M. An electronic copy of the report shall be sent to CHCS.

N. Print quantities shall be user configurable from one to three copies.

O. Multiple copy prints shall be colated.

P. The DIN-PACS shall be able to interface with voice/automatic dictation systems, spell checkers, thesauruses, and remote transcription services.

Q. Radiographic reports shall be capable of being generated and distributed on both CHCS and the DIN-PACS.

R. The vendor shall provide a listing of voice/automatic dictation systems, spell checkers, thesauruses, and remote transcription services supported by their architecture and be prepared to demonstrate the compatibility.

S. A report generated and/or modified in one system, shall be passed to the other upon completion without human intervention.

4.4.12 Exam Access Rights and Privilege Groups

A. The Contractor and Government system administrators shall be able to assign privileges and passwords to the DIN-PACS users.

B. DIN-PACS users shall be divided by their functional groups, such as: radiologists, clinical users, medical physicists, system administrators, technologists, clerks, and transcriptionists are examples of groups.

C. Examples of privileges that shall be site configurable by the system administrators are: hard copy printing, high priority fetch rights, access to the radiographic reports prior to approval, access and data entry capability to teaching file information, and the ability to save changes on an exam's images.

4.5 Prefetch/Fetch Requirements

4.5.1 Prefetch

A. A site configurable intelligent examination prefetch from the archive shall be provided.

B. The prefetch operations shall be a background activity of the archive.

C. The prefetch shall be activated by to any of the following:
- order status updated to "arrived" of a walk-in patient
- scheduled radiology appointments
- scheduled clinical visits.

D. The DIN-PACS system shall prefetch (de-archive) previously acquired historical exams, to be autorouted to referring location DIN-PACS workstations and diagnostic workstations, for scheduled patient appointments.

E. DIN-PACS shall receive patient appointment data from CHCS.

F. The DIN-PACS shall provide STAT prefetching of historical exams on patients that have had STAT radiology exams requested.

G. The intelligent prefetch shall also be functional at sites with remote archives (i.e., teleradiology sites).

H. A system administrator shall be able to configure the prefetch algorithms for exam type, number of exams, modalities, individual radiologists, each referring location, and inpatient vs. outpatient status.

I. Prefetch algorithms shall be sortable by the following parameters: modality, date of exam(s), body part, and referring locations.

J. Multiple combinations of these filters shall be permitted.

K. A system administrator shall be a able to monitor the success/failure rate of fetching and prefetching in the archival system, so that the fetch/prefetch algorithms can be modified to improve performance.

L. Ongoing reporting of failed and successful prefetch and fetch activity shall be provided to designated workstations.

4.5.2 Prefetch Examples

Scenario 1 - When patients have follow-up appointments with referring physicians, historical exams, that apply to the patient's condition, need to be "Prefetched" prior to the appointment time. EXAMPLE: Patient "Jones" was seen in the emergency room for a twisted ankle three weeks ago. Patient "Jones'" ankle was radiographed and the exam read as normal. Patient "Jones" now has an appointment in orthopedics because his/her ankle is still swollen and painful. The ankle radiographs shall need to be fetched from archive and autorouted to the DIN-PACS workstation in orthopedics.

Scenario 2 - A radiologist reviews pertinent historical exams when reading newly acquired exams of the same radiographic region of interest. The radiographic region of interest exams, may be from a different modality or from multiple modalities, over an extended period of time. EXAMPLE: If a radiologist is reading the newly acquired PA and Lateral Chest radiographs, on patient "Smith", the radiologist, may shall also want to see the last three chest radiographs patient "Smith" has had, along with any recent CT or MRI or Nuclear Medicine studies patient "Smith" may have had of his/her chest.

4.5.3 Fetch

A. DIN-PACS shall be capable of performing an immediate fetch of exams from the archive.

B. Fetch capability shall be provided for all DIN-PACS workstations connected to the DIN-PACS system.

C. The fetch capability shall be configurable with multiple levels of manual fetch priority.

D. A system administrator shall assign users to fetch priority groups.

E. The DIN-PACS system shall apply the appropriate fetch priority based upon user log-on.

F. When the images are available for viewing, the system shall notify the user requesting the fetch.

G. Fetch operations shall be integrated with other archive operations such that clinical operations are maximized while safe archival of examinations is a primary background operation.

H. Fetch operations shall be supported for remote sites from the workstation using DICOM Query and Retrieve.

5. Communications Network Interface.

A. The Contractor shall provide a network design for the DIN-PACS that allows other hospital networks to operate from the same network hardware devices used for the DIN-PACS network (see appendix G).

B. At a minimum the hospital shall need to bring the CHCS network and a general office automation network into the same physical areas that the DIN-PACS components shall be located.

C. The network design shall allow for a single set of hardware to provide all network services for a given physical area.

D. The hardware may be configurable so that DIN-PACS traffic is isolated from other hospital network traffic. For instance a chassis style hub may have several interface cards configured for the DIN-PACS network, and another ethernet card for the hospital administrative network and a terminal server card to support CHCS terminals in the area.

E. The Contractor may propose to replace existing equipment with new equipment that provides functionality for all networks in the area.

F. Alternatively the Contractor may propose to upgrade existing equipment or to add load to existing equipment without upgrade to meet the networking requirements of DIN-PACS.

G. The Government highly desires network designs that utilize ethernet, fast ethernet, or ATM as the physical layer transmission protocol. Designs that utilize FDDI, CDDI or Token Ring are acceptable but shall receive no preference.

H. Designs that use proprietary protocols are discouraged, but shall be evaluated. Proprietary designs shall have to provide substantial performance benefits to overcome the Government's increased long term risk of using a proprietary design.

I. Designs should allow for either multimode fiber or Category 5 UTP cabling as the physical media.

J. All network devices shall be manageable from a central console with a graphical user interface. At a minimum the console shall show the network manager: the status of each network device, including attached nodes; the aggregate traffic levels through each network device; the traffic

levels through each network port; transmission errors by the device and port; a method to capture traffic on any given segment or circuit; historical traffic pattern tracking; device configuration; and configurable network alarms.

K. The use of switching to maximize bandwidth for the chosen physical protocol is highly encouraged. Switches that can switch at both the level 2 (physical) layer and the level 3 (network) layer are highly desirable. If a switch is not the central switch operating as a collapsed backbone it shall have at least one port with a higher speed than the distribution ports on the switch. All switch designs shall demonstrate that over subscription does not occur under loaded conditions.

L. If ATM is used in the DIN-PACS network design, all ATM devices shall be able to communicate with the legacy packet based network in the hospital. Native ATM communications are encouraged between ATM devices to improve performance, but LANE or Classical IP services are required to ensure the functionality of the packet based networks.

M. The network design shall allow for redundant connections between network devices. The redundant lines shall take over for a failed line without any user intervention. The network devices shall also recognize when the primary line has been restored and take appropriate action.

N. Redundancy among network devices is highly desirable. Any component that is critical for network operations shall be fully redundant, i.e., a central switch acting as a collapsed backbone. Any device that services 100% of a critical network component shall also be fully redundant, i.e., a hub that serves the only image archive on the network. The design of the network shall include power protection for network devices critical to the operation of the network (reference paragraph 1.5).

O. The network design shall provide logical and physical methods to isolate key network nodes from any network segment that is connected to the general hospital network or the Internet. The Government shall be able to isolate segments from Internet traffic or provide packet filtering services for a network segment. Each network device shall have security measures available to prevent unauthorized configuration of the device.

P. Any wide-area connection shall be made as a network connection rather than a proprietary application-to-application connection. Wide area network connections shall all connect to a network device that is manageable from the network management console. Wide area connection shall be planned with redundancy in mind. Designs that can affordably supply on demand back up connections are highly desirable.

Q. Applications that use a single network layer protocol shall be favorably viewed, with TCP/IP being the required protocol. All network protocols used shall be configured to comply with local routing policies. The Government shall assign or approve the assignment of all network addresses.

R. The DIN-PACS network shall connect to existing hospital networks at one or many points. The DIN-PACS network shall support any of the preferred or acceptable physical media mentioned above for a connection to existing networks. The connection to the hospital LAN shall support sufficient bandwidth to accommodate the number of potential PC users of the DIN-PACS. The Government shall be responsible for appropriate network capabilities after the interface to the

DIN-PACS.

6. Legacy System Interface

The DoD has several existing PACS sites with an installed base of Medical Diagnostic Imaging Support (MDIS) systems which operate on several functional levels. These levels range from small sites functioning as teleradiology spokes to full hospital PACS systems which are major teleradiology hubs and have major MTF to MTF image communication links. Image archives and databases are currently greater than one terabyte at the larger sites.

6.1.1.1 Interaction with Existing MDIS Sites

The DIN-PACS system shall interact with these sites on several levels. The vendor shall include concepts in their proposal for each of the following scenarios:

A. DIN-PACS replacement systems for existing sites.

B. Incorporation of DIN-PACS activities into MDIS as extension of existing MDIS system.

C. Interaction of DIN-PACS and MDIS systems on local MTF to MTF basis (HyperPACS) and via teleradiology following spoke and hub concept.

6.1.1.2 MDIS to DIN-PACS Migration

A. The DIN-PACS vendor shall provide a transition plan for replacement of a current MDIS site and current MDIS-teleradiology sites. This replacement plan shall incorporate the existing MDIS RIS database into the DIN-PACS RIS database and incorporate the existing image storage into DIN-PACS. The use of existing hardware to the fullest extent possible is highly desired by the Government as long as the DIN-PACS performance requirements are not compromised.

6.1.1.3 Augmentation of MDIS Systems

A. The DIN-PACS vendor shall provide in his proposal a methodology for use of DIN-PACS equipment or sub-units to support the extension of existing MDIS systems.

6.1.1.4 HyperPACS and Teleradiology with MDIS

A. The DIN-PACS vendor shall provide in his proposal a specific methodology to provide DIN-PACS teleradiology service to an existing MDIS site which is capable of supporting teleradiology and propose a specific methodology to become the DIN-PACS hub for existing MDIS-teleradiology sites within the scope of Paragraph 8.

B. The DIN-PACS vendor shall propose a specific methodology to provide DIN-PACS MTF to MDIS MTF high performance teleradiology under the HyperPACS concept described in paragraph 8.2.

7. Integrated System Performance.

7.1 General

A. The DIN-PACS shall be a functional single entity that provides efficient radiographic image and patient data flow within the hospital (see Figure 7.1).

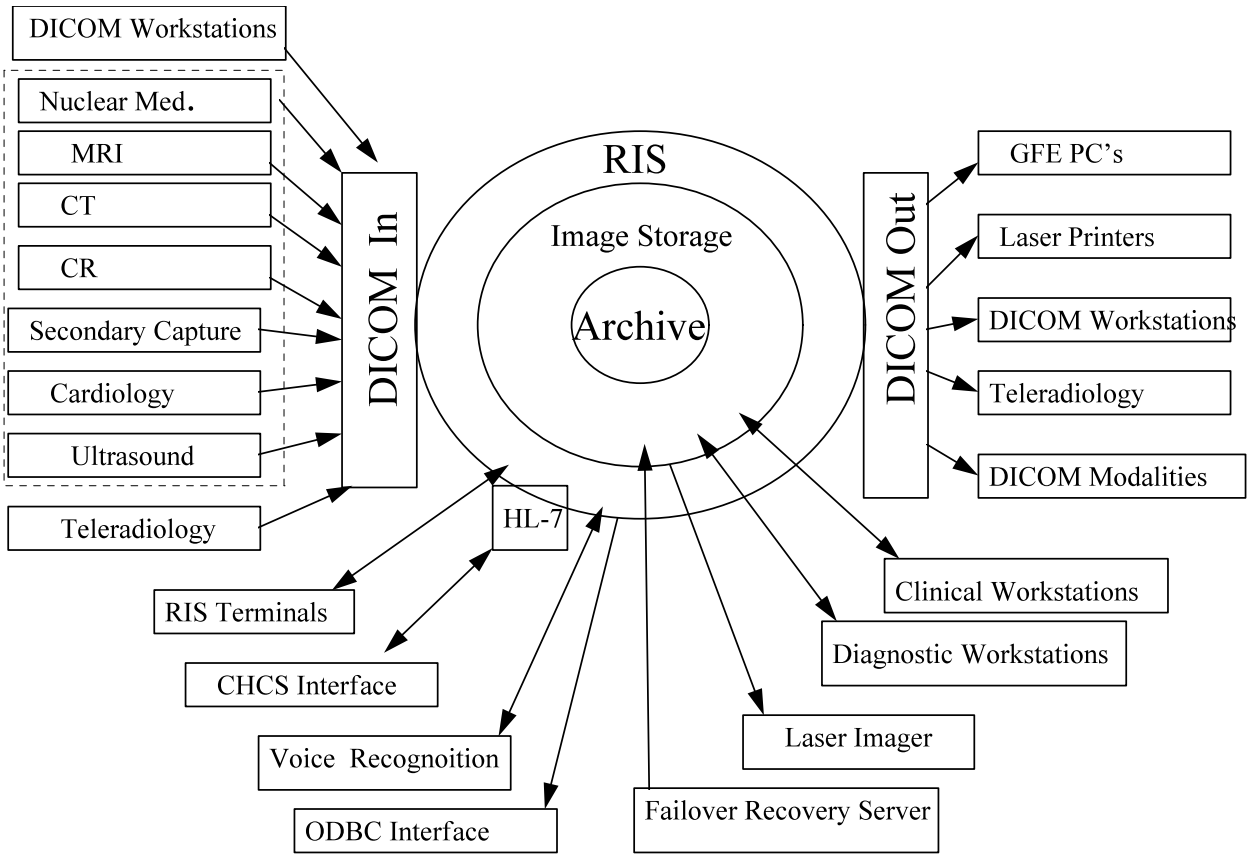
B. The DIN-PACS external interfaces shall be fully DICOM compliant across all devices and data structures.

C. The delivered system shall be fully compliant with the DICOM standard and all approved (i.e., balloted) extensions and supplements in existence 6 months prior to the delivery date.

Demonstration of a proposed system's ability to meet this requirement shall be mandatory prior to contract award. For purposes of the Product Demonstration, "DICOM Compliance" is defined as conformance to all aspects of the DICOM standard in effect at the time of contract award (reference Appendix C).

D. Any upgrades to hardware and software during the warranty period shall be provided as part of the contract pricing.

Figure 7.1. DIN-PACS Model



7.2 Concept of Operation

A. The DIN-PACS shall support the following concept of operation for radiologic practice.

7.2.1 Exam Ordering

A. Exams are ordered in the CHCS system.

B. This ordering information is passed to DIN-PACS via the CHCS interface.

C. As previously noted, CHCS shall notify DIN-PACS when a patient appointment has been scheduled within the hospital.

D. Based on how site parameters have been set, when an exam is scheduled a message shall be transmitted to DIN-PACS containing the scheduled date and time.

E. When an appointment date is modified, a message shall be sent to DIN-PACS containing the new schedule date and time and the reason the appointment was modified.

F. When an appointment is canceled, a message shall be transmitted to DIN-PACS containing the reason the appointment was canceled.

G. Conversely, the DIN-PACS system shall notify CHCS upon the scheduling and/or arrival of the patient within the DIN-PACS.

7.2.2 Prior Exam/Report Retrieval and Autorouting

A. CHCS also shall trigger a message to DIN-PACS containing clinical appointment data.

B. This data shall be used to automatically prefetch digital radiographic images and reports from long-term storage.

C. In the case of a distributed network the autorouted radiographic images and reports shall be placed in short term storage.

D. Autorouting operations shall not impede performance of acquisition devices or workstations.

E. This autorouting shall be targeted to specific acquisition and display devices, both in and outside of the radiology department according to site-unique, site definable/modifiable algorithms.

F. If the clinical appointment data trigger does not or cannot locate previous images or reports from long term on line storage, the system shall provide a visual message at the workstation indicating such.

7.2.3 Patient Arrival and Examination.

7.2.3.1 Pre-scheduled Patient

A. When a pre-scheduled patient reports to the radiology department for an exam, a radiology technologist logs the arrival of the patient and verifies the accuracy of the data on the DIN-PACS modality worklist.

B. This verification action shall require a minimum of typing (patient name or medical record number), *e.g.* bar code reading, selecting from a pick list, or equivalent.

C. If information, such as examination type, is incorrect, the technologist corrects it at this time.

D. This process shall require a minimum of manual operations and no redundant entry.

E. The new radiology exams are acquired and, following an image quality control check at the image acquisition site by the technologist (at the discretion of the user) , the examination is automatically sent to the DIN-PACS.

F. This "send" event shall trigger the following events:
- The DIN-PACS database is updated.
- If a distributed architecture is used, the exam is autorouted to the appropriate diagnostic workstation short-term storage.
- The exam is autorouted to both intermediate storage and long-term archive.

G. It shall be possible to route images to a film printer for hard copy printing. Updated DIN-PACS data shall be sent to CHCS.

7.2.3.2 Walk In Patient

Patients that do not have scheduled appointments may need radiology exams. Most facilities have walk in clinics or sick calls where patients can be seen without appointments. Patients from the emergency room shall not have appointments. When patients are seen in these areas, a health care provider shall enter radiology orders for the patient in CHCS. The patient will then come to the radiology department for the exam or a technologist shall come to them to perform a portable radiology exam.

A. The normal operation of the DIN-PACS shall provide the CHCS data exchange in a timely manner and allow for the walk in patient information to flow into the DIN-PACS and appear on

the Acquisition Worklists prior to image acquisition.

B. There may be occasions when the CHCS order has not reached DIN-PACS and the technologist must process the radiology imaging plates. DIN-PACS shall allow the technologist to enter the minimum RIS data fields, so the images can be processed and acquired on DIN-PACS.

C. DIN-PACS shall be capable of merging the patient and exam information to the CHCS order when it arrives.

D. The new radiology exams are acquired and, following an image quality control check at the image acquisition site by the technologist (at the discretion of the user), the examination is automatically sent to the DIN-PACS.

E. This "send" event shall trigger the following events:
- The DIN-PACS database is updated.
- If a distributed architecture is used, the exam is autorouted to the appropriate diagnostic workstation short-term storage.
- The exam is autorouted to both intermediate storage and long-term archive.

F. It shall be possible to route images to a film printer for hard copy printing.

G. Updated DIN-PACS data shall be sent to CHCS.

7.2.4 Diagnostic and Review Workstation Activity

A. Once generated the report shall be automatically routed to the requesting workstation when a procedure is requested and is available for immediate display.

B. Report display shall be configurable for a specified user.

C. If the site desires, a departmental default format shall be specified and used.

7.2.5 Image Presentation

A. The workstation short-term storage shall receive images from intermediate storage, long-term archive or directly from acquisition devices.

B. Reports corresponding to prefetched historical exams shall be autorouted to the workstation in a distributed architecture.

C. All necessary images and reports shall be pre-loaded on designated workstation/s (in a distributed architecture) and are available to designated workstations (in a centralized architecture) prior to the radiologist's arrival for a clinical session.

D. The worklist of exams shall be presented to the clinician upon log-on.

E. In some cases, such as emergency exams, exams shall be immediately routed so that they are available on a particular worklist, workstation or hardcopy device as they are produced.

F. The clinician shall be able to select new exams from the worklist.

G. Images shall be displayed using that particular user's appropriate default display settings saved centrally in the DIN-PACS.

H. The user shall also be able to query the database for retrieval of any other desired exam from the intermediate storage and long-term archive.

I. The DIN-PACS shall facilitate this query process by allowing the user to enter a combination of exam identification fields (*i.e.,* first few letters of patient last name, exam type, last four digits of the social security number, *etc.*) to limit the scope of the search.

J. All searches of the DIN-PACS database shall be case insensitive.

K. A STAT exam indicator (visual and/or audible) shall be presented at designated workstations when a STAT exam becomes available for interpretation.

L. This STAT exam indicator shall be site configurable.

7.2.5.1 Image Interpretation

A. When a radiologist dictates a report for the new exam, the radiologist indicates that he/she has completed the interpretation using one single keystroke equivalent (OSKE) and the DIN-PACS worklists shall be automatically updated.

B. The report shall be transcribed into CHCS either off-line, at the DIN-PACS through a separate window providing direct log-on access to CHCS, or directly into the DIN-PACS RIS with subsequent transfer to CHCS through the bidirectional interface, as selected by the site.

C. Transcription completion shall be indicated using OSKE and reports are stored in CHCS with appropriate data elements so that they are logically matched with the exams in the patient image exam folder in the DIN-PACS and the DIN-PACS worklists are automatically updated.

D. The radiologist returns to the DIN-PACS workstation to verify the completed report. The radiologist will complete the report in either DIN-PACS or CHCS using OSKE and the DIN-PACS worklists shall be automatically updated.

7.2.5.2 Access to Worklists

A. In a storage/database architecture, all workstations shall have access to all worklists.

7.3 System Performance

System throughput and system image quality are the two primary performance parameters of an effective DIN-PACS system. Each parameter is affected in part by the volume and complexity of image data, frequency and volume of user requests, degree of data compression, communication priority parameters and data access speed of the data storage devices. System performance requirements are described from several perspectives. The vendor shall explicitly describe how each of the requirements is addressed in the proposed system design.

For all remaining discussions on system performance, the following definitions shall apply:

- **"Loaded network condition":** The activity period during which all imaging systems and workstations in full clinical operation have the network operating at its designed maximum continuous performance level.
- **"Exam":** All autorouting, retrieval and display times shall be met for the following types of exams.

  Two - 2 K x 2.5 K x 12 bit Computed Radiography images, uncompressed.

  Fifty - 512 x 512 x 12 bit Computed Tomography images, uncompressed.

  In addition, all specified numeric throughput values shall apply to a dedicated Radiology network or segment unless the Contractor claims the ability to operate on a shared media.

7.3.1 Image Acquisition and Transfer Performance

A. Images shall be acquired at various imaging modalities such as CR, CT, MR, ultrasound, nuclear medicine, *etc.*

B. Once the images are acquired and processed by the acquisition device, they shall be transferred to and received by a segment of the DIN-PACS network.

C. Transfer of images from the imaging system to the network shall not impede normal operations of the acquisition system regardless of the network traffic condition.

D. The DIN-PACS system shall be able to support the modality throughputs.

E. The DIN-PACS database shall update worklists and composite exam lists with new exam information within 15 seconds of receipt of the first image of an exam across a DICOM interface.

7.3.2 Diagnostic and Review Workstation Performance.

7.3.2.1 Autorouting

A. In a loaded network condition new exams of scheduled patient cases shall be present for interpretation at the workstation within 30 seconds of transfer of the first image across the DICOM interface.

B. Subsequent images shall be added to the examination at the rate of receipt from the DICOM interface with a latency period not to exceed 15 seconds.

C. Arrival of such "STAT" exams shall trigger a user controlled audible/visual alarm at the workstation.

D. Workstations shall receive exams in the background without noticeable impediment to the viewing process.

7.3.2.2 Exam Retrieval and Display Speed.

Short-term Storage.

A. Assuming a two or four monitor workstation, the time to retrieve a single CR exam from the local or logically local workstation and fully display the first image on the first monitor shall not exceed 2 seconds. The second image of the CR exam shall be displayed on the next monitor within 2 seconds after full display of the first image. This timing shall be measured under loaded network conditions and begins upon user selection of the desired exam from a worklist / composite exam list, initiates the display command sequence, and ends upon full display of the image(s) on the monitor(s).

B. Assuming a two or four monitor workstation, the time to retrive a single CT, MR, US, or NM exam from the local or logically local workstation and fill the first monitor with displayed images shall not exceed 2.5 sec. Each subsquent monitor shall be filled with displayed images within 2.5 seconds of the previous. For a four monitor workstation the total time to have all four monitors completely filled with images shall not exceed 10 seconds. This timing shall be measured under loaded network conditions and begins upon user selection of the desired exam from a worklist / composite exam list, initiates the display command sequence, and ends upon full display of the image(s) on the monitor(s).

Intermediate Storage.

A. Assuming a two or four monitor workstation, the time to retrieve a single CR exam from the intermediate storage and fully display the first image on the first monitor shall not exceed 2.5

seconds. The second image of the CR exam shall be displayed on the next monitor within 2.5 seconds after full display of the first image. This timing shall be measured under loaded network conditions and begins upon user selection of the desired exam from a worklist / composite exam list, initiates the display command sequence, and ends upon full display of the image(s) on the monitor(s).

B. Assuming a two or four monitor workstation, the time to retrive a single CT, MR, US, or NM exam from the intermediate storage and fill the first monitor with displayed images shall not exceed 2.5 sec. Each subsquent monitor shall be filled with displayed images within 2.5 seconds of the previous. For a four monitor workstation the total time to have all four monitors completely filled with images shall not exceed 10 seconds. This timing shall be measured under loaded network conditions and begins upon user selection of the desired exam from a worklist / composite exam list, initiates the display command sequence, and ends upon full display of the image(s) on the monitor(s).

Long-term Archive.

A. Assuming a two or four monitor workstation, the time to retrieve an exam from long-term archive and fully display the first image, in the case of CR, or the first monitor-full of displayed CT, MR, US, or NM images, on the workstation monitor, assuming the exam is "on-line" in the long-term archive, shall not exceed 3 minutes. Each subsequent CR image or monitor-full of CT, MR, US or NM images, shall be fully displayed within 2.5 seconds after full display of the first image (or monitor). This timing shall be measured under loaded network conditions, assumes that the request is top in the retrieval queue priority, and begins upon user selection of the desired exam from a composite exam list, initiates the display command sequence, and ends upon full display of the image(s) on the monitor(s).

7.3.3 Hard Copy Device Interface Performance

A. The operations of the DIN-PACS network shall not be impeded by the operation of any hard copy devices nor shall the hard copy device be impeded by the DIN-PACS.

B. The interaction between hard copy devices and the network shall be such that image print requests are queued.

C. The hard copy devices shall produce hard copy images with either preselected default parameter values or with specially selected parameter values in response to requests from an authorized user/workstation.

D. The authorized user/workstation shall be able to direct images to any hard copy printer on the DIN-PACS network although each workstation shall be configured with a default printing location.

E. The hard copy device shall communicate the operational or service status to the workstation user and network manager workstation.

F. Workstations shall include the functionality of a DICOM Print Service Class User (SCU).

G. While "requested Image Size" is an optional DICOM field, it is required for all DIN-PACS components utilizing DICOM Print SCU. This is so a user can print an 8X10 film on a 14X17 printer and still get an 8X10 image.

H. Requests for printing shall run in background mode and shall not compromise workstation operation or performance.

I. It shall be possible to choose between multiple image formats: 1:1 actual size for CR, 2:1, 4:1, 6:1, 9:1, 12:1, 15:1, 20:1, and 40:1.

J. The user interface shall display the following print status information:
- Survey the current contents of print queue for all printers on the network.
- Status and messages for the current and other printers on the network (for example status on supply and receive magazine).

K. It shall be possible to print or reprint a copy of an already closed/finished print job.

L. It shall be possible to produce multiple copies of the same image with one request.

M. Number of copies in excess of a site definable quantity shall require verification.

N. It shall be possible to cancel the print request for all print jobs of a printer, a single sheet, or an entire study.

O. The system shall enable logging of print jobs for accounting purposes.

P. The log information, shall include, but is not limited to the following: requesting individual, requesting department, number of films, number of images, etc.

Q. Identification of the requester, date, and time, shall be printed on the border of the film.

R. The workstation shall allow the user to select and arrange key images from within single and multiple examinations for output to hardcopy film devices in multiformats.

7.4 System Availability and Crisis Management

A. The DIN-PACS shall prevent any loss of acquired images and data.

B. If a failure prevents image acquisition, the DIN-PACS shall provide a means to enter the images from the imaging equipment at a later time.

C. In case a single image or a set of images fails to be transmitted from an imaging system, there shall be a way to identify and restore the missing images.

D. Since a hospital must operate 24 hours per day, the system availability must be 98% measured over a monthly period of 24 hour days, including weekends and holidays.

E. The DIN-PACS workstations and archive shall include hardware and software features which allow the insertion of removeable random access media, of sufficient size to support at least five to ten 10 MByte images for the purpose of transporting images into and out of workstations and the image storage layer of the DIN-PACS.

F. Media shall be rewritable and reusable and shall be of consistent format across all workstations.

G. In the instance where there is a network failure at the point of connection of the acquisition modality to the DIN-PACS, software features of the DIN-PACS shall allow for merging of patient exam information and images in the DIN-PACS based on information in the DICOM header. For purposes of this RFP, this process shall be called “failover recovery”. The Government encourages vendors to propose multiple solutions to this process in their response.

H. The DIN-PACS shall be designed to operate 24 hours a day. All routine system maintenance such as: backups, disk defragmentation, and database consistency checks, shall be done while the system is up and functioning.

I. System maintenance can cause a degradation of normal performance levels as long as it is reasonable to schedule the maintenance during a slow shift. A system that allows each device in the system to be rebooted without causing the loss of any class of service is highly desirable.

J. Any function which is central to the operation of the system and is hardware based shall be supported by a redundant device which shall provide its service in the event of a failure.

K. Return to full system operation shall be no longer than the time required for system reboot.

L. The system shall provide monitoring capability via Simple Network Management Protocol (SNMP) of all server devices, controllers, routers, hubs, and CSU's/DSU's.

M. The Contractor shall have a system recovery / contingency plan. The plan shall be submitted for review as part of the vendor's written technical proposal. The vendor may propose multiple failover options with full corresponding technical and price information for each option for the Government's best value consideration. The plan shall address, but not be limited to, system action in response to the following failures that require data recovery:

- Failure of interface to image acquisition devices.
- Failure of interface to CHCS.
- Methods to restore information integrity between the CHCS and DIN-PACS databases.
- Failure of workstations or other major DIN-PACS components.
- Failure of interface to hard copy devices.
- Failure of network at each logical connection.
- Failure of intermediate storage capability.
- Failure of long-term archive capability.
- Failure to transfer teleradiology images.

8. DIN-PACS Teleradiology

A. The DIN-PACS teleradiology soution shall provide a means by which digital radiographic exam data sets and patient demographic data acquired at one geographical location can be transmitted over a telecommunications line to another geographical location.

B. The DIN-PACS teleradiology system shall provide an integrated, automated, and seamless, solution for the military services which shall accommodate the successful transmission and exchange of patient data and images in a DICOM compliant environment.

C. The DIN-PACS teleradiology implementation shall meet or exceed all requirements of the American College of Radiology (ACR) Standard for Teleradiology (RES.21-1994).

8.1 The Teleradiology Model

A. The DIN-PACS teleradiology architecture shall be DICOM compatible to the DIN-PACS Medical Treatment Facility (MTF) system parameters, as specified in appendix C, so that it can exchange full image and reports with an intra-MTF DIN-PACS system.

B. The teleradiology system shall encompass four separate bidirectional support concepts:

- MTF to MTF teleradiology
- Spoke to MTF Hub teleradiology
- Spoke to Spoke

- Take home teleradiology system.

C. Fetch operations shall be supported for remote sites from the workstation using DICOM Query and Retrieve. Figure 8-1 illustrates the DIN-PACS teleradiology model for MTF to MTF and spoke to MTF architectures.

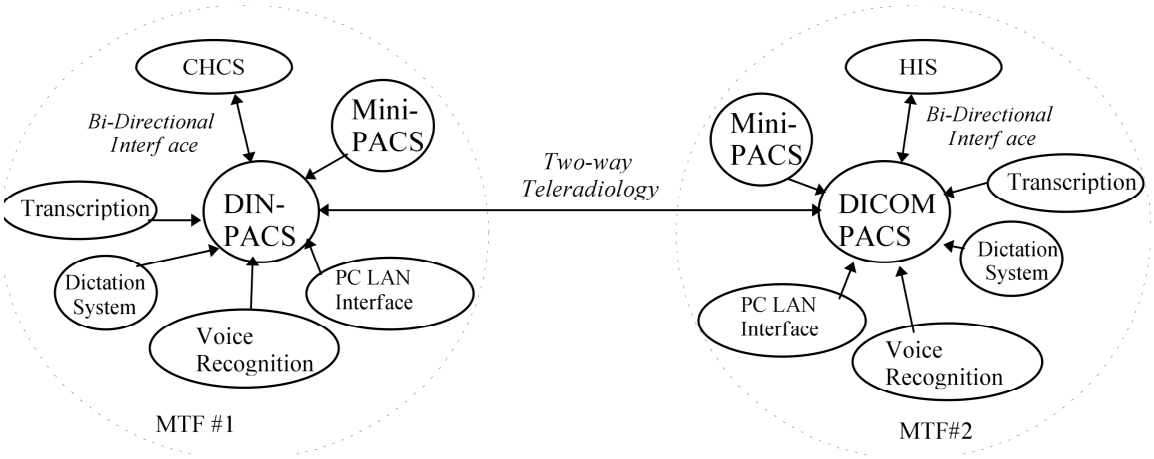
D. The vendor shall be able to communicate across multiple transmission platforms. The communication links to the teleradiology sites shall most often be Government Furnished Equipment (GFE), but the vendor shall be able to provide communication links when requested by the Government. ATM (OC3 and OC12), DS1 and fractional services, DS3, ISDN Basic Rate Interface (BRI) and ISDN Primary Rate Interface (PRI), switched 56 kbs, satellite, microwave, or POTS may be utilized for teleradiology links.

E. The vendor's communication tools shall support the full GFE bandwidth provided and support the Government's SNMP network management platform.

F. Different modes of operation shall be supported to include, as a minimum, batch transmission (i.e., a day's volume of work transmitted overnight), timed transmissions (e.g., batch shall start at 0200 hours), STAT single exam transmission (e.g., transmission triggered by exam priority), or ad hoc single exam transmissions.

G. Fetch operations shall be supported for remote sites from the DIN-PACS workstation worklist using the DICOM query and retrieve.

Figure 8-1, The DIN-PACS Teleradiology Model for MTF to MTF and Spoke to MTF



8.2 MTF to MTF Teleradiology

A. MTF to MTF teleradiology shall provide a high-performance medical systems infrastructure that shall support both the Picture Archival Communications System (PACS) and the open architecture "Hyper PACS" necessary for clinical operations required between multiple MTF's that must share archived digital images.

B. This infrastructure shall support a uniform base of coordinated services that shall: provide digital imaging archive, retrieval, and display of local and remote radiology exams in a DICOM

compliant environment.

C. It shall provide required access to radiological imaging and exams at multiple geographical locations, provide expert clinical consultation on a real time basis, and provide on-the-job medical training.

D. MTF to MTF teleradiology shall provide the capability of updating it's database with the location of patient radiological exams and images from other accessed sites.

E. Once another "source" site is identified and accessed, the "destination" site shall update it's database with the location of a patients "off-site" archived exams.

F. The destination site need not re-archive the images from the source site, but, at a minimum, shall maintain the location of an existing patients exams on all sites accessed by the DIN-PACS.

G. Where desired, the destination site archive may be utilized to provide an image back-up storage.

H. Automatic prefetch of remotely archived examinations shall be triggered by a scheduled patient visit or a patient "arrival" at a local DIN-PACS radiology department.

8.3 Spoke to Spoke and Spoke to MTF Hub Teleradiology

A. The most common purpose of spoke to MTF teleradiology is to provide radiological clinical support, primary diagnosis, and consultation to "spoke" locations from a "hub" location. Support shall include image interpretation, results reporting, image consultation, electronic image and report archiving in lieu of hard copy films and text-based radiographic files.

B. The architecture of the spoke shall be a scaled down version of the DIN-PACS architecture integrated through a communication link between the remote site and the central location to include the hyperPACS database concept.

C. Spoke exams shall be sent for archive based on any one of the following three site selectable, events:

- Verification of the exam.
- Dictation of the exam.
- Manual send of the exam.

D. This archive may reside at the performing location or at the other spoke/hub facility.

E. If desired, redundant storage at each facility may be utilized to serve as a image database storage back-up function.

F. Teleradiology shall provide the capability of updating it's database with the location of patient radiological exams and images from other accessed sites.

G. Once another "source" site is identified and accessed, the "destination" site shall update it's database with the location of a patients "off-site" archived exams.

H. The destination site need not re-archive the images from the source site, but, at a minimum, shall maintain the location of an existing patients exams on all sites accessed by the DIN-PACS and support retrieval of selected exams by both manual and automatic remote fetch.

8.4 Take Home Teleradiology

A. The "take-home" teleradiology system shall provide the capability to support "at-home"

consultation and diagnosis and is a component of the PC LAN interface.

B. User selectable compression rates shall be available to the user.

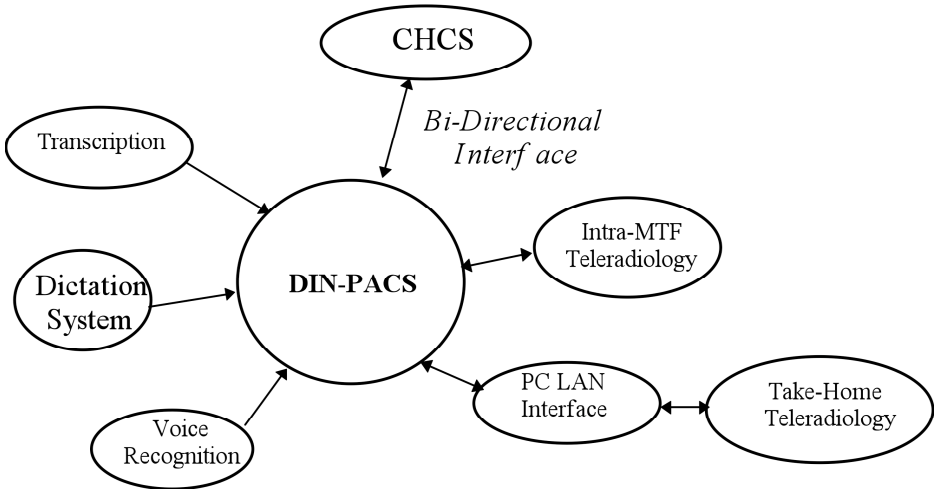
C. The selectable compression range for image transmission shall be from 30:1 minimally lossy to 2:1 lossless. Figure 8-2 illustrates the DIN-PACS "take-home" teleradiology model.

D. For purposes of the product demonstration, the vendor shall demonstrate systems which utilize 33.6 Kbps POTS modem and a 128 Kbps ISDN Basic Rate Interface (BRI) connection.

E. Electronic mail or other report generation capabiliity shall be provided for home use by the radiologist.

F. Take home teleradiology equipment will be equivalent to the Take-Home PC equipment specified in Appendix A.

Figure 8-2, The DIN-PACS Teleradiology Model for Take Home Teleradiology



9. Quality Control.

9.1 General.

A. The DIN-PACS shall have the necessary tools (images, patterns, software, etc.) to perform quality control (QC) on the DIN-PACS system.

B. These tools shall allow the QC testing of all software, firmware and hardware provided with the DIN-PACS, and tools to test the physical LAN.

C. These QC tools should include tools to run on a daily basis to check the general operation and availability of the network prior to commencing the day's work and more advanced tools to rigorously test the system operation and to detect subtle changes that indicate a possible developing problem.

D. A detailed quality control plan covering all phases of operation and equipment shall be provided. The vendor's recommended intervals for testing, preventive maintenance and more extensive

maintenance shall be itemized and enumerated.

9.2 Image Display Monitors.

A. Monitor display quality control shall support the requirements of NEMA Standard on Gray-Scale Display Function, working draft version 0.8, 23 Oct 96 (or the current version in effect 6 months prior to delivery).

9.2.1 Image Sharpness and Size.

A. The image sharpness shall be evaluated using a test image that shall provide some measure of how clearly a sharp edge is imaged. This can be accomplished with a dedicated test image or as part of a more encompassing test image.

B. This parameter shall be tested at multiple points in the image field to detect local areas of degraded performance as well as overall performance.

C. This quality control tool shall provide a quantitative means to evaluate edge sharpness, including the capability to calculate and plot the edge spread function, for an edge in any orientation (i.e. horizontal, vertical and diagonal) and at any location in the dedicated test image.

9.2.2 Image Contrast.

A. The image contrast shall be evaluated using a QC tool to measure the contrast performance of the monitor. This tool shall allow qualitative evaluation (can you see the contrast difference) and a quantitative evaluation by measuring and listing the actual pixel values in the areas of concern.

B. A detailed description of how to accomplish both of these tests shall be provided in the vendors proposal.

9.2.3 Brightness And Black Level.

A. The brightness and black level of the monitors shall be evaluated using a QC tool to measure the performance of each monitor of the workstation.

B. The QC tool used shall be available in the clinical image manipulation software.

C. This test shall be performed on each monitor on a work station and shall be compared with a selected standard monitor. It is the intent of this test to ensure that all the monitors on a work station are essentially the same and that all monitors on the DIN-PACS are also performing the same within some prescribed range.

9.2.4 Luminance Uniformity.

A. These QC tools shall be able to evaluate the uniformity of the brightness across the monitor. This shall be accomplished by making luminance measurements at the four corners and the center of the monitor face for a specified brightness or at several specified brightness.

9.2.5 Linearity.

A. Tools shall be provided to measure the linearity of the monitor. This is to ensure that the monitor is not distorting the image.

B. This test shall be able to measure the linearity at multiple locations in both the horizontal and vertical directions on the monitor and provide a quantitative value representative of the linearity.

9.2.6 Gray-scale and Color.

A. This test shall evaluate the monitor's and video circuitry's ability to display a specified number of gray levels (a minimum of 256).

B. The test shall allow the measurement of gray-scale to be made from left to right, right to left, top to bottom and bottom to top at the users discretion defaulting to left to right.

C. This test shall enable evaluation of chromaticity from test images for comparison with expected color response.

9.2.7 Image Size.

A. A QC test tool shall be provided which can evaluate the size of the image area of the monitors.

B. This tool shall be able to evaluate the length and width of the image as well as the diagonal distance on each of the monitors on a workstation.

9.3 DIN-PACS Network Quality Control

This section describes the necessary QC testing requirements to test all segments of the network. The intent is to be able to verify that the DIN-PACS is operating in an acceptable manner and to allow the localization of the cause of image degradation should it occur. That is, to say, identify whether the problem is with the workstation, the archive, or the transmission media.

9.3.1 Test Image(s)

A. Test image(s) and digitally created images of known values shall be provided to qualitatively and quantitatively test the status and fidelity of the DIN-PACS system.

B. At a minimum, one test image must be a test image of known values (i.e. a SMPTE image where the underlying data values used to generate the image are known and contain no noise) which can be used to make actual measurements of data values to verify data integrity after transmission through any portion of the DIN-PACS system.

C. These images shall contain enough objects to measure the critical imaging parameters (resolution, distortion, contrast, gray-scale).

D. The system shall provide secure storage for Government-furnished diagnostic test images.

9.3.2 Test Protocol

The test images shall be able to be injected into the system at various points to allow the testing of each section or group of sections of the DIN-PACS system. As a minimum the following shall be supported:

A. A test image shall be able to be injected at the point where any of the imaging modalities connect to the DIN-PACS system and can be routed to any workstation directly, to the archive (long, intermediate, and short term) for retrieval by any workstation or modality which can retrieve images from the archive (long, intermediate, and short term) or to any of the hard copy output devices attached to the network.

B. A pure test image shall reside on the short, intermediate, and long term archives which can be retrieved by any workstation or modality (which can retrieve images from the archives) attached to the DIN-PACS system or retrieved and sent to any hardcopy output device attached to the DIN-PACS system. The archive resident pure test images shall be protected against accidental deletion. The Contractor shall provide back up copies of all appropriate test images on appropriate magnetic media.

C. A pure test image shall reside on each of the workstations which can be transmitted to any other workstation or to any of the archives or hardcopy output devices. The workstation resident pure test images shall be protected against accidental deletion. The Contractor shall provide back up copies of all appropriate test images on appropriate magnetic media.

D. Transmitted test images shall be able to be viewed along with a pure test image (one that has not been transmitted) to allow a comparison of the two.

9.3.3 Test Image Software Tools

A. Software tools shall be provided to evaluate test images. This shall include a method to view the actual underlying data that is generating the image.

B. A printout of the actual pixel values contained within a user selected region of interest shall be provided. Hardcopy may be either on film or paper.

C. The user shall also be able to save this pixel value data as an ASCII file to removeable media (i.e. floppy disk). This shall allow evaluation of the amount of data degradation that has occurred.

D. It is highly desirable that the Contractor provide software that allows image math (adding, subtracting, multiplying or dividing two images or adding, subtracting, dividing, or multiplying an image by a constant), measurement of distances and angles, generation of histograms along any angle of the image, and curve generation using data obtained from a series of regions of interest from the image.

E. The software tools shall allow printing of the test data to film and paper hard copy, and also allow long term archiving of quality control test results.

9.3.4 Image Retrieval/Transmission Timing Test Tools

A. The Contractor shall provide a quality control test method to measure the time required to retrieve an appropriate set of test images from long and short term archive and to measure the time required to move an image from the point of acquisition to a designated workstation.

9.3.5 Effect of Compression

A. The Contractor shall provide image subtraction test software to demonstrate the differences in an image before and after data compression has been applied. The mathematical difference between the two images shall be used to evaluate "lossless" and "lossy" compression techniques.

9.3.6 Database Integrity

A. The system database shall provide a method for determining the integrity of the image and examination matching to database information.

B. This shall be a procedure that can be done at several workstations or from specified workstations.

C. The process must be simple enough for the radiology QC technicians to perform on a routine basis as part of their daily tasks.

D. Reports may be required as a result of this test that indicate the images/exams and data elements that fail to properly match with each other.

10. Training

A. Due to the evolutionary nature of the DIN-PACS implementation plan, training shall be a continuous process to include as a minimum, initial/new user training, remedial training, refresher training and system upgrade training.

B. For training purposes, two complete sets of OEM manuals and integrated system manuals covering the operation, installation, and maintenance, of all system components and of the system as a whole shall be provided.

C. All manuals shall be updated appropriately to reflect each new software release and hardware upgrade.

D. Training should be offered to the extent that the site requires no routine technical support from the Contractor.

E. All configuration options and routine maintenance should be accomplishable by the Government system administrator.

F. The proposal shall include a comprehensive training plan which covers at a minimum:

- On-site training staff
- Courses offered
- Summary of course content
- Frequency of course offerings
- Training programs for: technologists, radiologists, medical physicists, administrative personnel, residents, ICU staff, ED staff, and Government appointed system administrators
- Computer based training materials and programs

Details on training requirements are provided in Section H.

11. Installation

11.1 Standard Products

A. Materiel and equipment to be provided shall be the standard products of manufacturers regularly engaged in the manufacture of the products.

B. Products and components out of production, or due to be out of production within 12 months, at

the time of placement of a delivery order are not acceptable.

11.2 Dataplates

A. Major components of equipment shall have the manufacturer's name, address, type or style, component serial number and catalog/model number on a non-corrosive and non-heat sensitive plate which is securely attached to the equipment.

11.3 Full Installation

A. The Contractor shall be responsible for determination of, and compliance with federal, state and local code requirements, design data, and other factors necessary to design and install the system at each location.

B. All items of work not detailed in this specification and all data not furnished by the Government, but required by the Contractor for complete system installation, are the responsibility of the Contractor to request and obtain.

C. Approval for the Contractor to proceed with installation of the DIN-PACS shall be contingent upon the Government's approval of design submittals and written notification to proceed with the installation.

11.4 Installation Requirements

11.4.1 Rigging

A. The Contractor shall be responsible for the safe physical movement of equipment from the delivery point at the final destination to the area of uncrating and installation of the equipment.

11.4.2 Removal

A. The Contractor shall remove rubbish and debris from the site daily, unless otherwise directed. Burning is not acceptable.

B. The Contractor shall store all materials which cannot be removed daily in an area specified by the Contracting Officer.

11.4.3 Damages

A. All existing structures damaged or defaced as a result of the Contractor's installation work shall be restored by the Contractor, as directed and approved by the Contracting Officer, at no additional cost tot he Government.

11.4.4 Existing Utilities

A. The Contractor shall check and verify the location of existing utilities required to remain in place and in service, and those designated to be relocated or removed.

B. The Contractor shall be responsible to protect, maintain, remove and/or cap utilities as necessary, in accordance with local codes and regulations.

11.4.5 Utility Connections

A. The Contractor shall connect to designated utilities in a manner conforming to a nationally recognized code which addresses the specific utility, and at a time satisfactory to minimize or preclude disruption to existing functions or clinical services.

B. The Contractor shall provide at least two days (48 hours) notice to the Contracting Officer's on-site representative prior to making any tie-ins.

11.5 Installation Data Submittals

Reference Section J.

12. Turnkey Installation.

12.1 Definition

Turnkey installation refers to the Government's minimum requirements for the provision of a complete, functional and fully operational DIN-PACS system for each individual site. The term "turnkey" is broadly used here, **meaning "built, supplied and/or installed complete and ready to operate".** As such, all DIN-PACS supplied under this contract will require some degree of turnkey installation, ranging from DIN-PACS subsystems or upgrades with no site modifications and requiring installation, calibration, testing and training only, up to full scale DIN-PACS with extensive site modifications in addition to installation, calibration, testing and training.

This turnkey scope includes all equipment installation and integration, as well as any site-specific work items (site modifications) which may be required to achieve this installation and integration. Such work items include, but are not limited to:

- Architectural (i.e., new or existing floor, wall, ceiling, etc.), including all patch/repair of penetrations and/or damage, and the priming and replacement of existing finishes.
- Structural support
- Furnishing and installing support structures for the equipment including racks, tables, carts, and floor, wall and ceiling mounts
- Connecting with existing utilities, including plumbing and HVAC
- Provision of new utilities where existing utilities are 'maxed out'
- Installation of power equipment, power runs, disconnects, conduit, wiring, etc., including all terminations
- Lighting
- Power conditioning and UPS installations
- Plumbing, HVAC and fire protection (e.g., new equipment room)
- Communications infrastructure, including pulling of cables, cable drops, terminations, fiber installation, and the provision and installation of any hardware/software support.
- Integration of the required DIN-PACS with existing network(s) and devices.
- Network setup and testing.
- Provisional work surfaces, space saving and cable management systems such as cable trays, keyboard trays, etc.

Again, site modification requirements will vary in scope and nature for each Government activity. Past experience has revealed logistical and operational difficulties commensurate with placing the burden of such requirements on the Government activity. Turnkey installation has been a very successful and cost-effective solution to this problem, and has been implemented for various medical systems over the past decade. As such, the Contractor shall be responsible under this contract for providing all work items necessary to site and integrate the proposed DIN-PACS for each site, regardless of whether or not the Contractor uses in-house resources or subcontracts the work out.

12.2 Discussion of Overall Requirements

For each site, the Contractor shall furnish all design plans, labor, materials, and equipment necessary to accommodate the installation of the designated DIN-PACS. The DIN-PACS equipment required and a facility's existing conditions will be considered by the Government in determining the actual level of architectural and engineering support required for each site [see Section J, Contract Data Requirements List (CDRL) for structure]. In general, required turnkey documentation will range from simple room layout drawings/schematics to complete architectural and engineering drawings/plans, work statements and specifications. Actual site preparation work items will also vary, ranging from, for example, the installation of a dedicated outlet, to the provision of a dedicated equipment room with supporting utilities and extensive cable/fiber infrastructure.

Except for the contract line items in Section B of this solicitation for the three (3) specific Government installation sites, site preparation costs shall be quoted on a site specific basis following a site visit and review of existing hospital as-built drawings, where applicable.

Approval for the Contractor to proceed with installation of a particular DIN-PACS shall be contingent upon both the Government's approval of whatever turnkey documentation is required, and the Contracting Officer's written notification to proceed with installation. Details on this process can also be found in Section J, CDRL.

12.3 Specifications, Standards and Drawings

12.3.1 Specifications and Standards

Specifications and standards for site preparation and system installation/integration have not been previously developed by the Government. In the event of a conflict between the requirements and standards, the text of this document shall take precedence.

12.3.2 Architectural and Engineering Drawings

Aside from the three (3) specific sites listed in Section B of this solicitation, a list of as-built architectural and engineering drawings of a specific installation site will be provided to the Contractor when a full scale A&E effort is required.

***NOTE*: The Government assumes no liability for the accuracy of the existing drawings. Offerors shall verify all dimensions and other design features necessary for operation and installation of the proposed equipment.**

12.4 Specific Requirements

12.4.1 Scope

Turnkey installation, as a minimum, shall consist of architectural and engineering support to develop drawings/plans and work statements; facility alteration, including all demolition, renovation/site preparation, existing equipment removal, and construction; rigging, transporting, and installing the DIN-PACS; documentation; furnishing and installing any ancillary support (e.g. air conditioning, utilities, power regulation, etc.) equipment; and on-site project management, as specified to achieve a fully operational system. Contractor shall supply all materials, tools, equipment. labor, supervision and services necessary to fulfill the requirements of this specification.

12.4.2 Cost Breakdown

Regardless of the scope and nature of the expected site preparation requirements for a given facility, the Contractor shall provide a special quote on a per-site basis broken down by Division (CSI Masterformat). Instructions for this format can be found in Section J.

12.4.3 Construction Notes

Either union or non-union labor may be used, and Contractor(s) are not exempt from applicable city or state taxes.

12.4.4 Demolition

The Contractor shall perform demolition at a time satisfactory to the COR to preclude disruption of existing functions or clinical services. All material, *unless specified otherwise on a site-specific basis*, resulting from any demolition and renovation, shall become property of the Contractor and shall be removed from Government property daily. Any existing work that is damaged by the Contractor shall be restored at no additional cost to the Government. Contractor shall protect floors and walls of the exit path when removing items from the building.

12.4.5 Trade-in Equipment

The Contractor shall provide a special quote on a site-specific basis for any trade-in equipment. Regardless of whether or not a trade-in value is offered, any items identified as trade-in items by the Government shall be deinstalled and removed by the Contractor.

12.4.6 Materials

Unless otherwise specified, all materials used in all turnkey installation efforts shall be new and of first rate quality.

12.4.7 Dust Barrier

A dust barrier shall be installed per site-specific requirements outside of and around all areas where site preparation work items may generate dust/debris. Barriers shall be fire retardant and shall not block egress to existing exits.

12.4.8 Utilities

12.4.8.1 Existing Utilities

Contractor shall verify the location of existing utilities required to remain in place/service and those designated to be removed to meet the requirements of this contract. Contractor shall protect, maintain, remove and/or cap utilities as necessary in accordance with national and local codes and regulations. In addition, installation shall be performed in accordance with any hospital or service-specific (Army, Navy, Air Force) installation guidelines and/or codes, where applicable. The Contractor shall connect to utilities, as at a time satisfactory to preclude disruption of existing functions or clinical services.

12.4.8.2 Utility Connections

As a minimum, the Contractor shall be responsible for connections to, as well as disconnections of, utility services and related pumps and controls, hydrants and valves, meters and equipment. Contractor shall connect to utilities, as necessary, in a manner conforming to the nationally recognized code covering the specific utility and at a time satisfactory to the hospital to preclude disruption to existing functions or clinical services. Contractor shall provide at least two (2) days notice to the Contracting Officer's on-site representatives prior to making any shut-downs/tie-ins.

12.4.9 Rigging

The Contractor shall be responsible for the physical movement of equipment from the delivery point at the final destination to the area of installation, and for the subsequent uncrating of this equipment and removal of all crating/packing materials from the installation site.

12.4.10 Power Conditioning

It is assumed for the purposes of this contract that any particular site has NO good power survey information. The Contractor may survey a particular site's electrical power system to determine the system's adequacy for operation of the required DIN-PACS. The Contractor is responsible for ensuring that electrical power meets the quality requirements of the commercial warranty for the required DIN-PACS, and that the system and all other equipments provided under this contract will not be damaged due to electrical power problems, including brown outs, total power interruptions, electrical surges, sags, electrical storms, etc. System performance and MTBF must not be degraded due to electrical power problems. Uninterruptible Power Sources (UPS} shall be provided when equipment and/or site-specific characteristics require such protection.

12.4.11 Existing Systems and Structures

Connection of subsystems outlined herein shall not compromise or violate the performance of existing hospital systems and structures.

12.5 Scheduling, Coordination and Notification

12.5.1 Delivery

Contractor shall coordinate delivery of the system components with the installation effort. The Government will not store any Contractor items. A delivery schedule is included in Section F of this solicitation.

12.5.2 Project Manager

The Contractor shall appoint a *full-time* on-site project manager to act as the focal point for all turnkey installations from start to finish. The project manager shall be empowered to make on-the-spot decisions and implement actions necessary for the successful completion of the turnkey installation. If necessary, Contractor may appoint two (2) different full-time on-site project managers during the turnkey installation, one to coordinate the site preparation and construction phase, and one for the equipment installation phase. Removal or replacement of such key personnel shall not occur without prior written consent of the Contracting Officer.

12.5.3 Installation Commencement

Turnkey installation shall not commence until authorized by the Contracting Officer (CO). It shall commence within ten (10) days after receipt of notice to proceed from the CO. The Government is not responsible for any installation costs incurred before the CO authorizes commencement.

12.5.4 Duration

Unless otherwise specified by the CO, the turnkey installation shall in no event exceed ninety (90) calendar days from the turnkey installation commencement date.

12.5.5 Completion of Installation

12.5.5.1 Determination

Turnkey installation shall be determined complete when the DIN-PACS system is ready for acceptance inspection.

12.5.5.2 Notification

Upon completion of delivery and complete turnkey installation, the Contractor shall submit a written notice of "Readiness for Inspection" to:

Defense Personnel Support Center
ATTN: DPSC-MQX
2800 South 20th Street
Philadelphia, PA 19145-5099

12.5.6 Use of Equipment

The DIN-PACS system will be turned over to the Government for clinical use upon completion of turnkey installation and Government acceptance, unless specified otherwise. Failure to pass Government acceptance inspection does not negate the use of the equipment by hospital personnel. Use of equipment will be contingent upon the nature of the deficiency and the impact on patient or operator safety. All areas that fail inspection must be rectified by the Contractor.

12.6 Architectural Requirements

12.6.1 General

This installation site shall be modified as required by the Contractor to accommodate requirements that are specific to the Contractor's DIN-PACS. All existing functional areas of a specific site shall be maintained, unless otherwise specified on a site-specific basis. It is a requirement under this contract that the Contractor notify the COR (Contracting Officer's Representative, specific to each site) prior to concealing any work (e.g., electrical/data communications cable installation within walls) for a visual inspection.

12.6.2 Installation Site Location and Information

As a requirement for a DIN-PACS at a particular site arises, a site visit will typically be conducted to allow access to as-built drawings and to the installation area.

12.6.3 Turnkey Construction, Hardware, Coverings and Finishes

Turnkey construction, hardware, coverings and finishes used in the turnkey installation of a particular DIN-PACS, shall match or, if unable to match, compliment existing hardware, coverings and finishes. Final selection of all new construction hardware, coverings and finishes, unless specifically called for in this specification, shall be determined by the on-site COR based upon specification requirements and samples furnished for approval per Section J, Data Item CTR-001, Paragraph 1.2.3. Additionally, all existing coverings and finishes which are currently damaged, or those which are damaged during construction by the Contractor, shall be replaced under this contract with new identical/matching material, including, but not limited to, all applicable floor, wall and ceiling finishes.

12.6.4 Floor, Wall and Ceiling Structural Capacity

Unless otherwise specified, the structural capacity of existing floors, walls, and ceilings to support loads imposed by a Contractor's DIN-PACS equipment is uncertain. Contractor must evaluate load capacity and levelness of existing surfaces where required, and provide structural reinforcement and leveling where necessary.

12.6.5 Door Hardware

Architectural hardware for new doors, or as a replacement for defective hardware on reused doors, shall be of appropriate commercial grade and match existing. New locks provided with new or reused doors shall be keyed alike for entrances into new areas (e.g., equipment rooms) and master keyed to the existing building system, unless otherwise specified on a site-specific basis.

12.6.6 New Wall Construction

Any new wall partitions shall be constructed to match existing construction and finish. Any replacement or patching of existing walls shall match existing construction and finish. New partition walls must be smoke/fire rated per site-specific requirements.

12.6.6.1 Wall Protection Materials

If not already existing, or if damaged, new commercial grade vinyl corner guards, wall guards, and covered base shall be provided, as a minimum, wherever new walls and corners are susceptible to damage within an installation area.

12.6.7 New Ceiling Construction

If a Contractor provides a new finished ceiling in any new area of the installation site (e.g., equipment room), ceiling heights shall be compatible with the functional areas and equipment furnished. All new finished ceilings shall match or complement existing construction. Where applicable, the ceiling type provided shall not violate the specified fire rating in which it is furnished. If ceiling panels are removed and reused in areas where new finished ceilings are not required, the Contractor shall replace any damaged panels as required in Paragraph 12.6.3.

12.7 Mechanical Requirements

12.7.1 Heating, Ventilation and Air Conditioning (HVAC)

12.7.1.1 General

The Contractor is responsible for providing any new additional heating, ventilation, air conditioning, humidity regulation and ductwork required for all functional areas of the DIN-PACS installation if necessary to accommodate requirements that are specific to the Contractor's equipment. The Contractor shall design the HVAC system with sufficient redundancy to prevent a single point of failure in the DIN-PACS computer room(s).

12.7.1.2 HVAC Regulation

In addition to the above, the Contractor is responsible for providing, where necessary, all material and work required to maintain appropriate environmental conditions throughout the DIN-PACS installation site during all seasons, assuring satisfactory equipment operation and patient and staff comfort.

12.7.1.3 New HVAC

Any new/additional air conditioning necessary to comply with the requirements cited above shall be provided by either modifying (i.e., reconfiguring, rebalancing, or adding additional ductwork/vents) a hospital's existing HVAC system, or by providing supplemental stand-alone air conditioning unit(s). All HVAC work shall be performed in accordance with applicable industry standards and codes.

12.7.1.3.1 HVAC Testing and Balancing

Testing and balancing of any new HVAC system or any modified HVAC system(s)/zones shall be conducted in accordance with Associated Air Balance Council (AABC) guidelines, and shall be performed by an AABC certified balancing firm. Verification of proper system(s) functioning shall be submitted at the time of acceptance inspection testing.

12.7.1.3.2 Environmental Monitoring System (EMS)

The Contractor is required to provide and install all materials required to interface any new HVAC systems provided under this contract to the hospital's EMS. Contractor shall also be responsible for making all cable runs to, and all terminations at, the main EMS panel.

12.7.2 Plumbing

12.7.2.1 General

The Contractor shall be responsible for all plumbing modifications required to meet the requirements of this specification. All plumbing work shall be performed in accordance with applicable industry standards and codes. Connection to and provisions for acid waste systems shall be included in plumbing plans as required for the support of film processing operations.

12.7.2.2 Air Conditioning Drain Lines

If any new stand-alone air conditioning systems are required by the Contractor's equipment, a proper drainage shall be provided for the air handling units. Specifically, a drip pan and drain line shall be provided directly below any new air handler installed above the ceiling in the interstitial space. Alternately, a floor drain shall be installed below free-standing units, with or without raised computer flooring.

12.8 Electrical Requirements

12.8.1 General

The Contractor shall utilize existing circuits at each site, to maximum extent possible, for the DIN-PACS, associated subsystems and ancillary equipment (e.g. air conditioning equipment). All existing switches, outlets, panels or other equipment, if any, which are not to be reused shall be removed by the Contractor and turned over to the hospital. Proper removal shall include all necessary repairs/patching and finishing to affected walls, floors, etc. Finished electrical connectivity shall provide a cable free environment in clinical areas to enhance sanitary conditions and free work space.

12.8.2 Compliance

All electrical work shall be furnished and installed in accordance with applicable industry standards and codes. Additionally, all new electrical panels, fuse boxes and disconnect switches shall be properly labeled, indicating pertinent information such as equipment serviced, branch number, what it feeds/what it is fed from, etc.

12.8.3 Recessed Equipment

All new conduit, raceways, and pull boxes shall be installed recessed wherever possible. If recessing new equipment is not possible at all, surface-mounted conduits, raceways, and pull boxes shall be brought in via a corner of the room in question. All such equipment should be cosmetically covered/finished to match new construction throughout an installation site.

12.8.4 General Purpose Power

Contractor shall install additional new circuits, or, to the maximum extent possible, shall reconfigure existing circuits as required to accommodate any additional outlets, light fixtures or electrical components necessary for the Contractor's equipment. Any existing outlets fed by emergency power outlets shall remain on emergency power.

12.8.5 Lighting

Any new lighting required to accommodate the Contractor's equipment shall be provided and installed by the Contractor, and shall be controlled by conveniently located light switches. Existing lighting circuits and fixtures shall be reused whenever possible. All reused lighting fixtures shall be cleaned prior to reuse.

12.9 Communication Requirements

12.9.1 Telephone Lines

Existing phone lines and locations throughout suite shall remain. If the Contractor is to provide remote diagnostic service with the offered system, the Contractor is responsible for providing and installing all conduits, junction and terminal boxes, pull wire and cable hospital will supply the required cable. Contractor shall coordinate with the COR to arrange for the provision of these line(s); subsequent to this, the Contractor shall be responsible for pulling the wire from the hospital-designated panel to the terminal box in the installation site, and effecting the terminations if required by the facility. Finished connections to telephone systems shall provide a cable free environment in clinical areas to enhance sanitary conditions and free work space.

12.9.2 Data Communications

All work required with pulling cables, installing cable drops, effecting terminations, etc., shall be in accordance with the most recent version of all applicable industry standards and codes. Finished connections to data systems shall provide a cable free environment in clinical areas to enhance sanitary conditions and free work space.

12.10 Fire Protection Requirements

12.10.1 General

Contractor shall modify existing or provide new fire protection for any new room(s) in accordance with applicable industry standards and codes. A new room's protection shall consist of fire detection, fire suppression systems and combination smoke/fire dampers. The smoke/fire dampers shall be connected to the HVAC and fire alarm systems**.** All existing fire protection systems are to be reused to the fullest extent. The fire rating of the existing area, wherever applicable, shall be maintained. Penetrations and miscellaneous openings in fire barriers shall be protected as required by code.

12.10.2 Fire Detection System

12.10.2.1 Smoke Detectors

If required by the Contractor's design, the Contractor shall furnish and install new smoke detectors wherever required within new area to supplement existing detectors. The number of detectors shall be sufficient to ensure coverage of the total area encompassed by all functional areas of the new area. The smoke detectors shall be UL-listed and shall be compatible with the existing fire alarm control panel. Additionally, if any raised flooring is used by the Contractor, an appropriate number of smoke detectors shall be installed below this floor.

12.10.2.2 Annunciation

Contractor shall tie any new smoke detectors into existing smoke detectors within the existing fire zone in which the installation site is currently located. If for any reason modifications are required involving the cable runs from these detectors to the hospital's annunciation panel, the hospital will be responsible for any subsequent terminations at the annunciation panel. If this situation does arise, the Contractor shall notify the COR, and shall furnish all necessary equipment and provide assistance to the hospital as required.

12.10.3 Fire Suppression

12.10.3.1 Qualifications of the Installer

If an existing sprinkler system is required to be modified or reconfigured to accommodate the Contractor's equipment, the design, installation and testing of the modified fire protection system shall be performed by a Contractor fully experienced and qualified in the installation of the specific sprinkler system. The fire protection/detection design shall be certified by a registered professional engineer. The Contractor shall be U.L. certified for the installation and testing of fire alarm systems and possess a valid state fire sprinkler contractor's license. The modified/reconfigured system shall be inspected/approved by the base or post fire marshal after installation.

12.11 Contractor's Responsibility for Supervision in Connection with Installation

After room layout drawings have been approved by the Contracting Officer, installation shall begin within ten (10) days after receipt of notice to proceed from the Contracting Officer. The Contractor is required to provide well qualified personnel (installation manager(s) and/or field service engineers (FSE's)/technicians, as the stage of installation warrants) to oversee all stages of installation, and to oversee/perform all necessary system tests. Once supervision of installation is started, it shall be continuous, for at least eight (8) hours per day, forty (40) hours per week, coinciding with the regular working hours at the hospital. Compliance with this requirement shall be manifest by the continuous presence of the supervising Contractor personnel on the job site during the daily working period. Supervised installation shall be continuous without interruption until all site preparation, system installation, integration, and testing/calibration work has been completed.

Additionally, the Contractor is responsible for, and subsequently shall provide proper supervision of, the physical movement of the equipment from the delivery point at the hospital to the area of installation, the uncrating of the equipment, and the subsequent removal and disposal of all packing/crating materials. Additionally, all debris shall be removed from the installation site on a daily basis by the Contractor.

Upon issuance of a delivery order against this contract, the Contractor shall supply a preliminary work statement, single line room drawing, proposal description and a detailed cost breakout (See Section J). Unless otherwise stated or identified, the submission of the work statement shall constitute verification that the existing utilities are adequate for the system(s). The Contractor shall furnish design plans, labor, materials and equipment necessary to provide for installation to accommodate the designated system. The installation shall reflect minimum customer requirements providing for a safe and functional system, incorporating national and industry recognized trade organization codes, regulations and safety standards.

Additionally, installation shall include all necessary electrical and mechanical interconnections between components of the system. It shall also include adjustments and calibrations necessary to make the system ready for immediate clinical use.

13. Security and Off-Site Communication

A. The DIN-PACS shall effectively transmit and receive images to and from locations inside and outside of the hospital from multiple vendors' DICOM systems.

13.1 Security

A. Protection of the system and the system's data from unauthorized use should be accomplished through a variety of methods ranging from passwords, to more advanced firewalling techniques to isolate information from other networks.

B. All systems shall meet the C2 minimum level of trust as defined in DOD 5200.28-STD, 31 Dec 1992. The US Government's security classification system called Orange Book and "Trusted Network Interpretation Environments Guideline", called Red Book, define a series of divisions for D (Least secure) to A(most secure) and levels within those divisions. Division D (minimal protection) covers systems such as PCs running DOS. Division C, Level 1(discretionary security protection) is where most sytems come in (i.e. they have the concept of users, with users having control over objects they own). Division C, level 2 (controlled access protection) adds auditing and increased validations.

13.2 Communications

A. The DIN-PACS shall effectively transmit and receive DICOM objects to and from locations inside and outside of the MTF, utilizing the Internet, local area networks, and wide area networks.

B. Locations outside of the MTF shall have the option to utilize, but not be limited to all services defined in paragraph 8.1.D.

14. Additional Equipment Items

A. Contractor shall furnish and install the following equipment items as purchased by the Government at any time during the contract life cycle.

14.1 Network Interfaces to DICOM Devices

A. The network interfaces to DICOM devices to be made available for purchase by the Government at any time during the contract life cycle shall meet all requirements as specified in Appendix C.

14.2 Display Workstations

A. The diagnostic and review workstations to be made available for purchase by the Government at any time during the contract life cycle shall meet all requirements as specified in Section C, paragraph 3.

14.3 Upgrade of Short-term Storage

A. At the request of the Government at a future date, Contractor shall upgrade the short-term local storage capacity on any workstation in 2 GByte increments.

14.4 Upgrade of Intermediate Storage

A. At the request of the Government at a future date, Contractor shall upgrade the intermediate storage device capacity. Contractor shall propose logical increments of storage capacity by which to upgrade.

14.5 Upgrade of Long-term Archive

A. At the request of the Government at a future date, Contractor shall upgrade the long-term archive device capacity. Contractor shall propose logical increments of storage capacity by which to upgrade.

14.6 Redundant Long-term Archive

A. At the request of the Government at a future date, Contractor shall provide a redundant long-term archive. The Contractor shall propose logical increments of storage capacity to support single site, multiple site, and regional redundant archival.

B. For purposes of the proposal evaluation, Contractor shall propose solutions for the following multiple site scenarios using the generic site specifications in Appendix J:

- One large MTF
- One spoke
- One medium MTF with four spokes
- One Large MTF with two small MTF's and four spokes
- Two large MTF's with eight spokes

14.7 Communications Network Extension

At the request of the Government at a future date, Contractor shall perform any/all of the following work in order to extend the existing hospital communications network to add on additional DIN-PACS components:

A. Install 62.5 µm zip cord fiber in accordance with NFPA requirements (Contractor to price for materials and labor by the foot).

B. Install Category 5 Unshielded Twisted Pair (UTP) cable in accordance with NFPA requirements (Contractor to price for materials and labor by the foot).

C. Termination kit with connectors.

14.8 Additional Turnkey Installation

A. At the request of the Government at a future date, Contractor shall perform any additional turnkey installation required for installation of additional equipment items in the facility. Scope of work and exact pricing shall be negotiated at time of Government request.

14.9 Local Workstation Magneto-Optical Disk Device

A. At the request of the Government, the Contractor shall provide a magneto-optical disk device for installation at any workstation on the network.

B. The Contractor shall provide an initial quantity of ten (10) compatible disks. Each optical disk shall provide a minimum storage capacity of 1.3 GBytes.

C. The Contractor shall provide and install all appropriate software and cabling required for proper interfacing of the archive device to the workstation.

D. Utilization of the removeable media drive for reading or writing purposes shall be integrated into the workstation application software.

14.10 Local Workstation CD-R Disk Drive

A. At the request of the Government, the Contractor shall provide a CD-R disk drive which writes DICOM media exchange format data in ISO 9660 format to a CD at specified workstations.

B. The workstation shall also have the capability of reading images from a CD in ISO 9660 format which have been written in accordance with the DICOM media exchange format.

C. These images shall be loaded onto the short-term and/or intermediate storage. All patient demographic information shall be accessible via worklist management functions described in this specification.

D. Utilization of the removeable media drive for reading or writing purposes shall be integrated into the workstation application software.

E. The Contractor shall provide an initial quantity of 100 compatible disks. Each optical disk shall provide a minimum storage capacity of 640 MBytes.

F. The Contractor shall provide and install all appropriate software and cabling required for proper interfacing of the archive device to the workstation.

14.11 Teaching File Workstation

A. At the request of the Government, additional teaching file workstations shall be provided by the Contractor and installed at Government specified installed sites. Cost for such additions shall be established at contract award and exercised at the time of the Government's request.

14.12 35 mm Film Printer

A. At the request of the Government, additional 35 mm film printers shall be provided by the Contractor and installed at Government specified installed sites. Cost for such additions shall be established at contract award and exercised at the time of the Government's request.

14.13 Upgrade from 2 to 4 Monitor Workstation

A. At the request of the Government, the Contractor shall provide all hardware and software required to upgrade an existing 2 monitor workstation (either diagnostic or review) to its respective 4 monitor workstation.

B. The Contractor shall be responsible for recalibration of the upgraded workstation to ensure proper cross monitor calibration, as defined in paragraph 3.2.

14.14 Upgrade from 1 to 2 Monitor Workstation

A. At the request of the Government, the Contractor shall provide all hardware and software required to upgrade an existing 1 monitor workstation (either diagnostic or review) to its respective 2

monitor workstation.

B. The Contractor shall be responsible for recalibration of the upgraded workstation to ensure proper cross monitor calibration, as defined in paragraph 3.2.

14.15 Installed System DICOM Functionality Upgrade

A. At the request of the Government, the Contractor shall upgrade an existing installed DIN-PACS to provide the latest DICOM functionality in effect at the time of the upgrade. Cost for this upgrade shall be negotiated at the time of the Government's request.

14.16 Software Upgrades

A. At the request of the Government, major software upgrades providing additional functionality not already required in this specification, shall be provided by the Contractor and installed at Government specified installed sites. Cost for such upgrades shall be negotiated at the time of the Government's request.

14.17 Laser Film Printer

A. At the request of the Government, additional laser film printers shall be provided by the Contractor and installed at Government specified installed sites. Cost for such additions shall be established at contract award and exercised at the time of the Government's request.

14.18 Paper Printer

A. At the request of the Government, additional paper printers shall be provided by the Contractor and installed at Government specified installed sites. Cost for such additions shall be established at contract award and exercised at the time of the Government's request.

14.19 Wireless Mouse

A. At the request of the Government, additional wireless mice shall be provided by the Contractor and installed at Government specified installed sites. Cost for such additions shall be established at contract award and exercised at the time of the Government's request.

14.20 Video Communications on a Workstation to Workstation Basis

A. At the request of the Government, PC VTC to PC VTC capability shall be provided by the Contractor and installed at Government specified installed sites. Cost for such additions shall be established at contract award and exercised at the time of the Government's request.

14.21 Image and Report Fax Capability

A. At the request of the Government, image and report fax capability shall be provided by the Contractor and installed at Government specified installed sites. Cost for such additions shall be established at contract award and exercised at the time of the Government's request.

14.22 Systems Integration to Non-DICOM Compliant Devices/Systems

A. At the request of the Government, the Contractor shall provide system integration support to integrate non-DICOM compliant devices/systems into the DIN-PACS system. Such integration shall include all hardware, firmware and software required to meet all performance criteria specified above. Cost for such systems integration shall be negotiated on a site specific basis at

the time of the Government's request.

14.23 Quality Control Workstation

A. At the request of the Government, the Contractor shall provide and install additional quality control workstations (1 monitor and 2 monitor, as chosen by the Government) meeting all specifications as defined in paragraph 3.7. above.

15. Warranty

Reference Section H.

16. Post-Warranty Maintenance Service

Reference Section H.

17. System Acceptance Testing

Acceptance of each implementation of the DIN-PACS system shall consist of verifying that all required equipment and services have been provided and that the equipment and services meet the DIN-PACS requirements demonstrated at the Product Demonstration. Verification that the required equipment and services meet the DIN-PACS requirements shall be accomplished through an Acceptance Test. Further details are provided in Section E.

APPENDIX A - GOVERNMENT FURNISHED EQUIPMENT INTERFACES

1. Government Furnished PC's

Government furnished personal computers (PC's) running contractor software must be able to interface with the DIN-PACS network over unshielded twisted pair, level 3 (UTP3) or level 5 (UTP5) cabling, depending upon access speed. These PC's shall have the following minimum hardware/software requirements:

Processor - Intel Pentium 166 MHz microprocessor
RAM - 32 MB
Monitor - 17" NISVGA monitor (1024x768, .26 dpi, 15.9" viewable), Energy Star compliant
Floppy Drive - 1.44 MB, 3.5" diskette drive
Hard Drive - 2.5 GB EIDE < 15 ms
CD ROM Drive - Single Drive, minimum of 6X speed
Video Card - 64 bit PCI local-bus SVGA color graphics accelerator w/2 MB DRAM
PCMCIA Drive - Type III
Network Card - 10/100 Mb/s PCI twisted pair card
Pointing Device - MS compatible mouse and mouse pad
Ports - 2 Serial, 1 Parallel
Device Bays - Minimum of 5
Motherboard Slots - Minimum of 2, 16 bit ISA; 3, 32 bit PCI; 1 PCI ISA
Cache - 256k
Keyboard - 104 or better keyboard
Power Supply - 145 watt minimum
Warranty - 3 year parts
Operating System - Windows 95 (32 bit API) or Windows NT workstation, Version. 4.0 or later
Software - MS Office 95

2. Take-Home Teleradiology Equipment: Portable PC

Take home teleradiology equipment may be provided by either the Vendor or the Government. Vendors shall provide a detailed description of the proposed take home teleradiology hardware. Government furnished take home Portable PC teleradiology systems are COTS equipment and as a minimum will consist the following:

- Portable Personal Notebook Computer
- Pentium 120 MHz Processor
- Screen resolution with 65,536 colors, non-interlaced, active matrix display, and external monitor support
- 2 MB Video RAM
- 32 Mbytes RAM
- 1.44 MB Floppy
- 1.2 GB Hard Drive
- 6x CD ROM
- PCMCIA ISDN Modem
- PCMCIA 28.8 Modem
- Separate Mouse
- External SVGA monitor connection
- Operating System - Windows 95 (32 bit API) or Windows NT workstation, Version. 4.0 or later
- Software - MS Office 95
- For Primary Diagnosis, a 17" High resolution gray-scale Monitor (1024 x 1280, with minimum 50 ft-Lamberts)

3. At Home Teleradiology PC

The software for take home teleradiology shall be supported on "at home" PC's. At Home personal computers (PC's) running contractor software shall have the following minimum hardware/software requirements:

Processor - Intel Pentium 166 MHz microprocessor
RAM - 32 MB
Monitor - 17" NISVGA monitor (1024x768, .26 dpi, 15.9" viewable), Energy
Star compliant
Floppy Drive - 1.44 MB, 3.5" diskette drive
Hard Drive - 2.5 GB EIDE < 15 ms
CD ROM Drive - Single Drive, minimum of 6X speed
Video Card - 64 bit PCI local-bus SVGA color graphics accelerator
w/2 MB DRAM
Pointing Device - MS compatible mouse and mouse pad
Ports - 2 Serial, 1 Parallel
ISDN modem or 28.8 kb modem or faster
Device Bays - Minimum of 5
Motherboard Slots - Minimum of 2, 16 bit ISA; 3, 32 bit PCI; 1 PCI ISA
Cache - 256k
Keyboard - 104 or better keyboard
Power Supply - 145 watt minimum
Operating System - Windows 95 (32 bit API) or Windows NT workstation, Version. 4.0 or later
Software - MS Office 95

Portsmouth Acute Care Facility Government Furnished Equipment								
DEPARTMENT	ROOM	ROOM NAME	Modality	Manufacturer	Model	Network Interface	Facility Network Connection	
								NOTES
RADIOLOGY	132605	DIGITAL CHEST ROOM	CR				R	R : UTP5, RJ45 Connector
ORTHOPEDICS	160805	CAST ROOM	C-Arm				R	S: Optical Fiber, ST Connector
GASTROENTEROLOGY	210903	FLUORO ROOM	C-Arm				R	
PULMONARY MEDICINE	222123	BRONCHOSCOPY ROOM	C-Arm				R	
ANESTHESIOLOGY	320610	PAIN CLINIC	C-Arm				R	
OPERATING ROOM	322631	MAIN OR	C-Arm				R	
OPERATING ROOM	332812	MAIN OR	C-Arm				R	
OPERATING ROOM	332830	NEURO MOR	C-Arm				R	
CCU	350702	TREATMENT ROOM	C-Arm				R	
RADIOLOGY	130601	2 RAD PROCESSING	CR				R	
RADIOLOGY	130801	5 RAD PROCESSING	CR				R	
EMERGENCY ROOM	142102	DARKROOM	CR				R	
UROLOGY	221510	DARKROOM	CR				R	
OPERATING ROOM	321104	DARKROOM	CR				R	
MED SURG WARD	430401	STORAGE ROOM	CR				R	
ORTHOPEDICS	161201	DARKROOM	CR				R	
RADIOLOGY	133403	COMPUTED TOMOGRAPHY	CT Imager				S	
RADIOLOGY	133603	COMPUTED TOMOGRAPHY	CT Imager				S	
RADIOLOGY	130802	FILM DIGITIZER AREA	Digitizer				R	
RADIATION ONCOLOGY	121605	THERAPY SIMULATOR, CT	Fluoro				R	
RADIOLOGY	130822A	ANGIO SGPL	Fluoro				S	
RADIOLOGY	130822B	ANGIO SGPL	Fluoro				S	
RADIOLOGY	131205	R/F ROOM	Fluoro				R	
RADIOLOGY	131407	R/F ROOM	Fluoro				R	

Portsmouth Acute Care Facility Government Furnished Equipment								
DEPARTMENT	ROOM	ROOM NAME	Modality	Manufacturer	Model	Network Interface	Facility Network Connection	
								NOTES
RADIOLOGY	131802	R/F ROOM	Fluoro				R	
RADIOLOGY	132002	R/F ROOM	Fluoro				R	
UROLOGY	221502	CYSTO - R/F/Tomo	Fluoro				R	
UROLOGY	221503	CYSTO - R/F/Tomo	Fluoro				R	
UROLOGY	222501	CYSTO - R/F/Tomo	Fluoro				R	
OPERATING ROOM	320306	CYSTO-R/F MOR	Fluoro				R	
CARDIOLOGY	350805	CATH LAB	Fluoro				R	
NUCLEAR MEDICINE	121112	GENERAL IMAGING ROOM	Gamma Camera				S	
NUCLEAR MEDICINE	121120	GENERAL IMAGING ROOM	Gamma Camera				S	
NUCLEAR MEDICINE	121121	SPECIAL IMAGING ROOM	Gamma Camera				S	
NUCLEAR MEDICINE	121122	GENERAL IMAGING ROOM	Gamma Camera				S	
NUCLEAR MEDICINE	121123	SPECIAL IMAGING ROOM	Gamma Camera				S	
NUCLEAR MEDICINE	121117	COMPUTER ROOM	LAN Server				S	
RADIOLOGY	122502	ULTRASOUND PROCEDURES	LAN Server				R	
OB/GYN	4?????	ULTRASOUND PROCEDURES	LAN Server				R	
RADIOLOGY	130601	2 RAD PROCESSING	Laser Imager				R	
RADIOLOGY	130801	5 RAD PROCESSING	Laser Imager				R	
RADIOLOGY	133602	CT DARKROOM	Laser Imager				R	
RADIOLOGY	160241	FILM FILE ROOM	Laser Imager				R	
ORTHOPEDICS	161201	DARKROOM	Laser Imager				R	
UROLOGY	221510	DARKROOM	Laser Imager				R	
OPERATING ROOM	321104	DARKROOM	Laser Imager				R	
RADIOLOGY	134403	MAGNETIC RESONANCE	MR Imager				S	
RADIOLOGY	134417	MAGNETIC RESONANCE	MR Imager				S	

Portsmouth Acute Care Facility Government Furnished Equipment								
DEPARTMENT	ROOM	ROOM NAME	Modality	Manufacturer	Model	Network Interface	Facility Network Connection	
								NOTES
RADIOLOGY	130610M	ULTRASOUND PROCEDURES	U/S				R	
RADIOLOGY	130610P	ULTRASOUND PROCEDURES	U/S				R	
OB/GYN	441802	ULTRASOUND PROCEDURES	U/S				R	
OB/GYN	441804	ULTRASOUND PROCEDURES	U/S				R	
OB/GYN	441806	ULTRASOUND PROCEDURES	U/S				R	
RADIOLOGY	460740F	ULTRASOUND PROCEDURES	U/S				R	
RADIOLOGY	122502	ULTRASOUND PROCEDURES	U/S				R	
RADIOLOGY	131005	R/F READING ROOM	Work station				R	
RADIOLOGY	133601	CT CONTROL ROOM	Work Station				S	
RADIOLOGY	134403	MR CONTROL ROOM	Work Station				S	
RADIOLOGY	130401	STEREOTACTIC MAMMO	Mammo Spot				R	
		NUMBER OF INTERFACES:	59					

Elmendorf Hospital Government Furnished Equipment								
DEPARTMENT	ROOM	ROOM NAME	Modality	Manufacturer	Model	Network Interface	Facility Network Connection	
								NOTES
RADIOLOGY	1E139	View Sort	CR	Fuji	AC-3	DICOM, QC!	R,S	R : UTP5, RJ45 Connector
RADIOLOGY	1E139	View Sort	CR	Fuji	AC-3	DICOM, QC1	R,S	S: Optical Fiber, SC Connector
RADIOLOGY	1E139	View Sort	Dry Printer	3M	8700+	DICOM	R,S	
Urology	2D184	Dark Room	CR	Fuji	AC-3	DICOM, QC4	R,S	
OR	2E117	Dark Room	CR	Fuji	AC-3	DICOM, QC5	R,S	
ICU	2F167	Alcove	CR	Fuji	AC-3	DICOM, QC1	R,S	
Urology	2D184	Dark Room	Dry Printer	3M	8700+	DICOM	R,S	
RADIOLOGY	2E117	Film Processing	Laser Imager				R,S	
ICU	2F167	Alcove	Dry Printer	3M	8700+	DICOM	R,S	
RADIOLOGY	1E113	Film Sorting	Dry Printer	3M	8700+	DICOM	R,S	
RADIOLOGY	1E113	Film Sorting	Film Digitizer	Lumisys		DICOM, QC1	R,S	
RADIOLOGY	1D174	NM Scanning	NM Scanner	ADAC		QC3	R,S	
RADIOLOGY	1D175	NM Scanning	NM Scanner	ADAC		QC3	R,S	
RADIOLOGY	1D174	NM Scanning	NM Mini-PACS	ADAC		DICOM, QC3	R,S	
RADIOLOGY	1D164	CT Computer	CT	Toshiba		DICOM, QC2	R,S	
RADIOLOGY	1D165	CT Scanner	CT Scanner	Toshiba		DICOM	R,S	
RADIOLOGY	1D200	MRI Scanning	MRI Scanner			DICOM	R,S	
RADIOLOGY	1D203	MRI Computer Room	MRI Console			DICOM, QC2	R,S	
RADIOLOGY	1E114	Ultrasound Scanning	Ultrasound	Acuson	128	DICOM	R,S	
RADIOLOGY	1E110	Ultrasound Scanning	Ultrasound	Acuson	128	DICOM	R,S	
RADIOLOGY	1E107	Viewing Consultation	U/S Mini-PACS	Acuson	Aegis	DICOM, QC2	R,S	
RADIOLOGY	1D205		Dry Printer	3M	8700+	DICOM	R,S	
OR	2C156		C-Arm			DICOM, QC5	R,S	

OR	2E120		C-Arm	OEC		DICOM, QC5	R,S	
RADIOLOGY	1E143	Rad Fluoro	Rad Fluoro	Toshiba		DICOM, QC2	R,S	
RADIOLOGY	1E145	Rad Fluoro	Rad Fluoro	Toshiba		DICOM, QC2	R,S	
Urology	2D202	Rad Fluoro	Rad Fluoro	Liebel Florsheim		DICOM. QC4	R,S	
RADIOLOGY	1E140	Chest Room	CR	Fuji	9501	DICOM, QC1	R,S	
		NUMBER OF INTERFACES:	28					

Pentagon Tri-service Health Clinic Medical Equipment Interfaces								
DEPARTMENT	**ROOM**	**ROOM NAME**	**Modality**	**Manufacturer**	**Model**	**Network Interface**	**Facility Network Connection**	
								NOTES
Radiology	MF 867	R/F Room	Rad Fluoro	GE		QC1	R	R : UTP5, RJ45 Connector
Radiology	MF 865	Chest Room	Digital Chest			QC1		
Radiology	MF 866	Ultrasound	Ultrasound	Accuson		DICOM, QC1	R	
Radiology	MF 866	Ultrasound	CR	Fuji		GE Amber, QC1	R	
Radiology	MF 868	View Sort	CR	Fuji		GE Amber, QC1	R	
Radiology	MF 868	View Sort	FD	Lumisys			R	
Radiology	MF 868	View Sort	Dry Printer	3M		DICOM	R	
Radiology	MF 868	View Sort	MDIS IF	Lockheed/Martin		DICOM	R	
Radiology			Dry Printer	3M		DICOM	R	
Radiology			Workstations	GE		DICOM	R	
			Number of Interfaces	----→ 11				

APPENDIX B - DIN-PACS CONTRACTOR PROVIDED WORKSTATIONS

Portsmouth Acute Care Facility										
DEPARTMENT	ROOM NO.	ROOM NAME	MON D2	MON D4	MON R1	MON R2		Physical Connectors		NOTES
HEMATOLOGY/ONCOLOGY	120521	CONFERENCE ROOM				1		2R & 2S		R: UTP5, RJ45 CONNECTOR
RADIATION ONCOLOGY	121401	VIEWING ROOM				1		1R & 2S		S: Optical Fiber, ST Connector
RADIATION ONCOLOGY	121412	CONFERENCE ROOM				QC6, 1		2R & 2S		
NUCLEAR MEDICINE	121503	VIEWING ROOM				1		3R & 6S		
RADIOLOGY	130610K	MAMMO & U/S READING ROOM				1		2R & 4S		
RADIOLOGY	130802	MAIN READING ROOM*	1	3				8R & 16S		
RADIOLOGY	130820	ANGIO READING ROOM		1				1R & 2S		
RADIOLOGY	131005	R/F READING ROOM		1				3R & 6S		
RADIOLOGY	131102	DIN-PACS ROOM			1			3R & 5S		
RADIOLOGY	131701	CT READING ROOM		2				2R & 4S		
RADIOLOGY	133811	CONFERENCE ROOM		1		QC3, 1		3R & 6S		
RADIOLOGY	134003	MRI READING ROOM		2				3R & 6S		
EMERGENCY ROOM	141711	VIEWING ROOM				2		1R & 1S**		
MEDICAL ACUTE CARE	140816	DOCTOR OFFICE				1		1R & 1S		
RADIOLOGY	160241	MAIN FILE ROOM			1			4R & 7S		
ORTHOPEDICS	150321	CLUSTER				1		1R & 1S		
ORTHOPEDICS	161315	CLUSTER	1			1		1R **		
ORTHOPEDICS	161320	CLUSTER				QC9, 1		1R & 1S		
ORTHOPEDICS	161910	CLUSTER				1		1R & 1S		
ORTHOPEDICS	162021	CONFERENCE ROOM	1			1		2R & 2S		
PATHOLOGY	170903	CONFERENCE ROOM				1		2R & 2S		
GASTROENTEROLOGY	210602	VIEWING ROOM				1		1R & 1S		
NEPHROLOGY	220310	CONFERENCE ROOM				1		2R & 2S		
UROLOGY	221740	FILM FILE ROOM				QC5, 1		1R**		
UROLOGY	221221	CONFERENCE ROOM				1		1R & 2S		
PULMONARY MEDICINE	222121	CONFERENCE ROOM	1					2R & 2S		
SURGERY CLINIC	231021	CONFERENCE ROOM				2		1R & 2S		
NEURO/ENDO	231335	CONFERENCE ROOM				1		1R & 2S		
SPECIALTY SURGERY	241510	CONFERENCE ROOM				1		2R & 2S		
ORAL SURGERY	242712	CONFERENCE ROOM			1			1R & 2S		
OPTHALMOLOGY	260220	CONFERENCE ROOM				1		1R & 2S		
ENT	250804	CONFERENCE ROOM				1		1R & 2S		
PEDIATRICS	262202	CONFERENCE ROOM				1		2R & 2S		
OB/GYN CLINIC	270101	CONFERENCE ROOM				1		2R & 2S		
INTERNAL MEDICINE	270914	VIEWING ROOM				1		1R		
INTERNAL MEDICINE	270531	CONFERENCE ROOM				1		1R & 2S		
OPERATING ROOM	331104	CONFERENCE ROOM				1		2R & 2S		
ANESTHESIOLOGY	332010	RECOVERY ROOM				1		12R & 3S		
OPERATING ROOM	332812	MOBILE VIEW STATION				QC8, 3		17R &		

Portsmouth Acute Care Facility										
DEPARTMENT	ROOM	ROOM NAME	MON	MON	MON	MON		Physical		
								17S		
ICU	340901	CONFERENCE ROOM				1		1R & 2S		
CCU	351110	CONFERENCE ROOM				1		1R & 2S		
ORTHO WARD	370710	CONFERENCE ROOM				1		2R & 2S		
MED SURG 1 WARD	420406	CONFERENCE ROOM				1		2R & 2S		
MED SURG 2 WARD	431901	CONFERENCE ROOM				1		2R & 2S		
MED SURG 3 WARD	441105	CONFERENCE ROOM				1		2R & 2S		
PEDIATRIC WARD	451006	CONFERENCE ROOM				1		1R & 2S		
NICU	460740E	PHYS WORK				1		1R & 2S		
OB/GYN WARD	470713	CONFERENCE ROOM				1		2R & 4S		
	TBD	SPARE D4 UNITS AND QC WORKSTATIONS	2			QC, 5				
		TOTALS	**6**	**10**	**3**	**48**				
		GRAND TOTAL						**67**		
Note: D2 refers to 2 diagnostic monitors, each 2Kx2.5K; R2 refers to 2 review monitors, each 1Kx1.25K.										
The R2 Monitor in Radiology and Internal Medicine Conference Rooms hook into two, 1k x1k overhead projectors.										

Elmendorf Hospital								
DEPARTMENT	**ROOM**	**ROOM NAME**	**MON**	**MON**	**MON**	**MON**	**Physical**	
	NO.		**D2**	**D4**	**R1**	**R2**	**Connectors**	NOTES
								R: UTP5, RJ45 CONNECTOR
AeroSpace Medicine	1A147	Viewing Room				1	2R, 1O	S: Optical Fiber, ST Connector
Family Practice	1B195	Viewing Room				1	2R, 1O	O: Open Inter Duct For New Media
Family Practice	1C127	Viewing Room				1	2R, 1O	
Allergy Clinic	1C156	Physician Office				1	2R, 1O	
Pediatrics	1C188	Viewing Room				1	2R, 1O	
Orthopedics	1D140	Cast Room				2	2R, 1O	
Orthopedics	1D156	Viewing Alcove	1				2R, 1O	
ENT	2B174	Viewing Room	1				2R, 1O	
Internal Medicine	2C183	Viewing Room				2	2R, 1O	
Internal Medicine	2C213	Viewing Alcove	1				2R, 1O	
Surgery Clinic	2D166	Conference Room				1	2R, 1O	
Urology	2D207	Viewing Room				1	2R, 1O	
Urology	2H114	Doctor Charting Room				1	2R, 1O	
Radiology	1D174	NM Room				QC3, 1	2R, 1O	
Radiology	1D163	CT Console Room				QC2, 1	2R, 1O	
	2J114	Doctor Charting Room				1	2R, 1O	
Urology	2D184	Dark Room				QC4, 1	2R, 1O	
Surgery	2E117	OR Dark Room				QC5, 1	2R, 1O	
Orthopedics	1D186	Viewing Room	2				2R, 1O	
Radiology	1D204	Doctors Viewing Room		1			2R, 1O	
Emergency Medicine	1D209	Viewing Room	1				2R, 1O	
Radiology	1E107	Viewing/Consultation Room	1				2R, 1O	
Radiology	1E139	Film Sorting Room				QC1, 2	2R, 1O	
Radiology	1E162	Office of the Chief		1			2R, 1O	
Urology	2D158	Viewing Room	1				2R, 1O	
ICU	2F172	Viewing Room	1				2R, 1O	
Radiology	1E165	Doctors Office		1			2R, 1O	
Radiology	1E163	Doctors Office		1			2R, 1O	
Radiology	1E164	Doctors Office		1			2R, 1O	
Radiology	1E106	Computer Room				1	2R, 1O	
		TOTALS	**9**	**5**	**0**	**20**		
		GRAND TOTAL					**34**	
Note: D2 refers to 2 diagnostic monitors, each 2Kx2.5K; R2 refers to 2 review monitors, each 1Kx1.25K.								

PENTAGON TRI-SERVICE HEALTH CLINIC DIN-PACS WORKSTATION LOCATIONS								
DEPARTMENT	**ROOM**	**ROOM NAME**	**MON**	**MON**	**MON**	**MON**	**Physical**	
	NO.		**D2**	**D4**	**R1**	**R2**	**Connectors**	NOTES
								R: UTP5, RJ45 CONNECTOR
Radiology		Radiologist's Office		1			2R	
Radiology		Viewing Room				QC1, 1	2R	
General Clinic		Viewing Room				2	2R	
		TOTALS	**0**	**1**	**0**	**3**		
		GRAND TOTAL					**4**	
Note: D2 refers to 2 diagnostic monitors, each 2Kx2.5K; R2 refers to 2 review monitors, each 1Kx1.25K.								

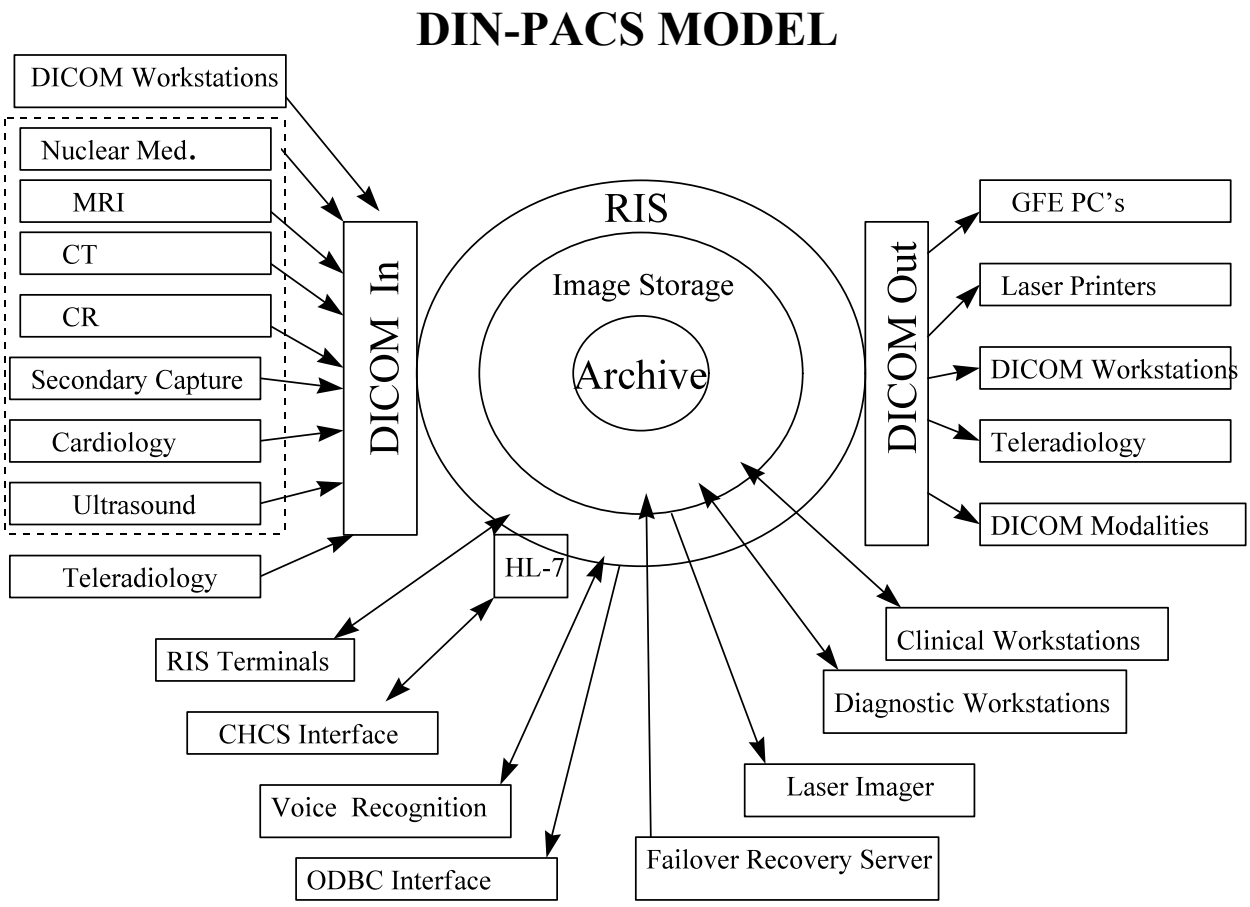
APPENDIX C - DICOM FUNCTIONALITY OF DIN-PACS

1. Introduction

This appendix contains the DICOM conformance requirements for the DIN-PACS system. It specifies the interface as shown in Fig C.1 "DIN-PACS Model" under "DICOM In" and "DICOM Out". These requirements are grouped according to functionality: 1. Acquisition or DICOM Modalities, 2. Quality Control Workstations, 3. Teleradiology, 4. DICOM workstations, 5. Laser Printers, 6. Government Furnished PC's.

This requirement specification is written from an "outside perspective" into the DIN-PACS system, i.e. based on the function that has to be provided via the DICOM interface viewed from the viewpoint of the devices that are connected.

Figure C.1. - DIN-PACS Model



2. General Requirements

The DIN-PACS interface shall conform with the DICOM Standard[1] in effect 6 months prior to the installation date specified in each delivery order. In addition, the interface shall conform to the specific requirements as defined below. The vendor shall provide a detailed description on how the proposed system meets the requirements set forth in this appendix. The vendor shall provide DICOM conformance statements for the

[1] Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-9, 1993

proposed DIN-PACS system compliant with the format as described in part PS 3.2 of the DICOM standard. The vendor is strongly encouraged to support the explicit Value Representation (VR) Presentation syntax.

3. Acquisition

This section specifies connectivity requirements for the DIN-PACS acquisition devices, AKA "modalities". All references in this document to "acquisition devices" and "modalities" apply to either the actual acquisition device (e.g., CT scanner) or specialty workstation (e.g., DICOM workstation). Images can be sent from the modality to both the DIN-PACS system and to other devices in the MINI PACS cluster such as the Specialty workstation. This section only deals with the interaction of modalities with the DIN-PACS system, via the DICOM IN and Out interface as shown in Figure C.1. "DIN-PACS Model".

3.1 Introduction

Vendor implementation of the DICOM communication standard has to support and accommodate the following functional requirements:

1. The primary activity of the modality is acquisition and image processing in order to provide a series of images that can be used for diagnosis. These images can be transferred to the DIN-PACS for softcopy display, print and/or store. This transfer can be operator initiated on a image by image base or study basis. In addition, this transfer can be performed automatically, i.e. as soon as an image is generated, it shall be sent to its destination(s).

2. The DIN-PACS shall take responsibility for the images that are sent from the modality to the DIN-PACS. This means that as soon as the DIN-PACS notifies the modality that the images are "committed" to be stored, the modality can delete them from its temporary storage.

3. Images shall be sent from the DIN-PACS to the modality or its specialty workstation. For example, CHCS can notify DIN-PACS when a patient is scheduled for an exam and DIN-PACS can prefetch previous exam(s) to be sent to the modality for comparison to make sure the positioning and exam parameters are similar.

4. The DIN-PACS shall be available for queries by the modality regarding studies performed using both study and patient keys. After the modality has successfully retrieved the appropriate identifying information, the DIN-PACS shall be able to send the study to the modality when requested. This shall allow a technologist the ability to retrieve previous studies on patients who have a repeat study in order to verify that positioning, area of interest, etc. is similar to the previous study. In addition, the DIN-PACS shall query the modality for additional images, series, and/or studies.

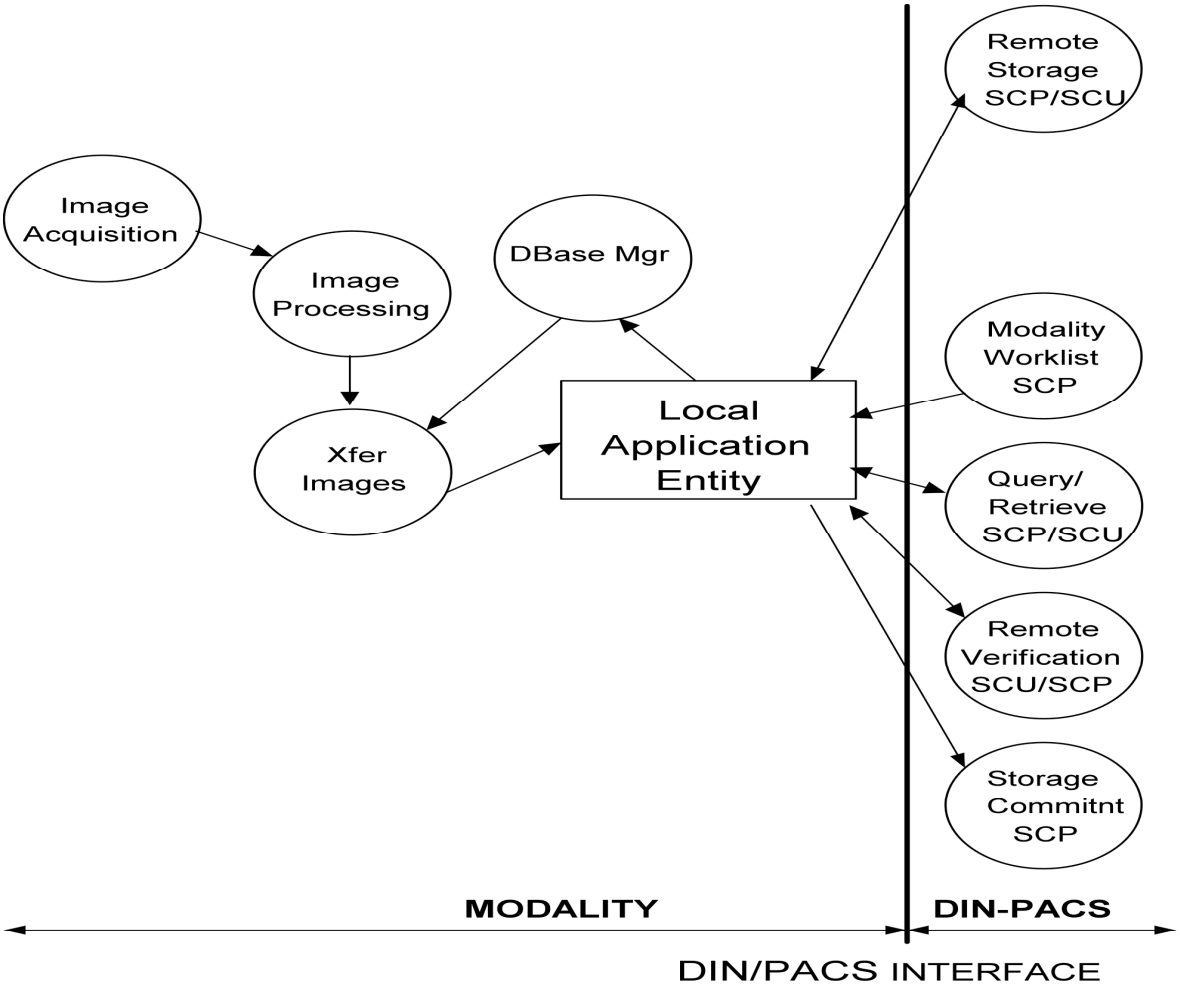
5. The DIN-PACS system shall provide a Modality Worklist to the modality. Schedule information and required patient demographic information will be provided so that the modality will not have to reenter this information.

6. The DIN-PACS shall be able to verify modality status and must respond to a status inquiry from the modality.

3.2 Implementation Model

The Implementation Model consists of an Application Data Flow Diagram, functional definitions of the Application Entities (AE's) and their related Real-World Activities. The actual implementation model for the local AE and DIN-PACS interaction shall very likely differ from the diagram as specified below. For example, a modality can implement the required functionality using one or more Application Entities, or break down the functionality into Real-World Activities. The vendor shall describe how the particular implementation of the DIN-PACS shall meet the required functionality, i.e. how its specific Application Data Flow diagram shall map onto the diagram specified below.

3.2.1 Application Data Flow Diagram



The modality functions and DIN-PACS system are called “Real World Activities” and are identified as bubbles in the diagram. The Rectangle is the Local Application Entity, i.e., the modality process responsible for DICOM communication. The local Application Entity (AE) initiates a connection, negotiates the specific class of service and syntax of the transaction using an Association, and, if applicable, sends or receives information to and from the DIN-PACS. In addition, the local AE shall respond to a request from a Remote Application Entity within the DIN-PACS for an Association, negotiate the transfer and execute the communication.

The DIN-PACS shall function as a “Provider” of a Storage service class (SCP) and communicate with a Remote Storage Service Class User (SCU) at the modality for receiving the images. In addition, the DIN-PACS shall function as a “User” (SCU) of the Storage service class by sending images to the modality for the technologist to use as a reference. In order to move images between the modality and the DIN-PACS, the DIN-PACS shall support the Query/Retrieve Storage Class as both a Provider and User (SCP/SCU). The DIN-PACS shall identify required studies using both patient and study level keys. The DIN-PACS shall respond to a “MOVE” to transfer the images. The DIN-PACS shall also function as a User to determine the existence of additional images, series or studies, and be able to move these images.

After the images have been transferred from the modality to the DIN-PACS, the modality needs to know when they can be deleted locally, i.e. it wants to make sure that the DIN-PACS system takes responsibility for these

images. The DIN-PACS shall provide the Storage Commitment Service class as a SCP to transfer information about the guaranteed storage of these images within the DIN-PACS system.

The DIN-PACS shall provide the Modality Worklist Services as a SCP to the modality in order for the modality to retrieve scheduling and patient demographic information.

The DIN-PACS shall respond to a query from a modality using a Verification Service Class as a User as well as initiate a query to a Verification Provider at a modality.

3.2.2 DIN-PACS AE - Specification

The DIN-PACS modality interface shall provide Standard Conformance to the following DICOM V3.0 SOP Class(es):

SOP Class Name	SOP Class UID	Usage
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	SCP/SCU
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCP/SCU
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCP/SCU
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.20	SCP/SCU
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	SCP/SCU
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCP/SCU
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCP/SCU
X-Ray Angiography Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCP/SCU
X-Ray Angiography Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	SCP/SCU
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCP/SCU
Modality Worklist Information Model Find	1.2.840.10008.5.1.4.31	SCP
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	SCP
Patient Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.1.1	SCP/SCU
Patient Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.1.2	SCP/SCU
Study Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP/SCU
Study Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCP/ SCU
Verification SOP Class	1.2.840.10008.1.1	SCP/SCU

Note: Support of the retired Nuclear Medicine and Ultrasound Image Storage SOP classes is not required.

3.3 Level of Conformance

The DIN-PACS shall provide full conformance (level 2) with regard to the required Storage classes. All Type 1, 2, and 3 attributes which are communicated shall be stored and may be accessed. Coercion is allowed for Patient ID, Study Instance UID, and the Series Instance UID to synchronize the DIN-PACS database with CHCS.

In addition, there are two scenarios when images can be sent without complete identification:

1. A study has not been entered in the RIS prior to the exam, and the modality cannot retrieve the information from the DIN-PACS. The patient information is entered at the modality, and a unique Study ID is generated by the modality. The DIN-PACS has to be able to match this study later with the study ID generated by the RIS after the images have been transferred.

2. Patient information is unknown, which could be the case with trauma patients. In that case, patient information as well as Study ID has to be filled in by the DIN-PACS. (Reference Section C, paragraph 4.4.)

3.4 Required Attributes

The DIN-PACS shall not require any attributes beyond those specified in the DICOM standard as part of the IOD definition. For example, if an attribute is defined as type "2" (required) but is sent with zero length (if unknown), the DIN-PACS shall not change the type of this attribute from a type 2 to a type 1. Likewise, the DIN-PACS shall not change a type 3 attribute to a type 2.

3.4.1 Modality Worklist Required Attributes

As a minimum, each modality worklist entry shall contain the following information:
Patient name, Patient ID, Requested Procedure Description, Study UID.

3.5 Communication Profiles

The modality will support TCP/IP as the communication protocol. Physical connection options shall be listed by the vendor. As a minimum, required communication profiles present in the medical facility, as specified in Appendices A and G, shall be supported.

3.5.1 Configurable Parameters

All operational parameters which may influence performance and/or AE behavior shall be configurable. These include the following:

- Number of simultaneous associations
- Maximum PDU size
- Time out values
- Local AE titles
- Local IP address and Netmask
- Remote AE Title fields
- Responding TCP/IP ports and addresses

The vendor shall provide a complete list of these parameters including the value range of the configuration parameters.

3.5.2 Transfer and Presentation Syntax

The vendor shall accommodate an wide range of transfer and presentation syntax. This includes both Implicit as well as Explicit VR Presentation syntax and Little as well as Big Endian transfer syntax.

3.5.3 Future Standard Extensions

The DIN-PACS vendor shall demonstrate plans for implementing future extensions to the DICOM implementation. This includes, but is not limited to, capability to support additional Storage SOP classes using newly defined IOD's, and capability to receive information from the modality based on the Performed Procedure Step Service class.

4. Quality Control Workstation

This section specifies connectivity requirements for the DIN-PACS quality control workstation to acquisition modalities and to the DIN-PACS. All QC workstation DICOM functionality specified in this paragraph as it relates to communications with the DIN-PACS shall be either true DICOM or functionally equivalent DICOM. All references in this document to "acquisition devices" and "modalities" apply to either the actual acquisition device (e.g., CT scanner) or specialty workstation (e.g., DICOM workstation). Images can be sent from the modality to the QC workstation, the DIN-PACS system and to other devices, such as the Specialty workstation, in a MINI PACS cluster. This section deals with the interaction of both the modalities with the QC workstation and the QC workstation with the DIN-PACS system.

4.1 Introduction

Vendor implementation of the DICOM communication standard shall to support and accommodate the following functional requirements:

1. The primary activity of the QC workstation is to act as an intermediate device between the modality and the DIN-PACS. The QC workstation provides extended DICOM functionality which the modality may not accommodate. Images shall be transferred to the QC workstation for softcopy display, image processing, worklist management operations, and other QC operations. This transfer can be operator initiated on a image by image basis or study basis. In addition, this transfer can be performed automatically, i.e. as soon as an image is generated, it shall be sent to its destination(s). Additionally,

images shall be transferred from the QC workstation to the DIN-PACS for softcopy display, print and/or store. This transfer can be operator initiated on a study basis. In addition, this transfer can be performed automatically on a study or image by image basis, i.e. as soon as an image is received by the QC workstation, it shall be forwarded to its DIN-PACS destination(s). Final verification of exam status is performed on the QC workstation and the "verified" status is assigned. This status and image processing/display changes made as part of the verification shall be forwarded into DIN-PACS as updates to the exam.

2. The QC workstation shall be responsible for the images that are sent from modality to the QC workstation. This means that as soon as the QC workstation notifies the modality that the images are "committed" to be stored, modality can delete them from its temporary storage.

3. The DIN-PACS shall be responsible for the images that are sent from the QC workstation to the DIN-PACS. This means that as soon as the DIN-PACS notifies the QC workstation that the images are "committed" to be stored, the QC workstation can delete them from its temporary storage.

4. Images shall be sent from the DIN-PACS to the QC workstation. The QC workstation shall serve as a fully functional review workstation in addition to functioning as a quality control workstation for acquisition devices.

5. The QC workstation shall be available for queries by both the modality and the DIN-PACS regarding studies performed using both study and patient keys. After the modality or DIN-PACS has successfully retrieved the appropriate identifying information, the QC workstation shall be able to send the study to the modality or DIN-PACS when requested. In addition, the QC workstation shall query the modality and DIN-PACS for additional images, series, and/or studies.

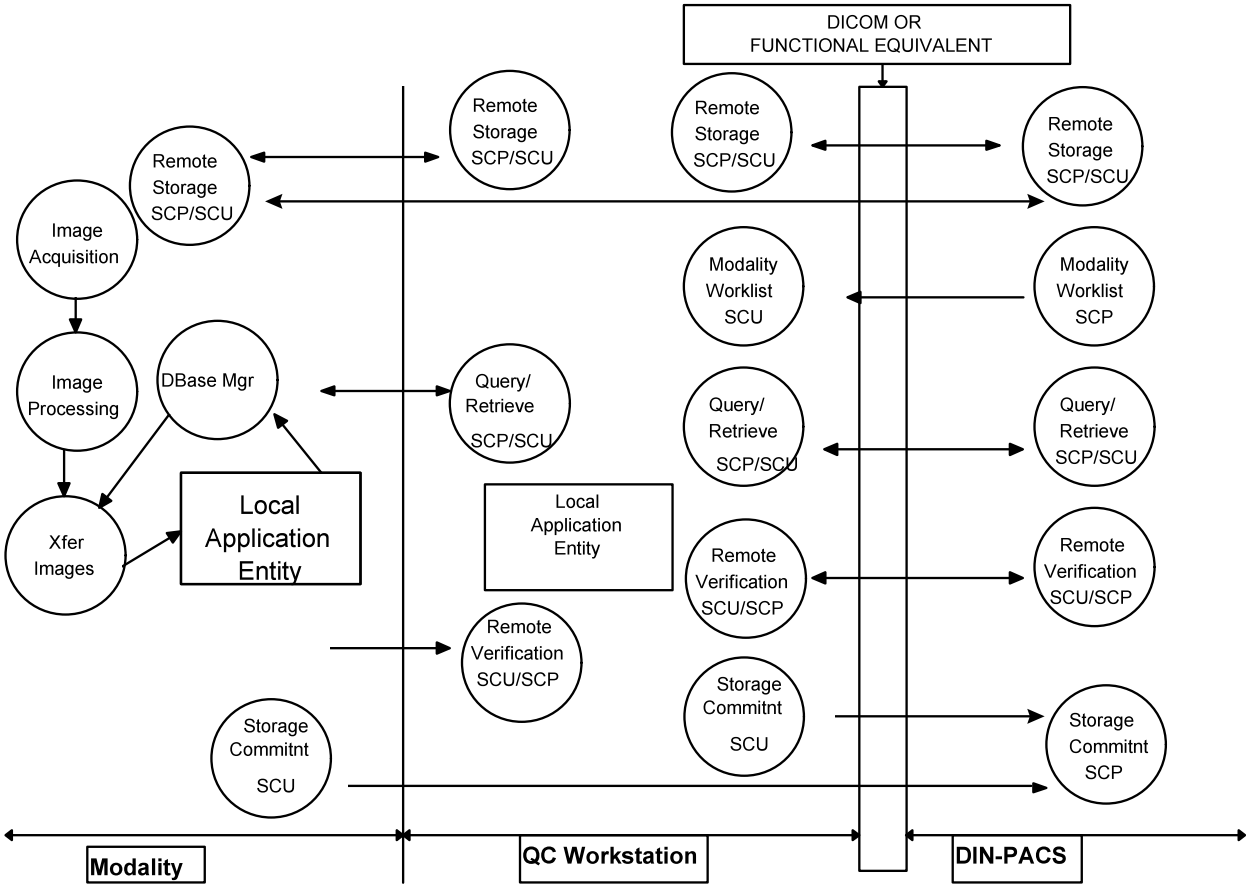
6. The QC workstation shall employ a worklist provided by the DIN-PACS. Examination information and required patient demographic information will be utilized so that the QC workstation operator will not have to reenter this information.

7. The QC workstation shall be able to verify modality and DIN-PACS status and must respond to a status inquiry from the modality and the DIN-PACS.

4.2 Implementation Model

The Implementation Model consists of an Application Data Flow Diagram, functional definitions of the Application Entities (AE's) and their related Real-World Activities. The actual implementation model for modality AE, QC workstation and DIN-PACS interaction may differ from the diagram as specified below. For example, a modality or QC workstation can implement the required functionality using one or more Application Entities, or break down the functionality into Real-World Activities. However, operation of the QC workstation shall support clinical activity in a seamless manner whereby the workstation operator is not required to halt operations and switch applications in order to continue, i.e., multiple applications must operate in a multi-tasking environment. The vendor shall describe how the particular implementation of the QC workstation shall meet the required functionality, i.e. how its specific Application Data Flow diagram shall map onto the diagram specified below.

4.2.1 Application Data Flow Diagram



The QC workstation functions and DIN-PACS system are called “Real World Activities” and are identified as bubbles in the diagram. The Rectangle is the Local Application Entity, i.e., the QC workstation processes responsible for DICOM communication. The Local Application Entity (AE) initiates a connection, negotiates the specific class of service and syntax of the transaction using an Association, and, if applicable, sends or receives information to and from the modality or DIN-PACS. In addition, the local AE shall respond to a request from a Remote Application Entity within the DIN-PACS or the modality for an Association, negotiate the transfer and execute the communication.

The QC workstation shall function as a “Provider” of a Storage service class (SCP) and communicate with a Remote Storage Service Class User (SCU) at the modality and the DIN-PACS for receiving the images. In addition, the QC workstation shall function as a “User” (SCU) of the Storage service class by sending images to the modality and the DIN-PACS. In order to move images between the QC workstation and the modality or DIN-PACS, QC workstation shall support the Query/Retrieve Storage Class as both a Provider and User (SCP/SCU). The QC workstation shall identify required studies using both patient and study level keys. The QC workstation shall respond to a “MOVE” to transfer the images. The QC workstation shall also function as a User to determine the existence of additional images, series or studies, and be able to move these images.

After the images have been transferred from the modality to the QC workstation, the modality needs to know when they can be deleted locally, i.e. it wants to make sure that DIN-PACS has committed to storage prior to the modality releasing the images.

The QC workstation will act as a User of a Storage Commitment Service class when images have been transferred into the DIN-PACS from the QC workstation.

The DIN-PACS will act as the Provider of the Storage Commitment Service class to both the QC workstation and the modality.

The QC workstation shall utilize the Modality Worklist Services as a SCU from the DIN-PACS in order to retrieve scheduling and patient demographic information.

The QC workstation shall respond to a query from a modality and the DIN-PACS using a Verification Service Class as a User as well as initiate a query to a Verification Provider at the modality and DIN-PACS.

4.2.2 DIN-PACS AE - Specification

The QC workstation interface shall provide Standard Conformance to the following DICOM V3.0 SOP Class(es):

SOP Class Name	SOP Class UID	Usage
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	SCP/SCU
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCP/SCU
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCP/SCU
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.20	SCP/SCU
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	SCP/SCU
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCP/SCU
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCP/SCU
X-Ray Angiography Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCP/SCU
X-Ray Angiography Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	SCP/SCU
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCP/SCU
Modality Worklist Information Model Find	1.2.840.10008.5.1.4.31	SCU
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	SCU
Patient Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.1.1	SCP/SCU
Patient Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.1.2	SCP/SCU
Study Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP/SCU
Study Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCP/ SCU
Verification SOP Class	1.2.840.10008.1.1	SCP/SCU

Note: Support of the retired Nuclear Medicine and Ultrasound Image Storage SOP classes is not required.

4.3 Level of Conformance

The QC workstation shall provide full conformance (level 2) with regard to the required Storage classes. All Type 1, 2, and 3 attributes which are communicated shall be stored and may be accessed. Coercion is allowed for Patient ID, Study Instance UID, and the Series Instance UID to synchronize the DIN-PACS database with CHCS.

4.4 Required Attributes

The QC workstation shall not require any attributes beyond those specified in the DICOM standard as part of the IOD definition. For example, if an attribute is defined as type "2" (required) but is sent with zero length (if unknown), the QC workstation shall not change the type of this attribute from a type 2 to a type 1. Likewise, the QC workstation shall not change a type 3 attribute to a type 2.

4.4.1 Modality Worklist Required Attributes

As a minimum, each modality worklist entry shall contain the following information:
Patient name, Patient ID, Requested Procedure Description, Study UID.

4.5 Communication Profiles

The QC workstation shall support TCP/IP as the communication protocol. Physical connection options shall be listed by the vendor. As a minimum, required communication profiles present in the medical facility, as specified in Appendices A and G, shall be supported.

4.5.1 Configurable Parameters

All operational parameters which may influence performance and/or AE behavior shall be configurable. These include the following:

- Number of simultaneous associations
- Maximum PDU size
- Time out values
- Local AE titles
- Local IP address and Netmask
- Remote AE Title fields
- Responding TCP/IP ports and addresses

The vendor shall provide a complete list of these parameters including the value range of the configuration parameters.

4.5.2 Transfer and Presentation Syntax

The vendor shall accommodate an wide range of transfer and presentation syntax. This includes both Implicit as well as Explicit VR Presentation syntax and Little as well as Big Endian transfer syntax.

4.5.3 Future Standard Extensions

The DIN-PACS vendor shall demonstrate plans for implementing future extensions to the DICOM implementation. This includes, but is not limited to, capability to support additional Storage SOP classes using newly defined IOD's, and capability to receive information from the modality based on the Performed Procedure Step Service class.

5. Teleradiology

This section specifies the connectivity requirements for communication among DIN-PACS systems. Images as well as results can be sent from one to the other DIN-PACS system using Teleradiology. This also allows for remote transcription.

5.1 Introduction

The implementation by the vendor of the DICOM communication standard has to support and accommodate the following functional requirements for optimal patient and procedure flow:

1. Images can be exchanged among DIN-PACS systems for softcopy display and/or storage. This allows a balance of resources, either from an acquisition perspective or from a physician perspective. For example, a patient might be examined at a location where a particular acquisition device is available, or a study might be read at a location where a radiologist is available. In addition, Teleradiology allows second opinion or subspecialty reading.

2. Particularly with the long distances that might be involved between the locations which exchange these images, it is important that the receiving DIN-PACS take responsibility for the images sent via Teleradiology. This means that as soon as the DIN-PACS notifies that the images are "committed" to be stored, the sender can delete them from its temporary storage.

3. The DIN-PACS shall be available for queries by the remote Teleradiology site regarding studies performed using both study and patient keys. After the remote Teleradiology site has successfully retrieved the appropriate identifying information, the DIN-PACS shall send the study to the appropriate entity when requested. This shall allow retrieval of previous studies.

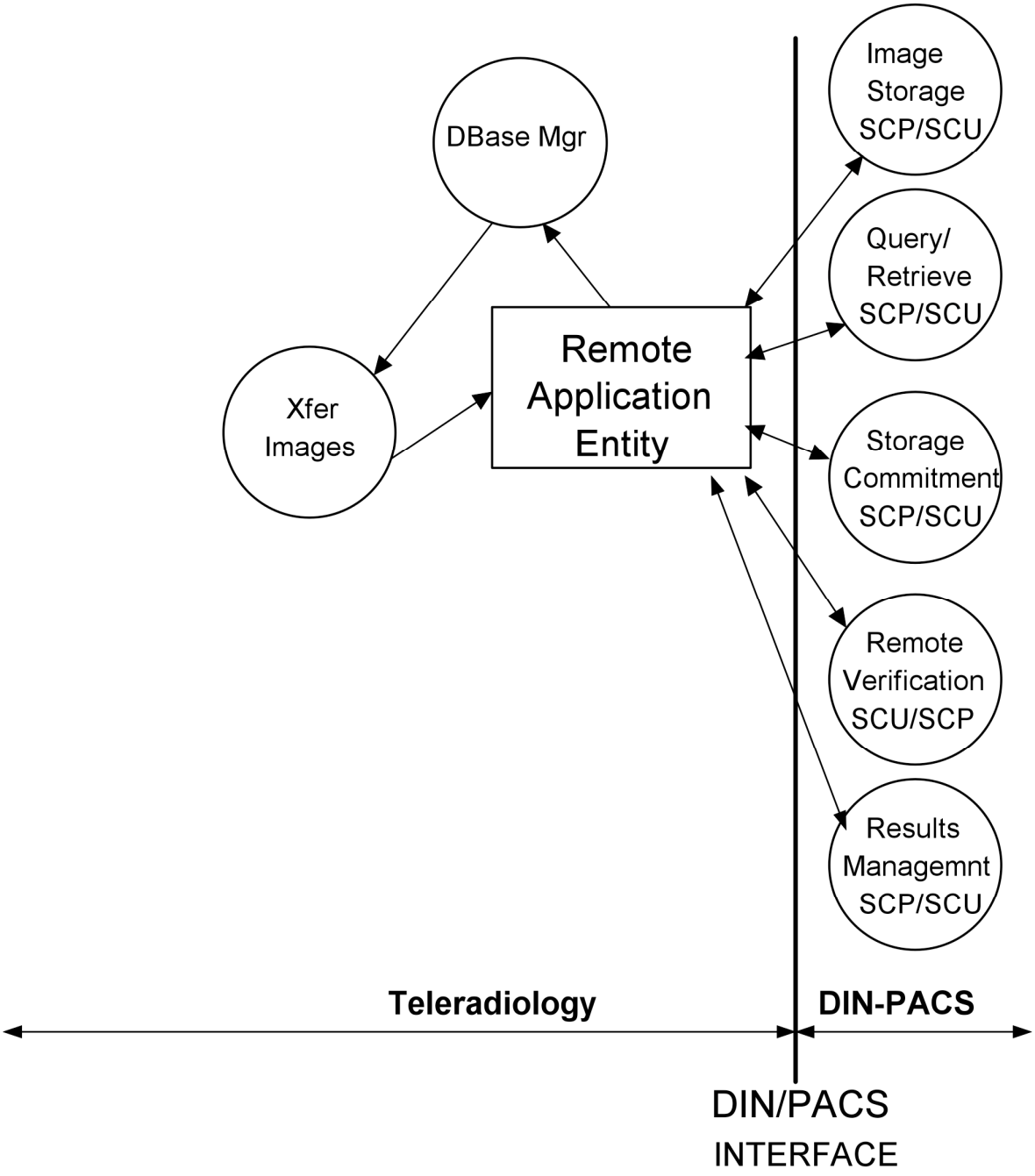
4. Results information shall be exchanged between the DIN-PACS and the remote Teleradiology site.

5. The DIN-PACS shall verify the existence and state of the remote Teleradiology site, and shall respond to a status inquiry from the remote Teleradiology site.

5.2 Implementation Model

The Implementation Model consists of an Application Data Flow Diagram, functional definitions of the Application Entities and their related Real-World Activities. The implementation model for the DIN-PACS may differ from the diagram as specified below. The vendor shall describe how the particular DIN-PACS implementation meets the required functionality, i.e. how its specific Application Data Flow diagram shall map onto the diagram specified below.

5.2.1 Application Data Flow Diagram



The functions of the remote Teleradiology site and DIN-PACS system are called “Real World Activities” and are identified as bubbles in the diagram. The Rectangle in the diagram is the Remote Application Entity, i.e., the process which is responsible for DICOM communication. The Remote Application Entity initiates a connection, negotiates the specific class of service and syntax of the transaction using an Association, and, if applicable, sends or receives information to and from the DIN-PACS. In addition, the remote Teleradiology site shall respond to a request from an Application Entity within the DIN-PACS for an Association, negotiate the transfer and execute the communication.

The DIN-PACS shall function as a "Provider" of a Storage service class (SCP) and communicate with a Remote Storage Service Class User (SCU) at the Remote Application Entity for receiving the images. In addition, the DIN-PACS shall function as a "User" (SCU) of the Storage service class by sending images to the Remote Application Entity. The DIN-PACS shall support the Query/Retrieve Storage Class as a Provider (SCP) as well as a User (SCU) to identify the required studies using both Patient and study level keys. The DIN-PACS shall either initiate or respond to a "MOVE" to transfer the images.

After the images have been transferred to the DIN-PACS, the sender needs to know when they can be deleted locally, i.e. it wants to make sure that the DIN-PACS system takes responsibility for these images. The DIN-PACS shall provide the Storage Commitment Service class as a SCP to transfer information about the guaranteed storage of these images within the DIN-PACS system. The same applies when images are sent out of the DIN-PACS; the DIN-PACS shall support the Storage Commitment Service class as a SCU.

The DIN-PACS shall support the Results Management service class both as a user and provider to allow results and interpretations to be exchanged.

The DIN-PACS shall respond to a query from a teleradiology remote application entity using a Verification Service Class as a User as well as initiate a query to a Verification Provider.

5.2.2 DIN-PACS AE - Specification

The DIN-PACS Teleradiology interface shall provide Standard Conformance to the following DICOM V3.0 SOP Class(es):

SOP Class Name	SOP Class UID	Usage
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	SCP/SCU
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCP/SCU
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCP/SCU
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.20	SCP/SCU
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	SCP/SCU
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCP/SCU
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCP/SCU
X-Ray Angiography Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCP/SCU
X-Ray Angiography Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	SCP/SCU
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCP/SCU
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	SCP/SCU
Patient Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.1.1	SCP/SCU
Patient Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.1.2	SCP/SCU
Study Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP/SCU
Study Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCP/SCU
Verification SOP Class	1.2.840.10008.1.1	SCP/SCU
Detached Results Management Meta SOP Class	1.2.840.10008.3.1.2.5.4	SCP/SCU

Note: Support of the retired Nuclear Medicine and Ultrasound Image Storage SOP classes is not required.

5.2.3 Required Attributes

The DIN-PACS shall not require any attributes beyond those specified in the DICOM standard as part of the IOD definition. For example, if an attribute is defined as type "2" (required) but is sent with zero length (if unknown), the DIN-PACS shall not change the type of this attribute from a type 2 to a type 1. Likewise, the DIN-PACS shall not change a type 3 attribute to a type 2.

The Teleradiology site and the DIN-PACS will exchange images which shall include all the appropriate patient and study information (i.e., an image or results object shall not be sent without the DIN-PACS ensuring that the study ID and all required attributes are available with the objects).

5.3 Communication Profiles

The Teleradiology interface shall support TCP/IP as the communication protocol. The physical connection options shall be defined and provided by the vendor. As a minimum, the required communication profiles present in the medical facility, as specified in Appendices A and G, shall be supported.

5.3.1 Configurable Parameters

Any operational parameters which may influence performance and/or AE behavior need to be configurable. These include the following:

- Number of simultaneous associations
- Maximum PDU size
- Time out values
- Local AE titles
- Local IP address and Netmask
- Remote AE Title fields
- Responding TCP/IP ports and addresses

The vendor shall provide a complete list of these parameters including the value range of the configuration parameters.

5.3.2 Transfer and Presentation Syntax

The vendor shall accommodate a wide range of transfer and presentation syntax's. This includes both Implicit as well as Explicit VR Presentation syntax and Little as well as Big Endian transfer syntax. In addition, this interface shall support compressed transfer syntax as well, with, as a minimum, the default lossless and lossy compression schemes as specified in the DICOM standard.

5.3.3 Future Standard Extensions

The DIN-PACS vendor shall demonstrate plans for implementing future extensions to the DICOM implementation. This includes, but is not limited to, the capability for supporting additional Storage SOP classes using newly defined IOD's, and support of new, to be defined, results IOD's which include Structured Reporting.

6. DICOM Workstations

This section specifies connectivity requirements for the DIN-PACS with DICOM Workstations. Images shall be sent from the DIN-PACS to the DICOM Workstation, as well as from the Workstation to the DIN-PACS. In addition, results can be exchanged. A DICOM Workstation is usually a device that performs a special function such as a 3-D rendering.

6.1 Introduction

Vendor implementation of the DICOM communication standard shall support and accommodate the following functional:

1. The primary activity of the DICOM Workstation is to perform image processing to assist the physician in making a diagnosis. This may result in additional images or series of images generated as part of the initial study that have to be sent back to the DIN-PACS for subsequent distribution and archiving. In addition, overlays and/or curves shall be added to the Image object IOD's and be sent back.

2. A physician may annotate images with text, arrows, etc. The annotation shall be displayed with the images as overlays and/or curves.

3. The DIN-PACS shall be available for queries by the DICOM Workstation regarding studies performed using both study and patient keys. After the DICOM Workstation successfully retrieves the appropriate identifying information, the DIN-PACS shall send the study to the DICOM Workstation when requested.

4. The DIN-PACS shall query the DICOM Workstation regarding studies performed using both study and patient keys. After the DIN-PACS retrieves the appropriate identifying information, DIN-PACS shall retrieve the applicable studies.

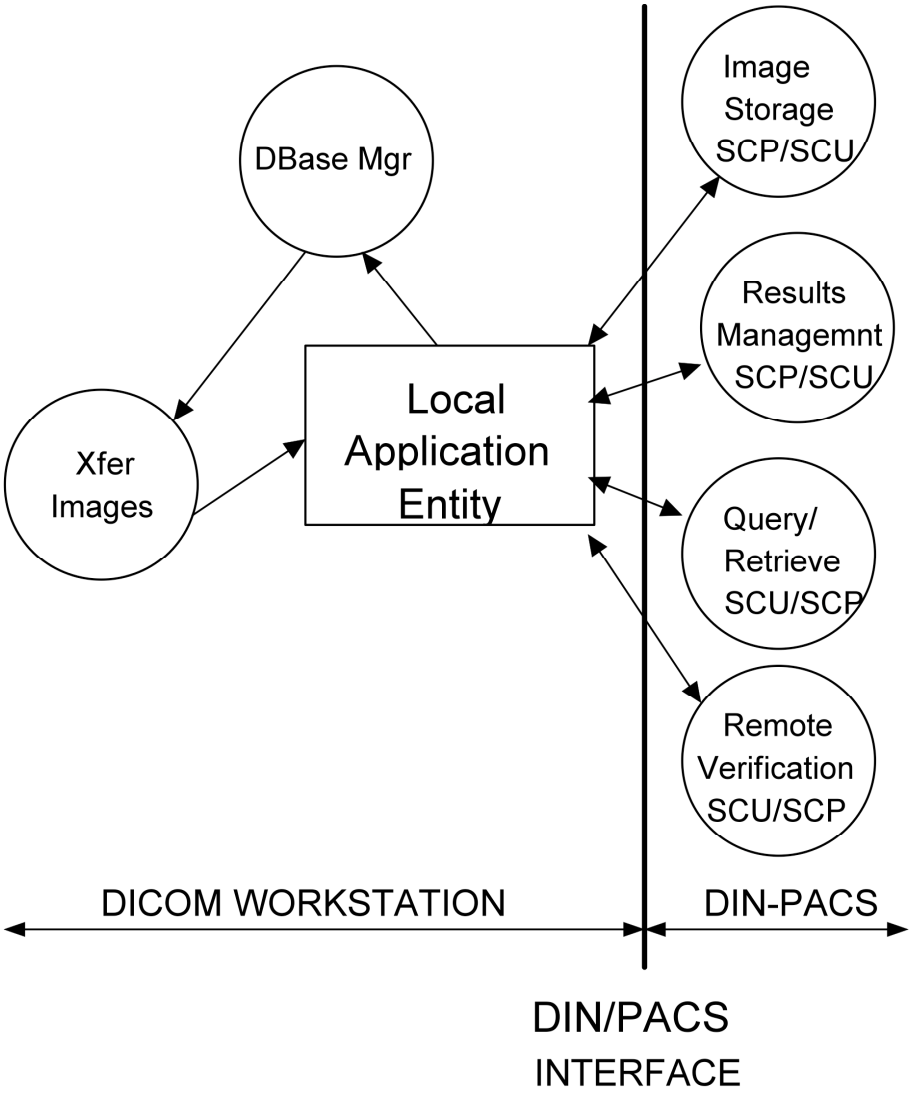
5. The DIN-PACS shall provide results to the DICOM workstation. The DICOM workstation shall be able to send results, either amended or completed, back to the DIN-PACS.

6. The DIN-PACS shall verify the existence and state of the DICOM workstation, and shall respond to a status inquiry from the DICOM workstation.

6.2 Implementation Model

The Implementation Model consists of an Application Data Flow Diagram, functional definitions of the Application Entities and their related Real World Activities. The implementation model for the DIN-PACS may differ from the diagram as specified below. The vendor shall describe how the particular implementation of the DIN-PACS meets the required functionality, i.e. how its specific Application Data Flow diagram maps to the diagram specified below.

6.2.1 Application Data Flow Diagram



The functions of the DICOM Workstation and DIN-PACS system are called "Real World Activities" and are identified as bubbles in the diagram. The Rectangle in the diagram is the Local Application Entity, i.e. the process at the DICOM Workstation which is responsible for the DICOM communication. The Local Application Entity initiates a connection, negotiates the specific class of service and syntax of the transaction using an Association, and, if applicable, sends or receives information to and from the DIN-PACS. In addition, the DICOM workstation shall respond to a request from a Remote Application Entity within the DIN-PACS for an Association, negotiate the transfer and execute the communication.

The DIN-PACS shall function as a "Provider" of a Storage service class (SCP) and communicate with a Remote Storage Service Class User (SCU) at the DICOM Workstation. In addition, the DIN-PACS shall function as a "User" (SCU) of the Storage service class by sending images to the DICOM Workstation. The DIN-PACS shall support the Query/Retrieve Storage Class as a User (SCU) and Provider (SCP) to identify the required studies using both Patient and study level keys. The DIN-PACS shall either initiate or respond to a "MOVE" to transfer the images.

The DIN-PACS shall support the Results Management service class both as a user and provider to allow results and interpretations to be exchanged.

The DIN-PACS shall respond to a DICOM query from a workstation using a Verification Service Class as a User as well as initiate a query to a Verification Provider.

6.2.2 DIN-PACS AE - Specification

The DIN-PACS DICOM Workstation interface shall provide Standard Conformance to the following DICOM V3.0 SOP Class(es):

SOP Class Name	SOP Class UID	Usage
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	SCP/SCU
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCP/SCU
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCP/SCU
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.20	SCP/SCU
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	SCP/SCU
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCP/SCU
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCP/SCU
X-Ray Angiography Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCP/SCU
X-Ray Angiography Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	SCP/SCU
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCP/SCU
Patient Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.1.1	SCP
Patient Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.1.2	SCP
Study Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP
Study Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCP
Verification SOP Class	1.2.840.10008.1.1	SCP/SCU
Detached Results Management Meta SOP Class	1.2.840.10008.3.1.2.5.4	SCP/SCU

Note: Support of the retired Nuclear Medicine and Ultrasound Image Storage SOP classes is not required.

6.2.3 Required Attributes

The DIN-PACS shall not require any attributes beyond those specified in the DICOM standard as part of the IOD definition. For example, if an attribute is defined as type "2" (required) but is sent with zero length (if unknown), the DIN-PACS shall not change the type of this attribute from a type 2 to a type 1. Likewise, the DIN-PACS shall not change a type 3 attribute to a type 2.

The DICOM Workstation and the DIN-PACS will exchange images which shall include all the appropriate patient and study information (i.e., an image or results object shall not be sent without the DIN-PACS ensuring that the study ID and all required attributes are available with the objects).

6.3 Communication Profiles

The DICOM Workstation interface will support TCP/IP as the communication protocol. The physical connection options shall be defined and provided by the vendor. As a minimum, the required communication profiles present in the medical facility, as specified in Appendices A and G, shall be supported.

6.3.1 Configurable Parameters

Any operational parameters which may either influence performance and/or AE behavior need to be configurable. These include the following:

- Number of simultaneous associations
- Maximum PDU size

- Time out values
- Local AE titles
- Local IP address and Netmask
- Remote AE Title fields
- Responding TCP/IP ports and addresses

The vendor shall provide a complete list of these parameters including the value range of the configuration parameters.

6.3.2 Transfer and Presentation Syntax

The vendor shall accommodate a wide range of transfer and presentation syntax's. This includes both Implicit as well as Explicit VR Presentation syntax and Little as well as Big Endian transfer syntax. In addition, this interface shall support compressed transfer syntax as well, with, as a minimum, the default lossless and lossy compression schemes as specified in the DICOM standard.

6.3.3 Future Standard Extensions

The DIN-PACS vendor shall demonstrate plans for implementing future extensions to the DICOM implementation. This includes, but is not limited to, the capability for supporting additional Storage SOP classes using newly defined IOD's, and support of new, to be defined, results IOD's which include Structured Reporting.

7. Government Furnished Equipment GFE PC's

This section specifies the connectivity requirements for the DIN-PACS with the GFE PC's. Images and results shall be sent from the DIN-PACS to the GFE PC's.

7.1 Introduction

Vendor implementation of the DICOM communication standard has to support and accommodate the following functional requirements for an optimal patient and procedure flow:

1. The primary activity of the PC's is to provide physicians with radiographic images and results for review purposes.

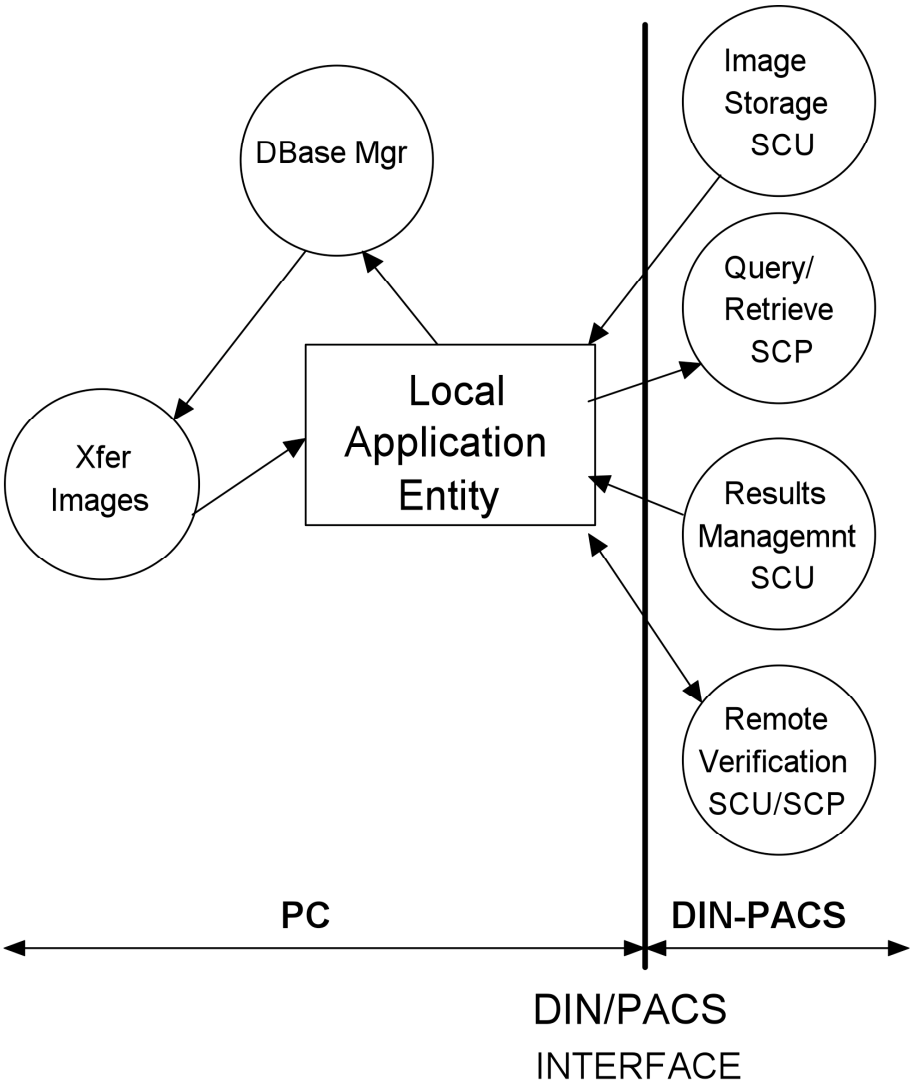
2. The DIN-PACS shall be available for queries by the PC's regarding studies performed using both study and patient keys. After the PC has successfully retrieved the appropriate identifying information, the DIN-PACS shall send the study to the DICOM Workstation when requested.

3. The DIN-PACS shall verify the existence and state of the GFE PC's, and shall respond to a status inquiry from the GFE PC's.

7.2 Implementation Model

The Implementation Model consists of an Application Data Flow Diagram, functional definitions of the Application Entities and their related Real-World Activities. The implementation model for the DIN-PACS may differ from the diagram as specified below. The vendor shall describe how the DIN-PACS implementation shall meet the required functionality, i.e. how its specific Application Data Flow diagram shall map to the diagram specified below.

7.2.1 Application Data Flow Diagram



The functions of the PC and DIN-PACS system are called "Real World Activities" and are identified as bubbles in the diagram. The Rectangle in the diagram is the Local Application Entity, i.e. the process at the PC which is responsible for the DICOM communication. The Local Application Entity initiates a connection, negotiates the specific class of service and syntax of the transaction using an Association, and, if applicable, sends or receives information to and from the DIN-PACS. In addition, the GFE PC shall respond to a request from a Remote Application Entity within the DIN-PACS for an Association, negotiate the transfer and execute the communication.

The DIN-PACS shall function as a "User" of a Storage service class (SCU) and communicate with a Remote Storage Service Class Provider (SCP) at the GFE PC for sending the images. Prior to moving the images, the DIN-PACS shall support the Query/Retrieve Storage Class as a Provider (SCP) to identify the required studies using both Patient and study level keys. The DIN-PACS shall respond to a "MOVE" to transfer the images.

The DIN-PACS shall support the Results Management service class both as a user and provider to allow results and interpretations to be exchanged.

The DIN-PACS shall respond to a DICOM query from a GFE PC using a Verification Service Class as a User (SCU). The GFE PC shall be able to initiate a query to a Verification Provider (SCP).

7.2.2 DIN-PACS AE - Specification

The DIN-PACS PC interface shall provide Standard Conformance to the following DICOM V3.0 SOP Class(es):

SOP Class Name	SOP Class UID	Usage
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	SCU
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCU
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCU
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.20	SCU
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	SCU
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCU
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCU
X-Ray Angiography Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCU
X-Ray Angiography Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	SCU
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCU
Patient Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.1.1	SCP
Patient Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.1.2	SCP
Study Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP
Study Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCP
Verification SOP Class	1.2.840.10008.1.1	SCP/SCU
Detached Results Management Meta SOP Class	1.2.840.10008.3.1.2.5.4	SCP/SCU

Note: Support of the retired Nuclear Medicine and Ultrasound Image Storage SOP classes is not required.

7.2.3 Required Attributes

The GFE PC and the DIN-PACS will exchange images which shall include all the appropriate patient and study information (i.e., an image or results object shall not be sent without the DIN-PACS ensuring that the study ID and all required attributes are available with the objects).

7.3 Communication Profiles

The GFE PC interface shall support TCP/IP as the communication protocol. The physical connection options shall be defined and provided by the vendor. As a minimum, the required communication profiles present in the medical facility, as specified in Appendices A and G, shall be supported.

7.3.1 Configurable Parameters

Any operational parameters which may influence performance and/or AE behavior need to be configurable. These include the following:

- Number of simultaneous associations
- Maximum PDU size
- Time out values
- Local AE titles
- Local IP address and Netmask
- Remote AE Title fields
- Responding TCP/IP ports and addresses

The vendor shall provide a complete list of these parameters including the value range of the configuration parameters.

7.3.2 Transfer and Presentation Syntax

The vendor shall accommodate a wide range of transfer and presentation syntax's. This includes both Implicit as well as Explicit VR Presentation syntax and Little as well as Big Endian transfer syntax. In addition, this interface shall support compressed transfer syntax as well, with, as a minimum, the default lossless and lossy compression schemes as specified in the DICOM standard.

7.3.3 Future Standard Extensions

The DIN-PACS vendor shall demonstrate plans for implementing future extensions to the DICOM implementation. This includes, but is not limited to, the capability for supporting additional Storage SOP classes using newly defined IOD's, and support of new, to be defined, results IOD's which include Structured Reporting.

8. Laser Printers and Other Hard Copy Devices

This section specifies the connectivity requirements for the DIN-PACS with laser printers and other hard copy devices (e.g., paper printer, etc.) used to print radiographic images. Images shall be sent from the DIN-PACS to the printer.

8.1 Introduction

Vendor implementation of the DICOM communication standard shall support and accommodate the following functional requirements:

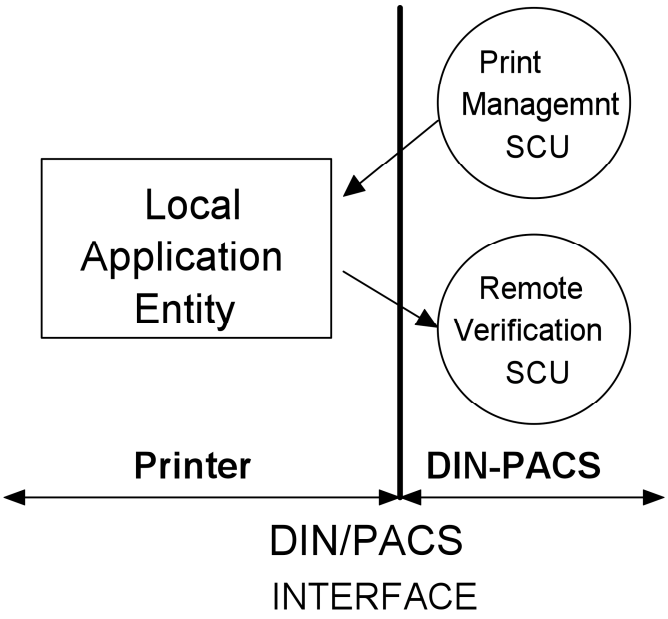
1. The primary activity of the printer is to produce hard copy radiographic images from the DIN-PACS system. The source of these images can be modalities, DIN-PACS workstations, DICOM Workstations, remote Teleradiology sites, or image archives.

2. The DIN-PACS shall verify printer status.

8.2 Implementation Model

The Implementation Model consists of an Application Data Flow Diagram, functional definitions of the Application Entities and their related Real-World Activities. The vendor shall describe how the DIN-PACS implementation meets the required functionality, i.e., how its specific Application Data Flow diagram shall map to the diagram specified below.

8.2.1 Application Data Flow Diagram



The functions of the Printer and DIN-PACS system are called “Real World Activities” and are identified as bubbles in the diagram. The Rectangle in the diagram is the Local Application Entity, i.e. the process at the Printer which is responsible for the DICOM communication. The DIN-PACS initiates a connection, negotiates the specific class of service and syntax of the transaction using an Association, and, if applicable, sends or receives information to and from the Printer.

The DIN-PACS shall function as a “User” of a Print Management service class (SCU) and communicate with a Remote Storage Service Class Provider (SCP) at the Printer for sending the images and additional information. It shall use the Basic Greyscale Print Management SOP class for the Session, Print box and Printer related communication, and the Basic Annotation Box and Image Overlay Box SOP Classes for the image annotations (text) and overlays.

The DIN-PACS shall initiate a query to a Verification Provider at a printer, i.e. it shall be a User of the Verification Service Class.

8.2.2 DIN-PACS AE - Specification

The DIN-PACS Printer interface shall provide Standard Conformance to the following DICOM V3.0 SOP Class(es):

SOP Class Name	SOP Class UID	Usage
Verification SOP Class	1.2.840.10008.1.1	SCU
Basic Greyscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	SCU
Basic Annotation Box SOP Class	1.2.840.10008.5.1.1.15	SCU
Image Overlay Box SOP Class	1.2.840.10008.5.1.1.24	SCU

8.3 Communication Profiles

The printer interface shall support TCP/IP as the communication protocol. The physical connection options shall be defined and provided by the vendor. As a minimum, the required communication profiles present in the medical facility, as specified in Appendices A and G, shall be supported.

8.3.1 Configurable Parameters

Any operational parameters which may influence performance and/or AE behavior need to be configurable. These include the following:

- Number of simultaneous associations
- Maximum PDU size
- Time out values
- Local AE titles
- Local IP address and Netmask
- Remote AE Title fields
- Responding TCP/IP ports and addresses
- Annotation ID's specifying the particular text and positioning of the annotations

The vendor shall provide a complete list of these parameters including the value range of the configuration parameters.

8.3.2 Transfer and Presentation Syntax

The vendor shall accommodate a wide range of transfer and presentation syntax's. This includes both Implicit as well as Explicit VR Presentation syntax and Little as well as Big Endian transfer syntax. In addition, this interface shall support compressed transfer syntax as well, with, as a minimum, the default lossless and lossy compression schemes as specified in the DICOM standard.

8.3.3 Future Standard Extensions

The DIN-PACS vendor shall demonstrate plans for implementing future extensions to the DICOM implementation. This includes, but is not limited to, the capability for supporting additional Storage SOP classes using newly defined IOD's, and support of new, to be defined, results IOD's which include Structured Reporting.

APPENDIX D - GLOSSARY OF ACRONYMS AND DEFINITIONS

ACR: American College of Radiology
ADT: Admission, Disposition and Transfer
AE: Application Entity
API: Application Programming Interface
ATM: Asynchronous Transfer Mode
BDF: Building Distribution Frame
BRI: Basic Rate Interface
CCU: Cardiac Care Unit
CDDI: Copper Distributed Data Interface
CDRL: Contract Data Requirements List
CHCS: Composite Health Care System
CHCS exam number: The internal entry number unique for every examination generated by the CHCS system.
cm: Centimeter
CPT: Clinical Procedure Type
CR: Computed Radiography
CR s-number: A Fuji unique number related to x-ray exposure to an imaging plate.
CT: Computed Tomography
CV/CVN: Air Craft Carriers
dB: Decibel
DoD: Department of Defense
DICOM: Digital Imaging and Communications in Medicine
DIN-PACS: Digital Imaging Network - Picture Archiving and Communications System
DOS: Disk Operating System
ENT: Ear, Nose and Throat
ER: Emergency Room
FDDI: Fiber Distributed Data Interface
FFD: Focus Film Distance
FM: Factory Mutual
FMP: Family Member Prefix
GFE: Government Furnished Equipment
GUI: Graphical User Interface
HIS: Hospital Information System
HL7: Health Level 7; a standard for electronic data interchange in the healthcare environment
HVAC: Heating, Ventilation and Air Conditioning
ICU: Intensive Care Unit
IOD: Information Object Definition
IPD: Images Per Day
ISDN: Integrated Services Digital Network
kVp: Kilovolt Potential
LAN: Local Area Network
LUT: Look Up Table
mAs: Milli Ampere Second
MDF: Main Distribution Frame
MDIS: Medical Diagnostic Imaging Support
mm: Millimeter
MRI: Magnetic Resonance Imaging
MTF: Medical Treatment Facility
MSDS: Materiel Safety Data Sheets
NEC: National Electrical Code
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association

NICU: Neonatal Intensive Care Unit
NM: Nuclear Medicine
OB/GYN: Obstetrics/Gynecology
OEM: Original Equipment Manufacturer
OR: Operating Room
OSKE: One Single Keystroke Equivalent
PA: Posterior Anterior
PACS: Picture Archiving and Communications System
PAD: Patient Administration Subsystem of CHCS
PAS: Patient Appointment and Scheduling Subsystem of CHCS
PC: Personnel Computer
PCMCIA: Personal Computer Memory Card International Association
PDU: Protocol Data Unit
POTS: Plain Old Telephone Service
PRI: Primary Rate Interface
PVC: Polyvinyl Chloride
PVD: Polyvinyl Dichloride
QC: Quality Control
RAM: Random Access Memory
RFP: Request for Proposals
RIS: Radiology Information System
RR: Recovery Room
SCU: Service Class User
SCP: Service Class Provider
SICU: Surgical Intensive Care Unit
SID: Source to Image Distance
SMPTE: Society of Motion Picture and Test Engineers
SNMP: Simple Network Management Protocol
SOP: Standard Operating Procedure
SSN: Social Security Number
TCP/IP: Transfer Control Protocol / Internet Protocol
UID: Unique Identifier
UL: Underwriters Laboratories
UPS: Uninterruptible Power Supply
US: Ultrasound
UTP: Unshielded Twisted Pair
VLANS: Virtual Local Area Network System
VNR: Virtual Network Routing
VR: Value Representation
WYSIWYG: What You See Is What You Get

APPENDIX E - ANNUAL WORKLOAD

PORTSMOUTH ACUTE CARE FACILITY						
DEPARTMENT	ROOM	ROOM NAME	CR	FILM	ANNUAL	IMAGES
	NO.			DIG'R	EXAMS	PER EXAM
RADIOLOGY	130610M	ULTRASOUND SUITE			9,000	30
RADIOLOGY	130822A	ANGIOGRAPHIC SUITE			1,500	40
RADIOLOGY	131005	R/F SUITE			2,500	8
RADIOLOGY	132605	DIGITAL CHEST ROOM			20,000	2
RADIOLOGY	133601	CT SUITE			11,000	23
RADIOLOGY	134403	MR SUITE			8,000	60
NUCLEAR MEDICINE	121117	COMPUTER ROOM			5,500	25
EMERGENCY ROOM	142102	DARKROOM	1		10,000	3
ORTHOPEDICS	161201	DARKROOM	1		20,000	3
RADIOLOGY	130601	2 RAD PROCESSING	1		10,000	3
RADIOLOGY	130801	5 RAD PROCESSING	1		30,000	3
RADIOLOGY	160241	FILM FILE ROOM		2	5,000	2
UROLOGY	221510	DARKROOM	1		3,500	4
OPERATING ROOM	321104	DARKROOM	1		11,000	2
MED SURG WARD	430401	STORAGE ROOM	1		11,000	2
		GRAND TOTALS	**7**	**2**	**158,000**	

ELMENDORF HOSPITAL			CR	FILM	ANNUAL	IMAGES
DEPARTMENT	ROOM	ROOM NAME		DIG'R	EXAMS	PER EXAM
RADIOLOGY	1E139	View Sort	1		11,000	2.5
RADIOLOGY	1E139	View Sort	1		11,000	2.5
Urology	2D184	Dark Room	1		300	2.5
OR	2E117	Dark Room	1		1,100	2.5
ICU	2F167	Alcove	1		300	2
RADIOLOGY	1E113	Film Sorting		1	3,000	2.5
RADIOLOGY	1D174	NM Scanning			1,313	20
RADIOLOGY	1D165	CT Scanner			2,300	40
RADIOLOGY	1D200	MRI Scanning			2,000	60
RADIOLOGY	1E107	Ultrasound			6,600	30
OR	2C156	C-Arm			100	2
OR	2E120	C-Arm			100	2
RADIOLOGY	1E143	Rad Fluoro			675	20
RADIOLOGY	1E145	Rad Fluoro			675	20
Urology	2D202	Rad Fluoro			20	2
RADIOLOGY	1E140	Chest Room	1		8,500	2
		GRAND TOTALS	**6**		**43,544**	

PENTAGON HEALTH CLINIC			CR	FILM	ANNUAL	IMAGES
DEPARTMENT	ROOM	ROOM NAME		DIG'R	EXAMS	PER EXAM
RADIOLOGY	MF868	View Sort		1	360	2
RADIOLOGY	MF866	Ultrasound	1		3,000	2.5
RADIOLOGY	MF868	View Sort	1		3,000	2.5
RADIOLOGY	MF866	Ultrasound			*960*	30
RADIOLOGY	MF867	Rad Fluoro			480	6
TELERAD REFERRALS					*7,000*	2
		GRAND TOTALS	**2**		**14,440**	

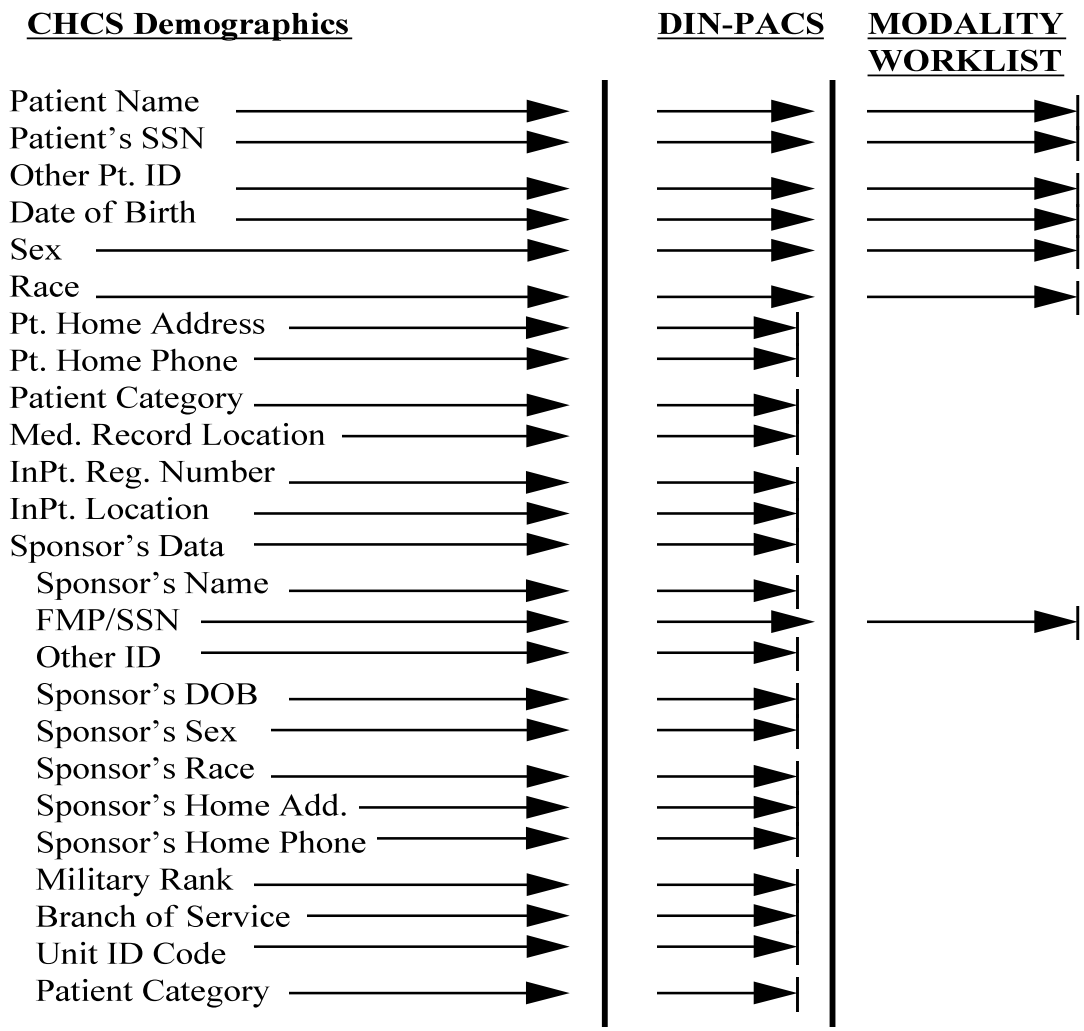
APPENDIX F - DIN-PACS INTERFACE DIRECTIONS

1. General

This appendix depicts the data elements and their direction of movement between CHCS, DIN-PACS, and the acquisition modalities. The arrows indicate the point of origin, storage location, and destinations. The data flow is indicated for the different phases of implementations to clarify the functionality expectations. Vendors are reminded that the desired goal is to achieve bi-directional HIS/RIS functionality with support of DICOM Worklist management. In the examples below the data elements are passed to the **MODALITY WORKLIST** the night before a scheduled appointment or at patient arrival. The CHCS HL7 Interface Specification for CHCS S/W Version 4.5, submitted in response to Contract DAHC 94-88-D-0005, SAIC/CHCS Doc. TC-4.5-0044, 8 July 1996 is attached to the solicitation.

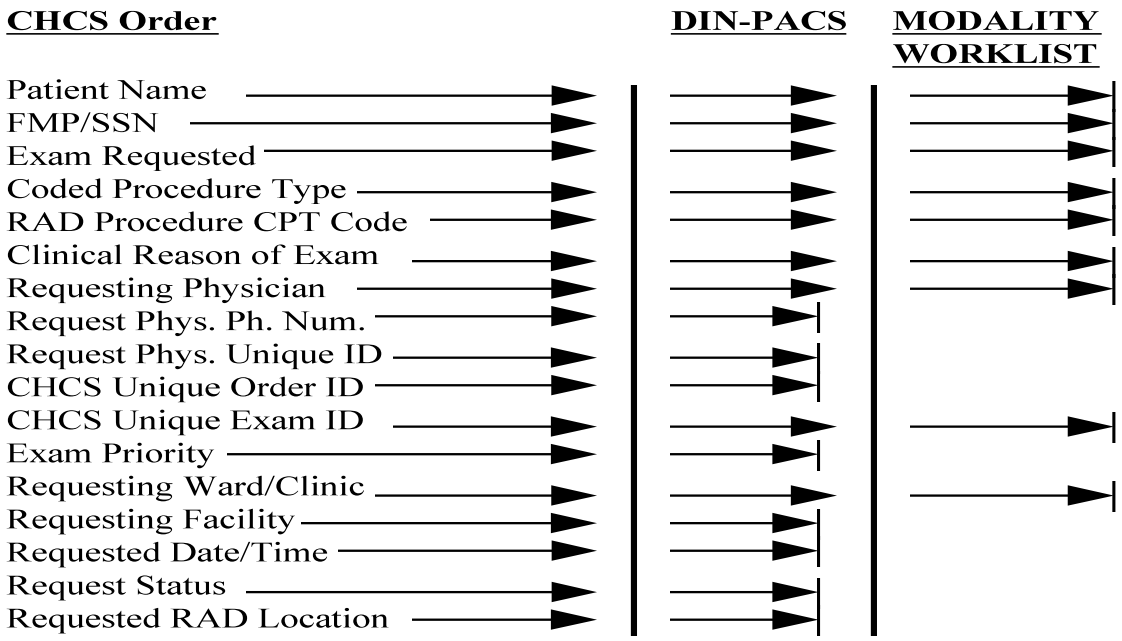
1.1 Patient Registration

Minimum data elements that shall be passed with the CHCS **patient registration** data from CHCS to DIN-PACS.



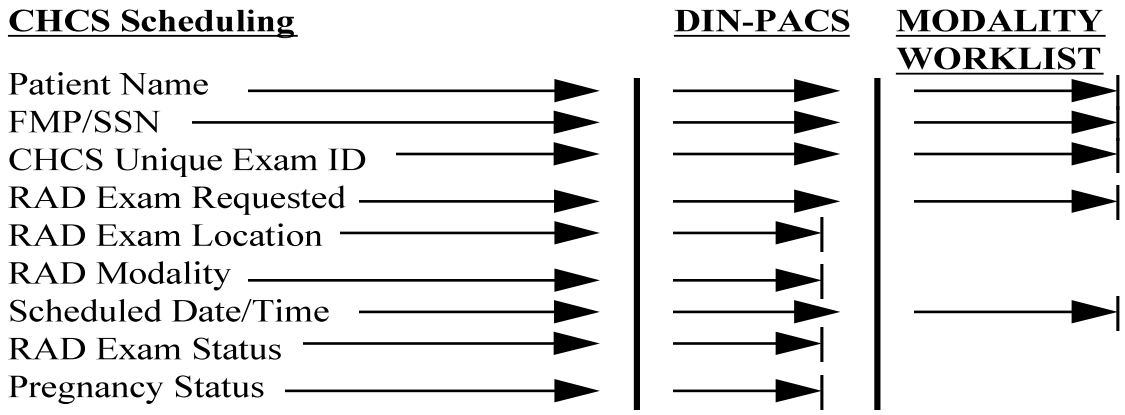
1.2 Order Entry

Minimum data elements that shall be passed with the **CHCS order entry** data from CHCS to DIN-PACS.

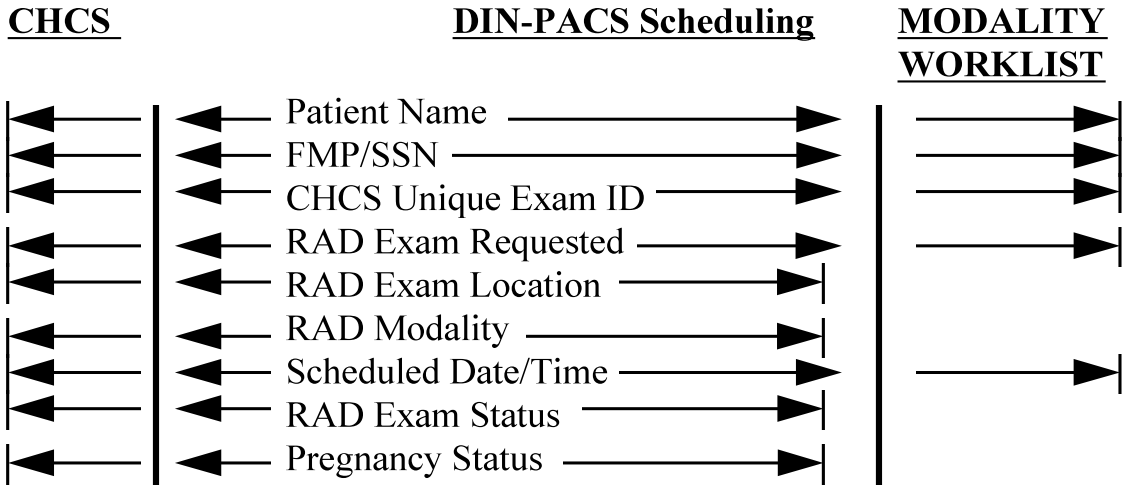


1.3 Patient Scheduling

Minimum data elements that shall be passed with the **patient scheduling** data from CHCS to DIN-PACSin Phase I. The information will be passed preferably to the modality the night before the exam is scheduled.

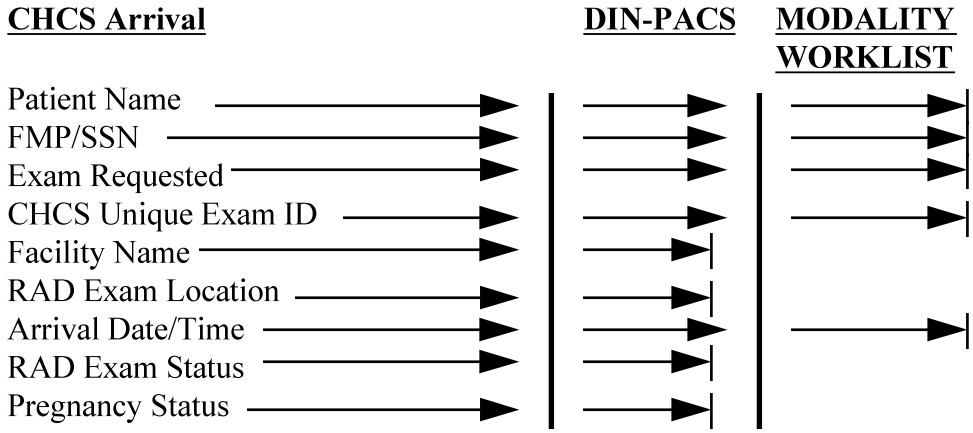


Minimum data elements that shall be passed with the **patient scheduling** data from DIN-PACSin Phase II and III. The information is passed to the modality the night before the exam is scheduled.

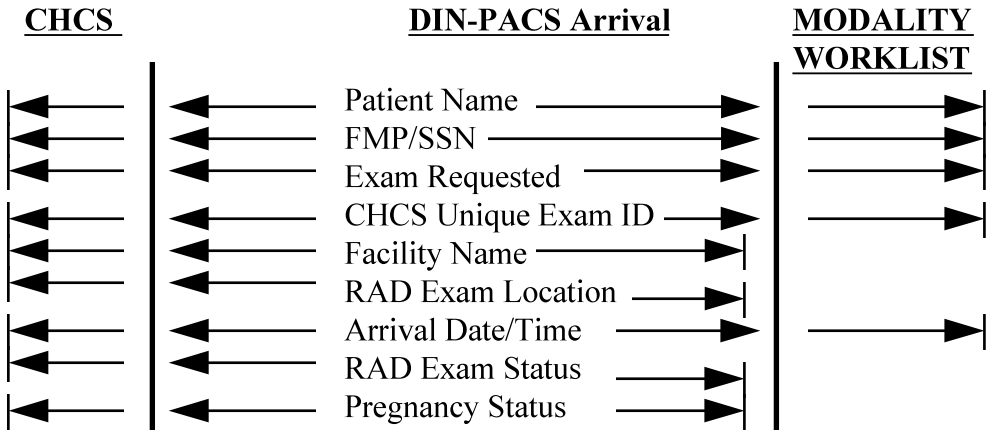


1.4 Patient Arrival

Minimum data elements that shall be passed with the **patient arrival** data from CHCS to DIN-PACSin Phase I.

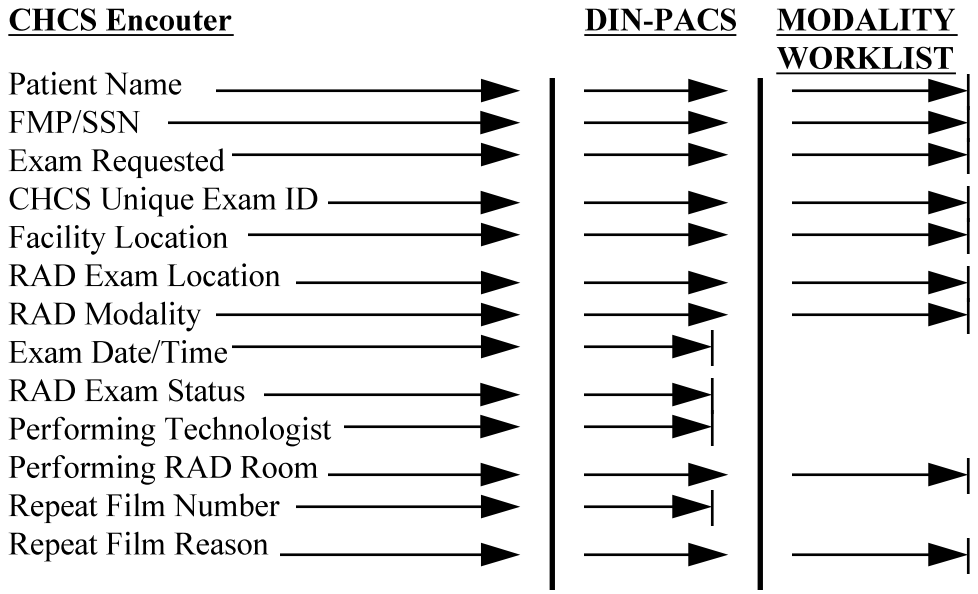


Minimum data elements that shall be passed with the **patient arrival** data in DIN-PACS in Phase II and III.

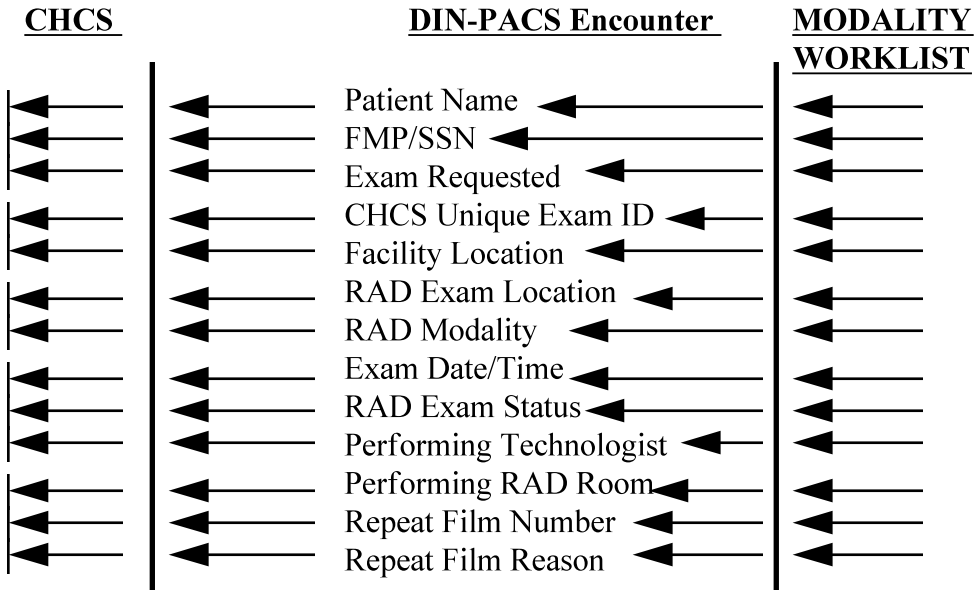


1.5 Radiology Encounter

Minimum data elements that shall be passed with the CHCS **radiology encounter** data from CHCS to DIN-PACSin phase I.

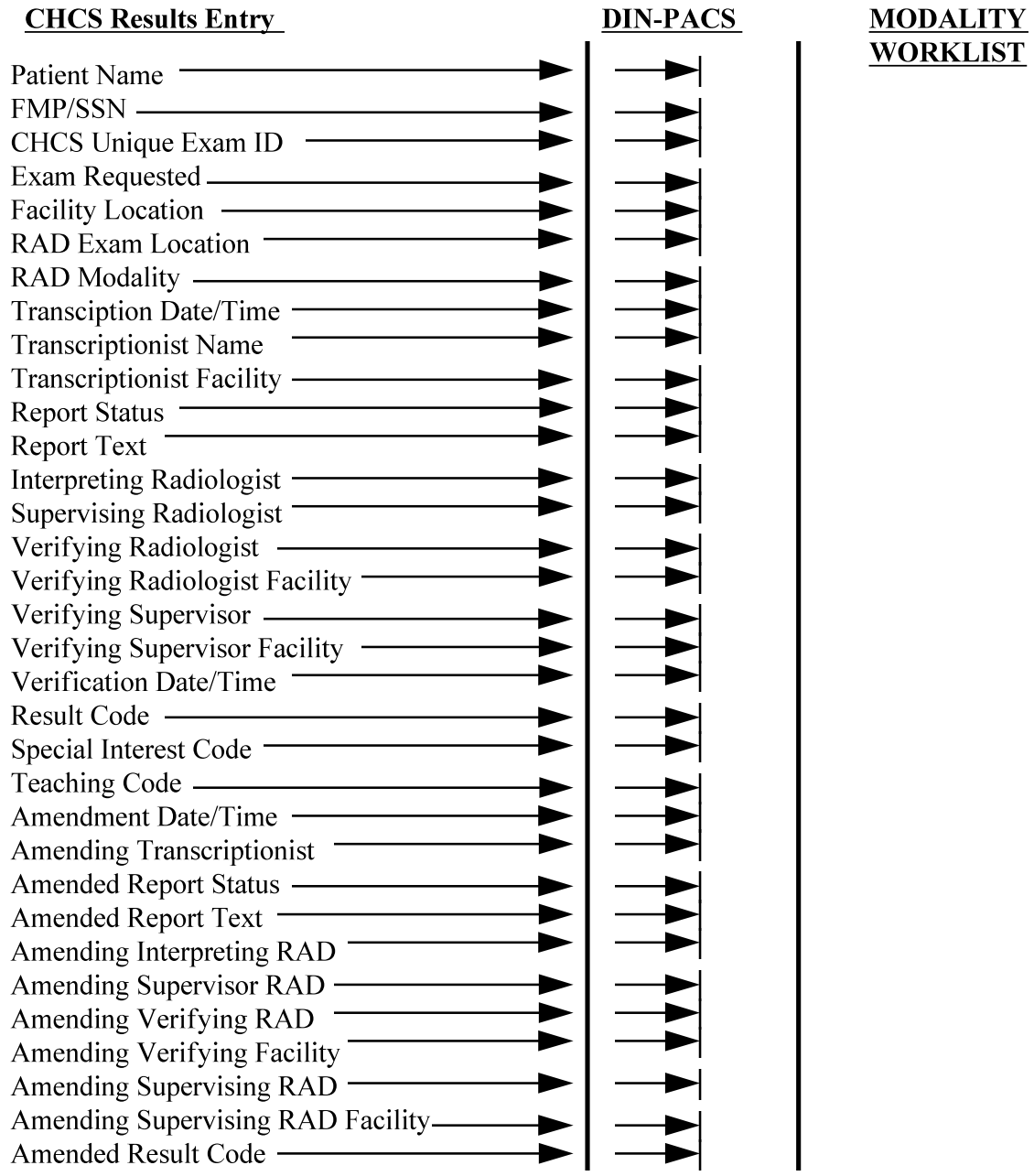


Minimum data elements that shall be passed with the **radiology encounter** data in DIN-PACS in Phase II and III. The radiology encounter data may flow from the acquisition modality to DIN-PACS, or from DIN-PACS to CHCS.

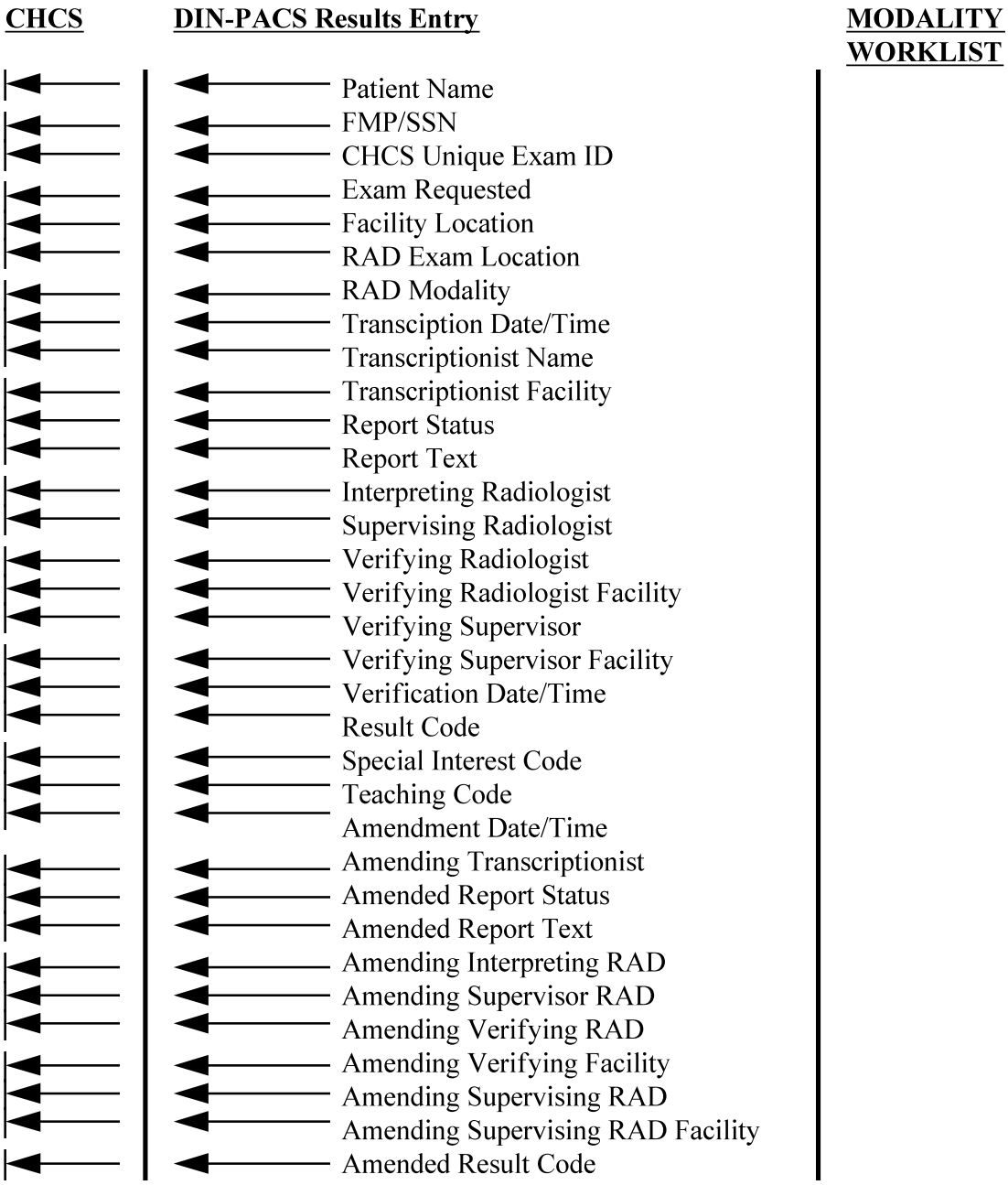


1.6 Results Entry

Minimum data elements that shall be passed from CHCS to DIN-PACS for radiology **results entry** in phase I.



Minimum data elements that shall be passed from DIN-PACS to CHCS for radiology **results entry** in phase II and III.

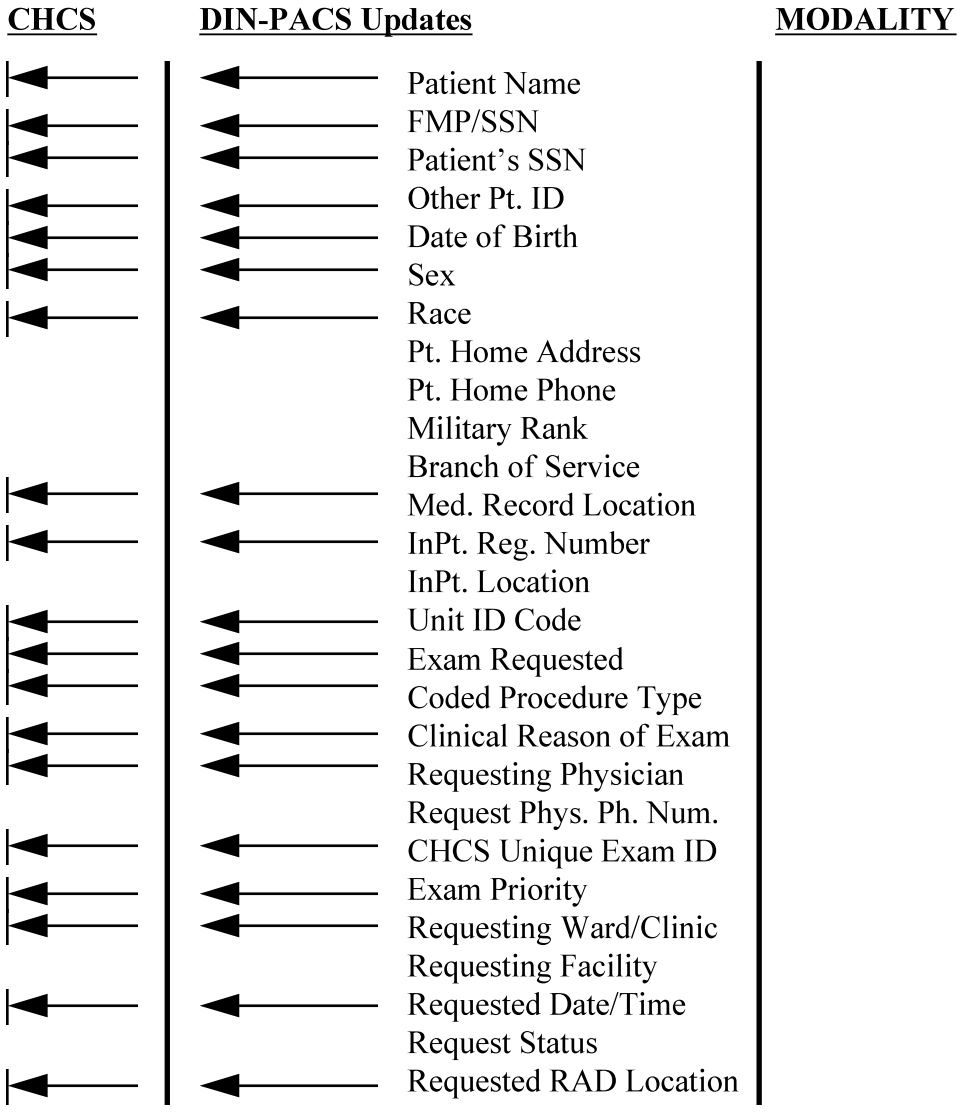


1.7 Results Distribution

CHCS will handle **results distribution** to the requesting facilities and requesting physicians. DIN-PACS shall handle **results distribution** to the DIN-PACS workstations and in the teleradiology scenarios.

1.8 Order Transfer to CHCS

In phase II and III the following data elements shall be passed from DIN-PACS to CHCS, when CHCS is not operational. Additionally, in teleradiology scenarios, DIN-PACS may receive exams from remote loactions that are not connected to the CHCS in the DIN-PACS location. DIN-PACS shall be able to update CHCS.



APPENDIX G - GOVERNMENT FURNISHED COMMUNICATIONS NETWORKS

1. Naval Medical Center Portsmouth

A communications infrastructure has been designed and built into the walls of the new medical facility. All fiber in the building stems from the main distribution frame in the Acute Care Facility building (communications closet 1D0-3) where a Bay Networks BCN enterprise router shall be housed. The network represents a collapsed architecture design. Fiber is brought from the communications center to communications closets locate at various locations on the floors. Ethernet, and possibly ATM, shall be run from the closet to the desktop over fiber or copper, as available.

In addition to the standard communications systems, there is also a dedicated 288 fiber backbone within the Radiology department. This backbone is strictly limited to the eight (8) computer rooms within the Radiology department and one (1) additional computer room on the second floor directly above the Radiology department. This backbone is physical media only. No hubs, switches or routers are provided on this backbone.

At this time, the Government expects to implement an ATM backbone in the building. Switched Ethernet or fast switched Ethernet may be used from the communication closets to the imaging devices listed in Appendix A. At design, the Acute Care Facility expected to support the DIN-PACS system using fiber from the acquisition points to the communications closets, from the closets to the MDF via the hospital backbone, and from the MDF to the radiology computer rooms via the imaging backbone. The DIN-PACS contractor should consider providing workstations, long term archive, and image servers utilizing direct ATM connections since this would be consistent with the hospital backbone design. The vendor can anticipate access to 25 percent of the Broadband Fiber Optic Distribution System Riser to support DIN-PACS. Fast switched/shared Ethernet might potentially be considered for selected non-radiology department workstations (see Appendix B). The idea behind this design is to maximize the network bandwidth and reduce collision domains. By using a switched Ethernet type of network, the Government looks to achieve a virtual LAN environment which shall facilitate troubleshooting and system management. At this time the Government anticipates implementing multiple Virtual Local Area Networks (VLANs), at least one of which shall be dedicated to imaging. The enterprise router in 1D0-3 shall support Virtual Network Routing (VNR - routing between VLANs).

The government shall be providing the hospital backbone and closet network components for the hospitals information systems excluding DIN-PACS. Baynetworks 5000AH/BH hubs and Centillion C-100 Switches shall from the main ATM cell matrix in the 1D0-3 MDF. ATM OC-3 shall provide “uplinks” to the individual communications closets. One OC-3 uplink is anticipated at this time. Each closet shall contain a Centillion Switch and a 5000N hub. The Switch shall provide VLAN generation and make these VLANs available to the 5000N.

The infrastructure currently being installed in the new facility shall probably be extended out onto other campuses and into the metropolitan area via Metropolitan Area Network (MAN) at some point in the future although such an expansion shall not be included within the scope of work of the DIN-PACS project.

The DIN-PACS Contractor is expected to provide notional drawings, a network model for loading analysis and a demonstration of a maximally loaded network performance of his network to demonstrate how they shall utilize the dedicated Radiology (i.e. 288 fiber) infrastructure and provide interfaces to the Government furnished VLAN environment.

2. Elmendorf Air Force Hospital

Elmendorf Air Force Base Hospital is a new construction project due to open for beneficial occupancy on or about February, 1998. Located on Elmendorf Air Force Base (EAFB) in Anchorage, Alaska, the hospital is the largest of the DoD medical treatment facilities in Alaska and will potentially serve as a regional archive for EAFB hospital as well as a redundant archive for the Indian Health Services Medical Center and the VA Medical Center, both in Anchorage. Plans for teleradiology and telemedicine connectivity have not been developed yet but meetings on this subject are expected to begin in late January, 1997. Outcomes of these meetings are expected to include a cooperative teleradiology and telemedicine system which links all Federal health care facilities and provides consultative support, primary and redundant archiving of examination data, and radiographic images.

The initial sites designated for connection to Elmendorf are: Fort Richardson Health Clinic, approximately five miles from Elmendorf with a workload of 10 radiological exams per day (20 film digitized images) and Bassett Army Community Hospital in Fairbanks, 350 miles north, with a consultative workload. Bassett has two radiologists assigned and will be designed to have its own archive. Additional connectivity to Tripler Army Medical

Center in Hawaii, Madigan Army Medical Center in Washington State and Travis Air Force Medical Center in Fairfield, CA, are planned for consultative purposes. All connections will be made with Government furnished telecommunications.

Elmendorf Air Force Hospital is constructed in three floors with two interstitial floors for utility and networking connectivity. Each DIN-PACS equipment location designated in Appendix A and B has one Category 5 UPT, one Category 3 telephone/data UTP connection and two unused data plate ports with open conduit and pull wires leading to the supporting communication closet. Communication closets all have 14 multi-mode and 4 single-mode optical fibers available for use. All fibers run from the communications closet to the central computer room and are terminated with SC connectors.

A designated radiology computer room is available to house the DIN-PACS central components and is located in the Radiology Department on the first floor. There are no network connections from this computer room to the central computer room. However, conduit and cable tray access are available for DIN-PACS use from the radiology communications closet to the radiology computer room.

Existing hospital network will be a switched Ethernet that provides 100 MHz to the desk top. Hubs in each communication closet will provide local area VLANs and are segmentable into 3 segments. The DIN-PACS vendor shall purchase additional cards for use in these hubs if required. Additional space in the communications closets is available for vendor-provided network equipment.

3. General Case

The Contractor shall describe their general network design requirements so that future locations can provide as much of the network as possible, and still keeping it designed specifically for DIN-PACS. While the government may opt to buy the entire network from the contractor, the government may instead choose to provide the entire network infrastructure themselves, this network shall be designed according to the general requirements stated by the DIN-PACS contractor. Network requirements shall be evaluated as part of the overall cost of the system. The government may also only provide the necessary cabling and fiber for the network and purchase the network devices as part of the DIN-PACS system.

The hospital network shall interface to the DIN-PACS system at one or more locations. Addressing and configuration schemes shall be assigned by the hospital network manager or the Base network manager. The government shall either provide a port for the DIN-PACS to connect to or shall provide a cable/fiber to connect to the DIN-PACS network.

APPENDIX H - SITE CONFIGURABLE FUNCTIONS LISTING

The purpose of this appendix to highlight for the convenience of the offeror those minimum site and user configurable functions identified elsewhere within the statement of work. Additional configurable functions may be required in order for the vendor's system to conform with the statement of work. The vendor is not precluded from offering additional functionality and configuration options.

The following is a listing of site and user configurable functions:

1.2.2.2 Second sentence: If the system relies on autorouting, then it shall be based on a site configurable algorithm…

1.4 Paragraph 1: Where appropriate (i.e., at the Government's discretion on a site specific basis), to guarantee against catastrophic failure, loss of image exam information, and interruption of clinical services, the vendor shall supply an uninterruptable Power Supply (UPS), sufficient to provide a minimum of 15 minutes of continued operation.

3.3.1 Paragraph E:Creation of specific worklists shall be a tool used by both the Government and Contractor system administrator to configure the system to each individual facility .....

3.3.2 Paragraph E: ..... This status change shall be reflected in the worklist. This function shall be configurable by the system administrator.

3.3.3 Site configurable privileges shall be assigned to control access to functions of the DIN-PACS.

3.3.4.4 Paragraph B: The production of default display protocols shall be provided as a tool allowing the Contractor's system administrator to construct these protocols as defined by the users.
Paragraph H: Creation/modification of site wide defaults shall require system administrator intervention.

3.3.14 Each workstation shall include an automatic time out function with a user-adjustable time default set by the system administrator ....

3.3.16 The cancel operation is a System Administrator definable function.

4.2.1 Paragraph A: Lossy compression and/or downsampled images is acceptable for PC workstations and shall be considered on a site configurable basis for image archive.

4.2.1 Paragraph E: The compression method and degree of compression shall be locally selectable.

4.2.2 Paragraph B and C: ....the exams and reports are automatically purged from the short-term storage on a first-in first-out basis to create space for additional exams. This feature shall be site configurable.

4.2.3 Paragraph D: All storage shall be scaleable, upgradeable and site configurable.

4.3.2 Paragraph C: Teaching file shall be site configurable.

4.4.13 Paragraph C: The system administrators shall be able to assign privileges and passwords to the DIN-PACS users.

4.5.1 Paragraph A: A site configurable intelligent examination prefetch from the archive shall be provided.

4.5.3 Paragraph C: The fetch capability shall be configurable with multiple levels on manual fetch priority.

5. Paragraph B: The hardware may be configurable so that DIN-PACS traffic is isolated from other hospital network traffic.

7.2.5 Paragraph L: This STAT exam indicator shall be site configurable.

7.3.4 Paragraph D: ....each workstation shall be configured with a default printing location.

7.3.4 Paragraph M: number of copies in excess of a site definable quantity shall require verification.

8.3 Paragraph C: Spoke exams shall be sent for archive based on any one of the following three site selectable, events .....

APPENDIX C: DICOM FUNCTIONALITY OF DIN-PACS

3.5.1 Configurable Parameters
4.3.1 Configurable Parameters
5.3.1 Configurable Parameters
6.3.1 Configurable Parameters
7.3.1 Configurable Parameters

APPENDIX I - CLINICAL SCENARIOS

These clinical scenarios are to be used as examples of current radiology practice in facilities without PACS and what is envisioned to be the radiology practice when DIN-PACS is implemented. In each scenario, the Composite Health Care System (CHCS) is to be considered the Hospital Information System (HIS). CHCS-RAD is the Radiology Information System (RIS) embedded in CHCS. In the DIN-PACS scenarios, a bi-directional interface to CHCS is required. It is also required that DIN-PACS be able to interface with acquisition modalities like Computed Radiography (CR), Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Ultrasound (U/S), and Nuclear Medicine (NM). These scenarios do not include every patient/modality/scheduling example of a radiology department's operation, but most radiology patients/modalities/schedules operate close to the flowcharted examples.

SCENARIOS 1 and 2 - CURRENT FILM BASED SCENARIO'S WITH CHCS

Scenarios 1 and 2 are examples of a film based radiology department with CHCS-RAD as the RIS. The step numbers in the scenario correspond to the event icons in the flowcharts.

SCENARIOS 3 and 4 - DIN-PACS with CHCS-RAD as RIS

Scenarios 3 and 4 are examples of the functionality of the DIN-PACS using CHCS-RAD as the DIN-PACS RIS. The step numbers in the scenario correspond with the event icons in the flowchart.

SCENARIOS 5 and 6 - DIN-PACS WITH AN INTERNAL DIN-PACS/RIS

Scenarios 5 and 6 are examples of the functionality of the DIN-PACS with an internal RIS and an interface to CHCS. The step numbers in the scenario correspond with the event icons in the flowchart.

Scenario 1 - Film Based Unscheduled Walk-In Patient. (See Figure 1)

1. - The patient has been registered, the patient's sponsor and demographic information has been entered into CHCS
2 - The patient has seen a physician in the Emergency Room or Walk-in-clinic and the physician has requested a radiology examination. Once the physician signs/accepts the order, the exam is marked ORDERED in CHCS-RAD.
3. - The patient proceeds to the Radiology Department.
4. - The patient's demographic and exam data are called up in CHCS-RAD, if the exam can be done now, the patient is questioned about pregnancy if applicable, and the exam is marked as ARRIVED.
5. - CHCS-RAD generates the appropriate paperwork. The paperwork contains patient exam and demographic data that travels with the patient and with the patient's radiographs through the radiology department, until the radiologist reads the exam.
6. - The patient is taken into a radiographic room and the examination is accomplished.
7. - The radiographs are developed and matched to the paperwork.
8. - The technologist reviews the radiographs for accuracy/quality and departs the patient in CHCS-RAD.
9. - The images are matched to an old film folder if available, or a new film folder is created.
10. - Existing film folder is pulled from file room.
11. - The film folder and new images travel to radiologist's office for interpretation.
12. - The radiologist interprets the images.
13. - The radiologist dictates a radiographic report.
14. - The film folder is returned to the file room.
15. - The transcriptionist enters the radiographic report into CHCS-RAD. When the transcription is completed the exam is marked TRANSCRIBED in CHCS-RAD.
16. - The radiologist checks the radiographic report for accuracy in CHCS.
17. - The radiologist can re-dictate the report and send it back to transcription.
18. - When the radiologist is satisfied, the report is verified. CHCS-RAD marks the exam as COMPLETE.
19. - Once the radiographic report is verified it is available to the requesting physician on CHCS.
20. - Hard copies of the report are generated for the film folder and the patient's medical record.

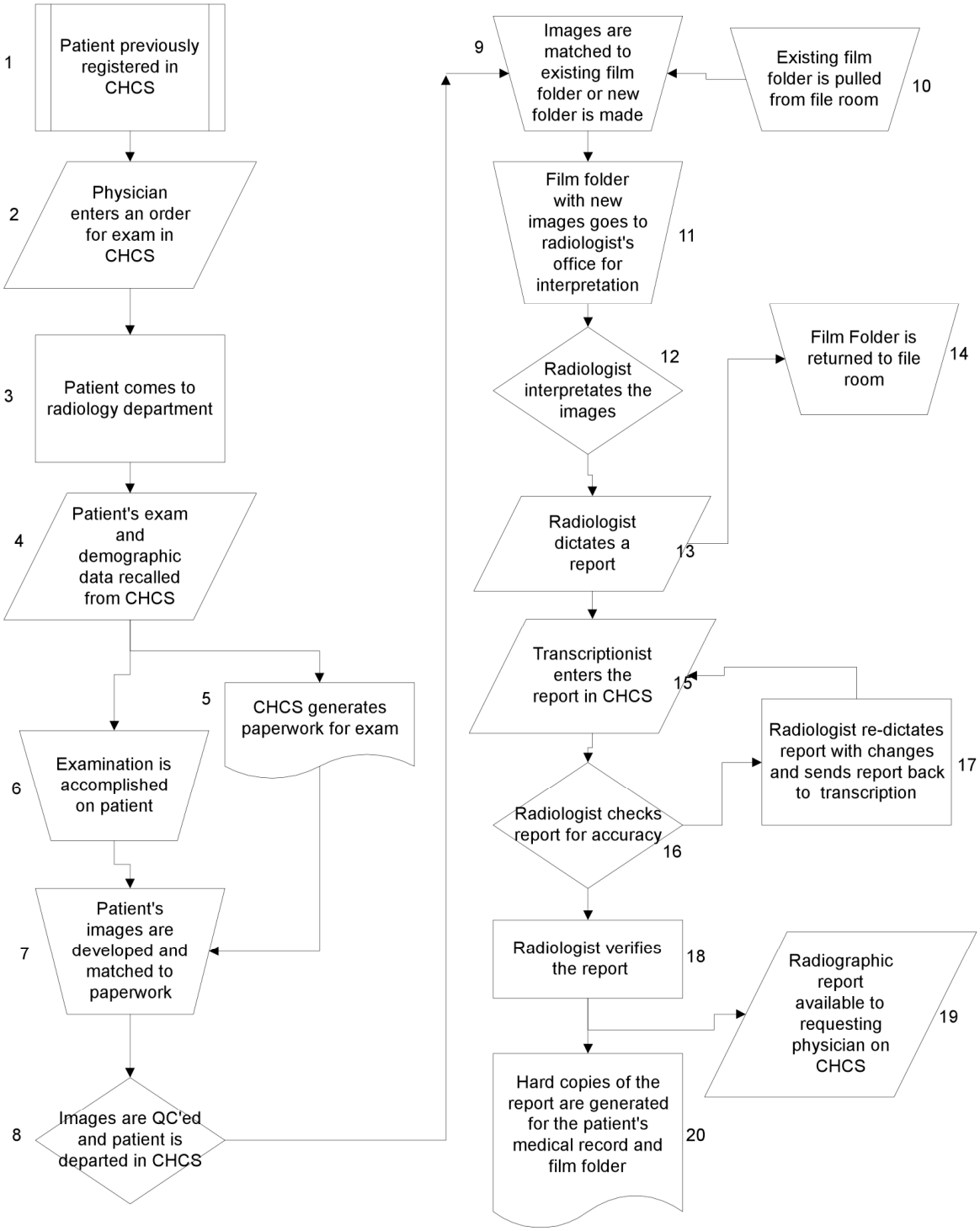


Figure 1, Film Based Un-scheduled Walk-In Patient

Scenario 2 - Film Based Scheduled Patient for a Radiology Appointment (See Figure 2)

1. - The patient has been registered, the patient's sponsor and demographic information has been entered into CHCS
2 - The patient has seen a physician in the Emergency Room or Walk-in-clinic and the physician has requested a radiology examination that must be scheduled. Once the physician signs/accepts the order, the exam is marked ORDERED in CHCS-RAD.
3. - The patient proceeds to the Radiology Department.
4. - The patient's demographic and exam data are called up in CHCS-RAD
5. - The patient's exam is scheduled using CHCS-RAD. CHCS marks the exam as SCHEDULED.
6 - Usually on the day prior to the patient's appointment, CHCS/RAD will generate a pull list so a patient's film folder can be pulled from the file room.
7. - The patient returns on the date and time scheduled, for the examination. The patient is questioned about pregnancy if applicable, and the exam is marked as ARRIVED in CHCS-RAD.
8. - CHCS-RAD generates the appropriate paperwork. The paperwork contains patient exam and demographic data that travels with the patient and with the patient's radiographs through the radiology department, until the radiologist reads the exam.
9. - The patient is taken into a radiographic room and the examination is accomplished.
10. - The radiographs are developed and matched to the paperwork.
11. - The technologist reviews the radiographs for accuracy/quality and departs the patient in CHCS-RAD the exam is marked EXAMINED.
12. - Images are matched to an old film folder, that was previously pulled, or new film folder is created.
13. - The pull list that was generated, by CHCS the evening prior to the exam is used in the file room to pull existing film folders.
14. - The film folder and new images travel to radiologist's office for interpretation.
15. - The radiologist interprets the images.
16. - The radiologist dictates a radiographic report.
17. - The film folder is returned to the file room.
18. - The transcriptionist enters the radiographic report into CHCS-RAD. When the transcription is completed, the exam is marked TRANSCRIBED in CHCS-RAD.
19. - The radiologist checks the radiographic report for accuracy in CHCS.
20. - The radiologist can re-dictate the report and send it back to transcription.
21. - When the radiologist is satisfied, the report is verified. CHCS-RAD marks the exam as COMPLETE.
22. - Once the radiographic report is verified it is available to the requesting physician on CHCS.
23. - Hard copies of the report are generated for the film folder and the patient's medical record.

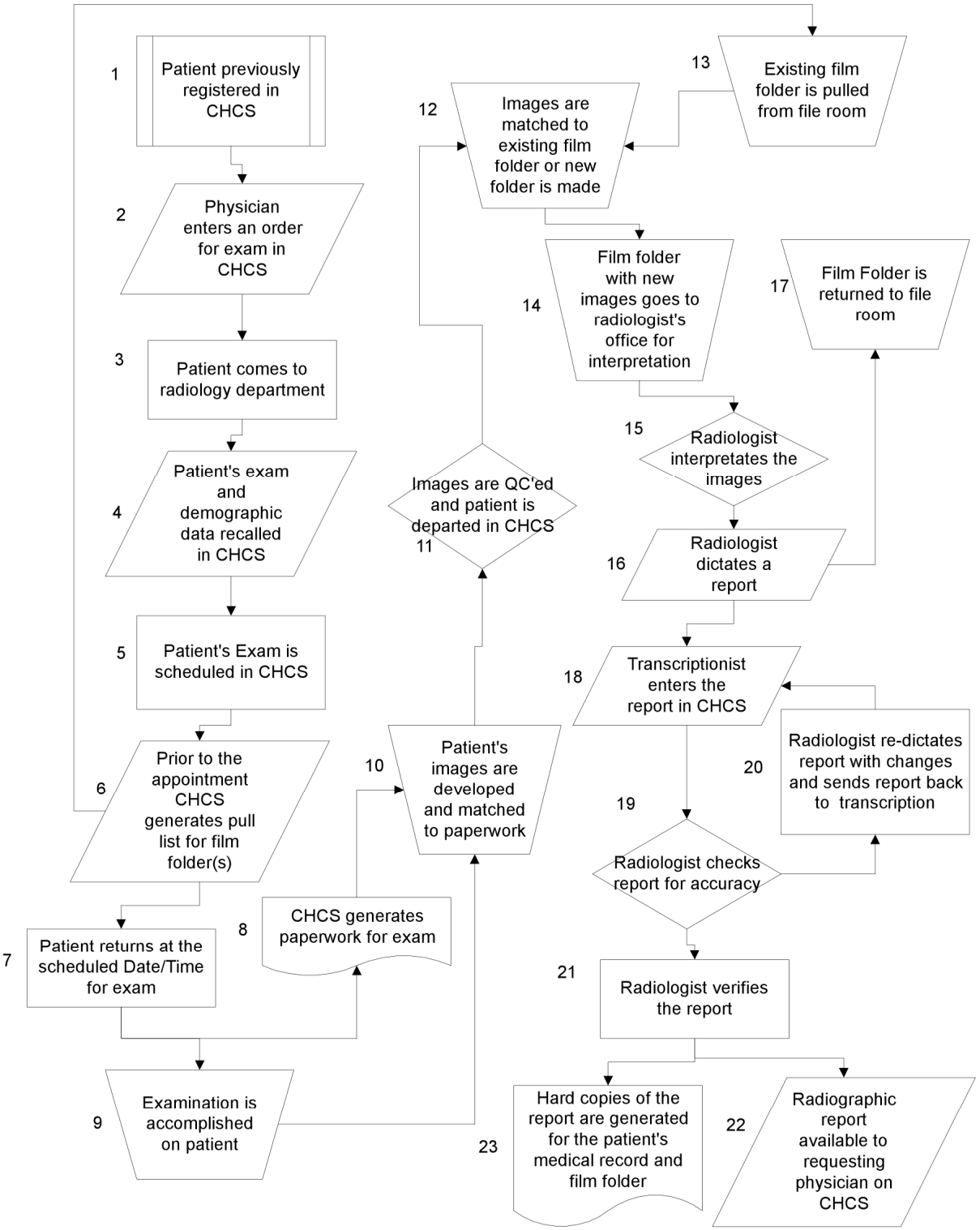


Figure 2, Film Based Scheduled Patient

Scenario 3 - DIN-PACS Walk-In Patient with CHCS-RAD as RIS (See Figure 3)

1. - The patient has been registered, the patient's sponsor and demographic information has been entered into CHCS
2 - The patient has seen a physician in the Emergency Room or Walk-in-clinic and the physician has requested a radiology examination. Once the physician signs/accepts the order, the exam is marked ORDERED in CHCS-RAD.
3. - The patient proceeds to the Radiology Department.
4. - The patient's demographic and exam data are called up in CHCS-RAD, if the exam can be done now, the patient is questioned about pregnancy if applicable, and the exam is marked as ARRIVED.
5. - Patient arrival triggers the patient and exam data to be sent to the acquisition modalities.
6. - Patient arrival triggers the DIN-PACS to look for archived exams.
7. - The patient's exam is acquired digitally.
8. - The DIN-PACS prefetches and autoroutes old exams if indicated.
9. - The technologist reviews the images for accuracy/quality at the acquisition modality. If the images are accepted, a message is sent to CHCS-RAD that the patient is finished and the exam is marked EXAMINED.
10. - The digitally acquired exam is sent to DIN-PACS.
11. - The images are autorouted to the appropriate DIN-PACS workstation where they are queued to be displayed. Prefetched exams from the archive are placed with the new exam at the workstation.
12. - The radiologist reads the exam at the DIN-PACS workstation and views the prefetched exams as needed. Prefetched exams are displayed with their radiographic reports.
13. - The radiologist dictates a radiographic report on the current exam.
14. - The transcriptionist enters the radiographic report into CHCS-RAD. When the transcription is completed the exam is marked TRANSCRIBED in CHCS-RAD.
15. - The radiologist checks the radiographic report for accuracy in CHCS.
16. - The radiologist can re-dictate the report and send it back to transcription.
17. - When the radiologist is satisfied, the report is verified. CHCS-RAD marks the exam as COMPLETE.
18. - Once the radiographic report is verified it is available to the requesting physician on CHCS.
19. - Hard copies of the report are generated for the patient's medical record.
20. - A copy of the report will automatically pass into DIN-PACS to be displayed with the exam.

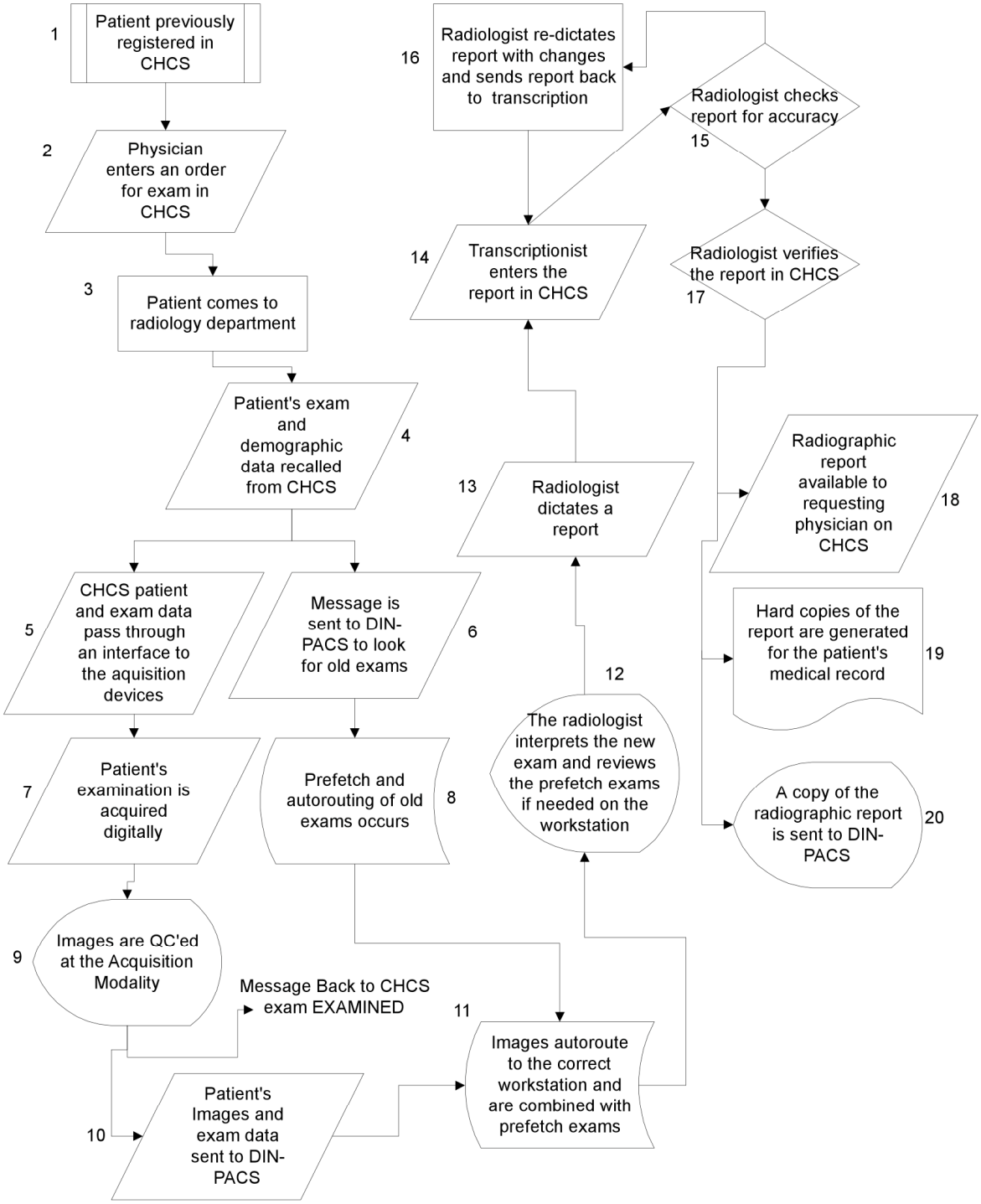


Figure 3, DIN-PACS Walk-In Patient with CHCS-RAD as RIS

Scenario 4 - DIN-PACS Scheduled Patient with CHCS-RAD as RIS (See Figure 4)

1. - The patient has been registered, the patient's sponsor and demographic information has been entered into CHCS
2 - The patient has seen a physician in the Emergency Room or Walk-in-clinic and the physician has requested a radiology examination that must be scheduled. Once the physician signs/accepts the order, the exam is marked ORDERED in CHCS-RAD.
3. - The patient proceeds to the Radiology Department.
4. - The patient's demographic and exam data are called up in CHCS-RAD
5. - The patient's exam is scheduled using CHCS-RAD. CHCS marks the exam as SCHEDULED.
6. - On the evening prior to the patient's appointment, CHCS/RAD will generate a pull list from which DIN-PACS can perform a prefetch of old exams from archive.
7. - The patient returns to radiology on the Date/Time of their appointment. The patient is questioned about pregnancy if applicable, and the exam is marked as ARRIVED in CHCS-RAD.
8. - Patient arrival triggers the patient and exam data to be sent to the acquisition modalities.
9. - The prefetch and autoroute of old exams occurs.
10. - The patient's exam is acquired digitally.
11. - The technologist reviews the images for accuracy/quality at the acquisition modality. If the images are accepted, a message is sent to CHCS-RAD that the patient is finished and the exam is marked EXAMINED.
12. - The digitally acquired exam is sent to DIN-PACS.
13. - The images are autorouted to the appropriate DIN-PACS workstation where they are queued to be displayed. Prefetched exams from the archive are placed with the new exam at the workstation.
14. - The radiologist reads the exam at the DIN-PACS workstation and views the prefetched exams as needed. Prefetched exams are displayed with their radiographic reports.
15. - The radiologist dictates a radiographic report on the current exam.
16. - The transcriptionist enters the radiographic report into CHCS-RAD. When the transcription is completed the exam is marked TRANSCRIBED in CHCS-RAD.
17. - The radiologist checks the radiographic report for accuracy in CHCS.
18. - The radiologist can re-dictate the report and send it back to transcription.
19. - When the radiologist is satisfied, the report is verified. CHCS-RAD marks the exam as COMPLETE.
20. - Once the radiographic report is verified it is available to the requesting physician on CHCS.
21. - Hard copies of the report are generated for the patient's medical record.
22. - A copy of the report will automatically pass into DIN-PACS to be displayed with the exam.

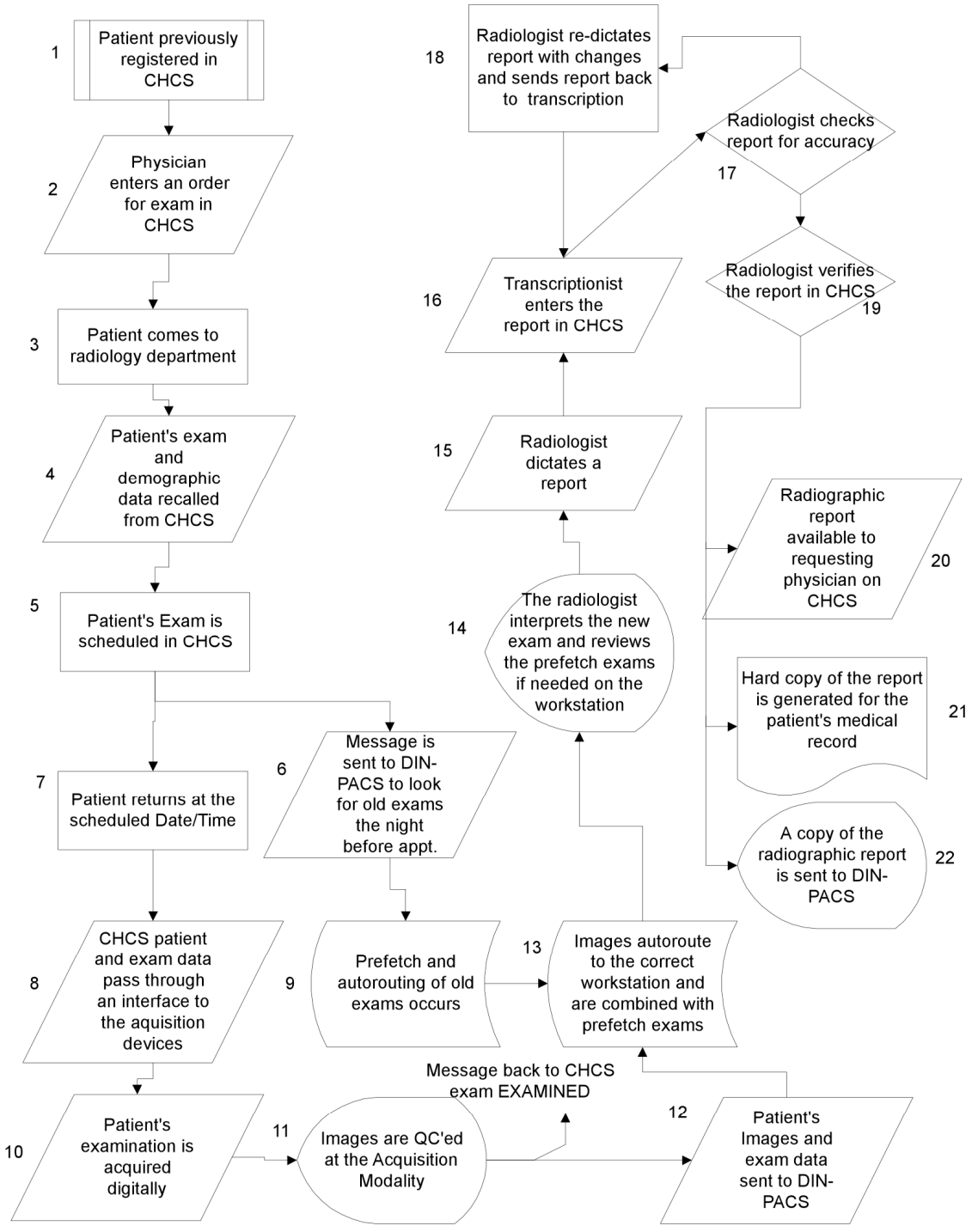


Figure 4, DIN-PACS Scheduled Patient with CHCS-RAD as RIS

Scenario 5 - DIN-PACS/RIS Walk-In Patient (See Figure 5)

1. - The patient has been registered, the patient's sponsor and demographic information has been entered into CHCS.
2 - The patient has seen a physician in the Emergency Room or Walk-in-clinic and the physician has requested a radiology examination. Once the physician signs/accepts the order, the exam is marked ORDERED in CHCS-RAD.
3. - The patient proceeds to the Radiology Department.
4. - The DIN-PACS/RIS - CHCS interface will have placed the patient's demographic and exam data into the DIN-PACS/RIS.
5. - If the exam can be done now, the patient is questioned about pregnancy if applicable. When the exam data is acknowledged, in the DIN-PACS/RIS, a message will be sent to CHCS and the CHCS exam status will be changed to ARRIVED.
6. - Patient arrival triggers the patient and exam data to be sent to the acquisition modalities.
7. - Patient arrival triggers the DIN-PACS to look for archived exams.
8. - The patient's exam is acquired digitally.
9. - The DIN-PACS prefetches and autoroutes old exams if indicated.
10. - The technologist reviews the images for accuracy/quality at the acquisition modality. If the images are accepted, a message is sent to CHCS-RAD that the patient is finished and the exam is marked EXAMINED.
11. - The digitally acquired exam is sent to DIN-PACS.
12. - The images are autorouted to the appropriate DIN-PACS workstation where they are queued to be displayed. Prefetched exams from the archive are placed with the new exam at the workstation.
13. - The radiologist reads the exam at the DIN-PACS workstation and views the prefetched exams as needed. Prefetched exams are displayed with their radiographic reports.
14. - The radiologist can dictate a radiographic report for transcription or they can enter a canned/normal radiographic report on the current exam, that will be automatically verified, at their DIN-PACS workstation.
15. - If the radiologist picks a canned report, it will automatically be verified and treated as a complete radiographic report when accepted.
16. - A transcriptionist enters a dictated report into the DIN-PACS/RIS. The DIN-PACS/RIS will send a message to CHCS to change the status of the exam to TRANSCRIBED.
17. - The radiologist checks the radiographic report for accuracy in DIN-PACS.
18. - The radiologist can re-dictate the report and send it back to transcription.
19. - The radiologist verifies his transcribed radiographic reports in DIN-PACS at the workstation. Once a report is verified, the DIN-PACS/RIS will send a message to CHCS that the exam is COMPLETE.
20. - Once CHCS has completed the radiographic report it is available to the requesting physician on CHCS.
21. - Hard copies of the report are generated for the patient's medical record.
22. - A copy of the report will be retained in DIN-PACS to be displayed with the exam.

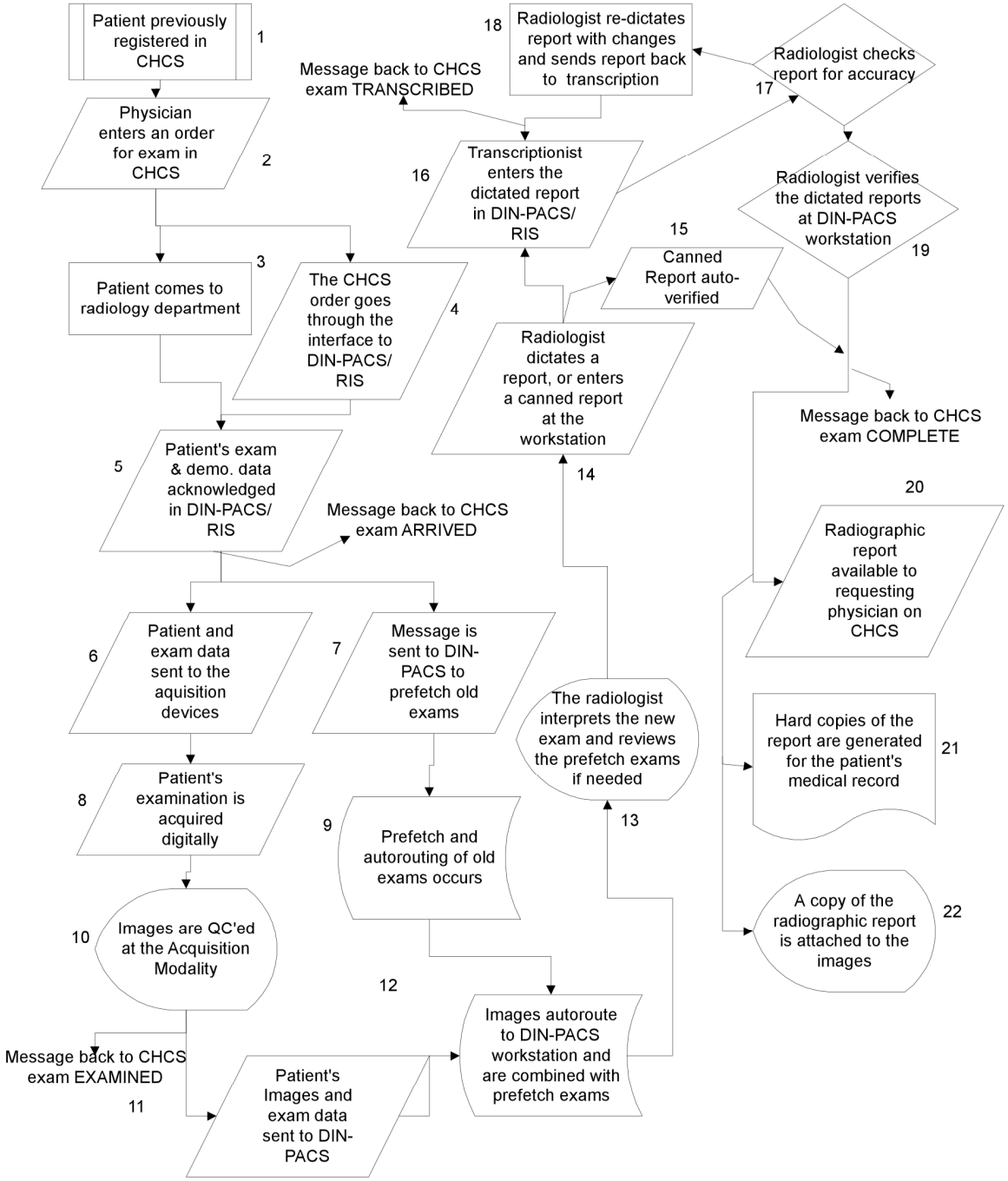


Figure 5, DIN-PACS/RIS Walk-In Patient

Scenario 6 - DIN-PACS/RIS Scheduled Patient (See Figure 6)

1. - The patient has been registered, the patient's sponsor and demographic information has been entered into CHCS
2 - The patient has seen a physician in the Emergency Room or Walk-in-clinic and the physician requests a radiology examination must be scheduled. Once the physician signs/accepts the order, the exam is marked ORDERED in CHCS-RAD.
3. - The patient comes to the radiology department to be scheduled.
4. - The DIN-PACS/RIS - CHCS interface will have placed the patient's demographic and exam data into the DIN-PACS/RIS.
5. - The patient's exam is scheduled using the DIN-PACS/RIS. Once the appointment date and time have been set, DIN-PACS/RIS sends a message to CHCS that the exam is SCHEDULED.
6. - On the evening prior to the patient's appointment, the DIN-PACS will perform a prefetch of old exams from archive.
7. - The patient returns to radiology on the Date/Time of their appointment.
8. - The patient will be acknowledged, in the DIN-PACS/RIS, the patient is questioned about pregnancy if applicable and a message will be sent back to CHCS and the CHCS exam status will be changed to ARRIVED.
9. - Patient arrival triggers the patient and exam data to be sent to the acquisition modalities.
10. - The patient's exam is acquired digitally.
11. - The technologist reviews the images for accuracy/quality at the acquisition modality. If the images are accepted, a message is sent to CHCS-RAD that the patient is finished and the exam is marked EXAMINED.
12. - The digitally acquired exam is sent to DIN-PACS.
13. - The images are autorouted to the appropriate DIN-PACS workstation where they are queued to be displayed. Prefetched exams from the archive are placed with the new exam at the workstation.
14. - The radiologist reads the exam at the DIN-PACS workstation and views the prefetched exams as needed. Prefetched exams are displayed with their radiographic reports.
15. - The radiologist can dictate a radiographic report for transcription or they can enter a canned/normal radiographic report on the current exam, that will be automatically verified, at the DIN-PACS workstation.
16. - If the radiologist picks a canned report, it will automatically be verified and treated as a complete radiographic report when accepted.
17. - A transcriptionist enters a dictated report into the DIN-PACS/RIS. The DIN-PACS/RIS will send a message to CHCS to change the status of the exam to TRANSCRIBED.
18. - The radiologist checks the radiographic report for accuracy in DIN-PACS.
19. - The radiologist can re-dictate the report and send it back to transcription.
20. - The radiologist verifies his transcribed radiographic reports in DIN-PACS at their workstation. Once a report is verified, the DIN-PACS/RIS will send a message to CHCS that the exam is COMPLETE.
21. - Once CHCS has completed the radiographic report it is available to the requesting physician on CHCS.
22. - Hard copies of the report are generated for the patient's medical record.
23. - A copy of the report will be retained in DIN-PACS to be displayed with the exam.

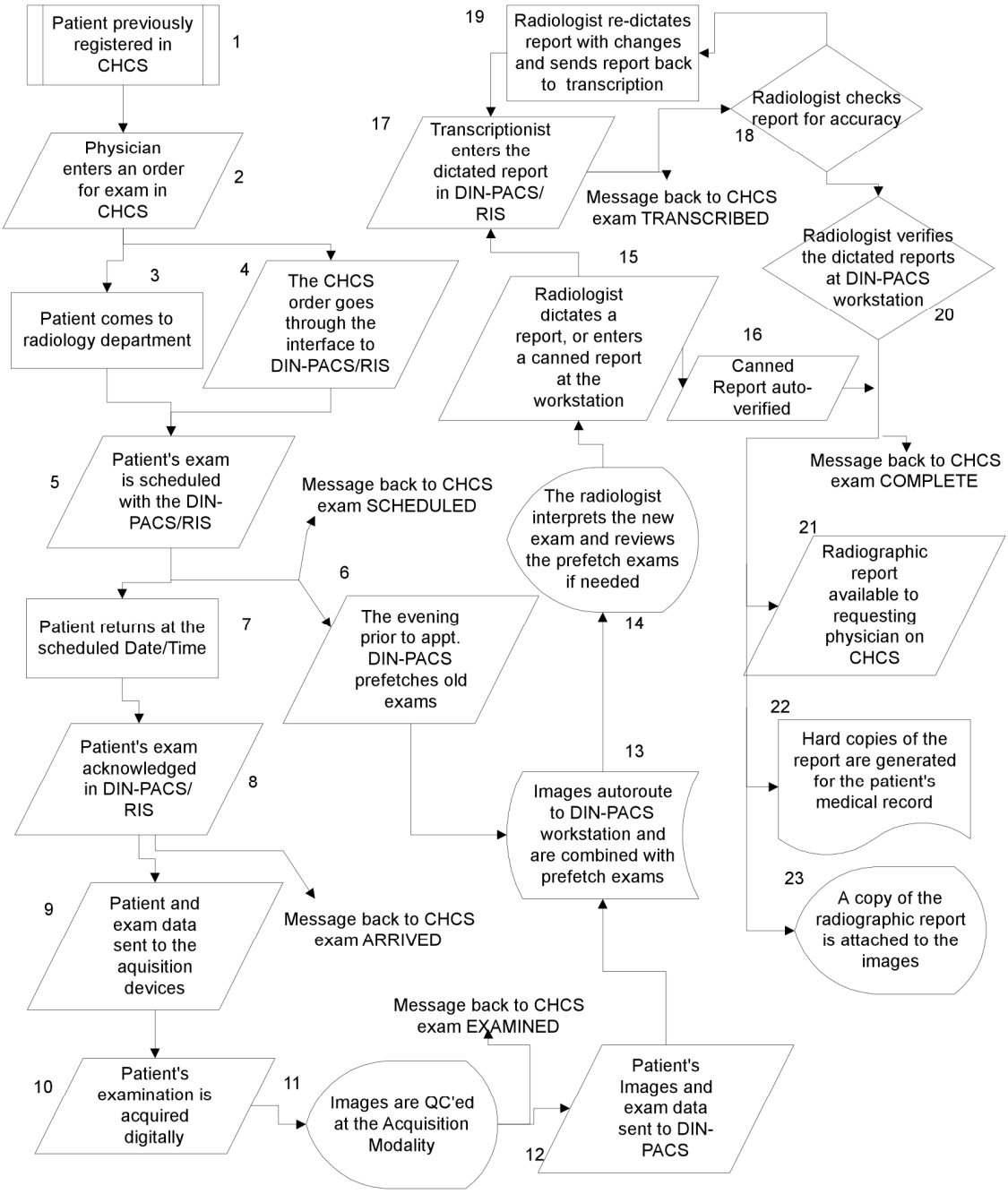


Figure 6, DIN-PACS/RIS Scheduled Patient

APPENDIX J - GENERIC SITE CONFIGURATIONS

1. General

The following generic site configurations describe the scope and installation phasing for follow- on DIN-PACS sites. Such follow-on sites shall be acquired by issuance of delivery orders using the contractor-proposed configurations that accommodate these generic site descriptions. Exact details regarding equipment configuration, installation and systems integration for these follow- on sites shall be determined as part of the actions associated with the issuance of a delivery order under the basic contract. The Contractor shall propose system solutions that support the phases of clinical activity that are described in this appendix. Section L of the solicitation describes the format for the submittal of technical proposals for these generic configurations. Section B of the solicitation provides pricing procedures.

2. Large Fixed Facility

2.1 Overview, Required Workload

Large fixed facilities produce 100,000 inpatient plain radiography images (exposures), 300,000 outpatient plain radiography images, and 900,000 digital images (CT, MR, US, NM) annually. Assuming 250 working days per year, workload shall be 400 inpatient and 1200 outpatient, conventional radiographic images as well as 3600 digital images per day. The average length of stay ranges from 4.5 to 7 days. These and subsequent numbers are generic and site specific information shall be available during site visits. The DIN-PACS shall be capable of being implemented in phases. Table 2.1 provides an overview of equipment to be broken into phases.

2.1.1 Image Acquisition, Large Fixed Facility

a. Use of Digital Acquisition. All images shall be obtained by direct digital acquisition. The digital imaging modalities shall produce 425,000 images per year for head and body CT exams (1700 images/day), 225,000 images per year for MRI (900 images/day), 150,000 images per year for ultrasound (600 images/day) and 100,000 images per year for NM (400 images/day).

b. Use of Computed Radiography. The acquisition of all plain radiographic images (1550/day) except the urology clinic exams (50 images/day) shall utilize CR in the following clinical locations; in radiology (1380 images/day), near the critical care areas (100 images/day), and in the orthopedic clinic (120 images/day). The peak throughput rate for plain radiographic exams within the radiology department is 60 patients in one hour (210 images/hour).

c. Other Acquisition Considerations. Mammography exams are not expected to utilize digital acquisition at this time but may be digitized from film for archiving purposes. The department of radiology has two CT devices, one MR device, two angiography suites, three US devices as well as five radiographic/fluoroscopic units, two dedicated chest and fourteen conventional exposure rooms.

Table 2.1 - Implementation Summary for a Large Fixed Facility

Work Load	**Annual:** 100,000 radiographic images for inpatients, 300,000 radiographic images for outpatients, 900,000 digital images. **Clinical Days:** 250 days per year, 400 inpatients and 1200 outpatients radiographic images per day, 3600 digital images per day.		
Image Input Devices	All digital modalities: 2 CT, 1 MRI, 2 Angio, 5 Fluoro, 3 US CR images per day (IPD): 1380 IPD for Radiology 100 IPD for Critical Care 120 IPD for Orthopedics Film Digitizer: 475 films/day	NM imaging systems CR reader at remote medical clinic for teleradiology	CR's for Urology and Operating Room support
Imaging Operations	- Primary focus in is to cover inpatient radiology - All plain radiographs are acquired by CR. - For inpatients, selected old films are digitized. - Laser printers and a 35 mm slide maker are used. RIS Interface to CHCS	- Primary focus expands to other outpatient services - US images are read on DIN-PACS workstations. - Orthopedics start reading on DIN-PACS workstations.	- Primary focus expansion covers the remainder of the hospital.
Diagnostic Workstation	Bone Radiology: 1 (D4) Chest Radiology: 2 (D4) ER Radiology: 1 (D4) MR/CT: 1 (D4)	Radiology: 6 (D4) Orthopedics: 1 (D4) Pulmonary: 2 (D2)	Pulmonary: 1 (D2)
Review Workstation	ICU: 1 (R2) CCU: 1 (R2) NICU: 1 (R2) SICU: 1 (R2) RR: 1 (R2) NM: 2 (R2) ER: 3 (R2) Radiology: 4 (R2)	Patient Care Unit Team Center: 3 (R1) OR: 14 (R2) Med Clinic: 1 (R2) Oral Surgery: 1 (R1) Hem-Onc: 1 (R2) ENT: 1 (R2) Cardiology: 1 (R2) Nephro/Urology: 1 (R2) Surgery: 2 (R2) Pediatrics: 2 (R2) Internal Med: 2 (R2) Family Prac: 2 (R2) Orthopedics: 5 (R2)	Pathology: 1 (R1) Labor/Del: 1 (R1) Card Care Step Down Unit:1 (R2) Ophthal: 1 (R2) Rad. Ther.: 1 (R2) Neurology: 2 (R2) OBGYN: 1 (R2)
Workstation Total	D4: 5 each R2: 14 each QC R2: 5 each	D4: 7 each D2: 2 each R2: 32 each R1: 4 each QC R2: 2 each	D2: 1 each R2: 6 each R1: 2 each QC R2: 2 each
Imaging Operations	- Primary focus in is to cover inpatient radiology - All plain radiographs except urology are acquired by CR. - For inpatients, selected old films are digitized.	- Primary focus expands to other outpatient services - US images are rad on DIN-PACS workstations. - Orthopedics start	- Primary focus expansion covers the remainder of the hospital.

	- Laser printers and a 35 mm slide maker are used. RIS Interface to CHCS	reading on DIN-PACS workstations.	

Included in the Large Facility Installation is support of 100 PC Workstations
Notes: D: Diagnostic Workstation, R: Review Workstation, 2: 2 monitors, etc.

3. Medium Fixed Facility

3.1 Overview, Required Workload

Medium fixed facilities produce 67,500 inpatient plain radiography images (exposures), 200,000 outpatient plain radiography images, and 600,000 digital images (CT, MR, US, NM) annually. Assuming 250 working days per year, workload shall be 270 inpatient and 800 outpatient, conventional radiographic images as well as 2400 digital images per day. The average length of stay ranges from 4.5 to 7.5 days. These and subsequent numbers are generic and site specific information shall be available during site visits. The DIN-PACS shall be implemented in 2 phases. Table 3.1 provides an overview of these phases.

3.2 Phase I, Medium Fixed Facility

3.2.1 Image Acquisition, Phase I, Medium Fixed Facility

a. Use of Digital Acquisition. All CT and MRI images shall be obtained by direct digital acquisition in phase one. The digital imaging modalities shall produce 210,000 images per year for head and body CT exams (840 images/day), 225,000 images per year for MRI (900 images/day), 130,000 images per year for ultrasound (520 images/day) and 35,000 images per year for NM (140 images/day).

b. Acquisition of Conventional Radiographs. The acquisition of all newly exposed plain radiographic images shall be accomplished through CR. Additionally if required, each inpatient, emergency room, and orthopedic clinic patient shall have the most recent (if any) prior exam of the same type that is on conventional film introduced into the network by utilizing a film digitizer. The film digitizers shall be located in a centralized location in or near the existing film library; two or more digitizers shall be proposed.

c. Other Acquisition Considerations. Mammography exams are not expected to utilize digital acquisition at this time but may be digitized from film for archiving purposes. The department of radiology in this facility has one CT, one MR, two angiography suites, two US devices as well as one head unit, three radiographic/fluoroscopic rooms, one dedicated chest and three conventional exposure rooms.

Table 3.1 - Implementation Summary for a Medium Fixed Facility

Work Load	**Annual:** 67,500 radiographic images for inpatients, 200,000 radiographic images for outpatients, 600,000 digital images. **Clinical Days:** 250 days per year, 270 inpatients and 800 outpatients radiographic images per day, 2400 digital images per day.	
Imaging Operations	- Primary focus in is to cover inpatient radiology - All in patient, ER and orthopedic cases are read at workstations. - For each inpatient, emergency room, and orthopedic clinic patient, selected old films are digitized. - Laser printers and a 35 mm slide maker are used. - RIS Interface to CHCS	- Primary focus expands to cover outpatient services - All digital images are read from DIN-PACS workstations.
Image Input Devices	All digital modalities: 1 CT, 1 MRI, 2 Angio, 3 Fluoro, 2 US, and 6 radiographic rooms CR: 1070 images per day Laser Film Digitizer: 450 films per day	1 CR device for Operating Room support 5 Nuclear Medicine Cameras and 3 Rad/Flouro
Diagnostic Workstation	Radiology: 4 (D4) Orthopedics: 1 (D4)	Radiology: 4 (D4)
Review Workstation	ICU: 1 (R2) CCU: 1 (R2) SICU: 1 (R2) NICU: 1 (R2) RR: 1 (R2) ER: 2 (R2) Radiology: 2 (R2) Orthopedics: 1 (R2)	Nuclear Medicine: 1 (R2) Internal Medicine: 2 (R2) Urology: 1 (R2) Ward Nursing Stations: 8 (R2) OR: 12 (R2) Medical Oncology: 1 (R2) Radiation Oncology: 1 (R2) Oral Surgery: 1 (R1) Pediatrics: 1 (R2) Flight Medicine: 1 (R2) Cardiac Cath Lab: 1 (R2) OB/GYN: 1 (R2) ENT: 1 (R2) Surgery: 2 (R2) Primary Care: 2 (R2)
Workstation Total	D4: 5 each R2: 10 each QC R2: 4 each	D4: 4 each R2: 35 each R1: 1 each QC R2: 2 each

NOTE: Included in the Medium Facility Installation is support of 50 PC Workstations
Notes: D: Diagnostic Workstation, R: Review Workstation, 2: 2 monitors, etc.

4. Small Fixed Facility

4.1 Overview, Required Workload

The small fixed facility DIN-PACS shall accommodate 20,000 inpatient plain radiographic images (exposures), 60,000 outpatient plain radiographic images, and 100,000 digital images (CT, US) per year. Assuming 250 working days per year, this equates to a daily workload of 80 inpatient, 240 outpatient, and 400 digital images per day. The average length of stay ranges from 4.5 to 7.5 days. These and subsequent numbers are generic and site specific information shall be available during site visits. This system shall be implemented in a single phase.

4.2 Image Acquisition, Small Facility

4.2.1 Acquisition of New Images

All images shall be obtained by direct digital acquisition. Mammography exams are not expected to utilize digital acquisition at this time, but may be digitized from film for archiving purposes. There are one CT, two US devices, two radiographic/fluoroscopic rooms, two general purpose radiographic rooms and one portable c-arms in each small fixed facility. The acquisition of all plain film images shall utilize CR.

4.2.2 Acquisition of Previous Images

When required, each inpatient, emergency room, and acute illness clinic patient shall have the most recent (if any) prior exam of the same type that is on conventional film introduced into the network by utilizing a film digitizer. The film digitizers shall be located in a centralized location in or near the existing film library.

4.3 Image Output and Display

4.3.1 Interpretation Activities

All exams (except mammograms) shall be read by soft copy directly from the workstation monitor. 3 Diagnostic workstations, each with 4 monitors, shall be required within the radiology department. One day's work shall. include new and comparison images.

4.3.2 Review Workstations

15 Review workstations, each with 2 monitors, are required in the following areas in the specified quantities. The clinical reviewing site in the emergency room shall review the equivalent of at least 150 CR images in two days including new and comparison images. The critical care areas shall review at least the equivalent of 12 CR images/day and compare them with any formerly reviewed image in that location for at least the four previous days.

4.3.3 Review Workstations

4.4 PC Workstations

25 PC workstations shall be supported at the Small Fixed Facility

4.5 QC Workstations

2 quality control (R2) workstations shall be supported at the Small Fixed Facility.

4.6 Image Database and RIS Support, Small Fixed Facility

All aspects of image storage, database functionality and RIS interface functionality shall meet the requirements as specified in Section C.

4.7 Communications and Network, Small Fixed Facility

The network shall support the throughput performance described in Section C. All images obtained digitally described above shall be available on the network.

5. Inter-MTF Teleradiology

5.1 Overview

As an element of DIN-PACS, interfacility teleradiology has two basic purposes:

1. To provide radiological and clinical support between remote spokes and centralized hubs. This support includes image interpretation and results reporting as well as image consultation.

2. To provide electronic image and report archiving in lieu of hard copy films and text-based radiologic files.

Teleradiology solutions shall be clinically and technically compatible with all DIN-PACS system parameters as described in the Section C performance work statement. As such, the system shall exchange the full range of image information and patient data with a hub or spoke or intra-MTF system.

5.1.1 Preparation for Transmission

The technologist works from a stack of the images that have been accumulated during the clinical day. For each set of patient films, he/she enters patient demographic data (either from paper form or from a RIS, if available) and digitized images are queued for transmission to the central viewing site. In the case of the use of CR, images are automatically transmitted to the central site and, on an as required basis, hard copies are produced at the spoke site. The images and patient data are already in a digital form and they shall be programmed to be transmitted to the hub automatically without user intervention.

5.1.2 Image Transmission

Image transmission shall be possible in one of two methods: (1) individual images may be transmitted on a case by case basis as required, or (2) images acquired during a clinical day may be batched and transmitted once a day. Regardless of the workload, the communication capability shall transmit one day's work in less than 5 hours in an automatic batch mode. This typically shall be during a non-peak period (e.g., at the end of the clinical day). The system shall have automatic line recovery mode so that in case of any transmission failure, it shall recover from line drop and continue transmitting the rest of the image batch. Moreover, interruption of the batch to transmit an emergency or stat image shall be possible. Resumption of the batch shall occur at the point interruption without starting over.

5.2 Teleradiology Performance Configurations

The following table depicts the performance configurations that the Contractor shall provide.

Table 5.1 - Required Performance at Teleradiology Spokes

	Communications Workload *	**Input**	**Display and Output**
Spoke **	300 images/day	Film Digitizer, CR, CT, US, Digital fluoro	2 each - 2 monitor Diagnostic Workstation and 3 each - 2 monitor Review Workstations 2 each - QC R2

Notes: * 14" x 17" images or equivalents
** Shall support receipt of images from hub