PICKER

Picker International Service Publications

DICOM Conformance Statement

COMPUTED TOMOGRAPHY

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Picker International, Inc.
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PQ SERIES SCANNERS:

PQ 6000
PQ 5000
PQ 2000
PQ2000S
PQ CT
PQS

PICKER

MORE THAN IMAGES. INSIGHT

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SYMBOL DESCRIPTIONS

Symbol	Description	Symbol	Description
⚠	Attention symbol.	☢	Radiation warning symbol.
☀	Laser warning symbol.	☣	Biohazard warning symbol.
🧲	Magnetism warning symbol.		Projectile warning symbol.
⚡	Electrical warning symbol.		
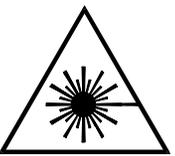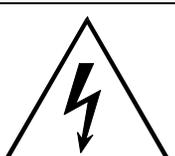
REVISION HISTORY

REVISION	DATE	COMMENTS
−1	01/10/95	Preliminary Issue
A	03/20/95	Released to CCB
A–1	09/21/95	Changes per Engineering review.
A–2	10/20/97	Added PQ 6000, 4.5A to front cover
A–3	10/13/98	Added 4.5B and 4.6 to front cover
B	05/04/99	Updated for **4.6B** Software. Send and Worklist tables per engineering. Added worklist and send tables per engineering. Add latin alphabet conversion table. Removed software list from cover sheet.

TO THE USER OF THIS MANUAL

THE USER OF THIS MANUAL IS DIRECTED TO READ AND CAREFULLY REVIEW THE INSTRUCTIONS, WARNINGS AND CAUTIONS CONTAINED HEREIN PRIOR TO BEGINNING INSTALLATION OR SERVICE ACTIVITIES. WHILE YOU MAY HAVE PREVIOUSLY INSTALLED OR SERVICED EQUIPMENT SIMILAR TO THAT DESCRIBED IN THIS MANUAL, CHANGES IN DESIGN, MANUFACTURE OR PROCEDURE MAY HAVE OCCURRED WHICH SIGNIFICANTLY AFFECT THE PRESENT INSTALLATION OR SERVICE.

THE INSTALLATION AND SERVICE OF EQUIPMENT DESCRIBED HEREIN IS TO BE PREFORMED BY AUTHORIZED, QUALIFIED PICKER INTERNATIONAL PERSONNEL. ASSEMBLERS AND OTHER PERSONNEL NOT EMPLOYED BY NOR DIRECTLY AFFILIATED WITH PICKER INTERNATIONAL TECHNICAL SERVICES ARE DIRECTED TO CONTACT THE LOCAL PICKER OFFICE BEFORE ATTEMPTING INSTALLATION OR SERVICE PROCEDURES.

INSTALLATION AND ENVIRONMENT

EXCEPT FOR INSTALLATIONS REQUIRING CERTIFICATION BY THE MANUFACTURER PER FEDERAL STANDARDS, SEE THAT A RADIATION PROTECTION SURVEY IS MADE BY A QUALIFIED EXPERT IN ACCORDANCE WITH NCRP 102, SECTION 7, AS REVISED OR REPLACED IN THE FUTURE. PERFORM A SURVEY AFTER EVERY CHANGE IN EQUIPMENT, WORKLOAD, OR OPERATING CONDITIONS WHICH MIGHT SIGNIFICANTLY INCREASE THE PROBABILITY OF PERSONS RECEIVING MORE THAN THE MAXIMUM PERMISSIBLE DOSE EQUIVALENT.

Diagnostic Imaging Systems – MECHANICAL-ELECTRICAL WARNING

ALL OF THE MOVEABLE ASSEMBLIES AND PARTS OF THIS EQUIPMENT SHOULD BE OPERATED WITH CARE AND ROUTINELY INSPECTED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS CONTAINED IN THE EQUIPMENT MANUALS.

ONLY PROPERLY TRAINED AND QUALIFIED PERSONNEL SHOULD BE PERMITTED ACCESS TO ANY INTERNAL PARTS. LIVE ELECTRICAL TERMINALS ARE DEADLY; BE SURE LINE DISCONNECTS ARE OPENED AND OTHER APPROPRIATE PRECAUTIONS ARE TAKEN BEFORE OPENING ACCESS DOORS, REMOVING ENCLOSURE PANELS, OR ATTACHING ACCESSORIES.

DO NOT UNDER ANY CIRCUMSTANCES, REMOVE THE FLEXIBLE HIGH TENSION CABLES FROM THE X-RAY TUBE HOUSING OR HIGH TENSION GENERATOR AND/OR THE ACCESS COVERS FROM THE GENERATOR UNTIL THE MAIN AND AUXILIARY POWER SUPPLIES HAVE BEEN DISCONNECTED. FAILURE TO COMPLY WITH THE ABOVE MAY RESULT IN SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

ELECTRICAL-GROUNDING INSTRUCTIONS

THE EQUIPMENT MUST BE GROUNDED TO AN EARTH GROUND BY A SEPARATE CONDUCTOR. THE NEUTRAL SIDE OF THE LINE IS NOT TO BE CONSIDERED THE EARTH GROUND. ON EQUIPMENT PROVIDED WITH A LINE CORD, THE EQUIPMENT MUST BE CONNECTED TO PROPERLY GROUNDED, THREE-PIN RECEPTACLE. DO NOT USE A THREE-TO-TWO PIN ADAPTER.

Diagnostic Imaging Systems – RADIATION WARNING

X-RAY AND GAMMA-RAYS ARE DANGEROUS TO BOTH OPERATOR AND OTHERS IN THE VICINITY UNLESS ESTABLISHED SAFE EXPOSURE PROCEDURES ARE STRICTLY OBSERVED. THE USEFUL AND SCATTERED BEAMS CAN PRODUCE SERIOUS OR FATAL BODILY INJURIES TO ANY PERSONS IN THE SURROUNDING AREA IF USED BY AN UNSKILLED OPERATOR. ADEQUATE PRECAUTIONS MUST ALWAYS BE TAKEN TO AVOID EXPOSURE TO THE USEFUL BEAM, AS WELL AS TO LEAKAGE RADIATION FROM WITHIN THE SOURCE HOUSING OR TO SCATTERED RADIATION RESULTING FROM THE PASSAGE OF RADIATION THROUGH MATTER.

THOSE AUTHORIZED TO OPERATE, PARTICIPATE IN OR SUPERVISE THE OPERATION OF THE EQUIPMENT MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH THE CURRENT ESTABLISHED SAFE EXPOSURE FACTORS AND PROCEDURES DESCRIBED IN PUBLICATIONS, SUCH AS: SUBCHAPTER J OF TITLE 21 OF THE CODE OF FEDERAL REGULATIONS, "DIAGNOSTIC X-RAY SYSTEMS AND THEIR MAJOR COMPONENTS", AND THE NATIONAL COUNCIL ON RADIATION PROTECTION (NCRP) NO. 102, "MEDICAL X-RAY AND GAMMA-RAY PROTECTION FOR ENERGIES UP TO 10 MEV-EQUIPMENT DESIGN AND USE", AS REVISED OR REPLACED IN THE FUTURE.

THOSE RESPONSIBLE FOR PLANNING OF X-RAY AND GAMMA-RAY EQUIPMENT INSTALLATIONS MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH NCRP NO. 49, "STRUCTURAL SHIELDING DESIGN AND EVALUATION FOR MEDICAL OF X-RAYS AND GAMMA-RAYS OF ENERGIES UP TO 10 MEV", AS REVISED AND REPLACED IN THE FUTURE. FAILURE TO OBSERVE THESE WARNINGS MAY CAUSE SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

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INTRODUCTION

Medical imaging devices claiming conformance to the DICOM standard must indicate in sufficient detail the service classes and information objects, as defined by the standard, to which they conform. This document details the conformance of Picker International's PQ series CT scanners to the DICOM standard. The specific products include the PQ 2000, PQ CT, and PQS CT scanners. This document does not attempt to detail any other Picker CT products or other medical imaging devices manufactured by Picker International.

1.) **Implementation Model**

This implementation provides for the simple transfer of images using the DICOM Storage Service Class as a Service Class User (SCU). It provides for the solicitation of worklists using the DICOM Basic Worklist Management Service Class as a SCU. It also provides for the initiation of a DICOM ECHO to verify the DICOM connectivity to a specified node.

Image transfers may be performed manually or automatically. Manual transfer mode sends studies specifically chosen by the operator. He/she chooses the manual send feature from the Network Transfer screens. He/she must explicitly "MARK" the desired studies from the associated patient directory screen. Once studies are marked, the operator specifically chooses to "PROCEED" with the send operation.

Automatic transfer mode sends the current study when the "NEW STUDY" key is activated. To transfer images in the automatic mode, the operator must first select the node he/she wishes to send the images to and turn on the autosend feature using the same screens as in the manual transfer case. The operator must also "MARK" the study for autosend using the screens on the Electronic Touch Panel.

Worklist solicitations can also be performed manually or automatically. A manual worklist request is initiated by the operator from the worklist operations screens. Automatic worklist requests are performed without user intervention at the time indices specified during system configuration.

The DICOM connectivity of the PQ scanner to another node can be verified by performing a DICOM ECHO. DICOM ECHO requests are initiated by invoking the "dicom_echo" command from the Regulus command prompt. The software package which runs to accomplish the DICOM ECHO request and reports the status of the subsequent DICOM ECHO response will be called the DICOM_ECHO software.

1.1.) **Application Data Flow Diagram**
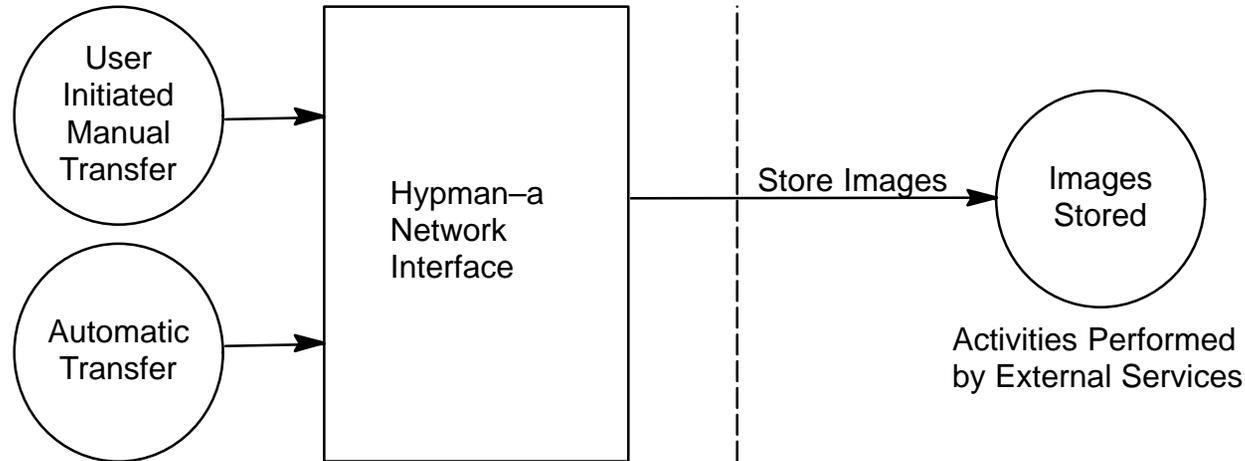
FIGURE 1 DICOM Send Standard Interface

Images are transferred from the PQ when the user selects a study or studies to transfer, or the user has set up the automatic transfer mode and has pressed the "NEW STUDY" key (thereby completing the prior study). The software package which runs to accomplish the transfer is known as the Hypman–a network interface. (HANI).

As mentioned in section 1.), the user must gain access to the Network Transfer Screens to set up the transfer. From the Network Transfer Screen the user will select the "SEND" softkey, which provides a set of softkeys to select a node, mark studies, and initiate the transfer. To select the destination node, the user presses the "Folders/Nodes" softkey. From this screen the user has the ability to set up the manual, auto and remote preview nodes. The user presses the "Man Node" softkey and uses the arrow keys to scroll through the list of nodes, pressing the "Select" softkey when the desired node name is highlighted.

The user would perform the same actions to set up the Auto send node selecting the "Auto Node" from the "Folder/Nodes" screen.

There are two important notes regarding the selection of node names. There is no indication to the user what protocol he/she is using when selecting node names. All protocols use the same user interface screens. The naming of the nodes is controlled by a utility program accessed by the Picker Service Engineer. The configuration program, to be described later, requires entries for the IP address and the Application Entity Title of the service class provider. Therefore it is recommended that the user choose an appropriate naming convention when selecting node names.

The second note is the remote preview node selection is limited to Picker's HyperLAN II protocol.

After selecting appropriate nodes the user can do a manual send or set the scanner up to do Auto sends. To do a manual send the user selects the "Patient Directory" softkey from the image "Send" softkey level, "Marks" one or more studies, and presses the "Proceed" key.

To set the system up to automatically send studies after the "NEW STUDY" key is pressed, the user has to tell the scanner to send all images marked to the SCP. The user does this by selecting the "Auto–Send" softkey from the Network Transfer Screens level ("SHIFT & PAT DIR" then "HyperLAN NET" softkey). Once the system is set up to send images automatically, the user must "MARK" each study for autosend. The user does this by toggling the "Mark For Autosend" box on the system electronic touch panel. To get to the appropriate screen on the touch panel the user must select a protocol, enter patient data, press the "System setup" box and toggle the appropriate box on the touch screen. Once the "Mark For Autosend" is toggled to "YES", all studies scanned will be automatically sent to the SCP until the user toggles the mark option off.
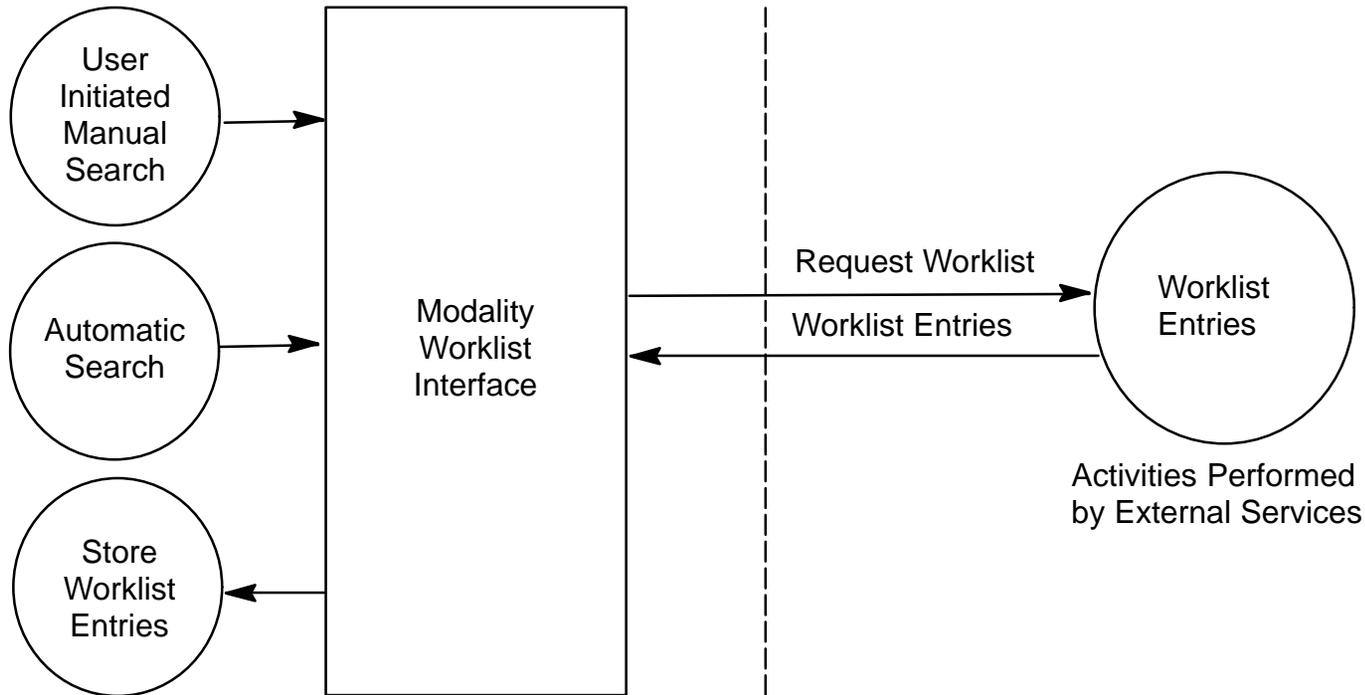
FIGURE 2   DICOM Worklist Standard Interface

Worklist requests are initiated in one of two ways. The first is "manual", when the operator specifically requests a worklist. The second is "automatic", when a configured time index is reached. The software package which runs to accomplish the worklist request and manage the subsequent return of the worklist records will be called the WORKLIST software.

To initiate a manual worklist request, the user must gain access to the worklist operations screen. From the "IMAGE MAINTENANCE" menu the user selects the PROfile Connect softkey to enter the "PROfile Connect Operations" menu. From this screen, the user has the option of narrowing the search by restricting the acceptable returned values of any of the listed fields. Once the search parameters are established, the user enters the "SEARCH" softkey. The WORKLIST software sends the worklist request to the configured node. It then accepts and processes any received worklist entries.

Automatic searches are set up at system configuration time. The time indices are specified to notify the WORKLIST software when to automatically initiate a worklist request. No value restrictions are placed on the requested fields. The WORKLIST software accepts and processes received worklist entries.

Nodes from which to solicit worklists are defined during system configuration. If more than one HIS/RIS is defined, the WORKLIST software solicits worklist information from each until the desired worklist entry is retrieved.
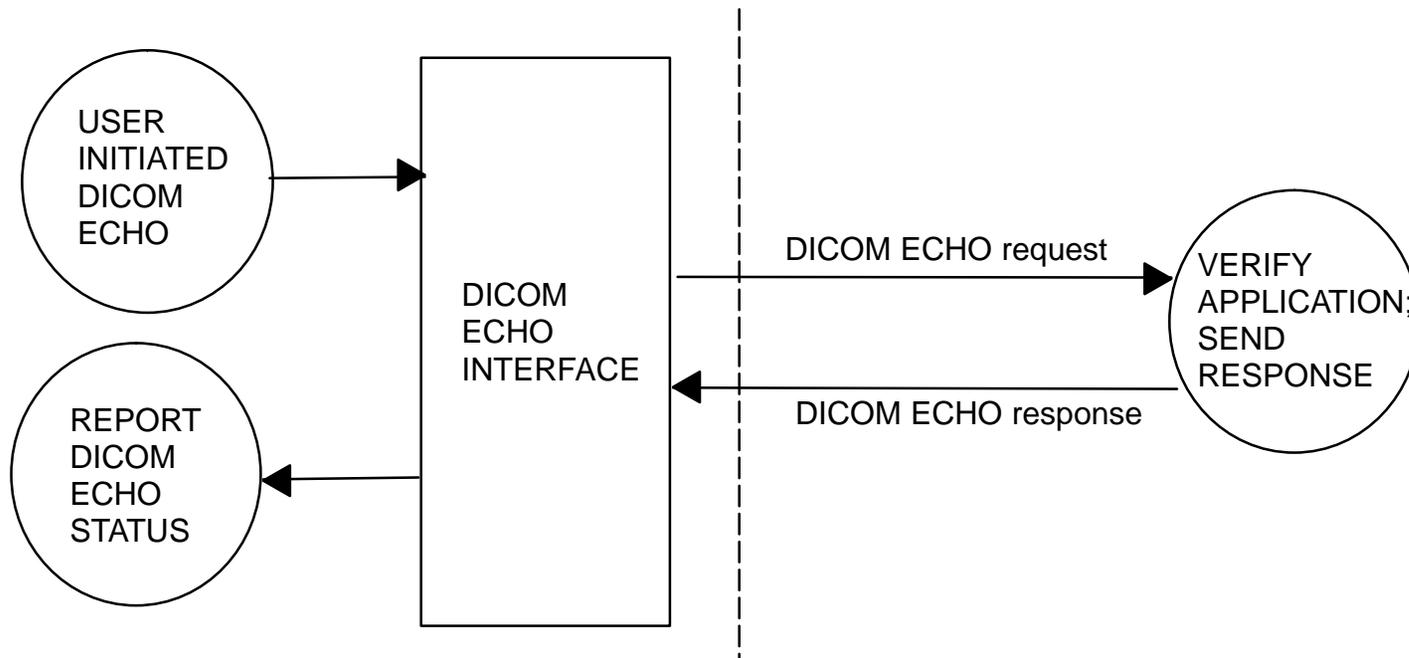
FIGURE 3

The DICOM Echo feature is initiated from the Regulus user prompt. Once at the Regulus prompt, the user must change directories to the directory that contains the "dicom_echo" program. The user invokes "dicom_echo" to initiate the ECHO request and report the results. The "dicom_echo" program is invoked with parameters that identify the remote node and DICOM application that is to receive the ECHO command and provide the ECHO response.

1.2.)   **Functional Definitions of AE's**

When the HANI software is invoked, an association will be established with the AE identified by the user. Images will be transferred one at a time until there are no more images to transfer.

When the WORKLIST software is invoked, an association will be established with the AE identified by the system configuration. Up to 300 returned worklist records are stored for subsequent use.

When the DICOM_ECHO software is invoked, an association will be established with the AE identified by the user. A single ECHO exchange is attempted to that AE and the results are reported.

2.) **AE Specifications**

The application entity HANI is compliant as a Storage Service Class User of the DICOM standard.

2.1.) **HANI Specification**

The HANI provides Standard Conformance to the following DICOM SOP Class as an SCU:

SOP Class Name	SOP Class UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2

The HANI software never acts in the role of an SCP.

2.1.1.) **Association Establishment Policy**

2.1.1.1.) **General**

The HANI software attempts to establish an association when the operator has chosen a set of studies to transfer, or the system is set up for auto sending of images and the "NEW Study" key is pressed.. The HANI software waits for a response message after each image is sent.

The HANI software places a restrictions on the maximum PDU size to be 4096 bytes. If the Service Class Provider for the association does not specify a maximum PDU size, or specifies a maximum PDU size greater than 4096 bytes, the HANI software will send PDU's of not more than 4096 bytes.

2.1.1.2.) **Number of Associations**

The HANI implementation can be configured to send data over a single or multiple associations. The HANI implementation has a configuration flag for each SCP for configuration of the number of associations.

2.1.1.2.1.) **HANI configured for single associations**

Images are sent one at a time over the open association until either all of the images have transferred successfully, the remote node's Service Class Provider software reports an error, the remote node breaks down the association, or the study number changes.

When more than one study is "Marked" the PQ system can provide data to the HANI interface in a random order, i.e., images from different studies can arrive out of order. When transferring images over a single association HANI will break the association down each time the study number changes.

SCP's that rely on the breaking of an association to indicate the end of a study may have a single study on the PQ broken up into many smaller studies on the SCP.

2.1.1.2.2.) **HANI configured for multiple associations**

When HANI is configured to send over multiple associations a new association will be established each time there is a current association open and the study number changes. When all images have been transferred for a "marked" study HANI will break down the association. All associations will have been terminated when there are no more images to be transferred, the SCP breaks down each association, or the SCP reports an error on each association.

Although there are multiple associations, only a single transfer will be ongoing at any time.

There is no restrictions to the number associations that can be open except for the exhaustion of system resources.

2.1.1.3.) **Asynchronous Nature**

The images are transferred one at a time over the open association. The HANI software waits for a response after each image is sent before sending the next image. Therefore, there is no Asynchronous activity in this implementation.

The Asynchronous Operations Window negotiation is not supported.

2.1.1.4.) Implementation Identifying Information

The HANI will provide a single Implementation Class UID which is 2.16.840.1.113662.2.1.1

2.1.2.) Association Initiation Policy

The HANI software attempts to initiate an association whenever the PQ operator selects a DICOM remote node for transfer and the operator marks studies for manual transfer. In addition, the HANI software attempts to initiate a transfer whenever the PQ operator selects a node for transfer, the autosend feature is turned on, the operator marks studies for autosend, and the study is completed and a new study is started.

Although an association is attempted by two distinct user actions there is an essential isomorphism of the two association initiation activities. The SCP only sees one behavior from the SCU. Therefore the two user actions will be treated as one real world activity in the following sections.

The HANI software never accepts an association request.

The implementation described here offers only the default transfer syntax.

2.1.2.1.) PQ operator selects node & marks images for transfer

2.1.2.1.1.) Associated Real World Activity

The operator initiates the image transfers by selecting the destination node and then marking images for transfer.

2.1.2.1.2.) Proposed presentation contexts

Each time an association is initiated, the HANI software proposes a single Presentation Context to be used on that association, as defined in the following table.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID list		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.1.2.2.) **SOP Specific Conformance**

The HANI software will run quietly as long as successful transfers are occurring. When all data which the PQ operator requested has been transferred the HANI software will update the Network Transfer Screens indicating the transfers are complete.

When a C–STORE response with an unsuccessful status is returned to the HANI, the transfer is aborted and the Network Transfer Screens are updated with the error message "Error in Network Call, Quit Now!"

Warning C–STORE response statuses are treated as successful statuses.

Extended Negotiation is not supported

2.1.2.2.1.) **CT Image IOD**

The following modules which make up the CT image IOD are sent. All type 1 and type 2 elements are sent as well as the listed type 3 elements.

All type 2 elements are sent during image transfers. However, the data corresponding to these elements may not exist due to operator discretion. If the data does not exist, the element will be empty (zero length indicated) or blank. If the data for a listed type 3 element does not exist due to operator discretion, the element may be empty, blank, or not sent at all. Refer to the implementation detail of each element in the table below for a precise description of how that element is handled.

SEND

Attribute Name	Tag	Type	Implementation Detail
Patient Module			

Patient Name	(0010,0010)	2	if Worklist record exists
			    Patient Name from Worklist record MWPATNM
			else
			    Patient Name from image header PATNAM

Patient ID	(0010,0020)	2	if Worklist record exists
			    Patient ID from Worklist record MWPATID
			else–if patient ID entered by operator
			    Patient ID from image header PATID
			else
			    field empty, zero length indicated.

Patient Birth Date	(0010,0030)	2	if Worklist record exists
			    Patient Birth Date from Worklist record MWBDATE
			else
			    field empty, zero length indicated

Patient's sex	(0010,0040)	2	If Worklist record exists
			     Patient Sex from Worklist record MWSEX
			else–if patient sex entered by operator
			     Patient Sex from header PATSEX
			else
			     field empty, zero length indicated.	

Patient Comments	(0010,4000)	3	If text exists in comment fields
			     Combination of comment fields from header
			     COMNT_1, COMNT_2, COMNT_3, COMNT_4
			else
			     all spaces	

General Study Module				

Study Instance UID	(0020,000D)	1	If Worklist record exists
			     Study Instance UID from Worklist record MWSTUID
			else
			     uniquely generated from image header S_N_CPU,
			     S_N_GNT, STNUM, SCNDATE, SCNTIME,
			     CONTR, RPRTAG	

Study Date	(0008,0020)	2	Scan date from image header SCNDATE	
Study Time	(0008,0030)	2	Scan time from image header SCNTIME	

Referring Physician	(0008,0090)	2	If Worklist record exists
			     Referring Physician from Worklist record MWREFPN
			else if referring physician entered by operator
			     referring physician from image header REFPHY
			else
			     field empty, zero length indicated	

Study ID	(0020,0010)	2	Study number from image header STNUM	

Accession Number	(0008,0050)	2	If Worklist record exists
			     Accession number from Worklist record MWACNUM
			else
			     field empty, zero length indicated	

Study Description	(0008,1030)	3	If text in first comment field
			     Comment field from image header COMNT_1
			else
			     contains all spaces

Reading Physicians	(0008,1060)	3	If referring radiologist entered by operator
			     Referring Radiologist from image header REFRAD
			else
			     contains all spaces.

Patient Study Module			

Patient's Age	(0010,1010)	3	If operator enters patient age
			     Patient age from image header PATAGYR
			else
			     this field IS NOT sent

General Series Module			

Modality	(0008,0060)	1	If Worklist record exists
			     Modality from Worklist record MWMODAL
			else
			     from image header MODAL
			[in effect is always "CT"]

Series Instance UID	(0020,000E)	1	Uniquely calculated from image header S_N_CPU, S_N_GNT, STNUM, SCNDATE, SCNTIME, CONTR, RPRTAG
Series Number	(0020,0011)	2	Uniquely calculated from image header CONTR, RPRFLAG, RPRTAG
Laterality	(0020,0060)	2C	field empty, zero length indicated
Series Date	(0008,0021)	3	scan date in image header SCNDATE
Series Time	(0008,0031)	3	scan date in image header SCNTIME

Performing Physicians Name	(0008,1050)	3	If referring radiologist entered by operator
			     Referring Radiologist from image header REFPHY
			else
			     contains all spaces

Protocol Name	(0018,1030)	3	image header PRTSCAN

Operator's Name	(0008,1070)	3	image header OPERID
Patient Position	(0018,5100)	2C	calculated from image header POSHF, POSPRN

Frame of Reference Module			
Frame of Reference UID	(0020, 0052)	1	uniquely calculated from image header S_N_CPU, S_N_GNT, STNUM, SCNDATE, SCNTIME, CONTR, RPRTAG
Position of Reference Indicator	(0020,1040)	2	field empty, zero length indicated

General Equipment Module			
Attribute Name	**Tag**	**Type**	**Implementation Detail**
Manufacturer	(0008,0070)	2	"Picker International, Inc."
Institution Name	(0008,0080)	3	from image header SCNHOSP
Station Name	(0008,1010)	3	"Picker CT"
Manufacturer's Model Name	(0008,1090)	3	from image header TYP_GNT
Device Serial Number	(0018,1000)	3	from image header S_N_CPU, S_N_GNT
Software Versions	(0018,1020)	3	from image header RCNREVL

General Image Module			
Image Number	(0020,0013)	2	from image number in image header IMNUM
Patient Orientation	(0020,0020)	2C	from image header LABLEFT, LABTOP
Image Date	(0008,0023)	2C	from scan date in image header SCNDATE
Image Time	(0008,0033)	2C	from scan date in image header SCNTIME
Acquisition Date	(0008,0022)	3	from scan date in image header SCNDATE
Acquisition Time	(0008,0032)	3	from scan date in image header SCNTIME

Image Plane Module			
Pixel Spacing	(0028,0030)	1	from image header RCNFSIZ, RCNMTRX, PILTFSZ, IMTYPE
Image Orientation	(0020,0037)	1	from image header LABLEFT, LABTOP, POSHF, POSPRN, GTILT
Image Position	(0020,0032)	1	from image header PILTING, PILTFSZ, COUCH, COUCHHT, GTILT, RCNCX, RCNCY, RCNFSIZ, RCNMTRX, POSPRN, POSHF, LABLEFT, LABTOP
Slice Thickness	(0018,0050)	2	from image header SCNTHKN
Slice Location	(0020,1041)	3	from image header COUCH

Image Pixel Module			
Samples Per Pixel	(0028,0002)	1	0x0001
Photometric Interpretation	(0028,0004)	1	"MONOCHROME2"
Rows	(0028,0010)	1	from image header RCNMTRX
Columns	(0028,0011)	1	from image header RCNMTRX
Bits Allocated	(0028,0100)	1	0x0010
Bits Stored	(0028,0101)	1	0x0010
High Bit	(0028,0102)	1	0x000f
Pixel Representation	(0028,0103)	1	0x0001
Pixel Data	(7FE0,0010)	1	image pixel data

Contrast Bolus Module			
Contrast/Bolus Agent	(0018, 0010)	2	from image header CONTR

CT Image Module			
Attribute Name	**Tag**	**Type**	**Implementation Detail**
Image Type	(0008,0008)	1	from image header IMTYPE
Samples Per Pixel	(0028,0002)	1	0x0001
Photometric Interpretation	(0028,0004	1	"MONOCHROME2"
Bits Allocated	(0028,0100)	1	0x0010
Bits Stored	(0028,0101)	1	0x0010
High Bit	(0028,0102)	1	0x000f
Rescale Intercept	(0028,1052)	1	"0 "
Rescale Slope	(0028,1053)	1	"1 "
KVP	(0018,0060)	2	from image header SCNKV
Acquisition Number	(0020,0012)	2	from image header CONTR, RPRFLAG, RPRTAG
Gantry/Detector Tilt	(0018,1120)	3	from image header GTILT
Rotational Direction	(0018,1140)	3	"CW"
Exposure Time	(0018,1150)	3	calculated from image header GNTNDET, SCNPART, SCNOVER, SCNNREV, RCNREVL, SCNSPED, IMTYPE, PILTLNG, SCNCSPD, COUCHIX
X–Ray Tube Current	(0018,1151)	3	from image header SCNMA
Exposure	(0018,1152)	3	from image header SCNMAS
Filter Type	(0018,1160)	3	from image header SCNFILT
Focal Spot	(0018,1190)	3	from image header SCNSPOT

VOI LUT Module			
Window Center	(0028,1050)	3	from image header LEVEL
Window Width	(0028,1051)	1C	from image header WINDOW

SCP Common Module			
SCP Class UID	(0008,0016)	1	"1.2.840.10008.5.1.4.1.1.2\0"
SCP Instance UID	(0008,0018)	1	uniquely generated from image header S_N_CPU, S_N_GNT, STNUM, SCNTIME, SCNDATE, RCNTIME
Specific Character Set	(0008,0005)	1C	"ISO_IR 100"
Instance Creation Date	(0008,0012)	3	from image header SCNDATE
Instance Creation Time	(0008,0013)	3	from image header SCNTIME

2.2.) WORKLIST Specification

The WORKLIST software provides Standard Conformance to the following DICOM SOP Class as an SCU:

SOP Class Name	SOP Class UID
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31

The WORKLIST software never acts in the role of an SCP.

2.2.1.) Association Establishment Policy

2.2.1.1.) General

The WORKLIST software attempts to establish an association when 1.) the operator has chosen to search the network for worklist procedures through the PROfile Connect access screens or 2.) a time index for automatic search is reached. Once the association is established, the WORKLIST software waits for returned worklist entries until the SCP sends an "end of worklist."

2.2.1.2.) Number of Associations

One PROFile Connect application requests one association at a time. However, more than one application is allowed to run at any given time. In addition, an automatic search may also be running at that time. This can result in multiple associations from one CT scanner. Each association is handled independently.

2.2.1.3.) Asynchronous Nature

Up to eight copies of the manual search application may be executing at one time. In addition, one automatic search may also run simultaneously. Therefore, up to nine associations may be open and providing worklist records at one point in time. This is limited only by system resources. Typical sites require only one or possibly two simultaneous associations.

2.2.1.4.) Implementation Identifying Information

The WORKLIST software provides a single Implementation Class UID of 2.16.840.1.113662.2.1.1

2.2.2.) Association Initiation Policy

The WORKLIST software attempts to initiate an associaton whenever the PQ operator selects "SEARCH" from the PROfile Connect Operations menu. In addition, the WORKLIST software attempts to initiate an association whenever an automatic search time index is reached. The SCP sees only one behavior from the SCU. Therefore, both situations are treated as one real world activity.

The WORKLIST software never accepts an association request.

2.2.2.1.) Search for Worklist Scheduled Procedure

2.2.2.1.1.) Associated Real World Activity

The PQ operator initiates the worklist request by selecting "SEARCH" from the PROfile Connect Operations menu. Or, a "time index" (specified at system configuration time) has been reached causing the WORKLIST software to initiate a worklist request without operator initiation.

2.2.2.1.2.) Proposed Presentation Contexts

Each time an association is initiated, the WORKLIST software proposes a single Presentation Context to be used on that association.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext.
Name	UID	Name List	UID list		Neg.
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.2.2.2.) SOP Specific Conformance Statement

To request a worklist, the WORKLIST software sends a C–FIND request. This request contains the desired search criteria for determining the matching worklist entries. It also contains a specification of which fields are requested to be returned with the matching entires. The WORKLIST software then looks for one or more C–Find responses containing the matching worklist records.

For a Manual Search, the WORKLIST software requires that the operator remain in the PROfile Connect Operations screen until the search is resolved, successful or unsuccessful. If any returned procedures exist, the WORKLIST software displays the returned procedures to the operator. It is the operator's choice to select worklist entries for subsequent use on the scanner. If no procedures are returned, or a communications failure occurs, an appropriate status is displayed to the operator.

At any time during a manual search operation, the operator may abort the worklist request. The WORKLIST software cancels it's association, cleans up its internal worklist record storage and returns the operator to the "PROfile Connect Operations" screen.

Extended Negotiation is not supported.

2.2.2.2.1.) Modality Worklist Information Model

The following table defines the WORKLIST software's usage of the attributes for the Modality Worklist Model. All type 1 and type 2 elements are sent as well as the listed type 3 elements.

WORKLIST

Attribute Name	Tag	Type	Implementation Description
SOP Common Module			
Special Character Set	(0008,0005)	1C	"ISO_IR 100"

Scheduled Procedure Step Module			
>Scheduled Procedure Step Sequence	(0040,0100)	1	Begin following sequence
>Scheduled Station AE Title	(0040,0001)	1	zero length, requesting "all"

>Scheduled Procedure Step Start Date	(0040,0002)	1	if operator enters date or date range 　　　single date or date range to match else 　　　field empty, zero length, requesting "all"
>Scheduled Procedure Step Start Time	(0040,0003)	1	field empty, zero length, requesting "all"
>Modality	(0008,0060)	1	"CT"
>Scheduled Performing Physician name	(0040,0006)	2	field empty, zero length, requesting "all"
>Scheduled Procedure Step Description	(0040,0007)	1C	field empty, zero length, requesting "all"
>Scheduled Action Item Code Sequence	(0040,0008)	1C	begin following sequence
>>Code Value	(0008,0100)	1C	field empty, zero length, requesting "all"
>>Coding Scheme Designator	(0008,0102)	1C	field empty, zero length, requesting "all"
>>Code Meaning	(0008,0104)	1C	field empty, zero length, requesting "all"

Requested Procedure Module			
Study Instance UID	(0020,000D)	1	field empty, zero length, requesting "all"

Imaging Service Request Module			
Accession Number	(0008,0050)	2	if operator enters text not followed by "*" 　　　single value match if operator enters text followed by "*" 　　　wildcard match else 　　　field empty, zero length, requesting "all"
Referring Physician	(0008,0090)	2	zero length, requesting "all"

Patient Identification Module			

Patient's Name	(0010,0010)	1	if operator enters text NOT followed by "*"
			      single value match
			 if operator enters text followed by "*"
			      wildcard match
			 else
			      zero length, requesting "all"

Patient ID	(0010,0020)	1	if operator enters text
			      single value match
			 else
			      field empty, zero length, requesting "all"

Patient Demographic Module			
Patient's Birth Date	(0010,0030)	2	field empty, zero length, requesting "all"
Patient's Sex	(0010,0040)	2	field empty, zero length, requesting "all"

2.3.) **DICOM_ECHO Specification**

The DICOM_ECHO software provides Standard Conformance to the following DICOM SOP Class as an SCU:

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1

2.3.1.) **Association Establishment Policy**

2.3.1.1.) **General**

The DICOM_ECHO software attempts to establish an association when the operator has invoked the dicom_echo executable. Once the association is established, the DICOM_ECHO software sends the DICOM echo request and waits to receive a DICOM echo response

2.3.1.2.) **Number of Associations**

One DICOM_ECHO software application requests one association. This association is handled independent of any other DICOM activity.

2.3.1.3.) **Asynchronous Nature**

One DICOM_ECHO request can be initiated from each terminal that has access to a Regulus prompt. Thus, multiple associations may be open at one point in time. This is limited by System resources.

2.3.1.4.) **Implementation Identifying Information**

The DICOM_ECHO software will provide a single Implementation Class UID of 2.16.840.1.113662.2.1.1.

2.3.2.) **Association Initiation Policy**

The DICOM_ECHO software attempts to initiate an association whenever it is invoked from the Regulus prompt by the PQ Operator.

2.3.2.1.) **PQ Operator invokes dicom_echo application**

2.3.2.1.1.) **Associated Real World Activity**

From the Regulus prompt, the PQ Operator invokes "dicom_echo" with the receiving node specified by the parameters.

2.3.2.1.2.) **Proposed Presentation Context**

Each time an association is initiated, the DICOM_ECHO software proposes a single Presentation Context to be used on that association, as defined in the following table.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID list		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian	1.2.840.1008.1.2	SCU	None

2.3.2.2.) **SOP Specific Conformance**

Initiation of the DICOM_ECHO software results in the sending of a C–ECHO request to the specified node. The return of a C–ECHO response with a "successful" status results in a "dicom_echo: successful" message presented to the operator. Any other status or no response results in an error message presented to the operator.

2.3.2.2.1.) **Data Set**

No Data Set is present with a C–ECHO request.

3.) **Communications Profiles**

3.1.) **Supported Communications Stacks (Parts 8,9)**

The DICOM software on the PQ scanner, both the image transfer and worklist request, provide DICOM TCP/IP network communications support as defined in part 8 of the DICOM standard.

3.2.) **TCP/IP Stack**

The TCP/IP protocol stack supported is a ported version of BSD TCP/IP Version 4.3

3.2.1.) **Physical Media Support**

The following media are supported on the PQ scanners:

10 Base T
10 Base 2
10 Base 5
10 Base FOIRL

An AUI connector is provided for maximum flexibility. The connector is located on the rear cover of the PQ scanners console.

4.) **Extensions/Specializations/Privatization**

No extensions, privatization, or specializations are used in this implementation.

5.) **Configuration**

HANI, WORKLIST, and DICOM_ECHO obtain their configuration information from the following files in the $SITE directory of the PQ scanner:

master.host
dicom.cfg
worklist.cfg

5.1.) **AE Title/Presentation Address Mapping**

The Application Entity Title for the HANI, WORKLIST, and DICOM_ECHO software is the same. This is specified in the dicom.cfg file.

The master.host file is used by the HANI, WORKLIST, and DICOM_ECHO software to establish associations to remote Application Entities.

5.2.) **Configurable Parameters**

The SCP port number and application entity title are configurable. They can be entered / changed by running the "netconfig" utility from the PQ operating system. If a SCP Application Entity Title is not entered the HANI software will use DICOM_STORAGE as a default AE Title. The maximum number of characters for the SCP AE Tile is 16. There is no default port number.

The HANI and DICOM_ECHO software will maintain an idle association for a configurable amount of time. The default is 30 seconds. This value is also changeable through "netconfig".

The HANI software can be configured to send over multiple associations. Using the "netconfig" utility each DICOM destination node can be set to send over multiple associations. Select "yes" or "no" when the question "send over simultaneous associations" is presented.

The DICOM option on the PQ must be enabled for the HANI and DICOM_ECHO software to function. For the WORKLIST

software to function, in addition to the DICOM option, the PROfile Connect option must be enabled on the PQ. Please consult your Picker Sales/Service representative for further details.

The amount of time to wait to complete a WORKLIST transaction is configurable.

The time indices when the WORKLIST software automatically solicits worklist entries are configurable.

All UID's generated by the PQ are based on Picker's UID root which is 2.16.840.1.113662.

5.2.1.) **Support of Extended Character Sets**

The WORKLIST software of the PQ scanner accepts data containing the Latin Alphabet No. 1 character set as described in ISO 8859–1. The Latin 1 characters are converted to a 7 bit ASCII form for display usage within the scanner. However, any data retrieved by WORKLIST containing Latin 1 characters is stored within the scanner. For any subsequent DICOM sends from the scanner, the original data containing the Latin 1 characters will be restored to the associated DICOM fields prior to transfer. See conversion table on next page.

DICOM LATIN ALPHABET NO. 1 CONVERSION TABLE

Original Character Set	° À Ð à ð	¡ +/− Á Ñ á ñ	¢ 2 Â Ò â ò	£ 3 Ã Ó ã ó	¤ ? Ä Ô ä ô	¥ ☐ Å Õ å õ	⊥ ¶ Æ Ö æ ö	§ · Ç x ç ☐	¨ , È Ø è ø	© 1 É Ù é ù	ª º Ê Ú ê ú	« » Ë Û ë û	¬ ¼ Ì Ü ì ü	− ½ Í Ý í ý	? ¾ Î Þ î þ	− ¿ Ï ß ï ÿ
Table 1 Equivalent Character Set displayed on scanner	A D a d	! +/− A N a n	c 2 A O a o	? 3 A O a o	? ' A O a o	Y u A O a o	| P AE O ae o	? . C x c :	" , E O e o	(c) 1 E U e u	a o E U e u	<< >> E U e u	− 1/4 I U i u	− 1/2 I Y i y	(R) 3/4 I Th i th	− ? I ss i y
Table 2 Equivalent Character Set displayed on scanner	A D a d	! ? A N a n	c 2 A O a o	? 3 A O a o	? ' A O a o	Y u A O a o	| P A O a o	? . c x c :	" , E O e o	c 1 E U e u	a o E U e u	< > E U e u	− ? I U i u	− ? I Y i y	R ? I T i t	− ? I s i y
Table 3 Equivalent Character Set displayed on scanner	A D a d	! +/− A N a n	c 2 A O a o	? 3 A O a o	? ' Ae O ae o	Y u Aa O aa o	| P AE Oe ae oe	? . C x c :	" , E Oe e oe	(c) 1 E U e u	a o E U e u	<< >> E U e u	− 1/4 I Ue i ue	− 1/2 I Y i y	R 3/4 I Th i th	− ? I ss i ij
Table 4 Equivalent Character Set displayed on scanner	A D a d	! +/− A N a n	c 2 A O a o	? 3 A O a o	$ ' [O { o	Y u] O } o	| P [\\ { |	? . C x c :	" , E \\ e |	(c) 1 @ U ' u	a o E U e u	<< >> E U e u	− 1/4 I ^ i ~	− 1/2 I Y i y	R 3/4 I Th i th	− ? I ss i y
Table 5 Equivalent Character Set displayed on scanner	[NS] [DG] [A!] [D−] [a!] [d−]	[!I] [+−] [A'] [N?] [a'] [n?]	[Ct] [2S] [A>] [O!] [a>] [o!]	[Pd] [3S] [A?] [O'] [a?] [o']	[Cu] ["'] [A:] [O>] [a:] [o>]	[Ye] [My] [AA] [O?] [aa] [o?]	[BB] [PI] [AE] [O:] [ae] [o:]	[SE] [.M] [C,] [*X] [c,] [−:]	[':] [',] [E!] [O/] [e!] [o/]	[Co] [1S] [E'] [U!] [e'] [u!]	[−a] [−o] [E>] [U'] [e>] [u']	[<<] [>>] [E:] [U>] [e:] [u>]	[NO] [14] [I!] [U:] [i!] [u:]	[—] [12] [I'] [Y'] [i'] [y']	[Rg] [34] [I>] [TH] [i>] [th]	['−] [?I] [I:] [ss] [i:] [y:]
Table 6 Equivalent Character Set displayed on scanner	A@' D@− a@' d@−	! +@− A@' N@~ a@' n@~	c@| 2 A@^ O@' a@^ o@'	L@− 3 A@~ O@' a@~ o@'	o@X ' A@" O@^ a@" o@^	Y@= u Aa O@~ aa o@~	| P AE O@" ae o@"	? . C@, x c@, −@:	" , E@' O@/ e@' o@/	(c) 1 E@' U@' e@' u@'	a@_ o@_ E@^ U@' e@^ u@'	<< >> E@" U@^ e@" u@^	−@, 1/4 I@' U@" i@' u@"	− 1/2 I@' Y@' i@' y@'	(R) 3/4 I@^ Th i@^ th	− ? I@" ss i@" y@"