PICKER

Applicable Software Release: **Ultra Z Release 1.0**	Rev: **Draft**	Date: **June 29, 1998**

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 Ultra Z CT scanner family to the DICOM standard. The Ultra Z CT scanner family requires software revision 1.0 as a minimum. This document does not attempt to detail any other Picker CT products or other medical imaging devices manufactured Picker International.

1 Implementation Model

This implementation provides for simple transfer of images to and from the Ultra Z CT scanner family. The transfer may be started locally by an operator on the scanner, or remotely by a DICOM compliant node. This implementation also provides for filming of images to DICOM compliant printers.
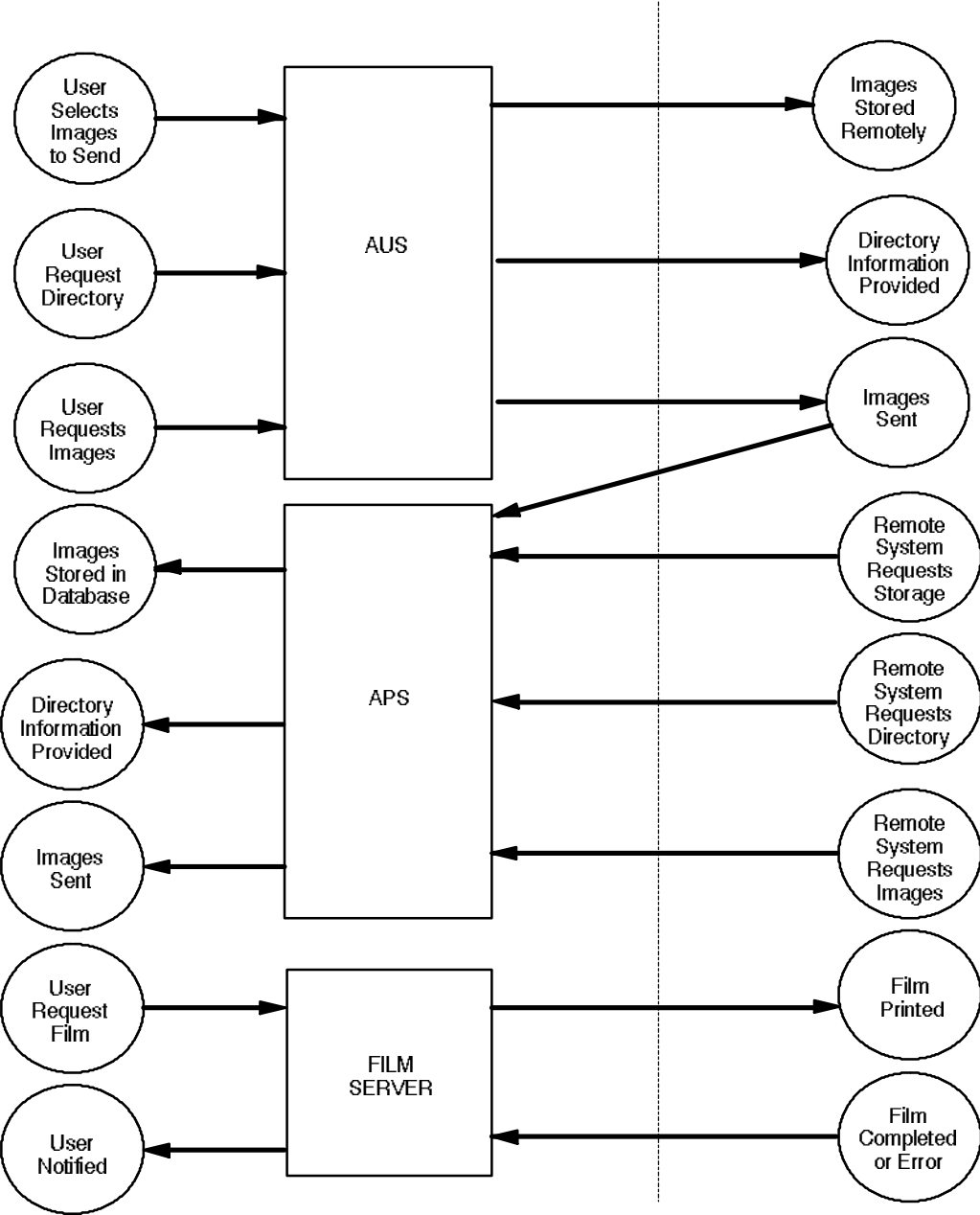
The Ultra Z operator initiates a transfer of images to a remote DICOM node by selecting "Study" from the clinical scanning application's menu bar. The operator then selects "DICOM" and then "Send". A dialog box displaying a directory of the data base and the list of possible destination DICOM nodes will appear. The operator then may select any combination of individual studies, series, and images to send. The operator must also select the DICOM node to send the images to by clicking on it with the mouse. If the operator mouse clicks on the "Cancel" button, the dialog will be dismissed and no action will be taken. If the operator mouse clicks on the "Send" button, the dialog will be dismissed and the requested transfers will be started. The operator will be informed of the progress of the transfer by way of the status area in the lower left corner of the screen. An error message will be displayed if the transfers fail, and a message will be displayed as each individually selected study/series/image is transferred. Images are sent using the DICOM Storage Service Class.

Similarly, a Ultra Z operator initiates a transfer of image from a remote DICOM node by selecting "Study" from the clinical scanning application's menu bar. The operator then selects "DICOM" and then "Receive". A dialog box displaying a list of possible image source DICOM nodes will appear. The operator selects a node from the list and may optionally select search criteria. When the operator clicks on "Retrieve Directory", a C- Find request is issued to obtain series level information. This information is displayed to the operator, who may then select studies/series to retrieve. The operator may request an image level directory of a series by clicking on the file icon next to the series. When the operator has selected the images to transfer, the "Retrieve" button is clicked. The dialog box is then dismissed and the image transfers are initiated. The operator will be informed of the progress of the transfer by way of the status area in the lower left corner of the screen. An error message will be displayed if the transfers fail, and a message will be displayed as each individually selected study/series/image is transferred.

Other DICOM compliant nodes may send images to the Ultra Z using the DICOM Storage Service Class or retrieve images from the Ultra Z using the DICOM Query/Retrieve Service class. No local operator action is required for a remote node to send or retrieve images.

To print to a DICOM compliant printer, the operator selects the printer from the list supplied in the "FILMING OPTIONS" dialog box. He then selects the images to print using the "Expose" key or clicking on a film cell in the film area on the left side of the screen. When the operator has selected all of the images he wishes to print, he may click on "Print" to print the images. Printing will also occur when a sheet of film is full.

2 Application Data Flow Diagram

User
Selects
Images
to Send

User
Request
Directory

User
Requests
Images

Images
Stored in
Database

Directory
Information
Provided

Images
Sent

User
Request
Film

User
Notified

AUS

APS

FILM
SERVER

Images
Stored
Remotely

Directory
Information
Provided

Images
Sent

Remote
System
Requests
Storage

Remote
System
Requests
Directory

Remote
System
Requests
Images

Film
Printed

Film
Completed
or Error

One way image data is transferred from the Ultra Z is when an operator selects a set of studies, series, or images to transfer. The software which runs to accomplish the transfer is known as the ACR- NEMA User Services (AUS). The AUS software also allows the operator to retrieve images and directory information from a remote DICOM node. Images retrieved in this manner are placed in the local system's data base.

Images may be transferred to and from the Ultra Z by remote DICOM nodes using the standard DICOM Storage and Query/Retrieve Service classes. The software handles DICOM requests from remote nodes is known as the ACR- NEMA Provider Services (APS). The APS software is started at system start- up time, and will accept images from other compliant nodes any time the system is running, subject to the availability of disk, memory, and network resources.

Ultra Z operators may film to DICOM compliant printers. The software which controls this is known as the Film Server. The film server forms an association with a printer when an operator has signalled that a sheet of film should be printed. Once the association is made, the film server sends the required information to the printer.

2.1 Functional definitions of AE's

The AUS software begins to run when a user selects DICOM send or DICOM receive from the menu bar. When the AUS 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.The APS software begins to run at system startup time. After initialization, the APS software waits for a connection at the port address configured for its Application Entity Title. When another node connects, the presentation and application contexts are checked to see if a valid context has been proposed. Once a valid context is proposed and the association is accepted, APS waits for C- ECHO, S- STORE, C- FIND and C- MOVE requests from the remote node. The association is maintained until the remote node initiates the release process or the association has been idle for a specified (configurable) amount of time.

The Film Server software also begins to run at system startup time. The Film Server does not attempt to make an association with a DICOM print device until it has all of the information needed to print a sheet of film. It then makes the association, sends the necessary information to the printer, waits for a completion status (if Print Job SOP Class is supported), and breaks the association. The Film Server may also attempt to make an association when a user selects a printer as a means of checking the printer's availability.

3 AE Specification

3.1 AUS software

The AUS software provides Standard Conformance to the following DICOM SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient/Study only Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient/Study only Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2

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

3.1.1 Association Establishment Policies

3.1.1.1 General

The AUS software attempts to establish an association when the operator has chosen a set of images to transfer, or when the operator has requested a directory to be retrieved. The association is maintained by AUS until the operator has pressed the cancel button, or the images specified by the operator have been transferred.

When transferring images to a remote node, the 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, or the remote node breaks down the association. The AUS software waits for a response message after each image is sent.

When transferring images from a remote node, AUS software issues a C- MOVE command for a study, series, or image and then waits for a C- MOVE reply before issuing the next C- MOVE command.

The AUS software does not place any restrictions on the maximum PDU size. If the Service Class Provider for the association does not specify a maximum PDU size, the AUS software sends PDU's of not more than 4096 bytes.

3.1.1.2 Number of Associations

The AUS software creates one association to a remote DICOM node for each user request. It is possible to have more than one association to a particular remote node if the operator issues multiple requests to the DICOM software in a short period of time. There is no specific maximum to the number of concurrent associations allowed by the AUS software, but it is constrained by disk and memory resources of the PQ 2000+ scanner. Also, more than four concurrent connections may result in a performance degradation.

3.1.1.3 Asynchronous Nature

The AUS software waits for a response after each DICOM command is sent before sending the next command. Therefore, there is no asynchronous activity in this implementation.

The Asynchronous Operations Window negotiation is not supported.

3.1.1.4 Implementation Identifying Information

The AUS will provide a single Implementation Class UID which is 2.16.840.1.113662.2.4.

3.1.2 Association Initiation Policy

3.1.2.1 Associated Real World Activity

There are two Real World Activities which causes association establishment. The AUS software attempts to initiate an association whenever the Ultra Z operator selects a set of studies for transfer, or requests directory information. The third real world activity, "User Requests Images", will use the same association that the directory request was made upon.

The AUS software requests the same SOP classes regardless of the Real World Activity which caused it to request the association.

3.1.2.2 Proposed presentation contexts.

The AUS software will propose all of the following contexts whenever an association establishment is tried. However, objects will only be sent over contexts that have been agreed upon.

The implementation described here offers only the default transfer syntax (DICOM Implicit VR Little Endian)

Presentation Context Table					
Abstract Syntax			Transfer Syntax		
Name	UID	U I D	Name	UID list		J.
CT Image Storage	1.2.840.10008.5.1.4.1.1.2		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
NM Image Storage	1.2.840.10008.5.1.4.1.1.20		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
SC Image Storage	1.2.840.10008.5.1.4.1.1.7		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
Patient/Study only Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.3.1		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None
Patient/Study only Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SC U	None

3.1.2.3 SOP Specific Conformance Statement

3.1.2.3.1 Real World Activity 1 - Images Selected to Send

The operator is informed when a selected study, series, or image has been transferred. If an attempt to store an image on a remote DICOM node fails, the operator will be notified and the AUS software will attempt to send the next selected item in the list.

Warning: C- STORE Response statuses are treated the same as successful statuses.

All optional (Type 3) data elements received on the Ultra Z scanner are saved in the database. The AUS software will send all of these optional elements whenever an image is transferred.

The Ultra Z scanner saves the following data elements for images created on the scanner. This is the set of optional elements which will be sent with an image generated on an Ultra Z scanner. Note: Some of these fields may be absent if the data for them has not been supplied by the operator.

IOD	Attribute Name	Attribute Tag	Possible Values
	Patient's Name	<0010, 0010>	Patient's Name or NULL
	Patient ID	<0010, 0020>	Patient ID
	Patient's Birth Date	<0010, 0030>	NULL
	Patient's Sex	<0010, 0040>	"M", "F", "O" or NULL
	Patient Birth Time	<0010, 1032>	NULL
	Ethnic Group	<0010, 2160>	NULL
	Patient Comments	<0010, 4000>	Comments

enera. ...de	Study Instance UID	<0020, 000D>	UID
	Study Date	<0008, 0020>	Date
	Study Time	<0008, 0030>	Time
	Study ID	<0020, 0010>	Numeric ID for this Study
	Accession Number	<0008, 0050>	NULL
	Referring Physician's Name	<0008, 0090>	Physician's Name or NULL
	Name of Physician Reading Study	<0008, 1060>	Physician's name or NULL
.uuy	Admitting Diagnoses Description	<0008, 1080>	NULL
	Patient's Age	<0010, 1010>	Patient's age or NULL
	Patient's Size	<0010, 1020>	NULL
	Patient's Weight	<0010, 1030>	Patient's weight or NULL
	Patient's Occupation	<0010, 2180>	NULL
	Additional Patient's History	<0010, 21B0>	NULL

	Modality	<0008, 0060>	"CT"
	Series Instance UID	<0020, 000E	UID
	Series Number	<0020, 0011>	Number
	Laterality	<0020, 0060>	NULL
	Series Date	<0008, 0021>	Date
	Series Time	<0008, 0031>	Time
	Protocol Name	<0018, 1030>	Protocol Name
	Series Description	<0008, 103E>	NULL
	Operator's Name	<0008, 1070>	Operator's Name or NULL
	Body Part Examined	<0018, 0015>	Body Part
	Manufacturer	<0008, 0070>	"Picker"
	Institution Name	<0008, 0080>	Name as configured by user
	Institution Address	<0008, 0081>	Address as configured by user
	Station Name	<0008, 1010>	Station name as configured by user
	Institutional Department Name	<0008, 1040>	Department name as configured by user
	Manufacturer's Model Name	<0008, 1090>	"Picker UltraZ"
	Spatial Resolution	<0018, 1050>	Number
	Date of Last Calibration	<0018, 1200>	Date
	Time of Last Calibration	<0018, 1201>	Time
	Pixel Padding Value	<0028, 0120>	0

...g.	Image Number	<0020, 0013>	Number
	Patient Orientation	<0020, 0020>	Combination of "H", "F", "A", "P", "L", and "R"
	Image Date	<0008, 0023>	Date
	Image Time	<0008, 0033>	Time
	Acquisition Number	<0020, 0012>	Number
	Acquisition Date	<0008, 0022>	Date
	Acquisition Time	<0008, 0032>	Time
	Derivation Description	<0008, 2111>	NULL
.....	Pixel Spacing	<0028, 0030>	Number pair
	Image Orientation (Patient)	<0020, 0037>	Direction cosines for orientation
	Image Position (Patient)	<0020, 0032>	x,y,z coordinates of first pixel
	Slice Thickness	<0018, 0050>	Number
	Slice Location	<0020, 1041>	Number

	Samples per Pixel	<0028, 0002>	1
...	Photometric Interpretation	<0028, 0004>	"MONOCHROME2"
	Rows	<0028, 0010>	Pixel rows (512 or 1024 for CT images)
	Columns	<0028, 0011>	Pixel columns (512 or 1024 for CT images)
	Bits allocated	<0028, 0100>	16 (for CT Images)
	Bits Stored	<0028, 0101>	16 (for CT images)
	High Bit	<0028, 0102>	15 (for CT images)
	Pixel Representation	<0028, 0103>	1 (Two's complement)
	Pixel data	<7FE0, 0010>	Pixel data
	Pixel Aspect Ratio	<0028, 0034>	Number pair
	Smallest Image Pixel Value	<0028, 0106>	Minimum actual pixel value in this image
	Largest Image Pixel Value	<0028, 0107>	Maximum actual pixel value in this image
...	Contrast/Bolus Agent	<0018, 0010>	Agent as provided by the operator
	Contrast/Bolus Route	<0018, 1040>	"IV", "GI", or "IV & GI"
	Contrast/Bolus Volume	<0018, 1041>	0
	Contrast/Bolus Start Time	<0018, 1042>	NULL
	Contrast/Bolus Stop Time	<0018, 1043>	NULL
	Contrast/Bolus Total Dose	<0018, 1044>	0

	Image Type	<0008, 0008>	
img.	Samples per Pixel	<0028, 0002>	1
	Photometric Interpretation	<0028, 0004>	"MONOCHROME2"
	Bits allocated	<0028, 0100>	16 (for CT images)
	Bits Stored	<0028, 0101>	16 (for CT images)
	High Bit	<0028, 0102>	15 (for CT images)
	Rescale Intercept	<0028, 1052>	0
	Rescale Slope	<0028, 1053>	1
	KVP	<0018, 0060>	Peak Voltage as specified by the protocol
	Acquisition Number	<0020, 0012>	Number
	Scan Options	<0018, 0022>	NULL
	Reconstruction Diameter	<0018, 1100>	Diameter in millimeters
	Distance Source to Detector	<0018, 1110>	Distance in millimeters
	Distance Source to Patient	<0018, 1111>	Distance in millimeters
	Gantry/Detector Tilt	<0018, 1120>	Tilt in degrees
	Table Height	<0018, 1130>	Height in millimeters
	Rotation Direction	<0018, 1140>	"CW"
	Exposure Time	<0018, 1150>	Exposure time in milliseconds
	X-ray Tube Current	<0018, 1151>	Current in mA
	Exposure	<0018, 1152>	Number
	Generator Power	<0018, 1170>	Power in kW

	Window Center	<0028, 1050>	Number
	Window Width	<0028, 1051>	Number
...r	SOP Class UID	<0008, 0016>	1.2.840.10008.5.1.4.1.1.2 for CT 1.2.840.10008.5.1.4.1.1.7 for SC
	SOP Instance UID	<0008, 0018>	UID
	Specific Character Set	<0008. 0005>	Character set used
	Instance Creation Date	<0008, 0012>	Date
	Instance Creation Time	<0008, 0013>	Time

Additionally, CT images that were created by an Ultra Z scanner will contain the following private elements.

Attribute Name	Attribute Tag	VR
Private Group Identifier	<0011, 0010>	LO
Patient Locale	<0011, 1010>	CS
Study Locale	<0011, 1020>	CS
Study Folder	<0011, 1021>	CS
Series Locale	<0011, 1030>	CS
Series Protocol Modifications	<0011, 1031>	CS
Image Compression	<0011, 1040>	CS
Image Locale	<0011, 1042>	CS
Pilot Tube Position	<0011, 1050>	FD
Reconstruction filter	<0011, 1051>	CS
Spiral Interpolation filter	<0011, 1052>	CS
Reconstruction Horizontal Center	<0011, 1053>	FD
Reconstruction Vertical Center	<0011, 1054>	FD
Injector Flag	<0011, 1055>	CS

Spiral Revolutions	<0011, 1056>	FD
Spiral Pitch	<0011, 1057>	FD
Pilot Edge Enhancement	<0011, 1058	CS
Pilot Scan Type	<0011, 1059>	CS
Sampling	<0011, 105A>	FD
Scan Type	<0011, 105B	CS
CT Image Locale	<0011, 105C>	CS

3.1.2.3.2 Real World Activity 2 - Directory requested

When the operator requests a directory, the AUS software issues one or more C-FIND requests to retrieve the information. The first directory displayed to the user usually contains series level information, but subsequent requests could include image data.

If the Study Root contexts are accepted, the AUS software uses them for all queries and image requests. If Study Root contexts are not accepted, AUS will use Patient Root contexts. If neither Study or Patient Root contexts are available, AUS uses Patient/Study only.

The following tables show the keys used by the various models. Keys listed as "Optional" will always be requested, but return data is not required in theses fields.

Study Root Model - Study Level Keys		
Description	**Tag**	**Type**
Study Date	(0008, 0020)	Required
Study Time	(0008, 0030)	Required
Accession Number	(0008, 0050)	Required
Patient Name	(0010, 0010)	Required
Patient ID	(0010, 0020)	Required
Study ID	(0020, 0010)	Required
Study Instance UID	(0020, 000D)	Unique

Referring Physician's Name	(0008, 0090)	Optional
Name of Physicians Reading Study	(0008, 1060)	Optional
Admitting Diagnoses Description	(0008,1080)	Optional
Patient Birth Date	(0010, 0030)	Optional
Patient Birth Time	(0010, 0032)	Optional
Patient Sex	(0010, 0040)	Optional
Patient's Age	(0010, 1010)	Optional
Patient's Size	(0010, 1020)	Optional
Patient's Weight	(0010, 1030)	Optional
Ethnic Group	(0010, 2160)	Optional
Patient Comments	(0010, 4000)	Optional
Occupation	(0010, 2180)	Optional

Patient Root Model - Patient Level Keys		
Description	Tag	Type
Patient Name	(0010, 0010)	Required
Patient ID	(0010, 0020)	Unique
Patient Birth Date	(0010, 0030)	Optional
Patient Birth Time	(0010, 0032)	Optional
Patient Sex	(0010, 0040)	Optional
Ethnic Group	(0010, 2160)	Optional
Patient Comments	(0010, 4000)	Optional

Patient Root Model - Study Level Keys		
Description	Tag	Type
Study Date	(0008, 0020)	Required
Study Time	(0008, 0030)	Required
Accession Number	(0008, 0050)	Required
Study ID	(0020, 0010)	Required
Study Instance UID	(0020, 000D)	Unique
Referring Physician's Name	(0008, 0090)	Optional
Name of Physicians Reading Study	(0008, 1060)	Optional
Admitting Diagnoses Description	(0008,1080)	Optional
Patient's Age	(0010, 1010)	Optional
Patient's Size	(0010, 1020)	Optional
Patient's Weight	(0010, 1030)	Optional
Occupation	(0010, 2180)	Optional

Patient Root and Study Root Models - Series Level Keys		
Description	Tag	Type
Modality	(0008, 0060)	Required
Series Number	(0020, 0011)	Required
Series Instance UID	(0020, 000E)	Unique
Series Laterality	(0020, 0060)	Optional
Series Date	(0008, 0021)	Optional
Series Time	(0008, 0031)	Optional
Performing Physician's Name	(0008, 1050)	Optional
Protocol Name	(0018, 1030)	Optional

Series Description	(0008, 103E)	Optional
Operator's Name	(0008, 1070)	Optional
Body Part Examined	(0018, 0015)	Optional
Patient Position	(0018, 5100)	Optional

Patient Root and Study Root Models - Image Level Keys		
Description	Tag	Type
Image number	(0020, 0013)	Required
SOP Instance UID	(0008, 0018)	Unique
Patient Orientation	(0020, 0020)	Optional
Image Date	(0008, 0023)	Optional
Image Time	(0008, 0033)	Optional
Image Type	(0008, 0008)	Optional
Acquisition Number	(0020, 0012)	Optional
Acquisition Date	(0008, 0022)	Optional
Acquisition Time	(0008, 0032)	Optional
Derivation description	(0008,2111)	Optional

The AUS software may request Wild Card matching, Range matching, Single Value matching, List of UID matching, and Universal Matching for any of the required or optional Key Attributes (depending on the VR of the Key Attribute)

Extended negotiation is not supported.

3.1.2.3.3 Real World Activity - User requests images

The AUS software will issue C- MOVE requests at the study, series, or image level based on how the user has requested the images. After issuing a C- MOVE request, the AUS software will wait until a C- MOVE response with a status other than PENDING is received. It will then issue additional C- MOVEs as necessary until all of the desired images have been transferred. When all of the images have been transferred, the association will be released.

The AUS software never attempts to cancel an ongoing transfer.

The AUS software and APS server share a common Application Entity Title, so C- STORE requests caused by the AUS software's C- MOVE request are processed by the APS server.

3.1.3 Association Acceptance policy

The AUS software never accepts associations.

3.2 APS Specification

The APS software provides Standard Conformance to the following DICOM SOP Classes as an SCP:

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient/Study only Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient/Study only Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2

The APS software never acts in the role of an SCU.

3.2.1 Association Establishment Policies

3.2.1.1 General

The APS software is started at system initialization time. After initializing, the APS waits for association requests. When a successful association is made, a new process is spawned to handle requests on the association. This process will receive one request at a time, process it, and send a response before reading the next request from the network. The process will close the association if it has been idle for more than the configured time, or if the Service Class User breaks down the connection.

The APS software does not place any restrictions on the maximum PDU size. If the Service Class User for the association does not specify a maximum PDU size, the APS software sends PDU's of not more than 4096 bytes.

3.2.1.2 Number of Associations

The APS software places no limits on the number of concurrent associations. However, more than 4 associations active concurrently will impact system performance. Other system resource limitations may also impact the maximum number of concurrent associations.

There are no additional restrictions on multiple simultaneous associations with a single AE.

3.2.1.3 Asynchronous Nature

Although there may be concurrent associations, images are processed in a serial fashion. The APS software processes each image in turn and sends a response before processing the next image. Therefore, there is no asynchronous activity in this implementation.

The Asynchronous Operation Window negotiation is not supported.

3.2.1.4 Implementation Identifying Information

APS will provide a single Implementation Class UID which is 2.16.840.1.113662.2.4

3.2.2 Association Initiation Policy

The APS software only initiates associations to perform C- STORE sub- operations for a C- MOVE request. It utilizes the AUS software described previously to make this association. Details of the association initiation policy may be seen in the AUS description above.

3.2.3 Association Acceptance Policy

There are three Real World Activities which may cause association establishment. These are: "Remote System Requests Image Storage", "Remote System Requests Directory", and "Remote System Requests Images". The APS software acts the same way in making the association regardless of the remote system's intent. The association acceptance policy for all three of these real world activities is grouped into "Remote connection to APS" below.

3.2.3.1 Remote connection to APS

3.2.3.1.1 Associated Real World Activity

The Associated Real World Activity is an attempt by a remote system to connect to the Ultra Z for image storage or retrieval.

3.2.3.1.2 Acceptable presentation contexts.

The table below indicates which presentation contexts will be accepted by the APS software.

Presentation Context Table					
Abstract Syntax		Transfer Syntax			
Name	UID	Name	UID list		ɟ.
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
Patient/Study only Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None
Patient/Study only Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	DICOM Implicit VR Little Endian	1.2.840.1000 8.1.2	SCP	None

3.2.3.1.2.1   SOP Specific Conformance to Verification SOP Class

APS provides standard conformance to the DICOM Verification Service Class.

3.2.3.1.2.2 SOP Specific Conformance to the Storage SOP Classes

APS conforms to the SOP's of the Storage Service Class at Level 2 (Full). Only minimal checks for data integrity are made during the image transfer. Specifically, the APS software verifies that all required (Type 1) fields are present. When the APS software returns a successful status, the image data has been successfully stored to the Ultra Z data base. The images are grouped by Study UID and Series UID. Two series with the same Study UID will be placed in the same study in the data base, even if they are transferred under different associations. Similarly, images with the same Study and Series UID's will be placed in the same series, even if they are transferred under different associations. Multiple studies, series, and images may be received over a single association.

No data element coercion is done.

Images are then available to be viewed at the Ultra Z or transferred to another DICOM node as soon as they are received. Images are available for viewing or transmission to other nodes until they are manually deleted by the operator..

The APS software will return one of the following error statuses when the C- STORE command is not successful.

A700	No resources available. Either memory, disk, or network resources were exhausted.
A902	A required (Type 1) field is missing.
A000	Function not supported. A command other than C-STORE, C-FIND, C-MOVE, C-CANCEL, or C-ECHO was received.
A800	The SOP class of the image is not supported. Only SOP classes for which presentation contexts have been established may be sent.

3.2.3.1.2.3 SOP Specific Conformance to the Query/Retrieve Service Class

3.2.3.1.2.3.1 C- FIND Conformance

The APS software conforms to C- FIND behavior in the standard way for Patient Root Model, Study Root Model, and Patient/Study Only Model.

Relational Search is not supported.

Extended Negotiation is not supported.

These Optional Keys are supported when a C- FIND is requested on the appropriate hierarchy level:

Optional Keys Supported by APS Software		
Description	Tag	Level

Patient Sex	(0010, 0040)	Patient
Patient's Age	(0010, 1010)	Patient
Patient's Size	(0010, 1020)	Patient
Patient's Weight	(0010, 1030)	Patient
Ethnic Group	(0010, 2160)	Patient
Patient Comments	(0010, 4000)	Patient
Occupation	(0010, 2180)	Patient
Referring Physician's Name	(0008, 0090)	Study
Name of Physicians Reading Study	(0008, 1060)	Study
Admitting Diagnoses Description	(0008,1080)	Study
Patient's Age	(0010, 1010)	Study
Patient's Size	(0010, 1020)	Study
Patient's Weight	(0010, 1030)	Study
Occupation	(0010, 2180)	Study
Series Laterality	(0020, 0060)	Series
Series Date	(0008, 0021)	Series
Series Time	(0008, 0031)	Series
Performing Physician's Name	(0008, 1050)	Series
Protocol Name	(0018, 1030)	Series
Series Description	(0008, 103E)	Series
Operator's Name	(0008, 1070)	Series
Body Part Examined	(0018, 0015)	Series
Patient Position	(0018, 5100)	Series
Patient Orientation	(0020, 0020)	Image
Image Date	(0008, 0023)	Image

Image Time	(0008, 0033)	Image
Image Type	(0008, 0008)	Image
Acquisition Number	(0020, 0012)	Image
Acquisition Date	(0008, 0022)	Image
Acquisition Time	(0008, 0032)	Image
Derivation description	(0008,2111)	Image

3.2.3.1.2.3.2 C- MOVE Conformance

The APS software conforms to C- MOVE behavior in the standard way for Patient Root Model, Study Root Model, and Patient/Study Only Model.

These are the Storage Service Class SOP Classes under which the APS software supports C- STORE sub- operations generated by the C- MOVE:

SOP Class Name	SOP Class UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
SC Image Storage	1.2.840.10008.5.1.4.1.1.7

3.2.3.1.3 Presentation Context Acceptance Criteria

APS will always accept any of the Presentation Contexts specified in section 2.2.3.1.2. As many as eleven contexts will be accepted per association.

3.2.3.1.4 Transfer Syntax Acceptance Criteria

APS accepts only the DICOM default transfer syntax (DICOM Implicit VR Little Endian).

3.3 Film Server Specification

The Film Server software provides Standard Conformance to the following DICOM SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
Printer SOP Class	1.2.840.10008.5.1.1.16
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18
Basic Film Session SOP Class	**1.2.840.10008.5.1.1.1**
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
Basic Color Image Box SOP Class	1.2.840.10008.5.1.1.4.1
Printer SOP Class	1.2.840.10008.5.1.1.16
Print Job SOP Class	1.2.840.10008.5.1.1.14

The Film Server software never acts in the role of an SCP.

3.3.1 Association Establishment Policies

3.3.1.1 General

The Film Server software attempts to establish an association when it determines that it has the necessary data to print a sheet of film. The film server obtains data when the operator indicates that an image is to be filmed, or when images are being created and the "Auto Film" option is enabled. One or more images may be placed on a film, depending on the format selected by the user.

The Film Server software does not place any restrictions on the maximum PDU size. If the Service Class Provider for the association does not specify a maximum PDU size, the Film Server software sends PDU's of s not more than 4096 bytes.

3.3.1.2 Number of Associations

The number of associations the film server will maintain with a single printer is configurable. The default is one. The maximum number of associations the film server will support is the sum of the number of associations allowed for each configured printer.

3.3.1.3 Asynchronous Nature

For each sheet of film to be printed, the Film Server software creates an association, sets film attributes, prints the film, and releases the association. There is no asynchronous activity.

The Asynchronous Operations Window negotiation is not supported.

3.3.1.4 Implementation Identifying Information

The Film Server software will provide a single Implementation Class UID which is 2.16.840.1.113662.2.4

3.3.2 Association Initiation Policy

There are two Real World Activities which may cause association establishment. First is when an operator selects a printer, and second is when the operator has indicated to the Film Server software that a sheet of film should be printed. The implementation described here offers only the default transfer syntax (DICOM Implicit VR Little Endian).

3.3.2.1 Printer Selected

3.3.2.1.1 Associated Real World Activity

When the operator selects a printer for the first time, the film server consults its configuration to determine what level of connection testing should be done. If the configuration indicates a DICOM association should be attempted, the Film server software will request an association.

3.3.2.1.2 Proposed presentation contexts.

The Film Server software will propose Job SOP Class and either Grayscale or Color Meta SOP class based on the type of printer. Only the default transfer syntax (DICOM Implicit VR Little Endian) will be offered.

Presentation Context Table					
Abstract Syntax		Transfer Syntax			
Name	UID	Name List	UID list		J.
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	**DICOM Implicit VR Little Endian**	**1.2.840.10008.1.2**	**SCU**	**None**
Print Job SOP Class	**1.2.840.10008.5.1.1.14**	**DICOM Implicit VR Little Endian**	**1.2.840.10008.1.2**	**SCU**	**None**

3.3.2.1.3 SOP Specific conformance

As a result of this Real World Activity, the Film Server software will only create, then release the association. It does not exercise any of functionality of the SOP classes and so it provides standard conformance to the service classes it associates with as a Service Class User.

3.3.2.2 Film Sheet to be Printed.

3.3.2.2.1 Associated Real World Activity

The Film Server is informed that a sheet of film is to be printed. This may occur because the operator has depressed the "Print" button, or enough images have been selected by the operator for a full sheet of film to be printed.

3.3.2.2.2 Proposed presentation contexts.

The Film Server software will propose Job SOP Class and either Grayscale or Color Meta SOP class based on the type of printer.   Only the default transfer syntax (DICOM Implicit VR Little Endian) will be offered.

Presentation Context Table					
Abstract Syntax		Transfer Syntax			
Name	UID	Name List	UID list		J.
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Print Job SOP Class	1.2.840.10008.5.1.1.14	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.3.2.3 SOP Specific Conformance Statement

The following DIMSE Service Elements and optional attributes are used by the Film Server software:

Basic Film Session SOP Class			
DIMSE Services Used	Optional Attribute Description	Tag	Possible Values
	Number of Copies	(2000, 0010)	See Note Below
	Number of Copies	(2000, 0010)	See Note Below
N- DELETE			
N- ACTION			

Basic Film Box SOP Class

DIMSE Services Used	Optional Attribute Description	Tag	Possible Values
	Magnification Type	(2010, 0060)	See Note Below
	Border Density	(2010, 0100)	See Note Below
	Trim	(2010, 0140)	See Note Below
	Magnification Type	(2010, 0060)	See Note Below
	Border Density	(2010, 0100)	See Note Below
	Trim	(2010, 0140)	See Note Below
N-DELETE			
N-ACTION			

Basic Grayscale Image Box SOP Class

DIMSE Services Used	Optional Attribute Description	Tag	Possible Values
	Magnification Type	(2010, 0060)	See Note Below

Basic Color Image Box SOP Class

DIMSE Services Used	Optional Attribute Description	Tag	Possible Values
	Magnification Type	(2010, 0060)	See Note Below

Print Job SOP Class

DIMSE Services Used	Optional Attribute Description	Tag	Possible Values

N- EVENT- REPORT	
N- GET	

Basic Film Session SOP Class

Basic Film Box SOP Class

Basic Grayscale Image Box SOP Class

Basic Color Image Box SOP Class

Print Job SOP ClassNOTE: The film server software uses a file to determine what the valid values are for mandatory and optional attributes. A separate file exists for each printer type and is generated by Picker. The data in the file is based on the conformance statement provided by the manufacturer of the printer.

3.3.3 Association Acceptance policy

The Film Server software never accepts associations.

4 Communications Profiles

4.1 Supported Communications Stacks (Parts 8,9)

The AUS, APS, and Film Server software provide DICOM 3.0 TCP/IP network communications support as defined in part 8 of the DICOM 3.0 standard.

4.2TCP/IP Stack

The TCP/IP protocol stack is supported as implemented in Sun Microsystems Solaris 2.5

4.2.1 Physical Media Support

The following physical media connections are available:

10 Base T, 10 Base 2, 10 Base 5, 10 Base FOIRL, An AUI connector is provided for maximum flexibility.

5 Extensions/Specializations/Privatization

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

6 Configuration

6.1 AE Title/Presentation Address mapping

The mapping between AE Title and presentation context is done in two files, film_server.cfg and dicom.cfg. These files should only be modified using the service application on the Ultra Z.

6.2 Configurable Parameters

The following local parameters are configurable using the Ultra Z Service Application. Please consult your Picker Service representative for detailed information on using the Service Application. Default values for each field are shown in parentheses.

- Application Title used by the Film Server software (PICKER_CAM_SCU)

- Connection wait time when connecting to a printer. (60 seconds)

- Time to wait between PDUs when connected to a printer (60 seconds)

- Application title used by AUS and APS software. (DICOM_STORAGE)

- TCP/IP Port used by APS software. (104)

- Defaults to use when APS software is associated with a host that has not been configured.

- Default connection wait time. (60 seconds)

- Default maximum time to wait between PDUs. (10 seconds)

- Default maximum time to keep an idle connection up. (600 seconds)

- Default maximum PDU length. (4096 bytes)

- For each configured printer:

- Application Title (PRINT_SCP)

- Port (104)

- Camera Type

- Connection Test Level (Ping)

- DICOM Print Job SOP Class Support (No)

- Print Time Out (300 seconds)

- Read Time Out (60 seconds)

- Number of Concurrent Associations. (1)

- For each configured storage/query/retrieve device:

- Application Title (DICOM_STORAGE)

- Port (104)

- Maximum time to wait between PDUs (10 seconds)

- Maximum time to wait for a connection (60 seconds)

- Maximum time to keep up an idle association (300 seconds)

- Maximum PDU length (4096)

- Insert length to end elements (No)

Please note: port numbers 6002, 6938, 6950, and 7020 are used for Picker CT proprietary protocols and should not be used for any of the DICOM ports.

In most cases, the system must be rebooted for configuration changes to take effect.

All UID's generated by the DICOM software on the Ultra Z product are based on Picker's UID root. This root is 2.16.840.1.113662.

6.3 Support of Extended Character Sets

The Ultra Z is capable of handling the Latin 1 character set (ISO- IR 100Latin alphabet No. 1, supplementary set). The Ultra Z will accept, send, and display images which use this character set. The Ultra Z will also accept and send images using other character sets, but data in them may not be displayed correctly.