

RamSoft PACS 5.0

DICOM Conformance

Statement

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1	Introduction.....	4
2	Implementation Model	4
2.1	Application Data Flow Diagram.....	4
2.2	Functional Definitions of AE's.....	7
3	AE Specifications	7
3.1	RamSoft PACS AE Specification.....	7
3.1.1	Association Establishment Policies.....	10
3.1.1.1	General	10
3.1.1.2	Number of Associations.....	10
3.1.1.3	Asynchronous Nature	10
3.1.1.4	Implementation Identifying Information	10
3.1.2	Association Initiation by Real-World Activity.....	11
3.1.2.1	Real-World Activity – User initiates storage.....	11
3.1.2.1.1	Associated Real-world Activity	11
3.1.2.1.2	Proposed Presentation Contexts	11
3.1.2.1.2.1	SOP Specific Conformance - Storage	12
3.1.2.1.2.2	SOP Specific Conformance – Grayscale Softcopy Presentation State Storage.....	12
3.1.2.1.2.3	SOP Specific Conformance – Structured Reporting Storage.....	12
3.1.2.1.2.4	SOP Specific Conformance - Media Storage Directory Storage.....	12
3.1.2.2	Real-World Activity – User initiates a query.....	13
3.1.2.2.1	Proposed Presentation Contexts	13
3.1.2.2.1.1	SOP Specific Conformance – Verification	13
3.1.2.2.1.2	SOP Specific Conformance – Query/Retrieve	13
3.1.2.2.1.3	SOP Specific Conformance – Modality Worklist Information Model	13
3.1.2.3	Real-World Activity – User requests printing of images	13
3.1.2.3.1	Proposed Presentation Contexts	14
3.1.2.3.1.1	SOP Specific Conformance – Basic Grayscale and Color Print Management	14
3.1.2.4	Real-World Activity – Transmit may initiate MPPS or storage commit	15
3.1.2.4.1	Proposed Presentation Contexts	15
3.1.2.4.1.1	SOP Specific Conformance – Storage Commitment Push Model.....	15
3.1.2.4.1.2	SOP Specific Conformance – Modality Performed Procedure Step (MPPS)	15
3.1.3	Association Acceptance Policy	15
3.1.3.1	Real-World Activity – External system initiates a transfer.....	15
3.1.3.1.1	Presentation Context Table	16
3.1.3.1.1.1	SOP Specific Conformance – Storage	16
3.1.3.1.1.2	SOP Specific Conformance – Grayscale Softcopy Presentation State Storage.....	16
3.1.3.1.1.3	SOP Specific Conformance – Structured Reporting Storage.....	16
3.1.3.1.2	Presentation Context Acceptance Criterion.....	17
3.1.3.1.3	Transfer Syntax Selection Policies.....	17
3.1.3.2	Real-World Activity – External system initiates a query	17
3.1.3.2.1	Associated Real-World Activity	17
3.1.3.2.2	Presentation Context Table	17
3.1.3.2.2.1	SOP Specific Conformance – Verification	18
3.1.3.2.2.2	SOP Specific Conformance – Modality Worklist Information Model.....	18
3.1.3.2.2.3	SOP Specific Conformance - Query/Retrieve	18
3.1.3.2.3	Presentation Context Acceptance Criterion.....	18
3.1.3.2.4	Transfer Syntax Selection Policies.....	18
3.1.3.3	Real-World Activity – External system initiates Storage Commitment or MPPS.....	18
3.1.3.3.1	Associated Real-World Activity	18
3.1.3.3.2	Presentation Context Table	18
3.1.3.3.2.1	SOP Specific Conformance – Storage Commitment Push Model.....	19
3.1.3.3.2.2	SOP Specific Conformance – Modality Performed Procedure Step.....	19
4	Communication Profiles.....	19
4.1	Supported Communications Stacks	19
4.2	TCP/IP Stack.....	19

4.2.1	Physical Media Support.....	19
5	Extensions/Specializations/Privatizations.....	20
5.1	Image IOD Description	20
6	Configuration	23
6.1	AE Title/Presentation Address Mapping.....	23
6.2	Configurable Parameters	23
7	Support of Extended Character Sets	23
8	Security Profiles	23

1 Introduction

This is the DICOM 3.0 Conformance Statement for RamSoft PACS 5.0 family of software produced by RamSoft Inc including PowerServer and Gateway.

PowerServer and Gateway are self-contained network computer systems used for capturing, storing, displaying, reporting, transmitting and archiving diagnostic medical images. The system conforms to the DICOM 3.0 standard to share medical data with other medical imaging devices.

2 Implementation Model

2.1 Application Data Flow Diagram

RamSoft workstations and servers can send and receive DICOM data. DICOM parameters are configurable through the Station List. DICOM communications can be secured through TLS.

The RamSoft DICOM Service is typically installed to start up automatically. Once the computer is turned on and Windows is started, the RamSoft DICOM Service is ready for DICOM communication. The RamSoft PACS application is typically installed to start up once an authorized user logs into Windows. RamSoft client workstations connected directly to a RamSoft server do not require the RamSoft DICOM Service running and do not connect through DICOM to the RamSoft server.

A RamSoft workstation can query a DICOM Modality Worklist server to obtain patient and study information.

A third party workstation can query a RamSoft server to obtain patient, study, series and image information.

A RamSoft workstation may contain an option to capture images through a video frame grabber, film digitizer, or document scanner. Alternately, images may be imported from various digital formats. Images are stored on the hard drive.

DICOM data can be pushed from the server to a DICOM AE by clicking on the Push button and selecting Station for Target. Once Target and Destination stations are selected and the priority level is set, then data is sent in the background. If any failures occur, the error is recorded in the Transmit List. RamSoft PACS will retry transmission until it completes.

DICOM data can also be set to be automatically routed from a RamSoft server.

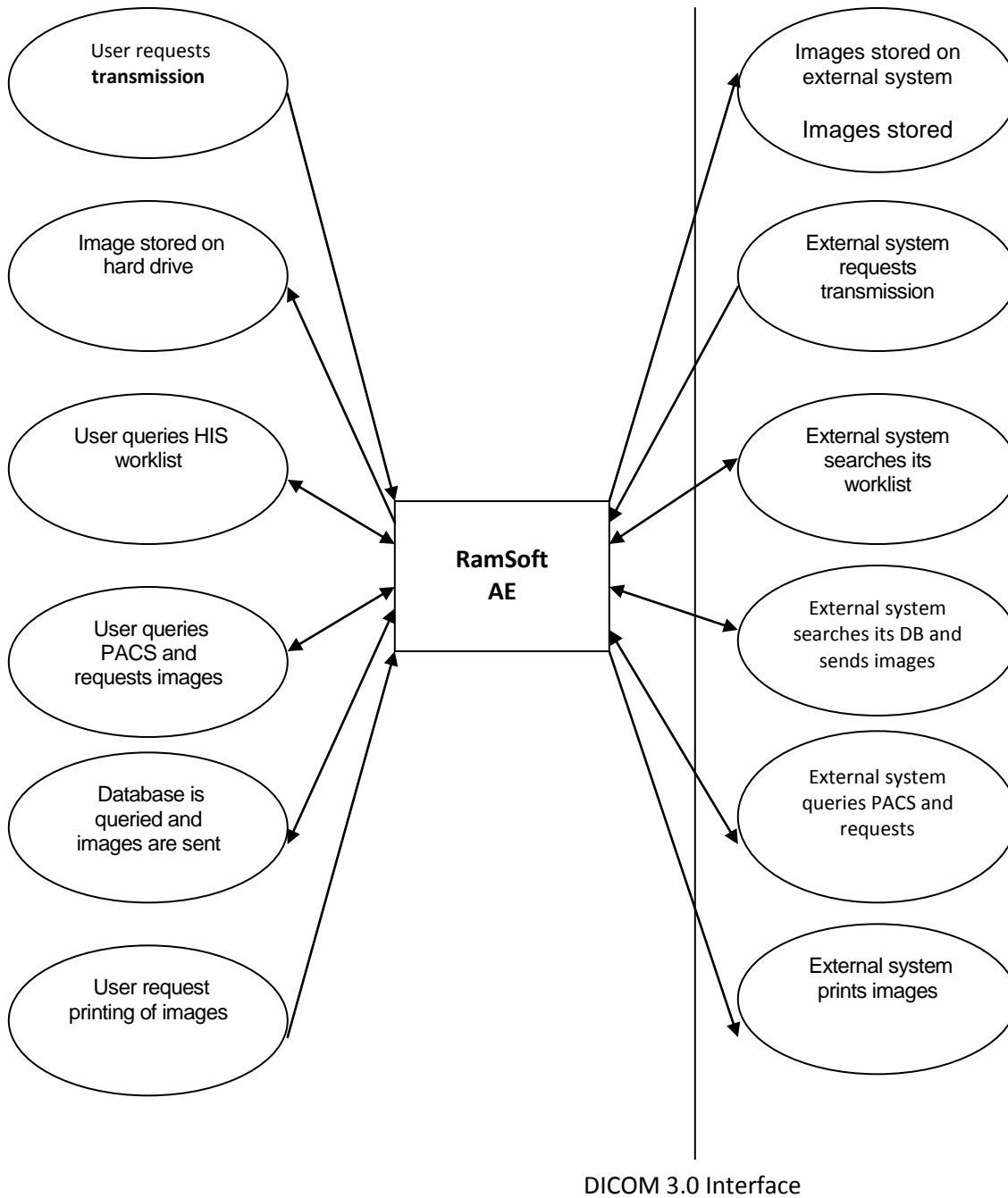
DICOM data can be requested from a DICOM AE through Query/Retrieve Service, by selecting Open or Request after finding the desired patients or studies on a remote workstation/server. Studies previously sent to an archive, may be retrieved automatically when accessed or retrieved from the Patient Explorer by clicking on the "Open data from server" icon.

DICOM data may be recorded on floppy disks, CD-R, CD-RW, DVD or MOD media.

RamSoft PACS can create, send and receive images, presentation states and SR document objects. It contains bi-directional query capabilities. RamSoft users can query and request information from other PACS stations. Many

RamSoft workstations and all RamSoft servers can process query requests. Scheduling information can be queried from a DICOM Modality Worklist. RamSoft PACS can format images for printing on a wide variety of DICOM printing devices. RamSoft PACS can create, read and update archival filesets on floppy disks, CD-Rs, CD-RWs, DVDs, MODs and other media.

Figure 2.1 RamSoft PACS Implementation Model



2.2 Functional Definitions of AE's

RamSoft PACS contains a single Application Entity that implements the Verification Service Class, Storage Service Class, Grayscale Softcopy Presentation State Storage SOP Class, Structured Reporting Storage SOP Class, Basic Worklist Management Service, the Query/Retrieve Service Class as a Service Class User (SCU) and a Service Class Provider (SCP), Modality Performed Procedure Step SOP Classes as a Service Class User(SCU) and a Service Class Provider(SCP) and Storage Commitment Service Class as a Service Class User(SCU) and a Service Class Provider(SCP). RamSoft PACS implements the Print Management Service Class as an SCU. RamSoft PACS implements the Media Storage Service Class as a File Set Creator (FSC), File Set Reader (FSR) and File Set Updater (FSU). Verification (SCP), Storage (SCU and SCP), Grayscale Softcopy Presentation State Storage (SCP), Structured Reporting Storage (SCP), Basic Worklist Management (SCP), Query (SCP)/Retrieve (SCU and SCP), Modality Performed Procedure Step (SCU and SCP) and Storage Commitment (SCU and SCP) are handled by the RamSoft DICOM Service. Other services are handled directly by the RamSoft PACS application. All DICOM operations are performed by a single RamSoft PACS AE.

3 AE Specifications

3.1 RamSoft PACS AE Specification

RamSoft PACS AE may support the following Application Profiles depending upon the installed hardware and software configuration.

Table 3.1 Media Storage Application Profiles

Supported Application Profiles	Real-World Activity	Roles	SC Option
STD-GEN-CD, STD-GEN-DVD-RAM General Purpose CD-R/DVD-RAM Interchange Profile	Media Storage	FSR, FSC, FSU	Interchange

This Application Entity provides Standard Conformances to the SOP Classes listed in Table 3.2 as an SCU and SCP.

Table 3.2 SOP Class Conformance as SCU and SCP

SOP Class Name	SOP Class UID
Service SOP Classes	
Verification SOP Class	1.2.840.10008.1.1
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18
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
Patient Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.1.3
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
Study Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.2.3
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

Patient/Study Only Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.3.3
Modality Worklist Information Model	1.2.840.10008.5.1.4.31
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1
Modality Performed Procedure Step SOP Class	1.2.840.10008.3.1.2.3.3
Storage SOP Classes	
Digital X-Ray Pres Image Storage	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Proc Image Storage	1.2.840.10008.5.1.4.1.1.1.1.1
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Digital Mammography X-Ray Image Storage for Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography X-Ray Image Storage for Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra Oral X-Ray Image Storage for Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra Oral X-Ray Image Storage for Processing	1.2.840.10008.5.1.4.1.1.1.3.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
RETIRED Ultrasound Multi Frame Image Storage	1.2.840.10008.5.1.4.1.1.3
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
MR Enhanced Image Storage	1.2.840.10008.5.1.4.1.1.4.1
MR Spectroscopy Image Storage	1.2.840.10008.5.1.4.1.1.4.2
RETIRED Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.5
RETIRED Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Multi Frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1
Multi Frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2
Multi Frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3
Multi Frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Fluoroscopy Image Storage	1.2.840.10008.5.1.4.1.1.12.2
RETIRED X-Ray Angiographic Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
RETIRED VL Image Storage	1.2.840.10008.5.1.4.1.1.77.1
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
VL Slide Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3
RETIRED VL Multi Frame Image Storage	1.2.840.10008.5.1.4.1.1.77.2
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50
Key Object Selection	1.2.840.10008.5.1.4.1.1.88.59
PET Image Storage	1.2.840.10008.5.1.4.1.1.128

Media Storage SOP Classes	
Media Storage Directory Storage	1.2.840.10008.1.3.10

3.1.1 Association Establishment Policies

3.1.1.1 General

The DICOM standard application context name, which is always proposed, is:

Application context name	1.2.840.10008.3.1.1.1
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This AE will initiate a new association whenever the user requests or sends a study. Multiple studies to a single destination may be transmitted in a single association. In Station List, a preference for compressed transfer syntaxes can be configured for each station. Default compression can be set through Settings/Server Settings/Compression. The order in which compressed transfer syntaxes are to be presented is also configured through Station List. Lossy compressed images will be sent as is, so long as the receiving station supports that transfer syntax. Otherwise, images will be decoded and encoded as necessary.

An association will be accepted with an external SCU if the requesting SCU provides valid parameters. Valid parameters include a valid presentation context. The AE's title is verified with RamSoft PACS' Station List unless promiscuous receiving is enabled.

The maximum PDU size is configurable.

3.1.1.2 Number of Associations

This AE will initiate at least one association with each destination for each task. Multiple associations are initiated on transmit objects and retrieving objects based on the configured maximum number of associations. A dedicated connection may be created for the following tasks: querying a worklist, querying an image database and printing.

Each time the AE accepts an association, an available thread is assigned to complete the transfer of medical image data or service the verification request. The maximum number of concurrent associations supported by RamSoft PACS is set by configuration. Once this number is reached, no more associations will be accepted until one of the threads become available.

3.1.1.3 Asynchronous Nature

RamSoft PACS AE's do not provide asynchronous behavior. All association requests must be completed and acknowledged before a new operation can be performed.

3.1.1.4 Implementation Identifying Information

An implementation class UID of "1.2.124.113540.1.5.0" is provided. The implementation version name is "RAMSOFT 5.0".

3.1.2 Association Initiation by Real-World Activity

3.1.2.1 Real-World Activity – User initiates storage

3.1.2.1.1 Associated Real-world Activity

An association is initiated when RamSoft PACS is requested to transmit a study. RamSoft PACS will continue to retry unless the study is removed from the Transmit List.

3.1.2.1.2 Proposed Presentation Contexts

Table 3.3 Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None
See Note	See Note	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCU	None
See Note	See Note	Deflated Explicit VR, Little Endian	1.2.840.10008.1.2.1.99	SCU	None
See Note	See Note	Explicit VR, Lossy JPEG 8-bit Image Compression	1.2.840.10008.1.2.4.50	SCU	None
See Note	See Note	Explicit VR, Lossy JPEG 12-bit Image Compression	1.2.840.10008.1.2.4.51	SCU	None
See Note	See Note	Explicit VR, Lossless JPEG, Non-hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	SCU	None
See Note	See Note	DICOM RLE Lossless Transfer Syntax	1.2.840.10008.1.2.5	SCU	None
See Note	See Note	JPEG 2000 Lossy (Baseline)	1.2.840.10008.1.2.4.91	SCU	None
See Note	See Note	JPEG 2000 Lossless	1.2.840.10008.1.2.4.90	SCU	None

NOTE: All Storage SOP classes in Table 3.2 support all of the above transfer syntaxes except the following SOP Classes:

SOP Class Name	SOP Class UID
Multiframe Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50
Key Object Selection	1.2.840.10008.5.1.4.1.1.88.59
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1

For these SOP Classes only the first three entries from Table 3.2 are supported

3.1.2.1.2.1 SOP Specific Conformance - Storage

After a successful C-STORE response from the SCP, the AE will continue to send any unsent images or SR documents belonging to the same study. If a particular image cannot be sent in the current transfer syntax (due to limitations of some compressed transfer syntaxes), the association will be released and a new association will be created. If a particular image and the association have the same transfer syntax then the image is sent keeping the original encapsulation format (compressed/uncompressed) even if the compression is disabled for association (as a user data configuration).

If an unsuccessful C-STORE response is received from the SCP, the AE will record the failure and close the association. The study will remain in the Transmit List for retry at the next available time.

Warnings in the C-STORE response from the SCP are ignored.

If RamSoft PACS originally acquired the image through video capture or a film digitizer, all the mandatory modules of the image storage objects are provided. All type 1 and type 2 data types are provided. Optional data types may not be provided.

If the image was originally acquired through a DICOM device, RamSoft PACS saves all tags received with the image. Thus, when these images are transmitted, all optional tags originally received by RamSoft PACS will also be transmitted.

If the acquired image has no DICOM SOP class item and the user has not specified a default SOP Class then RamSoft PACS stores the image as a Secondary Capture Image Storage object.

3.1.2.1.2.2 SOP Specific Conformance – Grayscale Softcopy Presentation State Storage

This AE provides standard conformance to Grayscale Softcopy Presentation State Storage. RamSoft PowerReader makes all mandatory presentation attributes available for application to the referenced images at the discretion of the user for all Image Storage SOP Classes listed in Table 3.2.

3.1.2.1.2.3 SOP Specific Conformance – Structured Reporting Storage

This AE provides standard conformance to Structured Reporting Storage. RamSoft PowerReader renders the structured report related attributes as an HTML document with a standard SR. No image or other composite object Storage SOP Classes will be displayed or otherwise rendered.

Text report body is stored on the first text node on the document tree. RamSoft PowerReader stores binary data such as Word or PDF documents on a private tag (3113, 1010) as raw data. The binary document size and type are specified on private tags (3113, 1020) and (3111, 1010). When a structured report has an associated Word template, template data and size of the template are stored on private tags (3113, 1030) and (3113, 1040).

3.1.2.1.2.4 SOP Specific Conformance - Media Storage Directory Storage

This AE provides standard conformance to the Interchange option of the Media Storage Service Class with Directory Information as a File-set Creator (FSC), File-set Reader (FSR) and File-set Updater (FSU). The directory information is present. No optional standard keys are included in directory records. All Storage SOP classes listed in Table 3.2 can also function as Media Storage SOP classes.

RamSoft PACS conforms to the application profiles listed in Table 3.1.

3.1.2.2 Real-World Activity – User initiates a query

An association is initiated when the user requests a query.

3.1.2.2.1 Proposed Presentation Contexts

Table 3.4 Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None
See Note	See Note	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCU	None
See Note	See Note	Deflated Explicit VR, Little Endian	1.2.840.10008.1.2.1.99	SCU	None
See Note	See Note	Explicit VR, Lossy JPEG 8-bit Image Compression	1.2.840.10008.1.2.4.50	SCU	None
See Note	See Note	Explicit VR, Lossy JPEG 12-bit Image Compression	1.2.840.10008.1.2.4.51	SCU	None
See Note	See Note	Explicit VR, Lossless JPEG, Non-hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	SCU	None
See Note	See Note	DICOM RLE Lossless Transfer Syntax	1.2.840.10008.1.2.5	SCU	None
See Note	See Note	JPEG 2000 Lossy (Baseline)	1.2.840.10008.1.2.4.91	SCU	None
See Note	See Note	JPEG 2000 Lossless	1.2.840.10008.1.2.4.90	SCU	None

NOTE: All move and find SOP classes from Table 3.2 are supported.

3.1.2.2.1.1 SOP Specific Conformance – Verification

This AE provides standard conformance to this SOP Class as an SCU.

3.1.2.2.1.2 SOP Specific Conformance – Query/Retrieve

This AE provides standard conformance to this SOP Class as an SCU. Modalities in Study (0008, 0061) is supported as an optional key. The user is permitted to enter multiple values for this key.

3.1.2.2.1.3 SOP Specific Conformance – Modality Worklist Information Model

This AE provides standard conformance to this SOP Class as an SCU. Optional Matching Key Attributes are not supported. Specific Character Set is ignored.

3.1.2.3 Real-World Activity – User requests printing of images

An association is initiated with the selected DICOM printer. The user can select the desired images and the output format. All image display parameters and annotations are burned into the image and the preformatted images are sent to the printer in the background. Any error messages from the printer are recorded in the Print List. Images are printed as 8 bits per pixel in grayscale or color format.

3.1.2.3.1 Proposed Presentation Contexts

Table 3.5 Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None
See Note	See Note	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCU	None
See Note	See Note	Deflated Explicit VR, Little Endian	1.2.840.10008.1.2.1.99	SCU	None

NOTE: All print service classes from Table 3.2 are supported.

3.1.2.3.1.1 SOP Specific Conformance – Basic Grayscale and Color Print Management

This AE provides standard conformance to this SOP Class as an SCU. All mandatory elements are set for film sessions, film boxes and image boxes. The mandatory attribute, Image Display Format (2010, 0010), has possible values: “STANDARD\x,y” where x,y (columns, rows) combinations can be configured for each target printer. The optional attributes listed in Table 3.6 can also be set when creating film sessions.

Table 3.6 Optional Attributes set for Creating Film Sessions

Entity Name	Tag	Values
Number Of Copies	(2000,0010)	1-99
Print Priority	(2000,0020)	LOW, MED, HIGH
Medium Type	(2000,0030)	BLUE FILM, CLEAR FILM, PAPER
Film Destination	(2000,0040)	MAGAZINE, PROCESSOR

Table 3.7 Optional Attributes set for Creating Film Boxes

Entity Name	Tag	Values
Film Orientation	(2010,0040)	Sent only if specified by user PORTRAIT, LANDSCAPE
Film Size ID	(2010,0050)	Sent only if specified by user 8INX10IN, 10INX12IN, 10INX14IN, 11INX14IN, 14INX14IN, 14INX17IN, 24CMX24CM, 24CMX30CM, 8_5INX11IN, A4, A3, A
Min Density	(2010,0120)	Sent only if specified by user 0
Max Density	(2010,0130)	Sent only if specified by user 399

Table 3.8 Optional Attributes set for Creating Image Boxes

Entity Name	Tag	Values
-------------	-----	--------

Requested Image Size	(2020,0030)	Values depend on Image Orientation, Film Width/Height/Columns
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3.1.2.4 Real-World Activity – Transmit may initiate MPPS or storage commit

An association is initiated when the Storage Commit or Modality Performed Procedure Step is initiated.

3.1.2.4.1 Proposed Presentation Contexts

Table 3.9 Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None
See Note	See Note	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCU	None
See Note	See Note	Deflated Explicit VR, Little Endian	1.2.840.10008.1.2.1.99	SCU	None

NOTE: Storage Commitment Push Model SOP Class and Modality Performed Procedure Step SOP Class from Table 3.2 are supported.

3.1.2.4.1.1 SOP Specific Conformance – Storage Commitment Push Model

This AE provides standard conformance to this SOP Class as an SCU. After transmit complete, N-Action is issued on the background with list of objects have been transmitted when peer AE is configured to support Storage Commitment. If N-Event-Report request is received on the same association, processing is completed. Otherwise, the system will wait until N-Event-Report request is received.

3.1.2.4.1.2 SOP Specific Conformance – Modality Performed Procedure Step (MPPS)

This AE provides standard conformance to this SOP Class as an SCU. While transmitting, N-Create and N-Set are issued on the background to deliver standard module information when peer AE supports MPPS.

3.1.3 Association Acceptance Policy

Associations are accepted only if they contain valid presentation contexts. Once the association is accepted for Storage Service, an available background thread is assigned to receive objects transmitted on that association and store them on the hard disk in a format required by the RamSoft PACS system. A background thread is also assigned for Verification, Query/Retrieve and Modality Worklist Service.

3.1.3.1 Real-World Activity – External system initiates a transfer

This activity is the transfer of medical images from an external SCU to the RamSoft PACS system.

The associated activity with the C-STORE service is the storage of medical objects on the configured hard disk. The AE will return a failure status if it is unable to perform this action.

3.1.3.1.1 Presentation Context Table

Any of the presentation contexts shown in the following table are acceptable for receiving images.

Table 3.10 Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR, Little Endian	1.2.840.10008.1.2	SCP	None
See Note	See Note	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
See Note	See Note	Deflated Explicit VR, Little Endian	1.2.840.10008.1.2.1.99	SCP	None
See Note	See Note	Explicit VR, Lossy JPEG 8-bit Image Compression	1.2.840.10008.1.2.4.50	SCP	None
See Note	See Note	Explicit VR, Lossy JPEG 12-bit Image Compression	1.2.840.10008.1.2.4.51	SCP	None
See Note	See Note	Explicit VR, Lossless JPEG, Non-hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	SCP	None
See Note	See Note	DICOM RLE Lossless Transfer Syntax	1.2.840.10008.1.2.5	SCP	None
See note	See Note	JPEG 2000 Lossy (Baseline)	1.2.840.10008.1.2.4.91	SCP	None
See note	See Note	JPEG 2000 Lossless	1.2.840.10008.1.2.4.90	SCP	None

NOTE: These presentation contexts are accepted for all storage SOP classes listed in Table 3.2.

3.1.3.1.1.1 SOP Specific Conformance – Storage

The Storage AE provides Level 2 (Full) conformance to the Storage SOP Class. A successful storage operation means that the image data has been written to the internal storage on the RamSoft PACS system.

The following status codes are returned if the C-STORE operation was unsuccessful:

1. A700 (Out of Resources) – Not enough disk space. Image will not be saved, association will be dropped.
2. A800 (SOP Class Not Supported) – SOP Class of image didn't match negotiated presentation context.
3. A900 (Data does not match SOP Class) – The data set doesn't encode an instance of the specified SOP class.
4. C000 (Cannot understand) – The Storage AE couldn't parse the data set into elements.

3.1.3.1.1.2 SOP Specific Conformance – Grayscale Softcopy Presentation State Storage

Presentation related attributes are derived from the displayed image and included in the IOD when image parameters are saved as selected by the user or when the displayed study is closed, if automatic saving of presentation states is enabled for the user. All Image Storage SOP Classes listed in Table 3.2 may be referenced by instances of the Grayscale Softcopy Presentation State Storage SOP Class.

3.1.3.1.1.3 SOP Specific Conformance – Structured Reporting Storage

No images or other composite object Storage SOP Classes may be referenced by newly created instances of Structured Reporting Storage SOP Class. Only Basic Text Structured Reporting Storage SOP Classes are created. A new SOP Instance UID is created for Structured Reporting Storage SOP Classes whenever any attribute of the SOP Class is modified.

Structured Reporting related attributes are rendered by the SCP as an HTML document. Image or other object storage SOP instances referenced by instances of the Structured Reporting SOP Class are ignored and not used to influence the display of the image or object. The SCP never renders content items with Rendering Intent Concept modifier set to "Presentation Optional".

3.1.3.1.2 Presentation Context Acceptance Criterion

This AE will accept the Presentation Contexts given in Table 3..

3.1.3.1.3 Transfer Syntax Selection Policies

RamSoft PACS' transfer syntax selection policy can be configured in the Station List. Support for any of Uncompressed, Lossy Compressed and Lossless Compressed transfer syntaxes may be enabled or disabled. The preference of each type of compression may also be set in the Station List.

3.1.3.2 Real-World Activity – External system initiates a query

3.1.3.2.1 Associated Real-World Activity

This activity is a request from an external SCU to perform a database query and to possibly retrieve medical images from the RamSoft PACS system.

The associated activity with the C-FIND, C-MOVE and C-GET services is a query on the RamSoft PACS databases. For the C-MOVE and C-GET service, a C-STORE sub-operation will be initiated to transmit the appropriate images to the destination.

3.1.3.2.2 Presentation Context Table

Any of the presentation contexts shown in the following table are acceptable for querying the database.

Table 3.9 Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR, Little Endian	1.2.840.10008.1.2	SCP	None
See Note	See Note	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
See Note	See Note	Deflated Explicit VR, Little Endian	1.2.840.10008.1.2.1.99	SCP	None
See Note	See Note	Explicit VR, Lossy JPEG 8-bit Image Compression	1.2.840.10008.1.2.4.50	SCP	None
See Note	See Note	Explicit VR, Lossy JPEG 12-bit Image Compression	1.2.840.10008.1.2.4.51	SCP	None
See Note	See Note	Explicit VR, Lossless JPEG, Non-hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	SCP	None
See Note	See Note	DICOM RLE Lossless Transfer Syntax	1.2.840.10008.1.2.5	SCP	None
See note	See Note	JPEG 2000 Lossy (Baseline)	1.2.840.10008.1.2.4.91	SCP	None

See note	See Note	JPEG 2000 Lossless	1.2.840.10008.1.2.4.90	SCP	None
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NOTE: These presentation contexts are accepted for all service SOP classes listed in Table 3.2.

3.1.3.2.2.1 SOP Specific Conformance – Verification

This AE provides standard conformance to the Verification SOP Class as an SCP.

3.1.3.2.2.2 SOP Specific Conformance – Modality Worklist Information Model

This AE provides standard conformance to this SOP Class as an SCP. Optional Matching Key Attributes are not supported. Specific Character Set is ignored. Type 3 Return Key Attributes are not supported.

Case insensitive matching is performed on all text attributes including PN VR attributes.

3.1.3.2.2.3 SOP Specific Conformance - Query/Retrieve

The AE provides standard conformance to this SOP Class as an SCP. Optional keys are not supported. Relational queries are not supported. It shall support C-STORE sub-operations for the Storage SOP Classes listed in Table 3.2.

3.1.3.2.3 Presentation Context Acceptance Criterion

This AE will accept the Presentation Contexts given in Table 3.9.

3.1.3.2.4 Transfer Syntax Selection Policies

RamSoft PACS prefers to receive images encoded using an explicit transfer syntax. Duplicate Presentation Contexts will not be accepted. If it is offered three identical Presentation Contexts, each of which offers any of the three acceptable Transfer Syntaxes, it will accept all Presentation Contexts, but with different Transfer Syntaxes in each. Other transfer syntax policies may be configured in the Station List.

3.1.3.3 Real-World Activity – External system initiates Storage Commitment or MPPS

3.1.3.3.1 Associated Real-World Activity

This activity is a request of normalized SOP from an external SCU to perform Storage Commitment or Modality Performed Procedure Step.

N-Action and N-Event-Report SOP Classes on DIMSE-N Service are processed to handle Storage Commitment. N-Create and N-Set requests are processed to handle Modality Performed Procedure Step.

3.1.3.3.2 Presentation Context Table

Any of the presentation contexts shown in the following table are acceptable.

Table 3.10 Proposed Presentation Contexts

Presentation Context Table			
Abstract Syntax	Transfer Syntax	Role	Extended

Name	UID	Name List	UID List		Negotiation
See Note	See Note	Implicit VR, Little Endian	1.2.840.10008.1.2	SCP	None
See Note	See Note	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
See Note	See Note	Deflated Explicit VR, Little Endian	1.2.840.10008.1.2.1.99	SCP	None
See Note	See Note	Explicit VR, Lossy JPEG 8-bit Image Compression	1.2.840.10008.1.2.4.50	SCP	None
See Note	See Note	Explicit VR, Lossy JPEG 12-bit Image Compression	1.2.840.10008.1.2.4.51	SCP	None
See Note	See Note	Explicit VR, Lossless JPEG, Non-hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	SCP	None
See Note	See Note	DICOM RLE Lossless Transfer Syntax	1.2.840.10008.1.2.5	SCP	None
See note	See Note	JPEG 2000 Lossy (Baseline)	1.2.840.10008.1.2.4.91	SCP	None
See note	See Note	JPEG 2000 Lossless	1.2.840.10008.1.2.4.90	SCP	None

NOTE: These presentation contexts are accepted for all service SOP classes listed in Table 3.2.

3.1.3.3.2.1 SOP Specific Conformance – Storage Commitment Push Model

This AE provides standard conformance to the Storage Commitment Push Model SOP Class as an SCP.

3.1.3.3.2.2 SOP Specific Conformance – Modality Performed Procedure Step

This AE provides standard conformance to the Modality Performed Procedure Step SOP Class as an SCP.

4 Communication Profiles

4.1 Supported Communications Stacks

All RamSoft PACS AE's provide DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

4.2 TCP/IP Stack

All RamSoft PACS AE's inherit their TCP/IP stack from the Windows system upon which they execute. RamSoft PACS has been tested with Winsock 2.2 on Windows XP, Windows 7 32-bit, Windows 7 64-bit, Windows 2003 Server, and Windows 2008 R2 Server.

4.2.1 Physical Media Support

All RamSoft PACS AE's are indifferent to the physical medium over which TCP/IP executes; they inherit this from the Windows system upon which they execute.

5 Extensions/Specializations/Privatizations

5.1 Image IOD Description

DICOM acquired images are stored AS IS by RamSoft PACS. Images that do not contain the mandatory fields for RamSoft PACS are rejected. Fields that are automatically filled by RamSoft PACS for frame-grabbed, digitized or scanned images are described below. Other fields may be entered through RamSoft PACS' user interface. For each peer station, field mapping may be enabled on RamSoft PACS to: copy any DICOM tag to another DICOM tag, move any DICOM tag to another DICOM tag, and delete any DICOM tag. This feature is intended to compensate for variances in the interpretation of DICOM by different vendors to allow seamless connectivity with RamSoft PACS.

Table 5.1 Image IOD Specifications

Entity Name	Tag	Type	Module Name	Details
Patient's Name	(0010,0010)	2	Patient	This field is mandatory for RamSoft PACS. At a minimum, the last name must be present.
Patient ID	(0010,0020)	2	Patient	This field is mandatory for RamSoft PACS.
Study Instance UID	0020,000D)	1	Study	This field is mandatory for RamSoft PACS.
Accession Number	(0008,0050)	2	Study	This field is essential for RIS connectivity, but not mandatory for RamSoft PACS.
Series Instance UID	(0020,000E)	1	General Series	This field is mandatory for RamSoft PACS.
Series Number	(0020,0011)	2	General Series	The first series of a study is assigned the number 1 for acquired and imported images. This acquisition number is incremented for each successive image.
Manufacturer	(0008,0070)	2	General Equipment	Set to "RamSoft Inc." for created images.
Manufacturer's Model Name	(0008,1090)	3	General Equipment	Set to "RamSoft PACS" for created images.
Software Versions	(0018,1020)	3	General Equipment	Set to "4.0" for created images.
Image Type	(0008,0008)	3	General Image and US Image	Set to "ORIGINAL\PRIMARY" for frame grabbed images. If an image is subjected to lossy image compression, then the first value will be set to "DERIVED."
Acquisition Number	(0020,0012)	3	General Image	The first created image of a series is assigned the number 1. This acquisition number is incremented for each successive created image.

Referenced Image Sequence	(0008,1140)	3	General Image	This is set and used to display scout thumbnails on CT/MR images.
>Referenced SOP Class UID	(0008,1150)	1C	General Image	Set and used if Referenced Image Sequence is present.
>Referenced SOP Instance UID	(0008,1155)	1C	General Image	Set and used if Referenced Image Sequence is present.
Derivation Description	(0008,2111)	3	General Image	If JPEG lossy compression is used to save the image, this is set to "JPEG Lossy N:1" to indicate the lossy compression ratio used. This field is displayed as an overlay on the image to indicate the lossy compression ratio of images.
Burned in Annotation	(0028,0301)	3	General Image	Set to "YES" for acquired and imported images.
Lossy Image Compression	(0028,2110)	3	General Image	Set to "01" if the image has been subjected to lossy image compression.
Lossy Image Compression Ratio	(0028,2112)	3	General Image	Set to the approximate lossy compression ratio that has been applied to the image e.g. 30 for 30:1 compression.
Pixel Spacing	(0028,0030)	1	Image Plane	Used to establish the pixel calibration of the image. This may be modified or created using the Calibration tool.
Image Orientation (Patient)	(0020,0037)	1	Image Plane	This field is required to use cross-sectional imaging tools.
Image Position (Patient)	(0020,0032)	1	Image Plane	This field is required to user cross-sectional imaging tools.
Conversion Type	(0008,0064)	1	SC Image	Set to "DV" if the images were frame grabbed and "DF" if the images were film digitized.
Physical Units X Direction	(0018,6024)	1	US Frame of Reference	US Frame of Reference is used only when the unit is cm (0003H)
Physical Units Y Direction	(0018,6026)	1	US Frame of Reference	US Frame of Reference is used only when the unit is cm (0003H)
Samples per Pixel	(0028,0002)	1	Image Pixel	Images can be displayed when this element is 1 or 3.
Photometric Interpretation	(0028,0004)	1	Image Pixel	Images can be displayed when this element is "MONOCHROME2", "MONOCHROME1", "RGB", "YBR_FULL", "YBR_FULL_422", "YBR_PARTIAL_422", and "PALETTE COLOR."

				This element may be set to "MONOCHROME2", "MONOCHROME1", "RGB", "YBR_FULL", and "YBR_FULL_422"
Rows	(0028,0010)	1	Image Pixel	No restriction is placed on the number of rows.
Columns	(0028,0011)	1	Image Pixel	No restriction is placed on the number of columns.
Ultrasound Color Data Present	(0028,0014)	3	US Image	This field is set for frame grabbed ultrasound color images.
Bits Allocated	(0028,0100)	1	Image Pixel	Images can be displayed when this field is set to between 1 bit to 16 bits.
Bits Stored	(0028,0101)	1	Image Pixel	Images can be displayed when this field is set to between 1 bit to 16 bits.
High Bit	(0028,0102)	1	Image Pixel	Images can be displayed when this field is set to between 1 bit to 15 bits.
Pixel Representation	(0028,0103)	1	Image Pixel	This must be set to 0 or 1.
Planar Configuration	(0028,0006)	1C	Image Pixel	Images can be displayed both color-by-plane and color-by-pixel. Created images always set this element to 1.
Red Palette Color Lookup Table Data	(0028,1201)	1C	Image Pixel	Mandatory for images with a palette. This element is unused for created images as images with a palette are never created.
Green Palette Color Lookup Table Data	(0028,1202)	1C	Image Pixel	Mandatory for images with a palette. This element is unused for created images as images with a palette are never created.
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Image Pixel	Mandatory for images with a palette. This element is unused for created images as images with a palette are never created.
Frame Time	(0018,1063)	1C	Cine	This element is used to calculate the playback speed for multi-frame images.
Number of Frames	(0028,0008)	1	Multi-frame	This element is used to display multi-frame images.
Modality LUT Sequence	(0028,3000)	1C	Modality LUT	Should be present if Rescale Intercept is not present for accurate display.
>LUT Descriptor	(0028,3002)	1C	Modality LUT	Must contain three values describing the format of LUT Data.

>Modality LUT Type	(0028,3004)	1C	Modality LUT	Specifies the units used in the LUT.
>LUT Data	(0028,3006)	1C	Modality LUT	Contains the LUT entry values.
Rescale Intercept	(0028,1052)	1C	Modality LUT	Should be present if Modality LUT Sequence is not present for accurate display.
Rescale Slope	(0028,1053)	1C	Modality LUT	Should be present if Modality LUT Sequence is not present for accurate display.
Window Center	(0028,1050)	3	VOI LUT	Should be present for accurate display.
Window Width	(0028,1051)	1C	VOI LUT	Should be present for accurate display.

6 Configuration

6.1 AE Title/Presentation Address Mapping

The mapping from AE Title to TCP/IP addresses and ports is configurable through the Station List. Refer to the RamSoft Service Manual.

6.2 Configurable Parameters

- For SCP, AE Title, TCP/IP address, port, TLS port, a list of external DICOM hosts which act as SCUs, field mapping to apply to DICOM objects from each SCU
- For SCU, a list of external DICOM hosts which act as SCPs, ports and AE titles for the SCPs, whether or not to use TLS
- The minimum amount of disk space required to accept DICOM images
- The number of concurrent associations
- The network timeout interval
- The communication retry interval
- Enabling and disabling compressed transfer syntaxes and selecting their priority

7 Support of Extended Character Sets

RamSoft PACS supports the ISO_IR 100 extended character set.

8 Security Profiles

RamSoft PACS supports the Basic TLS Secure Transport Connection Profile utilizing the framework and negotiation mechanism specified by the Transport Layer Security Version 1.0 protocol. This feature is enabled using the Station List. A private key and certificate must be generated and peer certificates must be installed for all connected SCUs. Care must be taken while creating and exchanging certificates ensuring the privacy and authenticity of them.

Supported TLS Feature	Mechanism
Entity Authentication	RSA based certificates

Exchange of Master Secrets	RSA
Data Integrity	SHA
Privacy	Triple DES EDE, CBC

RamSoft PACS will accept TLS connections on the port selected in the Station List. The default port is 2762, the registered port for the DICOM Upper Layer Protocol on TLS.

When an integrity check fails, the association will be aborted.