DAR-9000
DICOM Conformance Statement

Revision B

Revision Date: July, 25. 2005

DICOM service classes in this manual are provided as an optional item of DAR-9000. For your suitable system configuration, please consult with SHIMADZU representative.

SHIMADZU CORPORATION
KYOTO   JAPAN

Date	Rev.	Author	Comment
2005.03.01	First	Go Takayanagi	First Revision
2005-07-11	A	Go Takayanagi	Correction in section 5.2 for Anonymization
2005-07-25	B	Go Takayanagi	DICOM service classes are specified to be options.

1. Introduction

1.1. Purpose of this document

The purpose of this document is to describe how *DAR-9000* conforms to the DICOM standard. It describes what parts and definition it utilizes and in what way, in order to provide interoperability with other devices that claim same conformance.

1.2. Sources for this document

American College of Cardiology –National Manufactures Association (ACR-NEMA) Digital Imaging and Communications V2.0
ACR-NEMA Digital Imaging and Communications in Medicine (DICOM) v3.0, Final Draft, May. 1998

1.3. Acronyms and abbreviation

The following acronyms and abbreviations are used in this document.
- ACR   American College of Radiology
- ACSE   Association Control Service Element
- AE   Application Entity
- ANSI   American National Standards Institute
- AP   Application Profile
- API   Application Programming Interface
- ASCII   American Standard Code for Information Interchange
- DICOM   Digital Imaging and Communications in Medicine
- DIMSE   DICOM Message Service Element
- DIMSE-C   DICOM Message Service Element-Composite
- DIMSE-N   DICOM Message Service Element-Normalized
- FSC   File Set Creator
- FSR   File Set Reader
- FSU   File Set Updater
- GUI   Graphical User Interface
- NEMA   National Electrical Manufacturers Association
- PDU   Protocol Data Unit
- RWA   Real World Activity
- SCP   Service Class Provider
- SCU   Service Class User
- SOP   Service Object Pair
- TCP/IP   Transmission Control Protocol/Internet Protocol
- UID   Unique Identifier

1.4. Note to reader

- **Interoperability**

Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into a networked environment may require application functions that are not specified within the scope of the DICOM standard. Consequently, using only the information provided by this conformance statement does not guarantee interoperability of Shimadzu Equipment with other vendor's equipment. It is the user's responsibility to thoroughly analyze the application requirements and to specify a solution that integrates Shimadzu equipment with the projected other vendor's equipment.

- **Validation**

Although Shimadzu equipment has been completely tested to verify that the implementation of the DICOM interface for this product corresponds with this Conformance Statement, even if comparison of respective Conformance Statement indicates that successful interconnection should be possible with another vendor's equipment, additional validation will always be necessary to ensure full functionality. It is the responsibility of the user to specify the appropriate test suite and to carry out the additional validation tests.
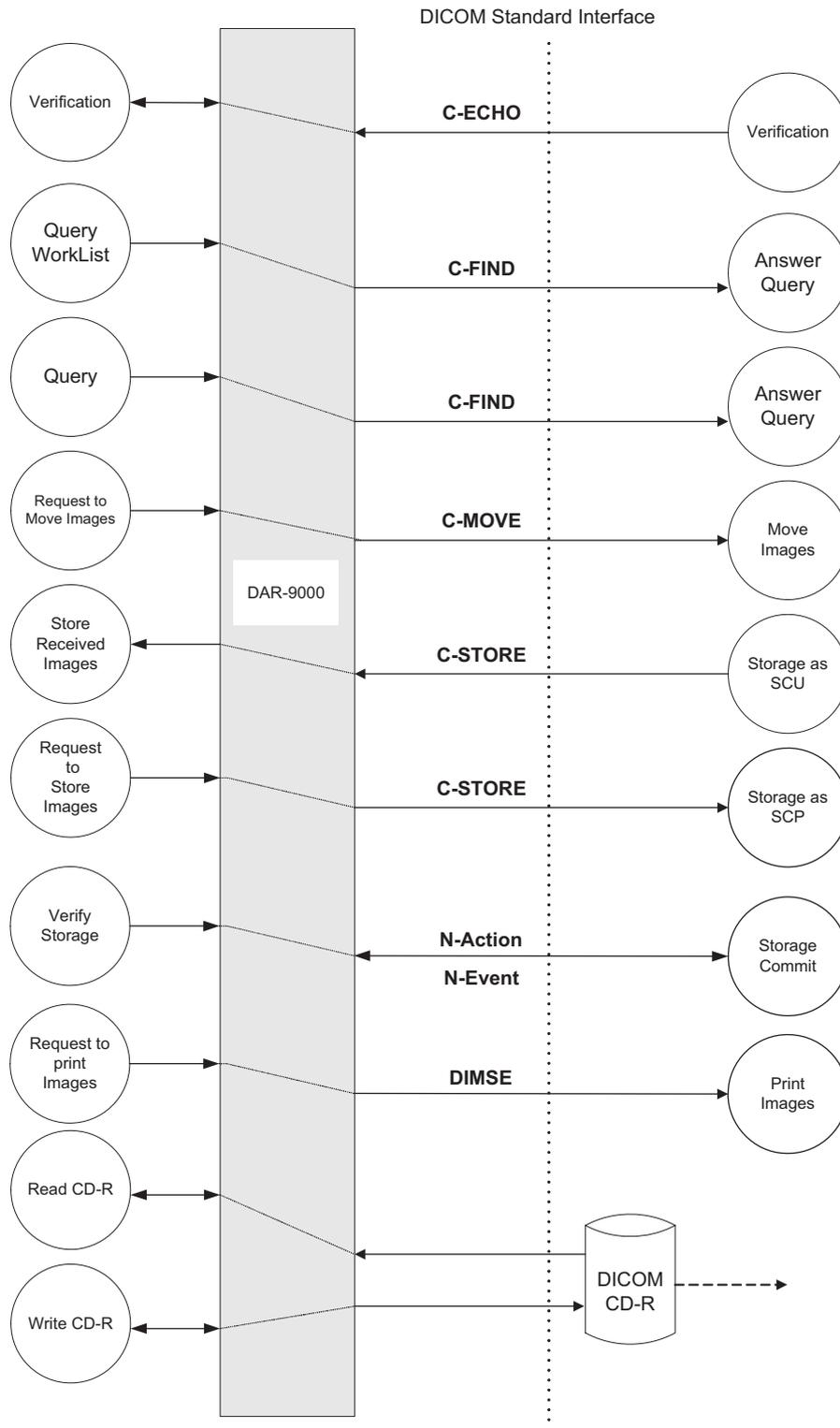
- **Version of the DICOM standard**

Shimadzu is committed to evolve with the DICOM standard as it adapts to meet the future requirement of users and technology. In order to do so, Shimadzu reserves the right to adapt and even discontinue delivery of its equipment. The user should ensure that any vendor whose equipment is connected to Shimadzu equipment also adapts to future version of the DICOM standard. If not, enhancement of Shimadzu may lead to loss of connectivity or interoperability.

2. Implementation Model

DAR-9000 is an acquisition and review station used in the Cardiology environment. The application, upon user request, will:

1- Acquire images from a CathLab and encapsulate them to the DICOM Standard Format.
2- Issue **C-STORE** command to configured SCP in order to archive the acquired images.
3- Issue **C-MOVE** command to configured SCP.
4- Query, retrieve and display XA and US images from a remote DICOM SCP.
5- Read and display XA and US images from DICOM CD.
6- Act as FSC for DICOM CD.
  Write DICOM conformant CD-R
7- Act as FSR for DICOM CD.
  Read and display XA and US images from a DICOM conformant CD-R .
8- Receive and process **C-STORE** command from a remote DICOM SCU.

2.1. Application Data flow diagram

DICOM Standard Interface

Verification	C-ECHO	Verification
Query WorkList	C-FIND	Answer Query
Query	C-FIND	Answer Query
Request to Move Images	C-MOVE	Move Images
	DAR-9000	
Store Received Images	C-STORE	Storage as SCU
Request to Store Images	C-STORE	Storage as SCP
Verify Storage	N-Action / N-Event	Storage Commit
Request to print Images	DIMSE	Print Images
Read CD-R		
Write CD-R		DICOM CD-R

1- All local Real World Activities are user activated or driven through an application GUI.

3

2.1.1. Verification

DAR-9000 will respond to a **C-ECHO** verification.

2.1.2. Basic Worklist Management

DAR-9000 will issue a C-FIND to a configured HIS/RIS machine for the hospital Worklist.

2.1.3. Find

DAR-9000 will issue a **C-FIND** command to a remote SCP to retrieve information about the studies stored on the remote SCP.

2.1.4. Move Images

DAR-9000 will issue a **C-MOVE** command to a remote SCP to copy study information from one SCP to another or from a remote SCP to itself.

2.1.5. Store Images as SCP

DAR-9000 will receive process and accept **C-STORE** command from a remote SCU and if the association succeeds, it will store the received data on its physical storage space.

2.1.6. Store Images as SCU

DAR-9000 will issue a **C-STORE** command to a remote SCP. If the association is successful it will send images for storage on the remote SCP.

2.1.7. Verify storage

If the "Storage Commit" option is enabled. *DAR-9000* will issue a storage Commit N-Action command for all files sent for storage .

2.1.8. Read CD-R

DAR-9000 will read any DICOM conformant CD-R although it will only display compatible images.

2.1.9. Write CD-R

DAR-9000 will write a DICOM conformant CD-R for the supported SOP classes.

2.1.10. Print

DAR-9000 will print an image or a group of images to a remote DICOM SCP printer.

2.2. Functional Description of AE's

The *DAR-9000* AE acts as a SCU and a SCP.
As a SCU:
- If configured, *DAR-9000* can query a HIS/RIS gateway for the patient Worklist. The list of scheduled patient will be presented to the user and all fields in the patient demographic entry forms will be filled with the chosen patient. If all mandatory fields cannot be filled a form will be presented to the user with the missing fields highlighted.

DAR-9000 will issue a **C-Find** request to retrieve Worklist information from a remote Modality Worklist SCP.

- *DAR-9000* is a system designed to acquire images coming from the camera of a catheterization laboratory. The system then compresses these images and transmits these compressed images over the network to a remote server that will place them in a safe place for long-term archive and retrieval.

- If configured to do so, when a study is terminated, *DAR-9000* will send a command to the remote server to move images to one or more secondary destinations. The move may involve all the images objects of a study or only specific images belonging to one or more series. There may be any number of secondary destinations.
  When "Secondary Destination" is/are configured, *DAR-9000* will issue a C-MOVE command to the server configured as "Primary Server" using either "Move by study" or "Move by Series" UID. The command will contain the "Primary Server" as origin and the "Secondary destination" as destination.

- *DAR-9000* will issue C-FIND command to get and display the content of a STORAGE-SCP remote server; it will then issue a C-MOVE command at study root level to the same server to transfer the selected image data proposing itself as destination.

- *DAR-9000* will issue a C-STORE command to a configured remote SCP to store images previously read from a DICOM CD.
- When a study is terminated, *DAR-9000* will verify that the remote server has received and stored all the images that were sent during the study before permitting deletion of local data. *DAR-9000* will issue a N-Action Storage Commitment command to the SCP that received the images for storage. Depending on the n-Event report result received from the remote SCP, the *DAR-9000* will resend all images for which a negative response was received.

- *DAR-9000* will issue a DIMSE-N set of commands to a Print SCP to print images.

As a SCP:
- *DAR-9000* will accept association from remote SCU and accept and process C-STORE commands for DICOM Data Object of the allowed SOP classes.
- *DAR-9000* will accept and respond to the verification C-ECHO command.

As a FSC
- *DAR-9000* will write the DICOM Data Objects of a selected study to a CD in DICOM format.

As a FSR
- *DAR-9000* will read data from a DIOCM CD that is present in its CD drive when requested to do so by the user.

2.3. Sequencing of real world activity

The storage Verification is done when a study is closed, and only if files for the study have been transmitted for storage to a remote SCP.
The Storage verification is done after the current study is closed.
The storage function of the SCP can be performed at any time.
The physical CD-R writing can only occur after an empty CD-R is inserted in the drive.

3. AE Specifications

3.1. *DAR-9000* specification

DAR-9000 provides Standard Conformance to the following DICOM V3.0 SOP Class as an SCU.

Table 1 Verification SOP Class as SCU

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1

Table 2 Query/Retrieve SOP Classes as SCU

SOP Class Name	SOP Class UID
Patient Root Query/Retrieve IM Find	1.2.840.10008.5.1.4.1.2.1.1
Study Root Query/Retrieve IM Find	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve IM Move	1.2.840.10008.5.1.4.1.2.2.2

Table 3 Storage SOP Classes as SCU

SOP Class Name	SOP Class UID
XA – X-ray Angiographic image storage	1.2.840.10008.5.1.4.1.1.12.1
XA – X-ray Bi-Plane Image storage	1.2.840.10008.5.1.4.1.1.12.3
Private Composite interpretation report	1.2.124.113532.3500.3
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Multi-frame Image storage (Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Multi-frame Image storage	1.2.840.10008.5.1.4.1.1.3.1
Secondary Capture Image storage	1.2.840.10008.5.1.4.1.1.7
US 95	1.2.840.10008.5.1.4.1.1.6.1

Table 4 Print SOP Classes as SCU

SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9

Table 5 Storage Commitment Service Class as SCU

SOP Class Name	SOP Class UID
Storage Commitment Push model SOP class	1.2.840.10008.1.20.1

Table 6 Modality Worklist Service Class as SCU

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

DAR-9000 provides Standard Conformance to the following DICOM V3.0 SOP Class as an SCP.

Table 7 Verification SOP Class as SCP

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1

Table 8 Storage SOP Classes as SCP

SOP Class Name	SOP Class UID
XA – X-ray Angiographic image storage	1.2.840.10008.5.1.4.1.1.12.1
XA – X-ray Bi-Plane Image storage	1.2.840.10008.5.1.4.1.1.12.3
Private Composite interpretation report	1.2.124.113532.3500.3
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Multi-frame Image storage (Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Multi-frame Image storage	1.2.840.10008.5.1.4.1.1.3.1
Secondary Capture Image storage	1.2.840.10008.5.1.4.1.1.7
US 95	1.2.840.10008.5.1.4.1.1.6.1

DAR-9000 provides Standard Conformance to the following DICOM V3.0 SOP Media Storage Application Profile.

Table 9 Related Application Profile

Supported APS	Real World Activity	Role	SC Option
DAR-9000	Read CD-R	FSR	Interchange
	Write CD-R	FSC	Interchange

3.1.1. Association establishment Policies

3.1.1.1. General

The following Application Context Name will be proposed and recognized by *DAR-9000*
• DICOM 3.0 Application Context   `1.2.840.10008.3.1.1.1`

3.1.1.2. Number of Associations

The maximum number of association accepted or maintained by *DAR-9000* is limited only by the physical memory of the machine on which it runs. Typically it can be up to 10.

3.1.1.3. Asynchronous nature

DAR-9000 allows a single outstanding operation on any association. Therefore, *DAR-9000* does not support asynchronous operations window negotiation, other than the default as specified by the DICOM specification.

3.1.1.4. Implementation Identifying Information

DAR-9000 will respond with the following implementation identifying parameters:

Implementation Class UID   **1.2.392.200036.91100.12.XXXXXXXXXXXXX**
The last number of the implementation class UID is the 13 digits maximum machine serial number.

Implementation Version Name   **VCOM_VX_X_X**
Where X_X_X is the software version

The implementation version name policies are the following: product name "**VCOM**" followed by the version of the product, "**_V1.0.0**".

3.1.1.5. Association initiation policy

DAR-9000 attempts to initiate a new association for each group of file it attempts to transfer. The group can be:
1. One or more files of a study
2. One or more complete study
3. One or more complete series of a study

Case one (1) will only occur after a new file is created (after acquisition) the system will try to group as many files as it can in one association.

Case two (2) can only occur when a user initiates a store of one or more study. In this case *DAR-9000* will attempt to negotiate a new association with the target destination. All files selected will be stored in the same association.

Case three (3) can only occur when a user initiates a store of one or more series of a study. In this case *DAR-9000* will attempt to negotiate a new association with the target destination. All files selected will be stored in the same association.

In all cases only the necessary presentation context will be negotiated based on the type of files to store. *DAR-9000* will analyse all files it has to transfer and prepare its presentation context in accord with the files to transfer.

3.1.2. Association Initiation by Real World Activity

3.1.2.1. Real World Activity – Find

3.1.2.1.1. Associated Real World Activity – Find
DAR-9000 will issue a **FIND** request when a user of *DAR-9000* wishes to view patient and study information from a remote DICOM SCP.

3.1.2.1.2. Presentation context Table – Find
DAR-9000 supports the transfer syntaxes listed in Table 10. For a **QUERY** request, *DAR-9000* supports the Presentation Contexts listed in Table 11 and Table 12.

Table 10 Query Transfer Syntaxes

Transfer Syntax	UID
DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2
DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1
DICOM Explicit VR Big Endian Transfer Syntax	1.2.840.10008.1.2.2

Table 11 Query Presentation Contexts

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	SOP Class UID			
Patient Root Query/Retrieve IM Find	1.2.840.10008.5.1.4.1.2.1.1	all from Table 10	SCU	See Note 1
Study Root Query/Retrieve IM Find	1.2.840.10008.5.1.4.1.2.2.1	all from Table 10	SCU	See Note 1
Patient Study Only Query/Retrieve IM Find	1.2.840.10008.5.1.4.1.2.3.1	all from Table 10	SCU	See Note 1

Note 1: Find Extended Negotiation will be supported. *DAR-9000* will negotiate with the following information:

Table 12 Query Extended Negotiation

Field Name	Value	Description of Field
Relational-queries	1	relational queries supported

3.1.2.1.3. SOP Specific conformance – Find
DAR-9000 uses hierarchical queries with Patient root level by default. If the extended negotiation is successful, *DAR-9000* will use Relational query with study root model.

3.1.2.2. Real World Activity - Move Images

3.1.2.2.1. Associated Real World Activity – Move Images

DAR-9000 will issue a MOVE request when a user of *DAR-9000* wishes to move one or more studies from a remote DICOM SCP back to *DAR-9000* (retrieve) or another remote DICOM SCP.

3.1.2.2.2. Presentation context Table – Move

DAR-9000 supports the transfer syntaxes listed in Table 13. For a **MOVE** request, *DAR-9000* supports the Presentation Contexts listed in Table 13 and Table 14.

Table 13 Move Transfer Syntaxes

Transfer Syntax	UID
DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2
DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1
DICOM Explicit VR Big Endian Transfer Syntax	1.2.840.10008.1.2.2

Table 14 Move Presentation Contexts

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	SOP Class UID			
Study Root Query/Retrieve IM Move	1.2.840.10008.5.1.4.1.2.2.2	all from Table 13	SCU	None

3.1.2.2.3. SOP Specific Conformance – Move

DAR-9000 uses specific keys for Move operation. When doing a series move the Study UID and Series UID are used as keys. When doing a study move only the Study UID is used as key.

3.1.2.3. Real World Activity - Storage as SCU

3.1.2.3.1. Associated Real World Activity – Storage as SCU

DAR-9000 will issue a **Storage** request when a user of *DAR-9000* wishes to send a study of images to a remote DICOM SCP.

3.1.2.3.2. Presentation context Table – Storage as SCU

DAR-9000 supports the transfer syntaxes listed in Table 15, Table 16 and Table 17. For a **Storage** request, *DAR-9000* supports the Presentation Contexts listed in Table 18.

Table 15 Storage Transfer Syntaxes

Transfer Syntax	UID
DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1
DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2
DICOM JPEG Lossless, hierarchical, first order prediction (Process 14)	1.2.840.10008.1.2.4.70

Table 16 Storage Transfer Syntaxes

Transfer Syntax	UID
DICOM Lossy JPEG 8 Bit – JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50

Table 17 Storage Transfer Syntaxes

Transfer Syntax	UID
RLE Lossless	1.2.840.10008.1.2.5

Table 18 Storage Presentation Contexts

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	**SOP Class UID**			
X-ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	All from Table 15 Table 16	SCU	None
X-Ray Angiographic BI-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	all from Table 15 Table 16	SCU	None
Composite interpretation report	1.2.124.113532.3500.3	1.2.840.10008.1.2	SCU	None
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	All from Table 15 Table 16 Table 17	SCU	None
Ultrasound Multi-frame Image storage (Retired)	1.2.840.10008.5.1.4.1.1.3	All from Table 15 Table 16 Table 17	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	All from Table 15 Table 16 Table 17	SCU	None
Ultrasound Multi-frame Image storage	1.2.840.10008.5.1.4.1.1.3.1	All from Table 15 Table 16 Table 17	SCU	None
Secondary Capture Image storage	1.2.840.10008.5.1.4.1.1.7	All from Table 15	SCU	None
US 95	1.2.840.10008.5.1.4.1.1.6.1	All from Table 15 Table 16 Table 17	SCU	None

3.1.2.4. Real World Activity - Print as SCU

3.1.2.4.1. Associated Real World Activity – Print as SCU
DAR-9000 will issue a **Print** request when a user of *DAR-9000* wishes to send a study of images to a remote DICOM Printer SCP.

3.1.2.4.2. Presentation context Table – Print as SCU
DAR-9000 supports the transfer syntaxes listed in Table 19 For a **Print** request, *DAR-9000* supports the Presentation Contexts listed in Table 20.

Table 19 Print Transfer Syntaxes

Transfer Syntax	UID
DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1

Table 20 Print Presentation Contexts

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	**SOP Class UID**			
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	all from Table 19	SCU	None
Printer	1.2.840.10008.5.1.1.16	All from Table 19	SCU	None

3.1.2.4.3. SOP Specific Conformance – Print as SCU

3.1.2.5. Real World Activity – Query Worklist

3.1.2.5.1. Associated Real World Activity – query Worklist as SCU
DAR-9000 will issue a **query Worklist** request when a user of *DAR-9000* opens a new study if a Modality Worklist SCP is configured in its host table.

3.1.2.5.2. Presentation context Table – Query Worklist as SCU
DAR-9000 supports the transfer syntaxes listed in Table 19 For a **Print** request, *DAR-9000* supports the Presentation Contexts listed in Table 20.

Table 21 Worklist Transfer Syntaxes

Transfer Syntax	UID
DICOM Implicit VR Little EndianTransfer Syntax	1.2.840.10008.1.2

Table 22 Worklist Presentation Contexts

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	SOP Class UID			
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	all from Table 19	SCU	None

3.1.2.5.3. SOP Specific Conformance – general purpose Worklist SOP Class as SCU
DAR-9000 supports queries against the Worklist Information Model using the baseline C-FIND SCU behavior.

3.1.2.5.3.1. DAR-9000 Request matching of the following key Attributes

DICOM Tag	VR	Description
0010:0010	PN	Patient's Name
0010:0020	LO	Patient ID
0008:0050	SH	Accession Number
SQ		Scheduled Procedure Step Sequence
0008:0060	CS	Modality
0040:0001	AE	Scheduled Station AE Title
0040:0002	DA	Scheduled Procedure Step Start Date
0040:0006	PN	Scheduled Performing Physician's Name

3.1.2.5.3.2. DAR-9000 does not use other character set than the default in its query for modality worklist.

3.1.3. Association Acceptance Policy

3.1.3.1. Real World Activity - Verification

3.1.3.1.1. Associated Real World Activity - Verification
DAR-9000 will respond to **Verification** requests to provide an SCU with the ability to determine if *DAR-9000* is receiving DICOM requests.

3.1.3.1.2. Presentation Context Table - Verification

DAR-9000 supports the transfer syntaxes listed in Table 23. *DAR-9000* will accept any of the Presentation Contexts listed in Table 24 for **Verification**.

Table 23 Verification Transfer Syntaxes

Transfer Syntax	UID
DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2

Table 24 Verification Presentation Contexts

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	SOP Class UID			
Verification	1.2.840.10008.1.1	all from Table 23	SCP	None

3.1.3.1.3. SOP Specific Conformance - Verification

DAR-9000 provides standard conformance to the DICOM **Verification** Service Class. *DAR-9000* returns one of the following status codes.

Table 25 Verification status codes.

Service Status	Further Meaning	Protocol Codes	Related Fields	Description
Error	Failed	C000		The operation was not successful.
Success	Success	0000		Operation performed properly.

3.1.3.1.4. Presentation Context Acceptance Criterion - Verification

DAR-9000 will always accept a Presentation Context for the Verification SOP Class with the default DICOM transfer syntax listed in Table 23

3.1.3.1.5. Transfer Syntax Selection Policies - Verification

Since no DICOM data object is associated with a **Verification** command, only the default DICOM transfer syntax is required/supported.

3.1.3.2. Real World Activity - Storage as SCP

3.1.3.2.1. Associated Real World Activity – Storage as SCP

DAR-9000 will archive images that are sent to it from an *SCU*.

3.1.3.2.2. Presentation Context Table – Storage as SCP

DAR-9000 supports the following transfer syntaxes listed in Table 26, Table 27 and Table 28. *DAR-9000* supports any of the Presentation Contexts listed in Table 29 for **Storage**.

Table 26 Storage Transfer Syntaxes

Transfer Syntax	UID
DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1
DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2
DICOM JPEG Lossless,hierarchical, first order prediction (Process 14)	1.2.840.10008.1.2.4.70

Table 27 Storage Transfer Syntaxes

Transfer Syntax	UID
DICOM Lossy JPEG 8 Bit – JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50

Table 28 Storage Transfer Syntaxes

Transfer Syntax	UID
RLE Lossless	1.2.840.10008.1.2.5

Table 29 Storage Presentation Contexts

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	**SOP Class UID**			
X-ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	All from Table 26 Table 27	SCU	None
X-Ray Angiographic BI-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	all from Table 26 Table 27	SCU	None
Composite interpretation report	1.2.124.113532.3500.3	1.2.840.10008.1.2	SCU	None
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	All from Table 26 Table 27 Table 28	SCU	None
Ultrasound Multi-frame Image storage (Retired)	1.2.840.10008.5.1.4.1.1.3	All from Table 26 Table 27 Table 28	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	All from Table 26 Table 27 Table 28	SCU	None
Ultrasound Multi-frame Image storage	1.2.840.10008.5.1.4.1.1.3.1	All from Table 26 Table 27 Table 28	SCU	None
Secondary Capture Image storage	1.2.840.10008.5.1.4.1.1.7	All from Table 26	SCU	None
US 95	1.2.840.10008.5.1.4.1.1.6.1	All from Table 26 Table 27 Table 28	SCU	None

Table 30 Storage Extended Negotiation

Field Name	Value	Description of Field
Level of Support	2	level 2 (FULL) SCP
Element Coercion	0	does not coerce any element

3.1.3.2.3. SOP Specific Conformance – Storage as SCP

DAR-9000 conforms to the DICOM **Storage** Service Class at Level 2 (Full). No elements are discarded or coerced by *DAR-9000*. In the event of a successful C-STORE operation, the Image has successfully been written to disk as a standard Windows™ file. As such, it may be accessed in the same manner as any other Windows™ file. DAR-9000 will delete a file received when space is needed; the duration of the storage of the image is determined by when it was last used by the system. Files are deleted by the *DAR-9000* in a last used basis.

DAR-9000 returns one of the following status codes (Table 31).

14

Table 31 Storage status codes.

Service Status	Further Meaning	Protocol Codes	Related Fields	Description
Refused	Out of resources	A700		Indicates that there was not enough storage space to store the image. Recovery from this condition is left to the administrative functions available in *DAR-9000*.
	SOP Class not supported	A800		Indicates that the SOP Class of the Image in the **C-Store** operation did not match the Abstract Syntax negotiated for the Presentation Context.
Error	Data set does not match SOP Class	A900		Indicates that the Data Set does not encode an instance of the SOP Class specified.
	Failed	C000		The operation was not successful.
	Cannot understand	C005		Indicates that the Data Set cannot be parsed into elements by *DAR-9000*.
Warning	Coercion of data elements	B000		Data elements were modified before being stored.
	Data set does not match SOP Class	B007		Indicates that the Data Set does not match the SOP Class, but that the image was stored anyway.
	Elements Discarded	B006		Indicates that some of the elements of the Data Set were discarded.
	Duplicate SOP Instance UID	D000		Indicates that the SOP Instance UID of the specified image is already stored in the database.
Success	Success	0000		Operation performed properly.

3.1.3.2.4. Presentation Context Acceptance Criterion – Storage as SCP

DAR-9000 will accept any number of **Storage** Presentation Contexts per association request. Any one Abstract Syntax may be specified more than once in an association request, if the Transfer Syntaxes differ between the Presentation Contexts.
The acceptable Presentation Contexts which *DAR-9000* may accept are specified in Table 29. *DAR-9000* will examine proposed Presentation Contexts in the order proposed. The first acceptable Presentation Context (other than Verification) determines the Abstract Syntax which will be used for the association.

3.1.4. Storage Media Application Profile

Table 32 Media profile supported Transfer Syntaxes

Transfer Syntax	UID
DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1
DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2
DICOM JPEG Lossless, hierarchical, first order prediction (Process 14)	1.2.840.10008.1.2.4.70

Table 33 Storage Transfer Syntaxes

Transfer Syntax	UID
DICOM Lossy JPEG 8 Bit – JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50

Table 34 Storage Transfer Syntaxes

Transfer Syntax	UID
RLE Lossless	1.2.840.10008.1.2.5

Table 35 Storage Presentation Contexts

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	**SOP Class UID**			
X-ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	All from Table 32 Table 33	SCU	None
X-Ray Angiographic BI-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	all from Table 32 Table 34	SCU	None
Composite interpretation report	1.2.124.113532.3500.3	1.2.840.10008.1.2	SCU	None
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	All from Table 32 Table 33 Table 34	SCU	None
Ultrasound Multi-frame Image storage (Retired)	1.2.840.10008.5.1.4.1.1.3	All from Table 32 Table 33 Table 34	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	All from Table 32 Table 33 Table 34	SCU	None
Ultrasound Multi-frame Image storage	1.2.840.10008.5.1.4.1.1.3.1	All from Table 32 Table 33 Table 34	SCU	None
Secondary Capture Image storage	1.2.840.10008.5.1.4.1.1.7	All from Table 32	SCU	None
US 95	1.2.840.10008.5.1.4.1.1.6.1	All from Table 32 Table 33 Table 34	SCU	None

3.1.4.1. Real World Activity - Read CD

The *DAR-9000* acts as a DICOM FSR with Interchange Service Class Option for images of SOP class in Table 35.

3.1.4.2. Real World Activity - Write CD

The *DAR-9000* acts as a DICOM FSC with Interchange Service Class Option for images of SOP class in Table 35.

3.1.5. Storage Commitment Conformance

3.1.5.1. Introduction

The *DAR-9000* system implements the DICOM Storage Commitment Push Model SOP Class. This system supports Storage Commitment as an SCU only.

3.1.5.2. Real World Activity - Storage as SCP

1. The Real-World activity that will cause the *DAR-9000* to initiate an association to a remote DICOM entity that is a Service Class Provider (SCP) of the Storage Commitment SOP class is choosing a remote DICOM AE that supports Storage Commitment as provider as the archive device.
2. Then acquiring images using the Cathlab. The acquired images to be committed are sent to the remote SCP entity first. The Commitment request for the transferred image instances is sent after the complete image transfer and the closure of the study.
3. The closure of the study is initiated by the user.
4. The Commitment response has to come on a different association.
5. The expected Real-World activity "Set Archive State" is performed by the DICOM Server AE to respond to an incoming Storage Commitment response from the remote DICOM AE.

3.1.5.3. Functional definitions

1. *DAR-9000* initiates the following operations:
   a. Negotiate and establish association with remote Storage Commitment Provider
   b. Send the acquired images to the remote DICOM AE SCP configured as the primary archive using C-STORE.
   c. Close the association.
   d. If there are any failures in the C-STORE for images
      i. The job will be marked as failed
      ii. The Storage Commitment request will not be sent for the failed STORE images.
      iii. The image C-STORE of the failed jobs will be retried continuously until successful.
   e. If all the images are transferred (C-STORE) without failures the following steps will be executed.
      i. Establish a new association for sending the commitment request.
         - The storage commitment request is done on a "Per study" basis.
         - The storage commitment request will contain all SOP instance UID of all the successfully stored images for a particular study.
      ii. Receive the response on same association or on a different association.
      iii. Updates the archive flag information for successful instances.
   f. When the files are successfully committed they become eligible for automatic deletion.
   g. Each file for which the system receives a "STORAGE COMITMENT failure" status is resent and a new storage commit process is started. After N unsuccessful retries (N configurable in the GUI) the user is notified.

3.1.5.4. Sequencing of real-world activities

1. The user has to declare a new study using the GUI
2. The user has to acquire new images
3. The user has to close the study.

4. Communication Profiles

DAR-9000 provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM standard.

4.1. TCP/IP Stack

DAR-9000 inherits its TCP/IP stack from the computer upon which it executes.

4.1.1. Physical media support

DAR-9000 is indifferent to the physical medium over which TCP/IP executes; it inherits the medium from the system upon which it executes.

4.2. Extensions/Specialization/Privatization

NA

4.3. Configuration

4.3.1. AE Title/Presentation address Mapping

DAR-9000 maps Application Entity titles to host name and port number via an internal configuration method. The mapping can be accessed in the configuration menu under the Database tab. Only a privileged user can change the mapping.

4.3.2. Configurable parameters

DAR-9000 receives its configuration parameters from the user trough the AE's GUI.
Configurable parameters are:
1. Local/remote application Entity title
2. Local/remote host name
3. Local/remote TCP/IP port
4. MAX PDU size
5. Time out for association
6. Time out for sub-operations
7. Machine serial Number
8. Remote host DICOM capabilities
   a- Store
   b- Commitment
   c- Print
   d- Query
   e- Move

4.4. Support for Extended Character Sets

DAR-9000 is known to support the following character sets:

ISO-IR 6 (default)	Basic G0 Set
ISO-IR 100	Latin Alphabet No. 1

5. UID Generation

This section will describe how UID are generated by the *DAR-9000* system.

5.1. Definitions

S**erial Number**: A thirteen digit maximum number unique to this type of system (*DAR-9000*).

Study Date: Date in format YYYYMMDD at which the study was created.

Study Time: Time in format HHMMSS at which the study was created.

Series Number: Type of the encoding/object:

1: Lossless Cine,
2: Lossy Cine,
3: Little Endian Implicit Cine,
13: Annotated images,
15: Reference Image,
51: DSA Lossless Cine
52: DSA Lossy Cine
53: DSA LEI.Cine

Instance Number: Sequential Number of the DICOM object generated by the *DAR-9000* for all objects of the same type in the same study.

Image Date: Date in format YYYYMMDD at which the image was created.

Image Time: Time in format HHMMSS at which the image was created

Image Time MS: Time in Milliseconds in format mmm at which the image was created

5.2. Root and implementation class UID

DAR-9000 **root is 1.2.392.200036.9110**

Implementation Class UID = <Root>.12.<Serial Number>

For the anonymize function:
This root is used only when competitor's files are being anonymized. Otherwise, the above roots are used.

DAR-9000 **Root for anonymization = <Root>.66**

5.3. Study UID

Study Instance UID = <ImplementationClassUID>.<StudyDate>

5.4. Series UID

Series Instance UID= <StudyInstanceUID>.<SeriesNumber>

5.5. SOP instance UID

The Instance sequential number is a number that is generated by the *DAR-9000* sequentially for each new sequence of the same type is a study.

1- Cine files
<SeriesInstanceUID>.<Instance SequentialNumber>

2- Annotated files
<SeriesInstanceUID>.< Instance SequentialNumber >.<ImageDate>.<ImageTime>

3- Reference Image files
<SeriesInstanceUID>.<ImageTime>.<ImageTimeMS>

4- Anonymized files
<Root>.66.12.<SerialNumber>.<ImageDate>.<ImageTime>.<SeriesNumber>.<ImageTimeMS>