


MiraQ - DICOM Conformance Statement

Revision History

Revision	Date	Reason for revision	By
A	25/SEP/2014	Initial version based on DOC-311-B (Medistim Device SW 4.0)	Jonas Crosby
B	11/OCT/2022	<ul style="list-style-type: none"> - Updated revision history in section 3.1 with changes up to software release 4.3.2. - Corrected typo in table 8.1-3: Value of "Study Description (0008,1030)" is copied from (0032,1060), not (0040,0254). - Table 4.2-31: Values from worklist attributes "Accession Number" and "Referring Physician's Name" are included in IOD. - Table 8.1-7: Added some details on "Instance Number". - Updated Chapter 6 "Support of Character Sets" to include changes in implementation. - Added some clarifications regarding ipv6 support. 	Jonas Crosby

Title: MiraQ - DICOM Conformance Statement				
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DICOM Conformance Statement

DICOM option for MiraQ Systems (MIRAQ-DCM)

Version 4.3

This DICOM Conformance Statement describes the conformance to the ACR-NEMA DICOM 3.0 standard for MiraQ systems with an activated DICOM option. The scope of the document is to facilitate data exchange between a MiraQ system and other DICOM systems in a medical environment.

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1 DICOM Conformance Statement Overview

This DICOM Conformance Statement describes the conformance to the ACR-NEMA DICOM 3.0 standard for MiraQ systems with an activated DICOM option (MIRAQ-DCM). The scope of the document is to facilitate data exchange between the MiraQ system and other DICOM systems in a medical environment. This document should be read in conjunction with the DICOM standard and its addenda.

1.1 NETWORK SERVICES

The MiraQ acts as an acquisition modality in a DICOM network. Table 1.1-1 provides an overview of the network services supported by MIRAQ-DCM.

Table 1.1-1: Overview of supported network services

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
TRANSFER		
Ultrasound Multi-frame Image Storage	Yes	No
WORKFLOW MANAGEMENT		
Modality Worklist Information Model – FIND	Yes	No
Storage Commitment Push Model SOP Class	Yes	No

1.2 MEDIA SERVICES

The MiraQ does not support any Media Storage Application Profiles.

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3 Introduction

This document describes the conformance to the ACR-NEMA DICOM 3.0 Standard of the DICOM option for the MiraQ systems.

The Medistim MiraQ Systems are designed to perform intra-operative guidance and quality control during cardiovascular surgical procedures and meet the demands for documentation of surgical procedures. The DICOM option allows the operators to retrieve patient demographics from a central server and send data to a PACS server using the hospital's Ethernet network.

The term MIRAQ-DCM will hereafter be used to refer to the MiraQ systems with an activated DICOM option.

3.1 REVISION HISTORY

The revision history in Table 3.1-1: Revision History Table 3.1-1 provides dates and differences of the different releases of the product and the Conformance Statement.

Table 3.1-1: Revision History

SW Version	Release Date	Conformance Statement	Change History
4.0.0	6/NOV/2014	DOC-813-A	Conformance Statement for MiraQ systems.
4.1.0	26/NOV/2015		No DICOM Changes.
4.1.1	15/NOV/2017		Includes bug fixes involving DICOM functionality, see release notes.; Added overriding of worklist character sets.
4.2.0	13/JUN/2019		No DICOM Changes.
4.2.1	6/NOV/2019		Includes bug fix involving DICOM worklist functionality, see release notes.
4.2.2	20/APR/2020		No DICOM Changes.
4.2.3	23/OCT/2020		No DICOM Changes.
4.3.0	1/FEB/2021		Hotfix 4.3.0.1 contains bug fixes involving DICOM functionality, see release notes.
4.3.1	27/OCT/2021		Includes bug fixes involving DICOM functionality, see release notes.
4.3.2	Q4/2022		DOC-813-B

3.2 INTENDED AUDIENCE

This Conformance Statement is intended for:

- Customers and potential customers.
- System integrators of medical equipment.
- Software designers and implementers of DICOM interfaces.
- Sales and marketing staff.

This document is written for the people that need to understand how the MIRAQ-DCM system will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. This document contains some basic DICOM definitions so that any reader may understand how this product implements DICOM features. However, integrators are expected to fully

understand all the DICOM terminology, how the tables in this document relate to the product's functionality, and how that functionality integrates with other devices that support compatible DICOM features

3.3 REMARKS

The scope of this DICOM Conformance Statement is to facilitate integration between MIRAQ-DCM and other DICOM products. The Conformance Statement should be read and understood in conjunction with the DICOM Standard. DICOM by itself does not guarantee interoperability. The Conformance Statement does, however, facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:

- The comparison of different Conformance Statements is just the first step towards assessing interconnectivity and interoperability between Medistim's MIRAQ-DCM product and other non-Medistim DICOM conformant equipment.
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility

3.4 TERMS AND DEFINITIONS

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class, and Ultrasound Image Storage SOP Class.

Application Entity (AE) – an end point of a DICOM information exchange, including the DICOM network or media interface software, i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title – the externally known name of an *Application Entity*, used to identify a DICOM application to other DICOM applications on the network.

Application Context – the specification of the type of communication used between *Application Entities*. Example: DICOM network protocol.

Association – a network communication channel set up between *Application Entities*.

Attribute – a unit of information in an object definition; a data element identified by a *tag*. The information may be a complex data structure (Sequence), itself composed of lower-level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD) – the specified set of *Attributes* that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The *Attributes* may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Joint Photographic Experts Group (JPEG) – a set of standardized image compression techniques, available for use by DICOM applications.

Module – a set of *Attributes* within an *Information Object Definition* that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation – first phase of *Association* establishment that allows *Application Entities* to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context – the set of DICOM network services used over an *Association*, as negotiated between *Application Entities*; includes *Abstract Syntaxes* and *Transfer Syntaxes*.

Protocol Data Unit (PDU) – a packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

Security Profile – a set of mechanisms, such as encryption, user authentication, or digital signatures, used by an *Application Entity* to ensure confidentiality, integrity, and/or availability of exchanged DICOM data.

Service Class Provider (SCP) – role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another *Application Entity* (*Service Class User*). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

Service Class User (SCU) – role of an *Application Entity* that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class – the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance – an information object; a specific occurrence of information exchanged in a *SOP Class*. Examples: a specific ultrasound image.

Tag – a 32-bit identifier for a data element, represented as a pair of four-digit hexadecimal numbers, the “group” and the “element”. If the “group” number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

Transfer Syntax – the encoding used for exchange of DICOM information objects and messages. Examples: *JPEG* compressed (images), little-endian explicit value representation.

Unique Identifier (UID) – a globally unique “dotted decimal” string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR) – the format type of an individual DICOM data element, such as text, an integer, a person’s name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

3.5 BASICS OF DICOM COMMUNICATION

This section describes terminology used in this Conformance Statement for the non-specialist.

The key terms used in the Conformance Statement are highlighted in *italics* below. This section is not a substitute for training about DICOM, and it makes many simplifications about the meanings of DICOM terms.

Two *Application Entities* (devices) that want to communicate with each other over a network using DICOM protocol must first agree on several things during an initial network “handshake”. One of the two devices must initiate an *Association* (a connection to the other device), and ask if specific services, information, and encoding can be supported by the other device (*Negotiation*).

DICOM specifies several network services and types of information objects, each of which is called an *Abstract Syntax* for the Negotiation. DICOM also specifies a variety of methods for encoding data, denoted *Transfer Syntaxes*. The Negotiation allows the initiating Application Entity to propose combinations of Abstract Syntax and Transfer Syntax to be used on the Association; these combinations are called *Presentation Contexts*. The receiving Application Entity accepts the Presentation Contexts it supports.

For each Presentation Context, the Association Negotiation also allows the devices to agree on *Roles* – which one is the *Service Class User* (SCU - client) and which is the *Service Class Provider* (SCP - server). Normally the device initiating the connection is the SCU, i.e., the client system calls the server, but not always.

The Association Negotiation finally enables exchange of maximum network packet (*PDU*) size, security information, and network service options (called *Extended Negotiation* information).

The Application Entities, having negotiated the Association parameters, may now commence exchanging data. Common data exchanges include queries for worklists and lists of stored images, transfer of image objects and analyses (structured reports) and sending images to film printers. Each exchangeable unit of data is formatted by the sender in accordance with the appropriate *Information Object Definition* and sent using the negotiated Transfer Syntax. There is a Default Transfer Syntax that all systems must accept, but it may not be the most efficient for some use cases. Each transfer is explicitly acknowledged by the receiver with a *Response Status* indicating success, failure, or that query or retrieve operations are still in process.

Two Application Entities may also communicate with each other by exchanging media (such as a CD-R). Since there is no Association Negotiation possible, they both use a *Media Application Profile* that specifies “pre-negotiated” exchange media format, Abstract Syntax, and Transfer Syntax.

3.6 ABBREVIATIONS

ACR	American College of Radiology
AE	Application Entity
AET	Application Entity Title
DHCP	Dynamic Host Configuration Protocol
DICOM	Digital Imaging and Communications in Medicine
DNS	Domain Name System
HIS	Hospital Information System
HL7	Health Level 7 Standard
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO	International Organization for Standards
JPEG	Joint Photographic Experts Group
LUT	Look-up Table
MPEG	Moving Picture Experts Group
MPPS	Modality Performed Procedure Step
MSPS	Modality Scheduled Procedure Step
MTU	Maximum Transmission Unit (IP)
MWL	Modality Worklist
NTP	Network Time Protocol
OSI	Open Systems Interconnection
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
RIS	Radiology Information System
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
SPS	Scheduled Procedure Step
TCP/IP	Transmission Control Protocol/Internet Protocol
US	Ultrasound
VR	Value Representation

3.7 REFERENCES

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/>

4 Networking

4.1 IMPLEMENTATION MODEL

4.1.1 Application Data Flow

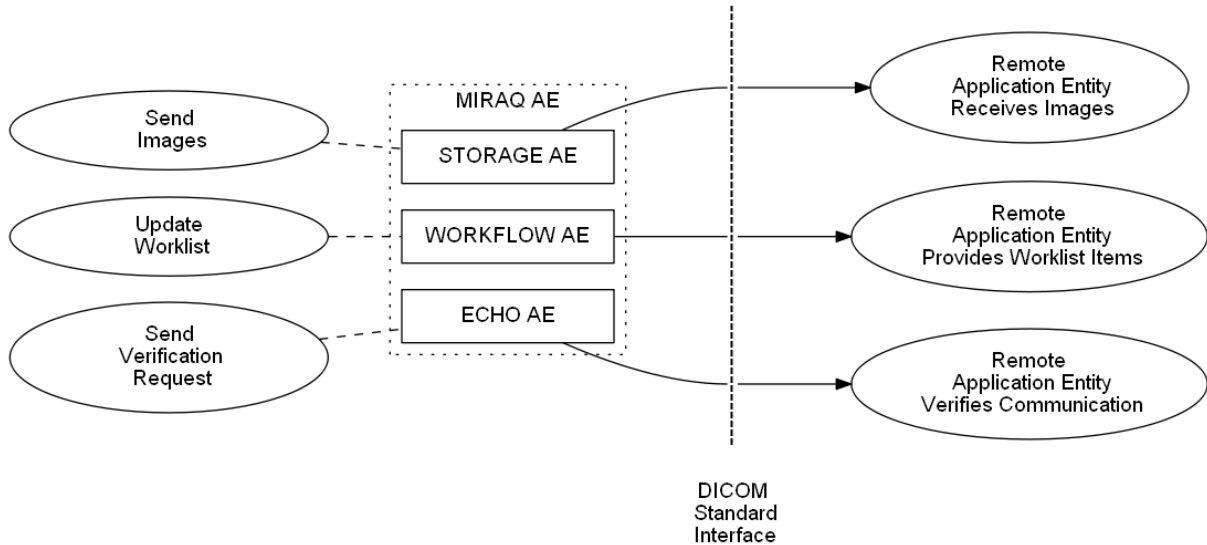


Figure 4.1-1: Application Data Flow Diagram

Figure 4.1-1 shows the application data flow. Conceptually the network services may be modeled as a *STORAGE AE*, a *WORKFLOW AE*, and an *ECHO AE*, though in fact all AE's share a single (configurable) AE Title.

- The *WORKFLOW AE* receives Worklist information from a remote AE. It is associated with the local real-world activity "Update Worklist". "Update Worklist" performed upon user request and triggers the *WORKFLOW AE* to query a remote AE for worklist items and provide the set of worklist items matching the query request.
- The *STORAGE AE* sends images to a remote AE. It is associated with the local real-world activity "Send images". "Send Images" is performed upon user request for a given patient or study, or for specific images selected. If the remote AE is configured as an archive device the *STORAGE AE* will request Storage Commitment, and if a commitment is successfully obtained will record this information in the local database.
- The *ECHO AE* sends or responds to verification requests.

4.1.2 Functional Definition of AE's

4.1.2.1 Functional Definition of ECHO AE

The *ECHO AE* SCU is activated by the MIRAQ-DCM operator when he/she selects a remote AE and requests a verification of the DICOM network connectivity.

4.1.2.2 Functional Definition of STORAGE AE

The existence of a send-job queue entry with associated network destination will activate the *STORAGE AE*. The MIRAQ-DCM database must be correctly configured with the host and port number of any external DICOM AE. An association request is sent to the destination AE and upon successful negotiation of a Presentation Context the image transfer is started. If the association cannot be opened, the related send-job is set to an error state and can be restarted by the user via job control interface. By default, the *STORAGE AE* will not try to initiate another association for this send-job automatically.

However, an automatic retry (retry timer, retry count) can be configured in the MIRAQ-DCM system's Network Settings (see Table 4.3-2).

4.1.2.3 Functional Definition of WORKFLOW AE

Worklist Update is activated by the user and will attempt to download a Worklist from a remote node if a network connection is available. If the WORKFLOW AE establishes an Association to a remote AE, it will transfer all worklist items via the open Association. During receiving the worklist response items are counted and the query processing is canceled if the configurable limit of items is reached (see Table 4.3-2). Patient and study information from the worklist items are copied to the local database and may thereafter be accessed offline.

4.1.3 Sequencing of Real-World Activities

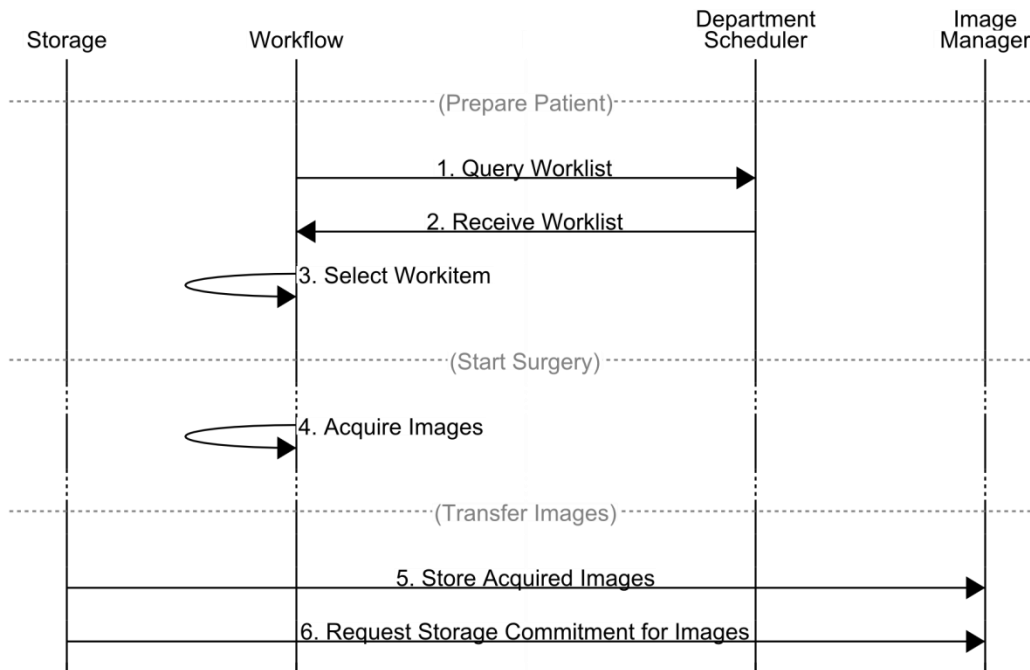


Figure 4.1-2: Sequencing Constraints

Under normal scheduled workflow conditions, the sequencing constraints illustrated in Figure 4.1-2 apply:

1. Query Worklist
2. Receive Worklist of Modality Scheduled Procedure Steps (MSPS)
3. Select WorkItem (MSPS) from Worklist
4. Acquire images
5. Store acquired images
6. If the Image Manager is configured as an archive device the STORAGE AE will request Storage Commitment for the images.

The ECHO AE SCP activities are performed asynchronously in the background and are not dependent on any sequencing. The other activities are sequentially initiated in the user interface, and another activity may not be initiated until the prior activity has completed.

4.2 AE SPECIFICATIONS

4.2.1 ECHO Application Entity Specification

4.2.1.1 SOP Classes

MIRAQ-DCM provides Standard Conformance to the SOP Class in Table 4.2-9.

Table 4.2-1: SOP classes for ECHO AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	Yes	Yes

4.2.1.2 Association Policies

4.2.1.2.1 General

The *ECHO AE* both accepts and initiates associations, The DICOM standard application context name for DICOM 3.0 is always proposed (Table 4.2-10).

Table 4.2-2: DICOM application context for ECHO AE

Application Context Name:	1.2.840.10008.3.1.1.1
---------------------------	-----------------------

4.2.1.2.2 Number of Associations

The *ECHO AE* can support multiple Associations as SCP. Each time *ECHO AE* receives an Association, a child thread will be spawned to process the Verification request. The maximum number of child threads, and thus the maximum number of simultaneous Associations is shown in Table 4.2-3. The maximum PDU size is also limited by the Operating System and available memory. As SCU, *ECHO AE* will only initiate one outgoing verification request at the time.

Table 4.2-3: Number of Simultaneous Associations for ECHO AE

Maximum number of simultaneous Associations initiated for ECHO AE:	1
Maximum number of simultaneous Associations accepted for ECHO AE:	20

Table 4.2-4: Maximum PDU size for ECHO AE

Maximum PDU size received:	Unlimited
----------------------------	-----------

4.2.1.2.3 Asynchronous Nature

The *ECHO AE* does not support asynchronous communication (multiple outstanding transactions over a single Association). All association requests must be completed and acknowledged before a new operation can be initiated.

Table 4.2-5: Asynchronous nature as SCU for ECHO AE

Maximum number of outstanding asynchronous transactions:	1
--	---

4.2.1.2.4 Implementation Identifying Information

The implementation information for this Application Entity is defined in Table 4.2-13.

Table 4.2-6: DICOM implementation class and version for ECHO AE

Implementation Class UID:	1.2.840.114236.0.900.100
Implementation Version Name:	CPS_10.7

4.2.1.3 Association Initiation Policy

4.2.1.3.1 Activity: Send Verification Request

4.2.1.3.1.1 Description and Sequencing of Activities

The Associated Real-World Activity is the attempt to verify communications with a remote AE. This occurs when the operator triggers a “Verify” task from the user interface. If the remote AE does not respond for some reason, the operations will time out after a configurable time interval and the association will be released (see Table 4.3-2). If the verification fails, for whatever reason, no retry will be performed. A message informing about the result of the verification request and the possible errors encountered is displayed.

4.2.1.3.1.2 Proposed Presentation Contexts

MIRAQ-DCM can propose the Presentation Contexts shown in Table 4.2-7.

Table 4.2-7: Proposed presentation contexts for activity Send Verification Request

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

4.2.1.3.1.3 SOP Specific Conformance for Verification SOP Class

ECHO AE provides standard conformance to the Verification Service Class.

4.2.1.4 Association Acceptance Policy

4.2.1.4.1 Activity: Receive Verification Request

4.2.1.4.1.1 Description and Sequencing of Activities

For each verification request on a successful Association, ECHO AE will issue a C-ECHO response message.

4.2.1.4.1.2 Accepted Presentation Contexts

The ECHO AE will accept the Presentation Contexts shown in Table 4.2-8.

Table 4.2-8: Acceptable presentation contexts for activity Receive Verification Request

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

4.2.1.4.1.3 SOP Specific Conformance for Verification SOP Class

ECHO AE provides standard conformance to the Verification Service Class.

4.2.1.4.1.3.1 Presentation Context Acceptance Criterion

ECHO AE will always accept any Presentation Context for the supported SOP Classes with the supported Transfer Syntaxes. More than one proposed Presentation Context will be accepted for the same Abstract Syntax if the Transfer Syntax is supported, whether or not it is the same as another Presentation Context.

4.2.1.4.1.3.2 Transfer Syntax Selection Policies

If offered a choice of Transfer Syntaxes in a Presentation Context, ECHO AE will apply the first encountered Transfer Syntax in the priority order indicated in Table 4.2-8.

ECHO AE will accept duplicate Presentation Contexts, that is, if it is offered multiple Presentation Contexts, each of which offers acceptable Transfer Syntaxes, it will accept all Presentation Contexts, applying the same priority for selecting a Transfer Syntax for each.

4.2.2 STORAGE Application Entity Specification

4.2.2.1 SOP Classes

MIRAQ-DCM provides Standard Conformance to the SOP Classes in Table 4.2-9.

Table 4.2-9: SOP classes for STORAGE AE

SOP Class Name	SOP Class UID	SCU	SCP
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	Yes	No

4.2.2.2 Association Policies

4.2.2.2.1 General

The *STORAGE AE* SCU is activated through the user interface when a user selects instances from a connected local archive and requests that they are sent to a remote AE (selected from a pre-configured list). The DICOM standard application context name for DICOM 3.0 is always proposed (Table 4.2-10).

Table 4.2-10: DICOM application context for STORAGE AE

Application Context Name:	1.2.840.10008.3.1.1.1
---------------------------	-----------------------

4.2.2.2.2 Number of Associations

MIRAQ-DCM initiates one Association at a time for each destination to which a transfer request is being processed in the active job queue list. Only one job will be active at a time, the other remains pending until the active job is completed or failed.

Table 4.2-11: Number of Simultaneous Associations for STORAGE AE

Maximum number of simultaneous Associations:	1
--	---

4.2.2.2.3 Asynchronous Nature

The *STORAGE AE* does not support asynchronous communication (multiple outstanding transactions over a single Association). All association requests must be completed and acknowledged before a new operation can be initiated.

Table 4.2-12: Asynchronous nature as SCU for STORAGE AE

Maximum number of outstanding asynchronous transactions:	1
--	---

4.2.2.2.4 Implementation Identifying Information

The implementation information for this Application Entity is defined in Table 4.2-13

Table 4.2-13: DICOM implementation class and version for STORAGE AE

Implementation Class UID:	1.2.840.114236.0.900.100
Implementation Version Name:	CPS_10.7

Note that the STORAGE AE, WORKFLOW AE and ECHO AE use the same Implementation Class UID.

4.2.2.3 Association Initiation Policy

STORAGE AE attempts to initiate a new association for each series of instances it attempts to transfer.

4.2.2.3.1 Activity: Send Images

4.2.2.3.1.1 Description and Sequencing of Activities

The Associated Real-World Activity is the request to send acquired image to a remote AE. Each request is forwarded to the job queue and processed individually.

The STORAGE AE is invoked by the job control interface that is responsible for processing the job queue. The job consists of data describing the instances marked for storage and the destination. An internal daemon process triggered by a job for a specific network destination initiates requests to store images. The Storage AE attempts to initiate a new Association to issue a C-STORE request. If the job contains multiple images, then multiple C-STORE requests will be issued over the same Association. Status of the transfer is reported through the job control interface. Only one job will be active at a time.

If the remote AE does not respond for some reason, the operations will time out after a configurable time interval and the association will be released. If the request fails, for whatever reason, no retry will be performed and an attempt will be made to send the next instance in the queue, unless the “auto-resend” option is enabled. When “auto-resend” is enabled, MIRAQ-DCM will attempt to resend the same data for the configured number of times (set for the remote AE in the system’s Network Settings) before moving to the next instance.

Failed jobs may be restarted at any time by user interaction and will be processed in accordance with their original position in the job queue (any ongoing image transfers will not be aborted).

If the Remote AE is configured as an archive device the Storage AE will, after all instances in the job have been sent, transmit a single Storage Commitment request (N-ACTION) over the same Association. Upon receiving the N-ACTION response the Storage AE will delay releasing the Association for a configurable amount of time. If no N-EVENT-REPORT is received within this time period, the Association will be immediately released (i.e., notification of Storage Commitment success or failure will be received over a separate association). However, the Storage AE is capable of receiving an N-EVENT-REPORT request at any time during an association provided a Presentation Context for the Storage Commitment Push Model has been successfully negotiated (i.e. the N-ACTION is sent at the end of one association and the N-EVENT-REPORT is received during an association initiated for a subsequent send job or during an association initiated by the Remote AE for the specific purpose of sending the N-EVENT-REPORT).

A possible sequence of interactions between the Storage AE and an Image Manager (e.g., a storage or archive device supporting the Storage and Storage Commitment SOP Classes as an SCP) is illustrated in Figure 4.2-1.

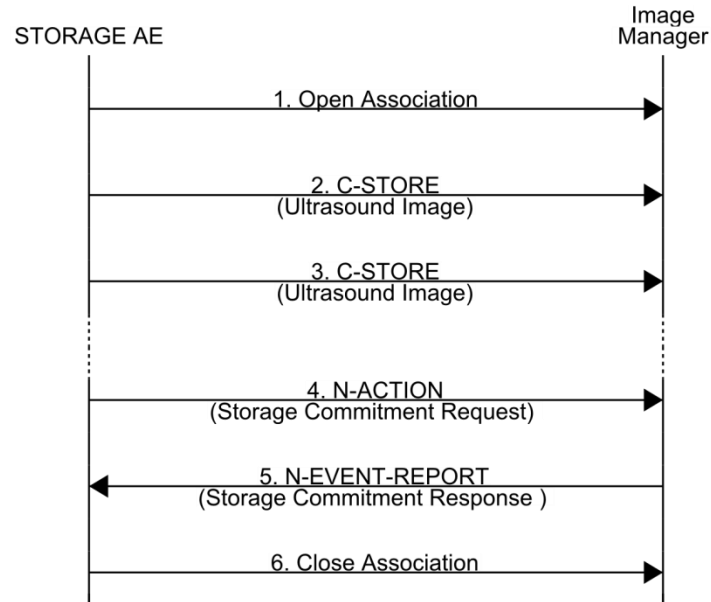


Figure 4.2-1: Sequencing of Activity - Send Images with immediate storage commitment response.

1. The Storage AE opens an association with the Image Manager.
2. An acquired ultrasound image is transmitted to the Image Manager using a C-STORE request and the Image Manager replies with a C-STORE response (status success).
3. Another acquired ultrasound image is transmitted to the Image Manager using a C-STORE request and the Image Manager replies with a C-STORE response (status success).
4. An N-ACTION request is transmitted to the Image Manager to obtain storage commitment of previously transmitted images. The Image Manager replies with an N-ACTION response indicating the request has been received and is being processed.
5. The Image Manager immediately transmits an N-EVENT-REPORT request notifying the Storage AE of the status of the Storage Commitment Request (sent in step 4 using the N-ACTION message). The Storage AE replies with an N-EVENT-REPORT response confirming receipt. The Image Manager could send this message at any time or omit it entirely in favor of transmitting the N-EVENT-REPORT over a separate dedicated association (see Figure 4.2-2).
6. The Storage AE closes the association with the Image Manager.

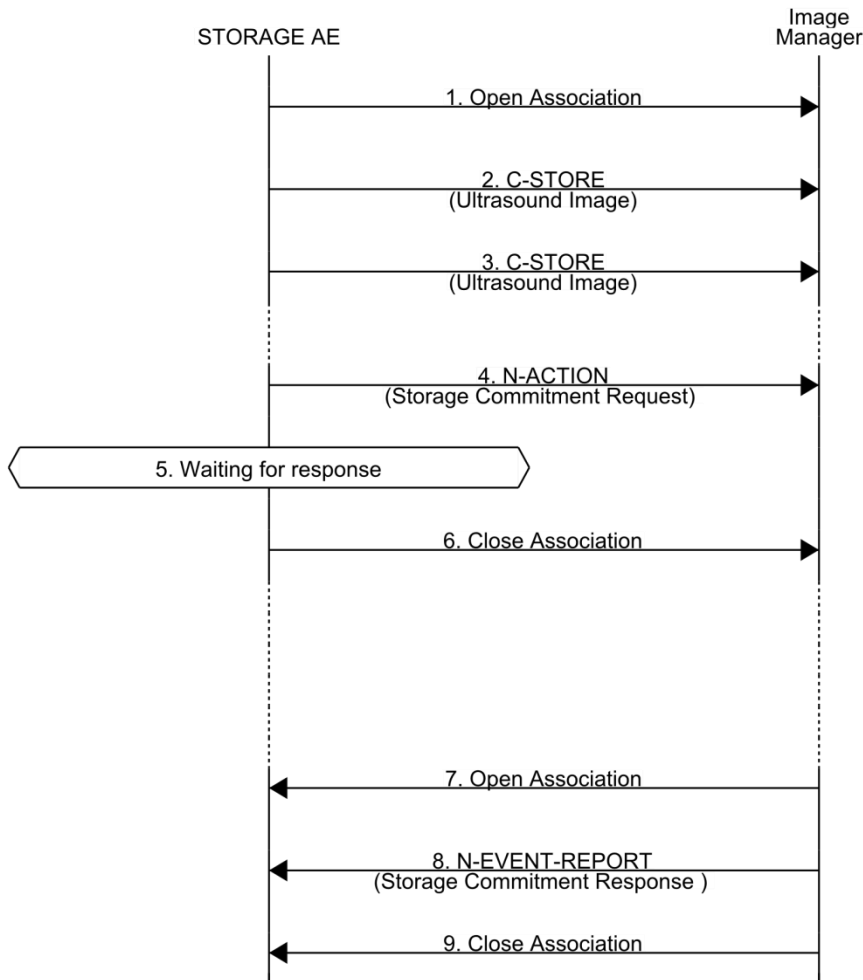


Figure 4.2-2: Sequencing of Activity - Send Images with delayed storage commitment response.

4.2.2.3.1.2 Proposed Presentation Contexts

MIRAQ-DCM can propose the Presentation Contexts shown in Table 4.2-14. Presentation Contexts for Ultrasound Multi-frame Image Storage will only be proposed if the Send Job contains instances for these SOP Classes. A Presentation Context for the Storage Commitment Push Model will only be proposed if the Remote AE is configured as an archive device.

Table 4.2-14: Proposed presentation contexts for activity Send Images

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID				
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	See Table 4.2-15		SCU	None
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

Table 4.2-15: Transfer Syntaxes for Send Images

Transfer Syntax	
Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
Explicit VR Big Endian	1.2.840.10008.1.2.2
JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50
JPEG Baseline (Process 2 & 4)	1.2.840.10008.1.2.4.51
JPEG Lossless, Non Hierarchical (Process 14)	1.2.840.10008.1.2.4.57
JPEG Lossless, Non Hierarchical, First Order Prediction (Process 14, Selection Value 1)	1.2.840.10008.1.2.4.70
RLE Lossless	1.2.840.10008.1.2.5

4.2.2.3.1.3 SOP Specific Conformance for Verification SOP Class

Standard conformance is provided to the DICOM Verification Service Class as an SCU. The Verification Service as an SCU is only supported as a diagnostic service tool for network communication issue, to test whether Association can be opened with a remote AE.

4.2.2.3.1.4 SOP Specific Conformance for Storage SOP Class

STORAGE AE provides standard conformance to the Storage Service Class as an SCU. The behavior when encountering status codes in a C-STORE response is summarized in Table 4.2-16.

Table 4.2-16: Storage C-STORE response status handling behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has successfully stored the SOP Instance. If all SOP Instances in a send job have status success, then the job is marked as complete.
Refused	Out of Resources	A7xx	The Association is aborted using A-ABORT and the send job is marked as failed. The status meaning is logged, and the job failure is reported to the user via the job control interface. This is a transient failure.
Error	Data Set does not match SOP Class	A9xx	The Association is aborted using A-ABORT and the send job is marked as failed. The status code is logged, and the job failure is reported to the user via the job control interface.
	Cannot Understand	Cxxx	The Association is aborted using A-ABORT and the send job is marked as failed. The status code is logged, and the job failure is reported to the user via the job control interface.
Warning	Coercion of Data Elements	B000	Image transmission is considered successful, but the status meaning is logged.
	Data Set does not match SOP Class	B007	Image transmission is considered successful, but the status meaning is logged.
	Elements Discarded	B006	Image transmission is considered successful, but the status meaning is logged.

*	*	Any other status code	The Association is aborted using A-ABORT and the send job is marked as failed. The status code is logged, and the job failure is reported to the user via the job control interface.
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The behavior of Storage AE during communication failure is summarized in Table 4.2-17.

Table 4.2-17: Storage communication failure behavior

Exception	Behavior
Timeout	The Association is aborted using A-ABORT and the send job is marked as failed. The reason is logged, and the job failure is reported to the user via the job control interface. This is regarded as a transient failure.
Association aborted by the SCP or network layers	The send job is marked as failed. The reason is logged, and the job failure is reported to the user via the job control interface. This is regarded as a transient failure.

A failed send job can be restarted by user interaction. The system can be configured to automatically resend failed jobs if a transient status code is received.

4.2.2.3.1.5 SOP Specific Conformance for Storage Commitment SOP Class

4.2.2.3.1.5.1 Storage Commitment Operations (N-ACTION)

The STORAGE AE will request storage commitment for instances of the Ultrasound Multi-frame Image Storage if the Remote AE is configured as an archive device and a presentation context for the Storage Commitment Push Model has been accepted.

The STORAGE AE will consider Storage Commitment failed if no N-EVENT-REPORT is received for a Transaction UID within a configurable time after receiving a successful N-ACTION response (duration of applicability for a Transaction UID).

The STORAGE AE does not send the optional Storage Media File-Set ID & UID Attributes or the Referenced Study Component Sequence Attribute in the N-ACTION request. The behavior of STORAGE AE when encountering status codes in an N-ACTION response is summarized in Table 4.2-18.

Table 4.2-18: Storage commitment N-ACTION response status handling behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The request for storage comment is considered successfully sent. A timer is started which will expire if no N-EVENT-REPORT for the Transaction UID is received within a configurable timeout period.
*	*	Any other status code	The Association is aborted using A-ABORT and the send job is marked as failed. The status code is logged, and the job failure is reported to the user via the job control interface.

The behavior of STORAGE AE during communication failure is the same as for the storage communication summarized in Table 4.2-17.

4.2.2.3.1.5.2 Storage Commitment Notifications (N-EVENT-REPORT)

The Storage AE can receive an N-EVENT-REPORT notification if it has successfully negotiated a Presentation Context for the Storage Commitment Push Model (i.e., only associations established with archive devices).

Upon receipt of an N-EVENT-REPORT the timer associated with the Transaction UID will be canceled.

The behavior of Storage AE when receiving Event Types within the N-EVENT-REPORT is summarized in Table 4.2-19.

Table 4.2-19: Storage commitment N-EVENT-REPORT behavior

Event Type	Event Type ID	Behavior
Storage Commitment Request Successful	1	The Referenced SOP Instances under Referenced SOP Sequence (0008,1199) are marked within the database as "Stored & Committed (SC)" to the value of Retrieve AE Title (0008,0054).
Storage Commitment Request Complete – Failures Exist	2	The Referenced SOP Instances under Referenced SOP Sequence (0008,1199) are treated in the same way as in the success case (Event Type 1). The Referenced SOP Instances under Failed SOP Sequence (0008,1198) are marked as not committed in the local database. The Failure Reasons are logged, and the job failure is reported to the user via the job control interface. A send job that failed storage commitment will not be automatically restarted but can be restarted by user interaction.

The reasons for returning specific status codes in an N-EVENT-REPORT response are summarized in Table 4.2-20.

Table 4.2-20: Storage commitment N-EVENT-REPORT response status reasons.

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The storage commitment result has been successfully received.
Failure	Unrecognized Operation	0211H	The Transaction UID in the N-EVENT-REPORT request is not recognized (was never issued within an N-ACTION request).
	Resource Limitation	0213H	The Transaction UID in the N-EVENT-REPORT request has expired
	No Such Event Type	0113H	An invalid Event Type ID was supplied in the N-EVENT-REPORT request.
	Processing Failure	0110H	An internal error occurred during processing of the N-EVENTREPORT. A short description of the error will be returned in Error Comment (0000,0902).
	Invalid Argument Value	0115H	One or more SOP Instance UIDs with the Referenced SOP Sequence (0008,1199) or Failed SOP Sequence (0008,1198) was not included in the Storage Commitment Request associated with this Transaction UID. The unrecognized SOP Instance UIDs will be returned within the Event Information of the N-EVENT-REPORT response.

4.2.2.4 Association Acceptance Policy

4.2.2.4.1 Activity: Send Images - Receive Storage Commitment Response

4.2.2.4.1.1 Description and Sequencing of Activities

The STORAGE AE will accept associations to receive responses to a Storage Commitment Request. A possible sequence of interactions between the Storage AE and an Image Manager (e.g., a storage or archive device supporting Storage Commitment SOP Classes as an SCP) is illustrated in the steps 7 to 9 in the sequence diagram in Figure 4.2-2:

7. The Image Manager opens a new association with the STORAGE AE.
8. The Image Manager sends an N-EVENT-REPORT request notifying the STORAGE AE of the status of a previous Storage Commitment Request. The Storage AE replies with an N-EVENT-REPORT response confirming receipt.
9. The Image Manager closes the association with the STORAGE AE.

The STORAGE AE may reject association attempts as shown in Table 4.2-21. The Result, Source and Reason/Diag columns represent the values returned in the appropriate fields of an ASSOCIATE-RJ PDU.

Table 4.2-21: Association rejection reasons.

Result	Source	Reason/Diag	Explanation
2 – rejected-transient	3 – DICOM UL service-provider (Presentation related function)	2 – local-limit-exceeded	The (configurable) maximum number of simultaneous associations has been reached. An association request with the same parameters may succeed later.
		1 – temporary-congestion	No associations can be accepted at this time due to the real-time requirements of higher priority activities (e.g., during image acquisition no associations will be accepted) for because insufficient resources are available (e.g., memory, processes, threads). An association request with the same parameters may succeed at a later time.
1 – rejected-permanent	1 – DICOM UL service-user	2 – application-context-name-not-supported	The association request contained an unsupported Application Context Name. An association request with the same parameters will not succeed later.
		7 – called-AE-title-not-recognized	The association request contained an unrecognized Called AE Title. An association request with the same parameters will not succeed later unless configuration changes are made. This rejection reason normally occurs when the association initiator is incorrectly configured and attempts to address the association acceptor using the wrong AE Title
		3 – calling-AE-title-not-recognized	The association request contained an unrecognized Calling AE Title. An association request with the same parameters will not succeed at a later time unless configuration changes are made. This rejection reason normally occurs when the association acceptor has not been configured to recognize the AE Title of the association initiator.

	2 – DICOM UL service-provider (ASCE related function)	1 – no-reason-given	The association request could not be parsed. An association request with the same format will not succeed at a later time.
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4.2.2.4.1.2 Accepted Presentation Contexts

The STORAGE AE will accept the Presentation Contexts shown in Table 4.2-22.

Table 4.2-22: Acceptable presentation contexts for activity Send Images - Receive Storage Commitment Response

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Storage Commitment Push Model	1.2.840.10008.1.2.0.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

If offered a choice of Transfer Syntaxes in a Presentation Context, STORAGE AE will apply the first encountered Transfer Syntax in the priority order indicated in Table 4.2-8.

4.2.2.4.1.3 SOP Specific Conformance for Verification SOP Class

The STORAGE AE provides standard conformance to the Verification SOP Class as an SCP (See Presentation Context Acceptance Criterion in Section 4.2.1.4.1.3.1).

4.2.2.4.1.4 SOP Specific Conformance for Storage Commitment SOP Class

4.2.2.4.1.4.1 Storage Commitment Notifications (N-EVENT-REPORT)

Upon receipt of an N-EVENT-REPORT the timer associated with the Transaction UID will be canceled.

The behavior of STORAGE AE when receiving Event Types within the N-EVENT-REPORT is summarized in Table 4.2-19, and the reasons for returning specific status codes in an N-EVENT-REPORT response are summarized in Table 4.2-20.

4.2.3 WORKFLOW Application Entity Specification

4.2.3.1 SOP Classes

MIRAQ-DCM provides Standard Conformance to the SOP Classes in Table 4.2-23.

Table 4.2-23: SOP classes for WORKFLOW AE

SOP Class Name	SOP Class UID	SCU	SCP
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	No

4.2.3.2 Association Policies

4.2.3.2.1 General

The WORKFLOW AE SCU is activated through the user interface when a user performs a worklist search. The DICOM standard application context name for DICOM 3.0 is always proposed (Table 4.2-24).

Table 4.2-24: DICOM application context for WORKFLOW AE

Application Context Name:	1.2.840.10008.3.1.1.1
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4.2.3.2.2 Number of Associations

MIRAQ-DCM initiates one Association at a time for each Worklist request.

Table 4.2-25: Number of Simultaneous Associations for WORKFLOW AE

Maximum number of simultaneous Associations:	1
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4.2.3.2.3 Asynchronous Nature

The WORKFLOW AE does not support asynchronous communication (multiple outstanding transactions over a single Association).

Table 4.2-26: Asynchronous nature as SCU for WORKFLOW AE

Maximum number of outstanding asynchronous transactions:	1
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4.2.3.2.4 Implementation Identifying Information

The implementation information for this Application Entity is defined in Table 4.2-27.

Table 4.2-27: DICOM implementation class and version for WORKFLOW AE

Implementation Class UID:	1.2.840.114236.0.900.100
Implementation Version Name:	CPS_10.7

Note that the STORAGE AE, WORKFLOW AE and ECHO AE use the same Implementation Class UID.

4.2.3.3 Association Initiation Policy

WORKFLOW AE attempts to initiate a new association for each series of instances it attempts to transfer.

4.2.3.3.1 Activity: Update Worklist

4.2.3.3.1.1 Description and Sequencing of Activities

The request for a Worklist Update is initiated by user interaction, i.e., when performing a worklist search with a valid network connection.

Upon initiation of the request, the MIRAQ-DCM will build an Identifier for the C-FIND request, initiate an Association to send the request and wait for Worklist responses. After retrieval of all responses, MIRAQ-DCM will access the local database to add or update patient demographic data. To protect the system from overflow, the MIRAQ-DCM will limit the number of processed worklist responses to a configurable maximum. During receiving the worklist response items are counted and the query processing is canceled by issuing a C-FIND-CANCEL if the configurable limit of items is reached.

MIRAQ-DCM will initiate an Association in order to issue a C-FIND request according to the Modality Worklist Information Model.

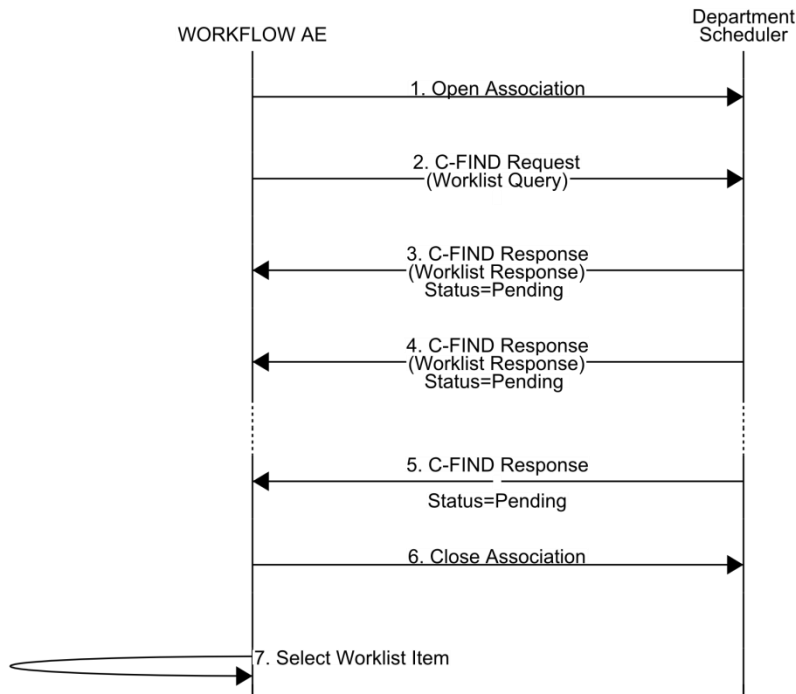


Figure 4.2-3: Sequencing of Activity - Update Worklist.

A possible sequence of interactions between the WORKFLOW AE and a Departmental Scheduler (e.g., a device such as a RIS or HIS which supports the Modality Worklist SOP Class as an SCP) is illustrated in Figure 4.2-3:

1. The Workflow AE opens an association with the Departmental Scheduler.
2. The Workflow AE sends a C-FIND request to the Departmental Scheduler containing the Worklist Query attributes.
3. The Departmental Scheduler returns a C-FIND response containing the requested attributes of the first matching Worklist Item.
4. The Departmental Scheduler returns another C-FIND response containing the requested attributes of the second matching Worklist Item.
5. The Departmental Scheduler returns another C-FIND response with status Success indicating that no further matching Worklist Items exist. This example assumes that only 2 Worklist items match the Worklist Query.
6. The Workflow AE closes the association with the Departmental Scheduler.
7. The user selects a Worklist Item from the Worklist and prepares to acquire new images.

4.2.3.3.1.2 Proposed Presentation Contexts

MIRAQ-DCM can propose the Presentation Contexts shown in Table 4.2-28.

Table 4.2-28: Proposed presentation contexts for activity Update Worklist

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

4.2.3.3.1.3 SOP Specific Conformance for Modality Worklist

The behavior of MIRAQ-DCM when encountering status codes in a Modality Worklist C-FIND response is summarized in Table 4.2-29. If any other SCP response status than "Success" or "Pending" is received by MIRAQ-DCM, a message "query failed" will appear on the user interface.

Table 4.2-29: Modality Worklist C-FIND response status handling behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has completed the matches. Worklist items are available for display or further processing.
Refused	Out of Resources	A700	The Association is aborted using A-ABORT and the worklist query is considered as failed. The status meaning is logged and is accessible to the user from a message box. Any additional error information in the Response will be logged.
Failed	Identifier does not match SOP Class	A900	The Association is aborted using A-ABORT and the worklist query is considered as failed. The status meaning is logged and reported to the user as a message box. Any additional error information in the Response will be logged.
	Unable to Process	Cxxx	The Association is aborted using A-ABORT and the worklist query is considered as failed. The status meaning is logged and is accessible to the user from a message box. Any additional error information in the Response will be logged.
Cancel	Matching terminated due to Cancel request	FE00	If the query was cancelled due to too many worklist items, then the SCP has completed the matches. Worklist items are available for display or further processing. Otherwise, the Association is aborted using A-ABORT and the worklist query is marked as failed. In this case, the status meaning is logged and is accessible to the user from a message box.
Pending	Matches are continuing	FF00	The worklist item contained in the Identifier is collected for later display or further processing.
	Matches are continuing – Warning that one or more Optional Keys was not supported	FF01	The worklist item contained in the Identifier is collected for later display or further processing. The status meaning is logged only once for each C-FIND operation.
*	*	Any other status code	The Association is aborted using A-ABORT and the worklist query is considered as failed. The status meaning is logged and is accessible to the user from a message box. Any additional error information in the Response will be logged.

The behavior of WORKFLOW AE during communication failure is summarized in Table 4.2-17.

Table 4.2-30: Modality Worklist communication failure behavior

Exception	Behavior
Timeout	The Association is aborted using A-ABORT and the worklist query marked as failed. The reason is logged is accessible to the user from a message box.

Association aborted by the SCP or network layers	The worklist query is marked as failed. The reason is logged and is accessible to the user from a message box.
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Acquired images will always use the Study Instance UID specified for the Scheduled Procedure Step (if available). If an acquisition is unscheduled, a Study Instance UID will be generated locally.

Table 4.2-31 provides a description of the MIRAQ-DCM Worklist Request Identifier and specifies the attributes that are copied into the images. Unexpected attributes returned in a C-FIND response are ignored.

Requested return attributes not supported by the SCP are set to have no value. Non-matching responses returned by the SCP due to unsupported optional matching keys are ignored. No attempt is made to filter out possible duplicate entries.

Table 4.2-31: Worklist request identifier

Module Name / Attribute Name	Tag	VR	Matching Key	Return Key	Displayed Key	IOD	Notes
SOP Common							
Specific Character Set	(0008,0005)	CS		X			See Chapter 6 for support of character sets.
Timezone Offset	(0008,0201)	SH		X			
Scheduled Procedure Step							
Scheduled Procedure Step Sequence	(0040,0100)	SQ		X			The Scheduled Procedure Step Sequence contains only a single Item.
➤ Scheduled Station AE Title	(0040,0001)	AE	X	X			Single Value Matching
➤ Scheduled Procedure Step Start Date	(0040,0002)	DA	X	X	X		Single Value or Range Matching.
➤ Scheduled Procedure Step Start Time	(0040,0003)	TM		X	X		
➤ Scheduled Procedure Step Start Date and Time	(0040,4005)	DT		X	X		
➤ Modality	(0008,0060)	CS	X	X			Single Value Matching: Modality = "US"
➤ Scheduled Performing Physician's Name	(0040,0006)	PN		X	X	X	Copied to Performing Physician's Name (0008,1050)
➤ Scheduled Procedure Step Description	(0040,0007)	LO		X	X		
➤ Scheduled Procedure Step ID	(0040,0009)	SH		X	X		
➤ Scheduled Station Name	(0040,0010)	SH		X			
Requested Procedure							
Requested Procedure ID	(0040,1001)	SH		X	X	X	Copied to Study ID (0020,0010)
Requested Procedure Description	(0032,1060)	LO		X	X	X	Copied to Study Description (0008,1030)
Study Instance UID	(0020,000D)	UI		X		X	
Imaging Service Request							
Accession Number	(0008,0050)	SH		X		X	
Referring Physician's Name	(0008,0090)	PN		X		X	
Patient Identification							
Patient Name	(0010,0010)	PN		X	X	X	
Patient ID	(0010,0020)	LO		X	X	X	
Patient Demographic							

Patient's Birth Date	(0010,0030)	DA		X	X	X	
Patient's Sex	(0010,0040)	CS		X	X	X	
Patient's Size	(0010,1020)	DS		X	X	X	
Patient's Weight	(0010,1030)	DS		X	X	X	

The above table should be read as follows:

Module Name:	The name of the associated module for supported worklist attributes.
Attribute Name:	Attributes supported to build a MIRAQ-DCM Worklist Request Identifier.
Tag:	DICOM tag for this attribute.
VR:	DICOM VR for this attribute.
Matching keys:	Matching keys for (automatic) Worklist Update. An "X" will indicate that MIRAQ-DCM will supply an attribute value for matching.
Return keys:	An "X" will indicate that MIRAQ-DCM will supply this attribute as Return Key with zero length for Universal Matching. The MIRAQ-DCM will support retired date format (yyyy.mm.dd) for "Patient's Birth Date" and "Scheduled Procedure Step Start Date" in the response identifiers. For "Scheduled Procedure Step Start Time" also retired time format is supported.
Displayed keys:	Displayed keys. An "X" indicates that this worklist attribute is displayed to the user, either in the case information dialog or as part of the patient registration view.
IOD:	An "X" indicates that this Worklist attribute is included into all Object Instances created during performance of the related Procedure Step.

4.2.3.4 Association Acceptance Policy

The WORKFLOW Application Entity does not accept Associations.

4.3 NETWORK INTERFACES

4.3.1 Physical Network Interface

MIRAQ-DCM supports a single network interface for DICOM communication, supporting three different transfer rates for Ethernet communication.

Table 4.3-1: Supported physical network interfaces

Network Standard	Transmission Speed
Ethernet 10BASE-T	10 Mbit/s
Ethernet 100BASE-TX	100 Mbit/s
Ethernet 1000BASE-T	1000 Mbit/s (1 Gbit/s)

4.3.2 Additional Protocols

4.3.2.1 DHCP

The MIRAQ-DCM may be configured (from the MiraQ Network Settings screen) to obtain TCP/IP network configuration information from the network using DHCP. If DHCP is enabled, MIRAQ-DCM will request configuration data from the DHCP server configured for the network, allowing auto-configuration of the IP address, subnet masking, default gateway and the DNS server. The machine name can be configured from the Network Settings.

If DHCP is not in use, TCP/IP network configuration information may be manually configured from the Network Settings screen. I

4.3.2.2 DNS

DNS can be used for address resolution. If DHCP is not in use or the DHCP server does not return any DNS server addresses, the identity of a DNS server can be configured from the Network Settings screen.

If a DNS server is not in use, local mapping between hostname and IP address may be manually configured from the Network Settings screen.

4.3.3 IPv4 and IPv6 Support

MIRAQ-DCM supports both IPv4 and IPv6. However, IPv6 will only be supported using Dynamic Host Configuration Protocol (DHCP), and does not utilize the optional configuration identification or security features of IPv6.

4.3.4 AE Title/Presentation Address Mapping

The AE Title and port of the MIRAQ-DCM machine, and Remote AE Titles are configurable by the user from the Network Settings screen. The IP address and port are picked by the site and may be changed via the MiraQ Network Settings.

4.3.5 Parameters

MIRAQ-DCM configuration parameters related to DICOM communications are found in Table 4.3-2. A blank cell in the "Default value" column indicates that there is no default value for the specific configuration attribute.

Table 4.3-2: Configuration parameters table

Parameter	Configurable	Default value
System Parameters		
AE Title	Yes	MIRAQ
DHCP	Yes	Yes
IP Address	Yes*	127.0.0.1
Network Mask	Yes*	255.0.0.0
DNS Server Address	Yes*	0.0.0.0
Storage Commitment Port	Yes	1083
General DICOM Server Parameters		
Remote AE Title	Yes	
Server Name	Yes	
Remote IP Address or Host Name	Yes	localhost
Responding TCP/IP Port	Yes	104
Connection Time-out	Yes	60 seconds
Maximum PDU size the AE can receive	Yes	65536 bytes
Maximum PDU size the AE can send	No	The lower of the above and the max PDU size specified by the Remote AE in the Association Request.
Retry Count	Yes	3
Storage Server Parameters		
Compression	Yes	
Maximum FPS	Yes	1000
Send Private Tags	Yes	No

Storage Commitment	Yes	No
Storage Commitment Timeout	Yes	60 seconds

* Configurable if DHCP is disabled

5 Media Interchange

MIRAQ-DCM does not support media interchange. (All data exports to USB Connected Removable Devices are done using proprietary file formats.)

6 Support of Character Sets

MIRAQ-DCM uses Unicode UTF-8 (ISO_IR 192) as default character set for STORAGE AE. This default behavior may be overridden¹ to use a specific character set or the character set determined by the configured ANSI code page for the MiraQ device (see Table 6.1-2).

WORKFLOW AE utilizes the value of Specific Character Set Attribute from the received worklist to interpret text from DICOM worklists. Any character set in Table 6.1-2 is accepted. If the attribute is missing or empty, the texts will be interpreted as ISO_IR 100 (Latin Alphabet No. 1). This default behavior may be overridden² to ignore the Specific Character Set Attribute and enforce text interpretation using a specific character set or the character set determined by the configured ANSI code page for the MiraQ device (see Table 6.1-2).

Table 6.1-1: Default Character Set for STORAGE AE

Character Set Description	Defined Term
Unicode (UTF-8)	ISO_IR 192

Table 6.1-2: Other Supported Character Sets (depending on configuration)

Locale (code page)	Character Set Description	Defined Term
874/1054	Thai	ISO_IR 166
932	Japanese Katakana	ISO_IR 13
936	Chinese (PRC)	GB18030
949	Korean	ISO_IR 149
1250	Latin Alphabet No. 2 Central Europe languages: Albanian, Croatian, Czech, Hungarian, Polish, Romanian, Serbian (Latin), Slovak, Slovenian (1250)	ISO_IR 101
1251	Cyrillic languages Azeri, Belarusian, Bulgarian, FYRO Macedonian, Kazakh, Kyrgyz, Mongolian, Russian, Serbian, Tatar, Ukrainian, Uzbek	ISO_IR 144
1252	Latin Alphabet No. 1 Afrikaans, Basque, Catalan, Danish, Dutch, English, Faroese, Finnish, French, Galician, German, Icelandic, Indonesian, Italian, Malay, Norwegian, Portuguese, Spanish, Swahili, Swedish	ISO_IR 100
1253	Greek	ISO_IR 126

¹ Please consult your Medistim contact to configure the device to communicate with servers not supporting ISO_IR 192.

² Please consult your Medistim contact to configure the device to override the character set used for interpreting text from worklists with missing or incorrect Specific Character Set Attribute.

1254	Latin Alphabet No. 5 Azeri (Latin), Turkish, Uzbek (Latin)	ISO_IR 148
1257	Latin Alphabet No. 4 Estonian, Latvian, Lithuanian	ISO_IR 110
Other	Basic character set	ISO_IR 6

7 Security

To minimize virus and hacking vulnerabilities, MIRAQ-DCM is configured with a minimal set of open ports and with network services not actively used by the system turned off.

It is assumed that MIRAQ-DCM is used within a secured environment. It is assumed that a secured environment includes at a minimum:

- a) Firewall or router protections to ensure that only approved external hosts have network access to MIRAQ-DCM.
- b) Firewall or router protections to ensure that MIRAQ-DCM only has network access to approved external hosts and services.
- c) Any communication with external hosts and services outside the locally secured environment use appropriate secure network channels (e.g., such as a Virtual Private Network (VPN)).

Additional security features may be established by the local security policy and are beyond the scope of this conformance statement.

8 Annexes

8.1 IOD CONTENTS

8.1.1 Created SOP Instances

Examples of images created by MIRAQ-DCM can be downloaded from:

<http://www.medistim.com/dicom>

The following tables use several abbreviations. The abbreviations used in the “Presence of ...” column are:

VNAP	Value Not Always Present (attribute sent zero length if no value is present)
ANAP	Attribute Not Always Present
ALWAYS	Always Present
EMPTY	Attribute is sent without a value

The abbreviations used in the “Source” column:

MWL	the attribute value source Modality Worklist
USER	the attribute value source is from User input
AUTO	the attribute value is generated automatically
CONFIG	the attribute value source is a configurable parameter

8.1.1.1 *Ultrasound Multi-frame Image IOD*

Table 8.1-1: IOD of created Ultrasound Image Multi-frame SOP instances

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8.1-2	ALWAYS
Study	General Study	Table 8.1-3	ALWAYS
	Patient Study	Table 8.1-4	ALWAYS
Series	General Series	Table 8.1-5	ALWAYS
Equipment	General Equipment	Table 8.1-6	ALWAYS
Image	General Image	Table 8.1-7	ALWAYS
	Image Pixel	Table 8.1-8	ALWAYS
	Contrast/bolus	Table 8.1-9	ALWAYS
	US Region Calibration	Table 8.1-12	ALWAYS
	US Image	Table 8.1-13	ALWAYS
	SOP Common	Table 8.1-14	ALWAYS
	Private Application	Table 8.1-15	Only if private tags are enabled

8.1.1.2 Common Modules

Table 8.1-2: Patient Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Name	(0010,0010)	PN	From Modality Worklist or user input. Values supplied via Modality Worklist will be entered as received. Values supplied via user input will contain the given name(s) and family name components (given name may be empty). Middle name, prefix and suffix components may be entered by the user in the "given name" field, using "^"-delimiters. Maximum 64 characters. If no patient name is defined, the system assigns a name of the format "Patient <date> <time>".	ALWAYS	MWL/ USER/ AUTO
Patient ID	(0010,0020)	LO	From Modality Worklist or user input. Maximum 64 characters.	VNAP	MWL/ USER
Patient's Birth Date	(0010,0030)	DA	From Modality Worklist or user input	VNAP	MWL/ USER
Patient's Sex	(0010,0040)	CS	From Modality Worklist or user input	VNAP	MWL/ USER
Patient Comments	(0010,4000)	LT	From User Input. Maximum 1024 characters.	VNAP	USER

Table 8.1-3: General Study Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Study Instance UID	(0020,000D)	UI	From Modality Worklist or generated by device	ALWAYS	MWL/ AUTO
Study Date	(0008,0020)	DA	<yyyymmdd>	ALWAYS	AUTO
Study Time	(0008,0030)	TM	<hhmmss>	ALWAYS	AUTO
Referring Physician's Name	(0008,0090)	PN	From Modality Worklist	VNAP	MWL
Study ID	(0020,0010)	SH	Requested Procedure ID from Modality Worklist	VNAP	MWL
Accession Number	(0008,0050)	SH	From Modality Worklist	VNAP	MWL
Study Description	(0008,1030)	LO	From Modality Worklist (Copied from Requested Procedure Description (0032,1060))	VNAP	MWL

Table 8.1-4: Patient Study Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Size	(0010,1020)	DS	From Modality Worklist or user input ("Height")	VNAP	MWL/ USER
Patient's Weight	(0010,1030)	DS	From Modality Worklist or user input	VNAP	MWL/ USER

Table 8.1-5: General Series Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	US	ALWAYS	AUTO
Series Instance UID	(0020,000E)	UI	Generated by device at creation of the Series	ALWAYS	AUTO
Series Number	(0020,0011)	IS	Generated by device	ALWAYS	AUTO
Laterality	(0020,0060)	CS	Zero length	EMPTY	AUTO
Series Date	(0008,0021)	DA	<yyyymmdd>	ALWAYS	AUTO
Series Time	(0008,0031)	TM	<hhmmss>	ALWAYS	AUTO
Performing Physician's Name	(0008,1050)	PN	From worklist or entered by user ("Surgeon" field). Maximum 64 characters.	VNAP	MWL/ USER

Table 8.1-6: General Equipment Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Manufacturer	(0008,0070)	LO	Medstim	ALWAYS	AUTO
Institution Name	(0008,0080)	LO	From Configuration (Hospital name field)	VNAP	CONFIG
Institution Address	(0008,0081)	ST	From Configuration (Hospital address field)	VNAP	CONFIG
Station Name	(0008,1010)	SH	From Configuration (local AE Title)	ALWAYS	CONFIG
Manufacturer's Model Name	(0008,1090)	LO	MiraQ	ALWAYS	AUTO
Device Serial Number	(0018,1000)	LO	From Configuration	ALWAYS	CONFIG
Software Version	(0018,1020)	LO	From Configuration (MiraQ SW version)	ALWAYS	CONFIG

Table 8.1-7: General Image Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Instance Number	(0020,0013)	IS	Generated by device. Set to 1 for the first saved measurement set in a new study, and thereafter increased it with 1 on each new saved measurement set.	ALWAYS	AUTO
Patient Orientation	(0020,0020)	CS	Zero length	EMPTY	AUTO
Content Date	(0008,0023)	DA	<yyyymmdd>	ALWAYS	AUTO
Content Time	(0008,0033)	TM	<hhmmss>	ALWAYS	AUTO
Image Comments	(0020,4000)	LT	From user input. Maximum 1024 characters.	VNAP	USER

Table 8.1-8: Image Pixel Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Samples per Pixel	(0028,0002)	US	Set to 3	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	Set to RGB	ALWAYS	AUTO
Rows	(0028,0010)	US	Set to height of rendered area	ALWAYS	AUTO
Columns	(0028,0011)	US	Set to width of rendered area	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	Set to 8	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	Set to 8	ALWAYS	AUTO
High Bit	(0028,0102)	US	Set to 7	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	Set to 0000H (= unsigned integer)	ALWAYS	AUTO
Pixel Data	(7FE0, 0010)	OW or OB		ALWAYS	AUTO
Planar Configuration	(0028,0006)	US	Set to 0 (color-by-pixel)	ALWAYS	AUTO

Table 8.1-9: Contrast/Bolus Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Contrast/Bolus Agent	(0018,0010)	LO	EMPTY	VNAP	AUTO

Table 8.1-10: Cine Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Recommended Display Frame Rate	(0008,2144)	IS	Set to frame rate of the transferred frames.	ALWAYS	AUTO
Cine Rate	(0018,0040)	IS	Set to frame rate of the transferred frames.	ALWAYS	AUTO

Effective Duration	(0018,0072)	DS	Set to Frame Time multiplied with number of transferred frames	ALWAYS	AUTO
Frame Time	(0018,0063)	LO	Set to interframe time (after any resampling on DICOM file generation)	ALWAYS	CONF/ AUTO
Preferred Playback Sequencing	(0018,1244)	US	Set to 0 = Looping	ALWAYS	AUTO

Table 8.1-11: Multi-Frame Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Number of Frames	(0028,0008)	IS	Set to the number of frames	ALWAYS	AUTO
Frame Increment Pointer	(0028,0009)	AT	Set to 00181063 = sequencing by Frame Time (0018,1063)	ALWAYS	AUTO

Table 8.1-12: US Region Calibration Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Sequence of Ultrasound Regions	(0018,6011)	SQ	Set to a sequence that includes all data regions in the image, including trace data regions.	ALWAYS	AUTO
► Region Location Min x_0	(0018,6018)	UL	Set to x_0 -value of the bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1	ALWAYS	AUTO
► Region Location Min y_0	(0018,601A)	UL	Set to y_0 -value of the bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1	ALWAYS	AUTO
► Region Location Max x_1	(0018,601C)	UL	Set to x_1 -value of the bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1	ALWAYS	AUTO
► Region Location Max y_1	(0018,601E)	UL	Set to y_1 -value of the bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1	ALWAYS	AUTO
► Physical Units X Direction	(0018,6024)	US	Set to one of the following, dependent on the region: 0000H: None or not applicable 0003H: cm 0004H: seconds 0005H : hertz(seconds-1)	ALWAYS	AUTO
► Physical Units Y Direction	(0018,6026)	US	Set to one of the following, dependent on the region: 0000H: None or not applicable 0001H: Percent 0002H: dB 0003H: cm 0005H : hertz(seconds-1) 0007H: cm/sec	ALWAYS	AUTO

➤ Physical Delta X	(0018,6028)	FD	Set to the physical value increments per positive X pixel increment	VNAP	AUTO
➤ Physical Delta Y	(0018,602A)	FD	Set to the physical value increments per positive Y pixel increment	VNAP	AUTO
➤ Reference Pixel x_0	(0018,6020)	SL	Set to the relative x-offset of the region's reference point from the Region Location Min x_0 (0018,6018)	VNAP	AUTO
➤ Reference Pixel y_0	(0018,6020)	SL	Set to the relative y-offset of the region's reference point from the Region Location Min y_0 (0018,601A)	VNAP	AUTO
➤ Ref. Pixel Physical Value X	(0018,6028)	FD	Set to the Physical Value at the reference pixel x location	VNAP	AUTO
➤ Ref. Pixel Physical Value Y	(0018,602A)	FD	Set to the Physical Value at the reference pixel x location	VNAP	AUTO
➤ Region Spatial Format	(0018,6012)	US	Set to the Enumerated Value that corresponds to the spatial organization within the region: 0000H: None or not applicable 0001H: 2D (B-mode or Color flow) 0002H: M-mode (Not used) 0003H: Spectral (PW Doppler) 0004H: Wave forms (e.g., ECG, flow, and pressure traces)	ALWAYS	AUTO
➤ Region Data Type	(0018,6014)	US	Set to the Enumerated Value that corresponds to the type of data in the region: 0000H: None or not applicable 0001H: Tissue (B-mode image) 0002H: Color Flow 0003H: PW Spectral Doppler 000AH: ECG Trace 0012H: Other Physiological (Amplitude vs. Time) input (e.g., flow and pressure traces)	ALWAYS	AUTO
➤ Region Flags	(0018,6016)	UL	Set to Enumerated Values according to the characteristics of the region. Bit 0 (Isb, Region Priority) is set to one of the following: 1 = Region pixels are low priority 0 = Region pixels are high priority Bit 1 (Scaling Protection) is always set to 1 = Protected. Bit 2-31 are set to zero	ALWAYS	AUTO

Table 8.1-13: US Image Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Samples per Pixel	(0028,0002)	US	Set to 3	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	Set to RGB	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	Set to 8	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	Set to 8	ALWAYS	AUTO
High Bit	(0028,0102)	US	Set to 7	ALWAYS	AUTO
Planar Configuration	(0028,0006)	US	Set to 0 (color-by-pixel)	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	Set to 0000H (= unsigned integer)	ALWAYS	AUTO
Frame Increment Pointer	(0028,0009)	AT	Set to 00181063 (= sequencing by Frame Time (0018,1063))	ALWAYS	AUTO
Image Type	(0008,0008)	CS	Value 1 is set to ORIGINAL Value 2 is set to SECONDARY Value 3 is set to INTRA-OPERATIVE	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	CS	Set to 00 (Image has NOT been subjected to lossy compression) or 01 (Image has been subjected to lossy compression).	ALWAYS	USER

Table 8.1-14: SOP Common Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	UI	1.2.840.10008.5.1.4.1.1.3.1	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	UI	Generated by Device	ALWAYS	AUTO
Specific Character Set	(0008,0005)	CS	Set to one of the supported character sets (Chapter 6), dependent on the locale settings	ALWAYS	CONF

Table 8.1-15: Private Application Module of created SOP instances

Attribute Name	Tag	VR	Value	Presence of Value	Source
Private Creator	(7FE1,0010)	LO	Set to "MEDISTIM_MEASUREMENTSET"	ANAP	AUTO
Medistim Measurement Set ID	(7FE1,1000)	LO	Medistim measurement set ID (e.g. "3530040a-5075-47a3-b44d-768c94bb88a9")	ANAP	AUTO
Medistim Measurement Set Data	(7FE1,1010)	OB	Medistim measurement set data	ANAP	AUTO
Medistim Private Sequence	(7FE1,1020)	SQ	Sequence of Medistim measurements	ANAP	AUTO

▶ Private Creator	(7FE1,0020)	LO	Set to "MEDISTIM_MEASUREMENT"	ANAP	AUTO
▶ Medistim Measurement ID	(7FE1,2000)	LO	Medistim measurement ID (e.g., "0cf1c3c4-8003-4d80-99bd-7650a4f2ab8a")	ANAP	AUTO
▶ Medistim Measurement Data	(7FE1,2010)	OB	Medistim measurement data	ANAP	AUTO

8.1.2 Used Fields in Received IOD by Application

The MIRAQ-DCM storage application does not receive any SOP Instances. The usage of attributes received via Modality Worklist is described in section 4.2.3.3.1.3.

8.1.3 Attribute Mapping

The relationships between attributes received via Modality Worklist and stored in acquired images are summarized in Table 8.1-16.

Table 8.1-16: Attribute mapping between Modality Worklist and stored image.

Modality Worklist	Image IOD	Editable
Patient's Name	Patient's Name	Yes
Patient ID	Patient ID	Yes
Patient's Birth Date	Patient's Birth Date	Yes
Patient's Sex	Patient's Sex	Yes
Patient's Size	Patient's Size	Yes
Patient's Weight	Patient's Weight	Yes
Study Instance UID	Study Instance UID	No
Referring Physician's Name	Referring Physician's Name	No
Requested Procedure ID	Study ID	No
Accession Number	Accession Number	No
Requested Procedure Description	Study Description	No
Scheduled Performing Physician's Name	Performing Physician's Name	Yes

8.1.4 Coerced/Modified Fields

The WORKFLOW AE will truncate attribute values received in the response to a Modality Worklist Query if the value length is longer than the maximum length permitted by the attribute's VR.

The user is not allowed to change the patient identifier received from the Modality Worklist query when the "Protect imported patient ID" option has been activated for the server in the System Settings.

8.2 DATA DICTIONARY OF PRIVATE ATTRIBUTES

The MIRAQ-DCM may be configured to send ultrasound raw data information in private data elements designated by the Private Creator element in Table 8.2-1. Further details on usage of these private attributes are contained in Section 8.1.

Table 8.2-1: Private Data Elements

Tag	Attribute Name	VR	VM
(7FE1,0010)	Private Creator	LO	1
(7FE1,1000)	Medistim Measurement Set ID	LO	1

(7FE1,1010)	Medistim Measurement Set Data	OB	1
(7FE1,1020)	Medistim Private Sequence	SQ	1
(7FE1,0020)	Private Creator	LO	1
(7FE1,2000)	Medistim Measurement ID	LO	1
(7FE1,2010)	Medistim Measurement Data	OB	1

8.3 CODED TERMINOLOGY AND TEMPLATES

MIRAQ-DCM is not using any Codes (SNOMED) or Controlled Terminology,

8.4 GRAYSCALE IMAGE CONSISTENCY

MIRAQ-DCM does not support the Grayscale Standard Display Function.

8.5 STANDARD EXTENDED/SPECIALIZED/PRIVATE SOP CLASSES

No Specialized or Private SOP Classes are supported.

8.5.1 Ultrasound Image Storage SOP Class

The Ultrasound Image Storage SOP Class is extended to create a Standard Extended SOP Class by addition of standard and private attributes to the created SOP Instances as documented in Section 8.1.

8.6 PRIVATE TRANSFER SYNTAXES

No Private Transfer Syntaxes is supported.