Technical Publications

Direction DOC2290740
Revision 2

Mac-Lab/CardioLab 7.0
DICOM CONFORMANCE STATEMENT

REVISION HISTORY

REV	DATE	REASON FOR CHANGE
1	October 29, 2019	Document created for software version 7.0 (AltiX). This version includes support for Secure Transport Connction Profiles.
2	November 8, 2019	Updated logo on title page.

CONFORMANCE STATEMENT OVERVIEW

The Mac-Lab/CardioLab system is a combined Hemodynamic and Electrophysiology (EP) recording and review system designed for the Cardiac Catheterization and EP labs. Using DICOM to interoperate with other system over a network allows the Mac-Lab/CardioLab system to do the following:

- Start a new study using patient demographics information from a worklist provider.
- Start a new study using scheduled procedure information (including both patient demographics and study data) from a worklist provider.
- Notify the worklist provider when a study has either started or completed.
- Notify the x-ray angiography modality that a study has just started.
- Share a worklist for the study currently in progress with an x-ray angiography modality or ultrasound modality, allowing these other modalities to be used during the same procedure without having to re-enter patient demographics and study data.
- Receive and store study data (such as x-ray dosage) from an x-ray angiography modality.

This document describes in detail how the Mac-Lab/CardioLab system uses the DICOM standards to provide this functionality.

Table 0.1 provides an overview of the network services supported by Mac-Lab/CardioLab.

Table 0.1 – NETWORK SERVICES

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Workflow Management		
Modality Performed Procedure Step SOP Class	Yes	Yes
Modality Performed Procedure Step Notification SOP Class	No	Yes
Modality Worklist Information Model – FIND SOP Class	Yes	Yes

Mac-Lab/CardioLab does not provide any Media Storage Application Profiles.

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1. INTRODUCTION

1.1 OVERVIEW

This DICOM Conformance Statement is divided into Sections as described below:

Section 1: Introduction, which describes the overall structure, intent, and references for this Conformance Statement.

Section 2: Network Conformance Statement, which specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Networking features.

Section 3: Modality Worklist Implementation (SCU), which specifies the GEHC equipment compliance to DICOM requirements for the implementation of the Modality Worklist service as an SCU.

Section 4: Modality Performed Procedure Step Implementation (SCU), which specifies the GEHC equipment compliance to DICOM requirements for the implementation of the Modality Performed Procedure Step service as an SCU.

Section 5: Modality Worklist Implementation (SCP), which specifies the GEHC equipment compliance to DICOM requirements for the implementation of the Modality Worklist service as an SCP.

Section 6: Modality Performed Procedure Step Implementation (SCP), which specifies the GEHC equipment compliance to DICOM requirements for the implementation of the Modality Performed Procedure Step service as an SCP.

Section 7: Modality Performed Procedure Step Notification Implementation (SCP), which specifies the GEHC equipment compliance to DICOM requirements for the implementation of the Modality Performed Procedure Step Notification service as an SCP.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEHC DICOM Conformance Statements is shown in the Illustration below.

This document specifies the DICOM implementation. It is entitled:

GEMS DICOM Conformance Statements

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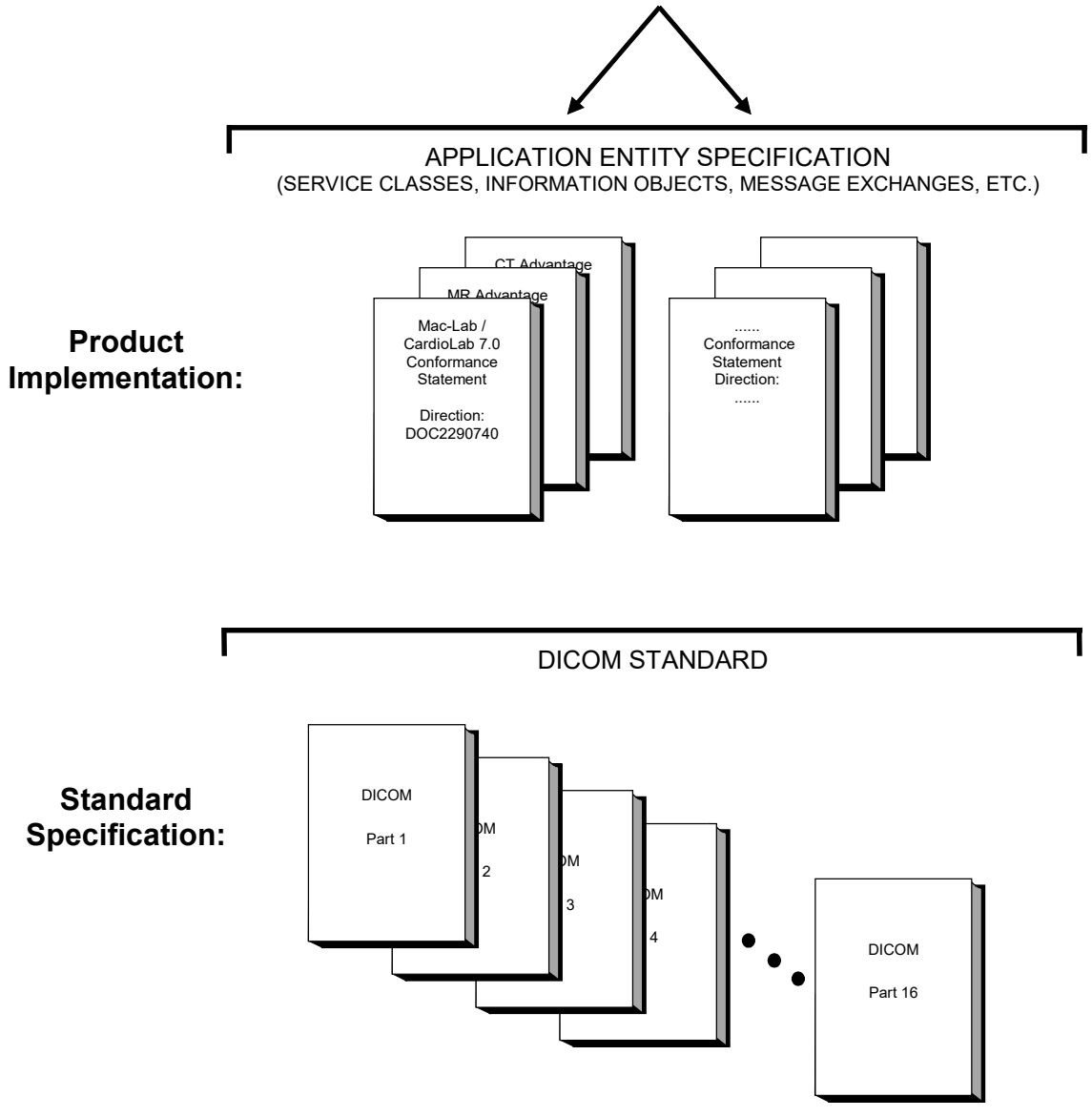
http://www.ge.com/DICOM



Conformance Statement for DICOM
Direction DOC2290740

This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required to interoperate with the GEHC network interface.

The GEHC Conformance Statement, contained in this document, also specifies the Lower Layer communications which it supports (e.g., TCP/IP). However, the Technical Specifications are defined in the DICOM Part 8 standard.

For more information regarding DICOM, copies of the Standard may be obtained on the Internet at http://medical.nema.org. Comments on the Standard may be addressed to:

DICOM Secretariat
NEMA
1300 N. 17th Street, Suite 1752
Rosslyn, VA 22209
USA
Phone: +1.703.841.3200

1.3 INTENDED AUDIENCE

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM Standard and with the terminology and concepts which are used in that Standard.

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document to provide an unambiguous specification for GEHC implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GEHC medical data exchanged using DICOM. The GEHC Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEHC devices are capable of using different Information Object Definitions. For example, a GEHC CT Scanner may send images using the CT Information Object, MR Information Object, Secondary Capture Object, etc.

Included in this DICOM Conformance Statement are the Module Definitions which define all data elements used by this GEHC implementation. If the user encounters unspecified private data elements while parsing a GEHC Data Set, the user is well advised to ignore those data elements (per the DICOM standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all of the private data elements which are sent by GEHC devices.

1.5 IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be successful**. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non–GE systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.

- **Validation** - Testing the complete range of possible interactions between any GE device and non–GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non–GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non–GE device and the stability of the image data for the intended applications.

  Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.

- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEHC protocol is based on DICOM as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which have implemented DICOM. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) described by these DICOM Conformance Statements**. The **user** should ensure that any non–GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

- **Interaction** - It is the sole responsibility of the **non–GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

1.6 REFERENCES

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

1.7 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, Computed Radiography 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.

Media Application Profile – the specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)

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 x-ray 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.

1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
AET	Application Entity Title
CA	Certificate Authority
CCW	Centricity Cardio Workflow
CVIS	Cardiovascular Information System
DICOM	Digital Imaging and Communications in Medicine
DMS	Centricity Cardiology Data Management System
EP	Electrophysiology
HIS	Hospital Information System
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition

ISO	International Organization for Standards
MPPS	Modality Performed Procedure Step
MRN	Medical Record Number
MSPS	Modality Scheduled Procedure Step
MWL	Modality Worklist
O	Optional (Key Attribute)
PDU	Protocol Data Unit
R	Required (Key Attribute)
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
SPS	Scheduled Procedure Step
SSL	Secure Sockets Layer
TCP/IP	Transmission Control Protocol/Internet Protocol
TLS	Transport Layer Security
U	Unique (Key Attribute)
US	Ultrasound
VPN	Virtual Private Network
VR	Value Representation
XA	X-ray Angiography

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the Mac-Lab/CardioLab compliance to DICOM requirements for **Networking** features.

The Mac-Lab/CardioLab is a combined Hemodynamic and Electrophysiology (EP) recording and review system designed for the Cardiac Catheterization and EP labs. It is designed to work in conjunction with the following systems:

- X-ray Angiography imaging modality, such as the GE Innova
- Ultrasound imaging modality, such as the GE Vivid *iq*
- Modality Worklist (MWL) / Modality Performed Procedure Step (MPPS) provider, such as the Centricity Cardiology Data Management System (DMS) or the Centricity Cardio Workflow (CCW)

The MWL/MPPS provider is typically a Cardiovascular Information System (CVIS), although this is not a requirement. For simplicity, these systems will be referred to throughout this document as follows:

- X-ray Angiography imaging modality: **X-ray Imaging System**
- Ultrasound imaging modality: **Ultrasound Imaging System**
- MWL / MPPS provider: **Information System**

When referring to both the X-ray Imaging System and the Ultrasound Imaging System together, the combined term “Imaging Systems” will be used.

Using standard DICOM protocols, the Mac-Lab/CardioLab can communicate with each of these systems to share information about a patient or a procedure to be performed. The Mac-Lab/CardioLab can request information about a patient or procedure from the Information System, and in turn can pass that information along to the X-ray Imaging System and Ultrasound Imaging System. The Mac-Lab/CardioLab can provide information about the procedure for which it recorded data to the Information System. The Mac-Lab/CardioLab can also collect information about the procedure that was performed by the X-ray Imaging System. Finally, the Mac-Lab/CardioLab can notify the X-ray Imaging System that the Mac-Lab/CardioLab procedure has started, allowing the X-ray Imaging System to automatically start its own exam.

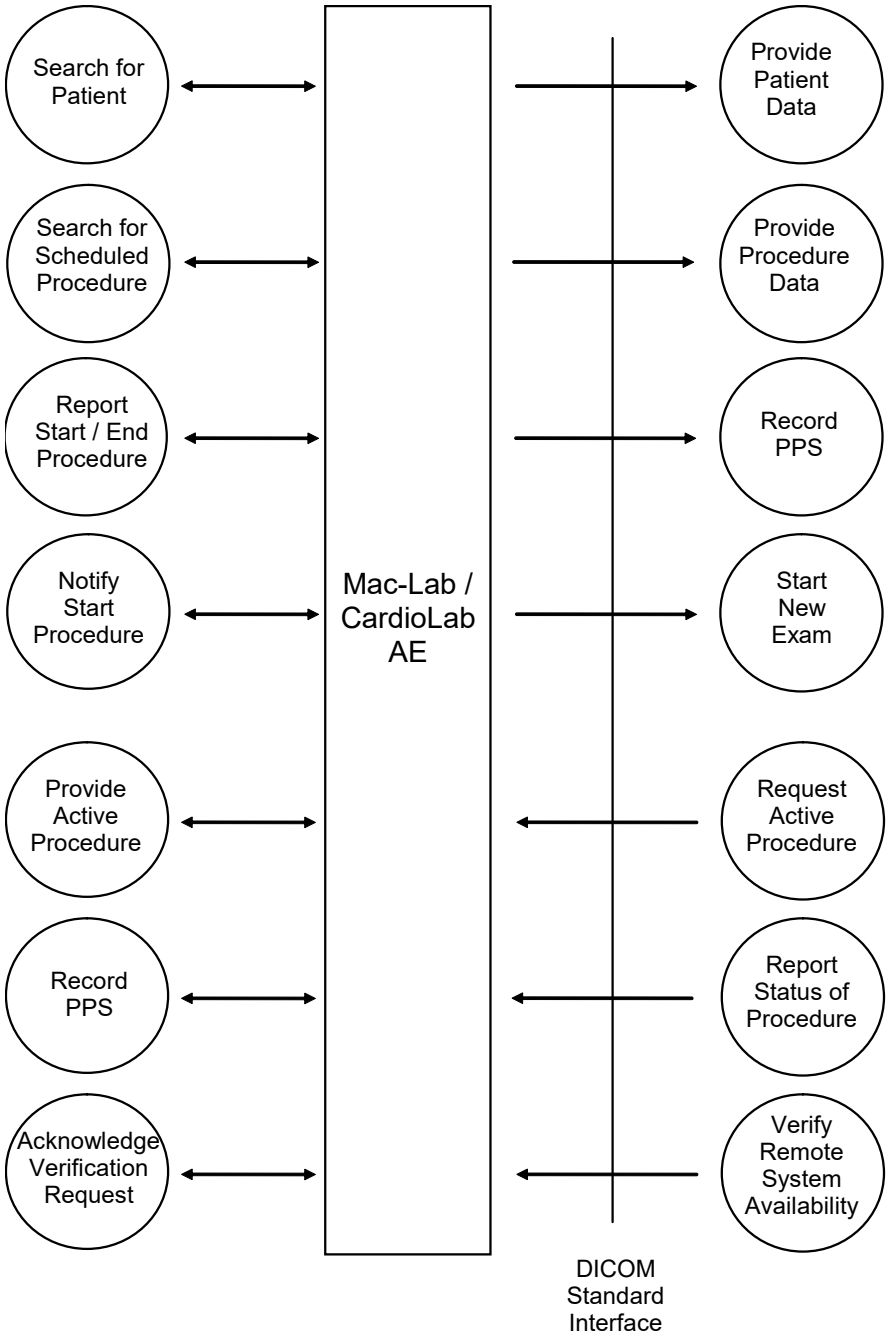
Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section.

2.2 IMPLEMENTATION MODEL

2.2.1 Application Data Flow Diagram

The network application model for the Mac-Lab/CardioLab is shown in the following Illustration. Note that there is a single Application Entity to communicate with both the Imaging Systems and the Information System.

ILLUSTRATION 2–1
MAC-LAB/CARDIOLAB NETWORK APPLICATION MODEL AND DATA FLOW DIAGRAM



The Mac-Lab/CardioLab operator may either Search for Patient or Search for Scheduled Procedure on the Information System. The Information System provides the requested information, which is then used to start a new study on the Mac-Lab/CardioLab system.

When the data recording starts or ends for a given study, the Mac-Lab/CardioLab will Report Start/End Procedure status to the Information System. This information could be used by the Information System to track the status of the procedure on a scheduling system, for example.

The X-ray Imaging System or Ultrasound Imaging System may Request Active Procedure information from the Mac-Lab/CardioLab system. The Active Procedure information contains the patient demographics and study attributes (including the Study Instance UID) for the study that is currently open on the Mac-Lab/CardioLab system. This data can be used by either Imaging System to start its own data acquisition using the same data that is in use on the Mac-Lab/CardioLab system, so that the Imaging System operator does not need to retype patient demographics. This also allows the acquired images to be tied to the Hemodynamic or EP recording (using the Study Instance UID) for the same patient.

For an X-ray Imaging System that supports the feature, Mac-Lab/CardioLab can optionally send a Notify Start Procedure message to the X-ray Imaging System. The X-ray Imaging System can use this notification to automatically start a new exam. When coupled with the X-ray Imaging System's ability to Request Active Procedure in response to this notification, the Notify Start Procedure message can allow the X-ray Imaging System to start an exam using the same patient and procedure information from the Mac-Lab/CardioLab, all without any operator intervention on the X-ray Imaging System.

During the procedure, the X-ray Imaging System can Report Status of Procedure to the Mac-Lab/CardioLab system. This allows the Mac-Lab/CardioLab system to record important information (such as x-ray dosage and details about acquired images) that can in turn be included in reports generated by the Mac-Lab/CardioLab system.

Finally, any remote system can Verify Remote System Availability with the Mac-Lab/CardioLab system to ensure that the Mac-Lab/CardioLab system is running and its DICOM interface is active.

2.2.2 Functional Definition of AE's

The Mac-Lab/CardioLab system is a single Application Entity that provides communication with the Imaging Systems and the Information System.

2.2.3 Sequencing of Real-World Activities

Some sequencing of Real-World Activities is dictated based on the usage outlined in Section 2.2.1. The following constraints are applicable:

- Request Active Procedure from the Imaging System to the Mac-Lab/CardioLab system will return no results if the Mac-Lab/CardioLab system is not currently acquiring data. If the Mac-Lab/CardioLab system is currently acquiring data, the request will return exactly one result with data for the current study, assuming that proper matching criteria are specified in the request.

- Report Status of Procedure from the X-ray Imaging System to the Mac-Lab/CardioLab system will have no effect if the Mac-Lab/CardioLab system is not currently acquiring data. If the Mac-Lab/CardioLab system is currently

acquiring data, the data provided in the request will be recorded in the active study.

- Notify Start Procedure can only happen when the Mac-Lab/CardioLab system is about to start recording for either a new or continued study. The notification is sent as soon as the *Patient Information* dialog is closed for the first time in the study.

Beyond the constraints listed here, only the logical sequencing of operations applies (e.g., Search for Scheduled Procedure should come before Report Start/End Procedure).

2.3 AE SPECIFICATIONS

2.3.1 Mac-Lab/CardioLab AE Specification

The Mac-Lab/CardioLab Application Entity provides Standard Conformance to the following DICOM SOP Classes as an **SCU**:

SOP Class Name	SOP Class UID
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3

This Application Entity provides Standard Conformance to the following DICOM SOP Classes as an **SCP**:

SOP Class Name	SOP Class UID
Verification SOP Class	1.2.840.10008.1.1
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3
Modality Performed Procedure Step Notification	1.2.840.10008.3.1.2.3.5

2.3.1.1 Association Establishment Policies

2.3.1.1.1 General

The DICOM Application Context Name (ACN), which is always proposed, is:

Application Context Name	1.2.840.10008.3.1.1.1

The maximum length PDU receive size for the Mac-Lab/CardioLab is:

Maximum Length PDU	64234 bytes

2.3.1.1.2 Number of Associations

The Mac-Lab/CardioLab will initiate only 1 association at a time to remote nodes.

The Mac-Lab/CardioLab will support only 2 associations at a time initiated by remote nodes (i.e., X-ray Imaging System and Ultrasound Imaging System).

2.3.1.1.3 Asynchronous Nature

Asynchronous mode is not supported. All operations will be performed synchronously.

2.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM Implementation is:

Mac-Lab/CardioLab Implementation UID	1.2.840.113619.6.106.1.1.1

The Implementation Version Name for this DICOM Implementation is:

Mac-Lab/CardioLab Implementation Version Name	GEMS_MLCL_7.0

2.3.1.2 Association Initiation Policy

When the Mac-Lab/CardioLab Application Entity initiates an Association for any Real-World Activity, it will propose the Presentation Contexts for all Real-World Activities; i.e., there is only a single, comprehensive Presentation Context Negotiation proposed for the AE.

The Mac-Lab/CardioLab AE proposes multiple Transfer Syntax values for the Presentation Context; i.e., for each Abstract Syntax in the following Presentation Context Tables, the AE proposes one Presentation Context for each set of Transfer Syntax values.

2.3.1.2.1 Real-World Activity: Search for Patient

2.3.1.2.1.1 Associated Real-World Activity

The local operator may use the “Patient Search” option to request information about patients from the remote host. The operator must select one or more of the following search terms in the request:

- Patient Name (wildcards supported)
- Patient ID (MRN)
- Date of Admission

All responses that are received, up to the configured response limit (default = 150), will be displayed to the operator. This response limit is enforced to prevent the system from being overrun by the results of very broad search requests.

Once all results are received, the operator may select any patient and use the associated information to Start New Study. When this is done, attributes from the response (e.g., Patient Name) are automatically populated into the new study.

The association with the remote host is initiated when the operator starts the search. The association is released as soon as the complete response to the search request has been received or the operator cancels the search request.

2.3.1.2.1.2 Proposed Presentation Context Table

The Mac-Lab/CardioLab will propose the set of Presentation Contexts shown in the following table.

Note that this list includes one or more Abstract Syntax types that will not actually be used for this Real-World Activity. The reason these types are proposed is so that all Real-World Activities can propose the same set of Presentation Contexts.

Presentation Context Table – Proposed for Activity "Search for Patient"					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step Notification	1.2.840.10008.3.1.2.3.5	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

Note that for the Modality Performed Procedure Step Notification SOP Class, the Role Selection Sub-Item will be sent as part of the negotiation for this SOP Class.

2.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for the Modality Worklist Information Model - FIND SOP Class

The Mac-Lab/CardioLab includes matching keys in the Modality Worklist queries as described in Section 3. Note that a Search for Patient request is intended only to retrieve patient information and therefore does not include any Scheduled Procedure fields in the request. These differences are outlined in detail in Section 3.

The operator may choose any combination of search terms, as outlined in Section 2.3.1.2.1.1 above. A summary of the retrieved results is displayed to the operator, who may then choose one result to be used to Start New Study.

For the FIND request message, the Specific Character Set (0008,0005) value in the request message is set according to the current Text Encoding configuration of the Mac-Lab/CardioLab system for the Modality Worklist Host. The same Specific Character Set encoding method is applied to the request message as described in DICOM Standard PS 3.5. In the FIND response message, the Specific Character Set in the message is used to interpret the contents of the response. For more information about the extended character set support in Mac-Lab/CardioLab, refer to Section 2.7.

If the operator cancels the operation before it has completed, a CANCEL request will be sent to the remote host and the association will be closed. This will also be done if the configurable maximum number of responses is received, as noted in Section 2.3.1.2.1.1 above.

The system also provides configurable timeout values, such as the connection and inactivity timeouts. If any of these timeout values is exceeded, the association is closed, and the operator is notified of the failure.

The following are the status codes that are specifically processed when receiving messages from a Modality Worklist SCP:

Service Status	Status Code	Further Meaning	Application Behavior When Receiving Status Code
Failure	A700	Refused: Out of resources	Association is closed and the operator is notified of the failure.
	A900	Error: Identifier does not match SOP Class	Association is closed and the operator is notified of the failure.
	C001	Error: Unable to process	Association is closed and the operator is notified of the failure.
Cancel	FE00	Matching terminated due to cancel	Association is closed.
Success	0000	Matching is complete - No final identifier is supplied	Association is closed. If no results were received, the operator is notified that the search returned no results.
Pending	FF00	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	Response is added to list of responses and processing continues. If the maximum number of allowed responses is received, a C-CANCEL-FIND request is sent and the association is closed.
	FF01	Matches are continuing - Warning that one or more Optional Keys were not supported for existence for this Identifier	Same as above.
*	*	Any other status code.	Association is closed and the operator is notified of the failure.

2.3.1.2.2 Real-World Activity: Search for Scheduled Procedure

2.3.1.2.2.1 Associated Real-World Activity

There are two ways to invoke the Search for Scheduled Procedure activity for the Mac-Lab/CardioLab. Each of these is outlined below. In all cases, the association with the remote host is initiated when the operator starts the search. The association is released as

soon as the complete response to the search request has been received or the operator cancels the search request.

2.3.1.2.2.1.1 Schedule Search: Browse for Scheduled Procedures

The local operator may use the "Schedule Search" option to request information about a scheduled procedure from the remote host. The operator may select any combination of the following search terms in the request:

- Patient Name (wildcards supported)
- Patient ID (MRN)
- Procedure Type (Cath or EP)
- Scheduled Lab (This Lab or Any Lab)
- Scheduled Study Date
- Scheduled Performing Physician
- Order Number

All responses that are received, up to the configured response limit (default = 150), will be displayed to the operator. This response limit is enforced to prevent the system from being overrun by the results of very broad search requests.

Once all results are received, the operator may select any study and use the associated information to Start a New Study. When this is done, attributes from the response (e.g., Patient Name) are automatically populated into the new study.

2.3.1.2.2.1.2 Get Active Patient: Retrieve Single Currently Scheduled Procedure

The local operator may use the "Get Active Patient" option to request information about the procedure that is currently scheduled for the local system. With this interface, the operator does not specify any search criteria. Rather, the request will always be made for the procedure that is currently scheduled for the requesting system, with the expectation that only a single result will be returned.

This retrieval method is intended for use only with an Information System that supports returning exactly one scheduled procedure in response to a general query, such as the Centricity Cardio Workflow. Retrieval of scheduled procedure data from a system that does not support this method should be done using the more flexible "Schedule Search" option described above.

Since "Get Active Patient" makes a request for the single currently scheduled procedure, the response must contain exactly one scheduled procedure. A summary of this result will then be displayed to the operator. The operator may use this retrieved information to Start a New Study. When this is done, attributes from the response (e.g., Patient Name) are automatically populated into the new study.

If the remote system returns no responses or more than one response, the operator is notified. A response containing more than one result is considered a failure that will cause the request to be cancelled.

This same active study request mechanism can be invoked directly from the Centricity Cardio Workflow (CCW) client software that is running on the Mac-Lab/CardioLab system. In this case, the operation is invoked directly from the CCW client, which triggers the Start New Study operation in the Mac-Lab/CardioLab. The request and response are handled in the same way as when the "Get Active Patient" option is used.

2.3.1.2.2.2 Proposed Presentation Context Table

The Mac-Lab/CardioLab will propose the set of Presentation Contexts shown in the following table.

Note that this list includes one or more Abstract Syntax types that will not actually be used for this Real-World Activity. The reason these types are proposed is so that all Real-World Activities can propose the same set of Presentation Contexts.

Presentation Context Table – Proposed for Activity "Search for Scheduled Procedure"					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step Notification	1.2.840.10008.3.1.2.3.5	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

Note that for the Modality Performed Procedure Step Notification SOP Class, the Role Selection Sub-Item will be sent as part of the negotiation for this SOP Class.

2.3.1.2.2.2.1 SOP Specific DICOM Conformance Statement for the Modality Worklist Information Model - FIND SOP Class

The Mac-Lab/CardioLab includes matching keys in the Modality Worklist queries as described in Section 3.

For the "Schedule Search" option, the operator may choose any combination of search terms, as outlined in Section 2.3.1.2.2.1.1 above. A summary of the retrieved results is displayed to the operator, who may then choose one result to be used to Start a New Study.

For the "Get Active Patient" option or the transfer method that is invoked by the Centricity Cardio Workflow (CCW) client, the operator does not choose the search terms. The only query term specified is the Scheduled Station AE Title (0040,0001), which is automatically set to the Mac-Lab/CardioLab's AE Title. With the "Get Active Patient" interface, the operator is shown a summary of the results and given the option of using that information to start a new study. With the CCW client transfer method, there is no summary of results, and the new study is started automatically.

For both the "Schedule Search" and "Get Active Patient" options, if the operator chooses to cancel the search while it is in progress, a CANCEL request will be sent to the remote

host and the association will be closed. A CANCEL request will also be sent if the configurable maximum number of responses is received. Note that for a "Get Active Patient" or CCW client transfer search the maximum number of responses is always 1.

The system also provides configurable timeout values, such as the connection and inactivity timeouts. If any of these timeout values is exceeded, the association is closed, and the operator is notified of the failure.

For the FIND request message, the Specific Character Set (0008,0005) value in the request message is set according to the current Text Encoding configuration of the Mac-Lab/CardioLab system for the Modality Worklist Host. The same Specific Character Set encoding method is applied to the request message as described in DICOM Standard PS 3.5. In the FIND response message, the Specific Character Set in the message is used to interpret the contents of the response. For more information about the extended character set support in Mac-Lab/CardioLab, refer to Section 2.7.

The following are the status codes that are specifically processed when receiving messages from a Modality Worklist SCP:

Service Status	Status Code	Further Meaning	Application Behavior When Receiving Status Code
Failure	A700	Refused: Out of resources	Association is closed and the operator is notified of the failure.
	A900	Error: Identifier does not match SOP Class	Association is closed and the operator is notified of the failure.
	C001	Error: Unable to process	Association is closed and the operator is notified of the failure.
Cancel	FE00	Matching terminated due to cancel	Association is closed.
Success	0000	Matching is complete - No final identifier is supplied	Association is closed. If no results were received, the operator is notified that the search returned no results.
Pending	FF00	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	Response is added to list of responses and processing continues. If the maximum number of allowed responses is received, a C-CANCEL-FIND request is sent and the association is closed.
	FF01	Matches are continuing - Warning that one or more Optional Keys were not supported for existence for this Identifier	Same as above.
*	*	Any other status code.	Association is closed and the operator is notified of the failure.

2.3.1.2.3 Real-World Activity: Report Start/End Procedure

2.3.1.2.3.1 Associated Real-World Activity

When the local operator either creates a new study (Start New Study) or continues an existing study (Continue Study), the start of the procedure ("IN PROGRESS") is reported to the SCP. When the local operator closes the new or continued study, the completion of the procedure ("COMPLETED") is reported to the SCP. The Report Start/End Procedure will happen only when a study is started to record hemodynamic or electrophysiology data, not when a study is opened to review previously recorded data or to join a study in progress on another system.

Both the "IN PROGRESS" and "COMPLETED" requests will contain the current patient and study attributes at the time of the request. It is still possible to change these attributes at a later time, although these changes may not be propagated to the SCP. For example, the Patient Name is sent at the start of the procedure, but this field is not part of the completion request. Therefore, if the operator changes the Patient Name after the study has started, the updated information is not reported to the SCP.

The "IN PROGRESS" and "COMPLETED" requests will always reference exactly one Performed Procedure Step (PPS). The Mac-Lab/CardioLab uses a 1:1 mapping between study and PPS, so each study has one and only one PPS. The Mac-Lab/CardioLab PPS will always start when the study is opened to record hemodynamic or electrophysiology data, and the PPS will end when the study is closed.

The association with the remote host is initiated when the operator starts a new study, continues a study, or closes a study. The association is released as soon as the response to the request has been received.

2.3.1.2.3.2 Proposed Presentation Context Table

The Mac-Lab/CardioLab will propose the set of Presentation Contexts shown in the following table.

Note that this list includes one or more Abstract Syntax types that will not actually be used for this Real-World Activity. The reason these types are proposed is so that all Real-World Activities can propose the same set of Presentation Contexts.

Presentation Context Table – Proposed for Activity "Report Start/End Procedure"					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step Notification	1.2.840.10008.3.1.2.3.5	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

Note that for the Modality Performed Procedure Step Notification SOP Class, the Role Selection Sub-Item will be sent as part of the negotiation for this SOP Class.

2.3.1.2.3.2.1 SOP Specific DICOM Conformance Statement for Modality Performed Procedure Step SOP Class

The Modality Performed Procedure Step (MPPS) N-CREATE request is sent whenever a new study is started, or an existing study is continued. This will happen only when a study is started to record data, not to review data or join a study in progress on another system. The Mac-Lab/CardioLab includes attributes in the MPPS N-CREATE request as described in Section 4. In general, attributes in the N-CREATE request are either fixed or are taken from the attributes for the study. Some of these attributes may have been retrieved through a MWL request that was used to start the study. Refer to Section 4 for details.

If the N-CREATE response indicates a failure, which in this case is defined as any value other than 0000 (Success), the operator is notified of the failure and no attempt is made to send the corresponding N-SET request. In addition, if the status code is A300 (Refused: Already received N-CREATE for another SOP Instance), the operator is also notified that the requested study is already in progress on the remote system. The A300 status code is a proprietary status code reported by the GE CVIS. The SCP is assumed to only report this status code when the Study Instance UID (0020,000D) in the request matches a study that is already in progress. This proprietary status code is a GE feature to aid in the detection of accidental attempts to start the same study on two different modalities.

The MPPS N-SET request is sent whenever a new or continued study is closed. This will happen only when a study was started to record data, not to review data or join a study in progress on another system. Again, the Mac-Lab/CardioLab includes attributes in the MPPS N-SET request as described in Section 4. In general, attributes in the N-SET request are either fixed or are taken from the attributes for the study. The Performed Procedure Step Status (0040,0252) is always set to “COMPLETED”. Under no circumstances will this value be set to “DISCONTINUED”. Some of these attributes may have been retrieved through a MWL request. Refer to Section 4 for details.

If the N-SET response indicates a failure, which again is defined as any value other than 0000 (Success), the operator is notified of the failure. When this happens, the study is considered to still be “in progress”, so if the study is later continued and then closed, the same N-SET request will be issued again to attempt to move the study to the “completed” state.

For the N-CREATE request message, the Specific Character Set (0008,0005) value in the request message is set according to the current Text Encoding configuration of the Mac-Lab/CardioLab system for the MPPS Host. For both the N-CREATE and N-SET request messages, the same Specific Character Set encoding method is applied to the request message as described in DICOM Standard PS 3.5. For more information about the extended character set support in Mac-Lab/CardioLab, refer to Section 2.7.

2.3.1.2.4 Real-World Activity: Notify Start Procedure

2.3.1.2.4.1 Associated Real-World Activity

When the local operator either creates a new study (Start New Study) or continues an existing study (Continue Study), the operator may choose to send a notification of the start of the procedure to the SCU. The Notify Start Procedure will happen only when a

study is started to record hemodynamic or electrophysiology data, not when a study is opened to review previously recorded data or to join a study in progress on another system.

The notification message will always indicate that a procedure is "In Progress". No other type of notification message is sent.

The association with the remote host is initiated when the operator starts a new study or continues an existing study. The association is released as soon as the response to the request has been received.

2.3.1.2.4.2 Proposed Presentation Context Table

The Mac-Lab/CardioLab will propose the set of Presentation Contexts shown in the following table.

Note that this list includes one or more Abstract Syntax types that will not actually be used for this Real-World Activity. The reason these types are proposed is so that all Real-World Activities can propose the same set of Presentation Contexts.

Presentation Context Table – Proposed for Activity "Notify Start Procedure"					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step Notification	1.2.840.10008.3.1.2.3.5	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

Note that for the Modality Performed Procedure Step Notification SOP Class, the Role Selection Sub-Item will be sent as part of the negotiation for this SOP Class.

2.3.1.2.4.2.1 SOP Specific DICOM Conformance Statement for Modality Performed Procedure Step Notification SOP Class

The Modality Performed Procedure Step (MPPS) Notification request is a N-EVENT-REPORT request. The N-EVENT-REPORT request may be sent when a new study is started, or an existing study is continued. This can happen only when a study is started to record data, not to review data or join a study in progress on another system. This will also only happen if the operator chooses to send the notification, as the operator may choose to send or not to send the notification for each study. The Mac-Lab/CardioLab includes attributes in the N-EVENT-REPORT request as described in Section 7. The Event Type ID (0000,1002) in this message will always be 1 ("Performed Procedure Step In Progress").

If the N-EVENT-REPORT response indicates a failure, which in this case is defined as any value other than 0000 (Success), the operator is notified of the failure and informed that the exam on the X-ray Imaging System must be started manually. It is assumed that a

failure status from the SCU means that the X-ray Imaging System will not be able to start the corresponding exam.

2.3.1.3 Association Acceptance Policy

The Mac-Lab/CardioLab Application Entity will accept an association at any time, consistent with the maximum number of simultaneous associations as described in Section 2.3.1.1.2.

The Mac-Lab/CardioLab Application Entity will accept associations to support the following Real-World Activities that are initiated by the Remote Host:

- Request Active Procedure
- Report Status of Procedure
- Verify Remote System Availability

Each of these Real-World Activities is outlined in detail in the sections that follow.

2.3.1.3.1 Real-World Activity: Request Active Procedure

2.3.1.3.1.1 Associated Real-World Activity

The Mac-Lab/CardioLab supports sharing of patient and study demographics with an associated X-ray Imaging System or Ultrasound Imaging System by allowing those systems to Request the Active Procedure on the Mac-Lab/CardioLab. The operator of the Imaging Systems can request the currently active procedure from the Mac-Lab/CardioLab and use this information to start a new study on the Imaging System. This study would then contain the same patient and study demographics as on the Mac-Lab/CardioLab, which prevents the Imaging System operator from having to enter this information manually. Since the Study Instance UID is also shared, this also enables the linking of the Mac-Lab/CardioLab study with the images and data acquired on the Imaging System.

It is important to note that the Mac-Lab/CardioLab will only provide information about its currently active procedure. This is the only information that is available through this mechanism. Again, the intent is simply to allow an associated X-ray Imaging System or Ultrasound Imaging System to retrieve information about the active procedure and share the patient and study demographics.

2.3.1.3.1.2 Accepted Presentation Context Table

Presentation Context Table - Accepted for Activity "Request Active Procedure"					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

2.3.1.3.1.2.1 SOP Specific DICOM Conformance Statement for the Modality Worklist Information Model – FIND SOP Class

The Mac-Lab/CardioLab provides matching against query keys as described in Section 5.

The AE supports case-insensitive matching for the attributes of Value Representation PN as described in Section 5.

The following criteria must be met for the Mac-Lab/CardioLab to return a study in response to a FIND request:

1. There is an active procedure on the Mac-Lab/CardioLab. This means that there must be a study currently open on the system.

2. The AE Title of the system issuing the worklist request must match either the configured X-Ray Imaging System's AE Title or the Ultrasound Imaging System's AE Title.

3. The FIND request *may* contain a query value for *any* of the following fields. If a query value (other than *blank* or *match any*) is specified for any of these fields, the query value must match the corresponding value on the Mac-Lab/CardioLab as follows:

    - Patient's Name (0010,0010) – Must match the patient name as displayed on the Mac-Lab/CardioLab *Patient Information* window on the *Case* tab. Wildcard matching is supported.

    - Patient ID (0010,0020) – Must match the *MRN* as displayed on the Mac-Lab/CardioLab *Patient Information* window on the *Case* tab.

    - Scheduled Procedure Step Start Date (0040,0002) – Must match the study date as displayed on the Mac-Lab/CardioLab *Patient Information* window on the *Case* tab. Range matching is supported.

    - Scheduled Procedure Step Start Time (0040,0003) – Must match the Study time as displayed on the Mac-Lab/CardioLab *Patient Information* window on the *Case* tab. Range matching is not supported.

    - Scheduled Station AE Title (0040,0001) – Must match either the configured X-Ray Imaging System's AE Title or the Ultrasound Imaging System's AE Title on the Mac-Lab/CardioLab.

    - Modality (0008,0060) – Must match either the configured X-Ray Imaging System's Modality or the Ultrasound Imaging System's Modality on the Mac-Lab/CardioLab.

If any of the above conditions is not met, the Mac-Lab/CardioLab response will indicate success (0000) but no results will be returned. **It is recommended that the requesting system send blank values (*match any*) in its Modality Worklist – FIND request for all of the fields listed in item 3 above.** Since the Mac-Lab/CardioLab will always return only the currently active study, there is no need to send query values for any of these fields.

For the received request message, the Specific Character Set (0008,0005) value in the request message is used to process the message. The Specific Character Set value in the response message is set according to the current Text Encoding configuration of the Mac-Lab/CardioLab system for either the X-Ray Imaging System or the Ultrasound Imaging System (depending on which system sent the request), and this character set is used to encode the message. For more information about the extended character set support in Mac-Lab/CardioLab, refer to Section 2.7.

The following are the status codes the Application may send back to the SCU Equipment while performing the requested **Query**:

Service Status	Status Code	Further Meaning	Status Code Explanation	Related Fields Sent Back to the SCU
Success	0000	Matching is complete - No final identifier is supplied	Either no results were found, or a single matching study was found and has already been returned.	None
Failure	C001	Error: Unable to process	There was an error either interpreting or processing the request.	(0000,0901)
Pending	FF00	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	A study was found that matches the requested search criteria. The study details are returned in this response.	Identifier

2.3.1.3.1.3 Presentation Context Acceptance Criterion

The Mac-Lab/CardioLab evaluates each Presentation Context independently and accepts any Presentation Context that matches an Abstract Syntax for any Real-World Activity.

2.3.1.3.1.4 Transfer Syntax Selection Policies

Within each Presentation Context, the Mac-Lab/CardioLab will accept one proposed transfer syntax that it also supports for that Abstract Syntax. The Mac-Lab/CardioLab will accept a proposed transfer using the following order of preference:

1. Explicit VR Little Endian (1.2.840.10008.1.2.1)
2. Explicit VR Big Endian (1.2.840.10008.1.2.2)
3. Implicit VR Little Endian (1.2.840.10008.1.2)

As shown, Explicit VR Little Endian is the preferred transfer syntax.

2.3.1.3.2 Real-World Activity: Report Status of Procedure

2.3.1.3.2.1 Associated Real-World Activity

The Mac-Lab/CardioLab supports receiving and storing information about the procedure that is in progress on the associated X-ray Imaging System. During or at the conclusion of the imaging procedure, the X-ray Imaging System can submit the current procedure status and a summary of results to the Mac-Lab/CardioLab. Information that is needed by the Mac-Lab/CardioLab (such as x-ray dosage and data about the images that were acquired) is recorded and added into the study at the Mac-Lab/CardioLab. This process is only supported for studies that were started on the X-ray Imaging System using the Request Active Procedure method described above.

The Mac-Lab/CardioLab does not support receiving procedure status from the Ultrasound Imaging System.

2.3.1.3.2.2 Accepted Presentation Context Table

Presentation Context Table - Accepted for Activity "Report Status of Procedure"					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

2.3.1.3.2.2.1 SOP Specific DICOM Conformance Statement for the Modality Performed Procedure Step SOP Class

The Mac-Lab/CardioLab will process and store information from N-CREATE and N-SET requests as described in Section 6.

When an N-CREATE request is received, the request is first processed to determine if the request refers to the study that is currently in progress on the system. All of the following must be true for processing of the N-CREATE request to continue:

1. A study is currently open on the Mac-Lab/CardioLab. The study must be open to record hemodynamic or electrophysiology data, not to review previously recorded data or to join a study in progress on another system.

2. The Study Instance UID (0020,000D) in the request must match the Study Instance UID for the current study.

3. The Modality (0008,0060) in the request must match the X-Ray Imaging System's Modality that is configured on the Mac-Lab/CardioLab.

If *any* of the above criteria are not met, the N-CREATE request is ignored, and the Mac-Lab/CardioLab will return a response of success (0000). If *all* the above criteria are met, the request is processed and data from the request is stored as described in Section 6.

For the received N-CREATE request message, the Specific Character Set (0008,0005) value in the request message is used to process the message. For more information about the extended character set support in Mac-Lab/CardioLab, refer to Section 2.7.

When an N-SET request is received, the request is again processed to determine if the request refers to the study that is currently in progress on the system. All of the following must be true for processing of the N-SET request to continue:

1. A study is currently open on the Mac-Lab/CardioLab. The study must be open to record hemodynamic or electrophysiology data, not to review previously recorded data or to join a study in progress on another system.

2. The Requested SOP Instance UID (0000,1001) in the request must match the Affected SOP Instance UID (0000,1000) from the prior N-CREATE request.

If *any* of the above criteria are not met, the N-SET request is ignored, and the Mac-Lab/CardioLab will return a response of success (0000). If *all* of the above criteria are met, the request is processed and data from the request is stored as described in Section 6.

Listed below are the status codes the Application may send back to the X-ray Imaging System while responding to the requested **MPPS N-CREATE** or **N-SET** request. Note that a "Success" status code (0000) is sent in response to every request that is received.

Service Status	Status Code	Further Meaning	Status Code Explanation	Related Fields Sent Back to the SCU
Success	0000	Message was received and processed	This value is always returned in response to any MPPS request.	None

2.3.1.3.2.3 Presentation Context Acceptance Criterion

The Mac-Lab/CardioLab evaluates each Presentation Context independently and accepts any Presentation Context that matches an Abstract Syntax for any Real-World Activity.

2.3.1.3.2.4 Transfer Syntax Selection Policies

Within each Presentation Context, the Mac-Lab/CardioLab will accept one proposed transfer syntax that it also supports for that Abstract Syntax. The Mac-Lab/CardioLab will accept a proposed transfer using the following order of preference:

1. Explicit VR Little Endian (1.2.840.10008.1.2.1)
2. Explicit VR Big Endian (1.2.840.10008.1.2.2)
3. Implicit VR Little Endian (1.2.840.10008.1.2)

As shown, Explicit VR Little Endian is the preferred transfer syntax.

2.3.1.3.3 Real-World Activity: Verify Remote System Availability

2.3.1.3.3.1 Associated Real-World Activity

The Mac-Lab/CardioLab supports verification requests from remote systems. These requests are used to verify that the Mac-Lab/CardioLab is running as well as that the DICOM configuration parameters on both systems are set correctly.

2.3.1.3.3.2 Accepted Presentation Context Table

Presentation Context Table - Accepted for Activity "Verify Remote System Availability"					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

2.3.1.3.3.2.1 SOP Specific DICOM Conformance Statement for the Verification SOP Class

The Mac-Lab/CardioLab conforms to the standard Verification SOP Class. There is no special behavior to be noted.

2.3.1.3.3.3 Presentation Context Acceptance Criterion

The Mac-Lab/CardioLab evaluates each Presentation Context independently and accepts any Presentation Context that matches an Abstract Syntax for any Real-World Activity.

2.3.1.3.3.4 Transfer Syntax Selection Policies

Within each Presentation Context, the Mac-Lab/CardioLab will accept one proposed transfer syntax that it also supports for that Abstract Syntax.

2.4 COMMUNICATION PROFILES

2.4.1 Supported Communication Stacks

The DICOM Upper Layer Protocol is supported using TCP/IP, as specified in DICOM Standard PS 3.8.

The TCP/IP stack is inherited from the operating system on which the software is running.

2.4.2 Physical Media Support

The Mac-Lab/CardioLab Acquisition or Review Workstation is provided with a 10/100/1000 Mbps auto-sensing Ethernet interface. For the Software-Only Review Workstation, the physical medium for TCP/IP does not matter, but typically this would be Ethernet as well.

Note: Additional information about the Physical Media used on Mac-Lab/CardioLab is available on request.

2.4.3 Additional Protocols

The Mac-Lab/CardioLab system supports both static IP addresses and **Dynamic Host Configuration Protocol (DHCP)** addressing. The Mac-Lab/CardioLab system also supports **Domain Name System (DNS)** address resolution so that either a hostname or IP address may be used to refer to DICOM systems on the network.

2.4.4 IPv4 and IPv6 Support

The Mac-Lab/CardioLab system supports only IPv4 addressing. IPv6 is not supported.

2.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

2.5.1 Standard Extended / Specialized / Private SOP Classes

2.5.1.1 Standard Extended SOP Classes

The product provides Standard Extended Conformance to all supported SOP Classes, through the inclusion of additional Type 3 and Private Data Elements. The extensions are defined in Sections **Error! Reference source not found.** and 6.3. No other extensions, specializations, or privatizations are supported.

2.6 CONFIGURATION

The Mac-Lab/CardioLab is installed and configured by GE Healthcare Field Engineers. The most commonly changed settings, including local and remote AE Titles, are configured through a user interface within the application. Settings that are not typically

changed, such as timeout values, must be changed directly through configuration files or registry entries.

2.6.1 AE Title/Presentation Address Mapping

Mapping of an AE Title to a Presentation Address is required only for each remote host. This is done by configuring the AE Title, Hostname/IP Address, and Port Number for each host as noted in the following section.

2.6.2 Configurable Parameters

The following fields are configurable for the Mac-Lab/CardioLab system's AE (local):

- AE Title (through application configuration)
- IP Address (through Operating System configuration)
- Listening Port Number (through application configuration)
  The default port for normal (unsecure) transport is 1225, and the default port for secure transport is 2762.
- IP Subnet Mask (through Operating System configuration)
- Server Security (through application configuration)
  Refer to Section 2.9 for details.

The following fields are configurable for the remote X-ray Imaging System using the application configuration:

- AE Title – This is the AE Title of the X-ray Imaging System. This field must be populated if the Mac-Lab/CardioLab system is to communicate with the X-ray Imaging System.
- Hostname/IP Address – This is either the hostname or IP address of the X-ray Imaging System. This information is used only when sending the Notify Start Procedure message with the Automatic Exam Start feature and may be left blank if that feature is not being used.
- Port Number – This is the listening port for the X-ray Imaging System. This information is used only when sending the Notify Start Procedure message with the Automatic Exam Start feature and may be left blank if that feature is not being used.
- Modality – This is the modality of the X-ray Imaging System. Typically, this value should be set to "XA". This value will be sent in the Modality (0008,0060) field in response to any MWL request message sent by the X-ray Imaging System.
- Text Encoding – This setting defines the Specific Character Set (0008,0005) that is used to encode data *sent* to this host. It has no effect on the processing of data *received* from this host. This value should be set based on the capabilities of the remote host system. See Section 2.7 for more information.
- Client Security – Refer to Section 2.9 for details.
- Automatic Exam Start – When this box is checked, the operator will be allowed to send the Notify Start Procedure message to the X-ray Imaging System. This notification allows the X-ray Imaging System to automatically trigger a Modality Worklist Request to Mac-Lab/CardioLab, which in turn allows the X-ray Imaging System to start a new exam using the same patient and study demographics that are in

the Mac-Lab/CardioLab study. This notification may only be sent when the Mac-Lab/CardioLab starts or continues a study that was opened to record hemodynamic or electrophysiology data. **This option should only be checked if the X-ray Imaging System supports this feature.**

- Append Mode - When this option is not selected, the Mac-Lab/CardioLab system replaces old dosage and run information when it receives new dosage and run information. When this option is selected, the Mac-Lab/CardioLab system adds new dosage and run information to any previously received dosage and run information. If the Mac-Lab/CardioLab system will connect to an Innova system with the MPPS feature, this option should be selected. **For any other X-ray system, including an Innova with the Exam Data Export feature, the option should not be selected.**

The following fields are configurable for the remote Ultrasound Imaging System using the application configuration:

- AE Title – This is the AE Title of the Ultrasound Imaging System. This field must be populated if the Mac-Lab/CardioLab system is to communicate with the Ultrasound Imaging System.
- Hostname/IP Address – This is either the hostname or IP address of the Ultrasound Imaging System.
- Port Number – This is the listening port for the Ultrasound Imaging System.
- Modality – This is the modality of the Ultrasound Imaging System. Typically, this value should be set to "US". This value will be sent in the Modality (0008,0060) field in response to any MWL request message sent by the Ultrasound Imaging System. This field must be populated if the Mac-Lab/CardioLab system is to communicate with the Ultrasound Imaging System.
- Text Encoding – This setting defines the Specific Character Set (0008,0005) that is used to encode data *sent* to this host. It has no effect on the processing of data *received* from this host. This value should be set based on the capabilities of the remote host system. See Section 2.7 for more information.
- Client Security – Refer to Section 2.9 for details.

The following fields are configurable for both the remote Modality Worklist Host and MPPS Host using the application configuration:

- AE Title – This is the AE Title of either the Modality Worklist Host or the MPPS Host. This field must be populated if the Mac-Lab/CardioLab system is to communicate with the Modality Worklist Host or MPPS Host.
- Hostname or IP Address – This is either the hostname or IP address of the Modality Worklist Host or the MPPS Host. This field must be populated if the Mac-Lab/CardioLab system is to communicate with the Modality Worklist Host or MPPS Host.
- Port Number – This is the listening port of the Modality Worklist Host or the MPPS Host. This field must be populated if the Mac-Lab/CardioLab system is to communicate with the Modality Worklist Host or MPPS Host.
- Text Encoding – This setting defines the Specific Character Set (0008,0005) that is used to encode data *sent* to this host. It has no effect on the processing of data *received* from this host. This value should be set based on the capabilities of the remote host system. See Section 2.7 for more information.

- Client Security – Refer to Section 2.9 for details.

Note that the Modality Worklist Host and MPPS Host configuration settings may be identical if the same system is providing both services.

The following fields are also configurable through configuration files:

- Maximum Length PDU
- Inactivity and connection timers

Note: A GE Healthcare Field Engineer must perform all configuration file changes.

2.7 SUPPORT OF EXTENDED CHARACTER SETS

For *incoming* requests, the Mac-Lab/CardioLab supports the following extended character sets:

- ISO-IR 100 (Latin-1)
- ISO-IR 192 (Unicode in UTF-8)

Incoming requests that specify one of these extended character sets will be translated and processed accordingly. If any other character set is specified, the data must still be translated to the application's internal character set (Unicode). For Specific Character Set (0008,0005) values other than those listed above, this translation is not supported, and the results are undefined.

For *outgoing* requests, the Mac-Lab/CardioLab will use the character set encoding method that is configured for the remote host, as noted in Section 2.6.2. This encoding method may be any one of the following:

- ISO-IR 6 (default DICOM repertoire)
- ISO-IR 100 (Latin-1) – This is the application default for all remote hosts.
- ISO-IR 192 (Unicode in UTF-8)

Whenever a request or response message is sent to a remote host, the Text Encoding method that is configured for that host is applied automatically to the message as specified in DICOM Standard PS 3.5 (Data Structures and Encoding).

2.8 CODES AND CONTROLLED TERMINOLOGY

The product uses no coded terminology.

2.9 SECURITY PROFILES

The product supports Secure Transport Connection Profiles based on the system configuration. The system can also operate with no transport security (**None**), which is the default setting. This mode is provided for interoperability with remote systems that do not support secure transport or are incompatible with the configurations listed below.

It is assumed that the product is used within a secured environment. It is assumed that a secured environment includes at a minimum:

1. Firewall or router protections to ensure that only approved external hosts have network access to the product.
2. Firewall or router protections to ensure that the product only has network access to approved external hosts and services.
3. Any communications with external hosts and services outside the locally secured environment use appropriate secure network channels (such as a Virtual Private Network (VPN)).

2.9.1 Legacy Mode

Legacy Mode is intended for use with systems that support only the older DICOM secure transport profiles or do not support certificate validation. This mode prefers TLS v1.2 but will downgrade to TLS v1.0 as needed. SSL is not supported.

Legacy Mode	
DICOM Profile(s)	Basic TLS Secure Transport Connection Profile (Retired) AES TLS Secure Transport Connection Profile (Retired) BCP195 Secure Transport Connection Profile
TLS Version Supported	1.2 down to 1.0
Peer Authentication	None
Supported Cipher Suites	TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 TLS_DHE_RSA_WITH_AES_256_GCM_SHA384 TLS_RSA_WITH_AES_256_CBC_SHA256 TLS_RSA_WITH_AES_128_CBC_SHA
Certificate Storage	File System

The first four cipher suites listed are for the BCP195 Secure Transport Connection Profile. Cipher suite TLS_RSA_WITH_AES_256_CBC_SHA256 is included for interoperability with some GE Innova and Discovery systems. TLS_RSA_WITH_AES_128_CBC_SHA is included for the AES TLS Secure Transport Connection Profile. The cipher suite TLS_RSA_WITH_3DES_EDE_CBC_SHA that is also part of the AES TLS Secure Transport Connection Profile is not supported due to the known vulnerabilities of Triple DES.

This mode does not include certificate validation, hostname validation, or certificate revocation checks.

2.9.2 Enhanced Mode

Enhanced Mode is intended for use only with the most current implementations of DICOM secure transport. This mode uses TLS v1.2 and will not downgrade. This mode includes validation of the remote system's certificate. The remote system's CA must be in the Windows Certificate Store to perform certificate authentication.

Enhanced Mode

DICOM Profile(s)	Non-Downgrading BCP195 Secure Transport Connection Profile
TLS Version Supported	1.2
Peer Authentication	Yes
Supported Cipher Suites	TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 TLS_DHE_RSA_WITH_AES_256_GCM_SHA384
Certificate Storage	Windows Certificate Store

This mode includes certificate validation. The remote system must use the Mac-Lab/CardioLab's certificate and CA. Refer to section Certificates and Key Management below. This mode does not include hostname validation or certificate revocation checks.

2.9.3 Mode Selection

The incoming (server) security mode is set on the ***Administration*** > ***System Settings*** > ***Connectivity*** > ***Local System*** configuration page. A single DICOM server receives all incoming connection requests. This server runs in one of the three modes listed above, so all incoming connections must use the same security mode. Choose the security mode that accommodates all remote DICOM systems that use the Mac-Lab/CardioLab system's DICOM services. For example, if the x-ray system supports **Legacy** mode but the ultrasound system does not support secure transport, select **None**.

Note: When the server is configured for Legacy or Enhanced Mode, all incoming connection requests are assumed to be secure. Unsecure requests, including verification (echo) requests, will be rejected.

The outgoing (client) security modes are set on the ***Administration*** > ***System Settings*** > ***Connectivity*** > ***Remote Hosts*** configuration page. Each remote host has an independent configuration setting that does not affect any of the other remote hosts. For example, the Modality Worklist Host can be configured for **Enhanced** client security while the MPPS Host can be configured with a client security setting of **None**.

2.9.4 Certificates and Key Management

For Legacy Mode, the certificate (MLCL_DICOM) used for transport is stored in the file system, as is the corresponding self-signed Certificate Authority (MLCL_CA). MLCL_DICOM is an RSA certificate with a 2048-bit key.

For Enhanced Mode, the certificate (MLCL_DICOM) used for transport is stored in the Windows Certificate Store, as is the corresponding self-signed Certificate Authority (MLCL_CA). MLCL_DICOM is an RSA certificate with a 2048-bit key.

Enhanced mode assumes that a GE Healthcare Field Engineer has replaced the default Mac-Lab/CardioLab certificates with site-specific certificates that are generated through a validated GE process. These certificates, keys, and CA are owned by the customer and are unique to that customer. Once these certificates are generated and installed on the Mac-Lab/CardioLab systems, the Mac-Lab/CardioLab DICOM certificate and key pair,

intermediate CA, and root CA should be loaded onto the remote DICOM host. The remote host should be configured to transmit this DICOM certificate to the Mac-Lab/CardioLab system. Using Enhanced mode with this configuration ensures that only DICOM hosts on which the Mac-Lab/CardioLab certificate and CA have been installed can communicate with the Mac-Lab/CardioLab systems.

3. MODALITY WORKLIST IMPLEMENTATION (SCU)

This section describes details about the Mac-Lab/CardioLab Modality Worklist implementation as an SCU. Refer to Sections 2.3.1.2.1 and 2.3.1.2.2 for additional information.

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of the Basic Worklist Management Service. Also, refer to DICOM Standard PS 3.3 (Information Object Definitions) for a description of the modules that are part of the Modality Worklist Information Object.

3.1 WORKLIST INFORMATION MODEL

The following table shows the set of modules used for the Modality Worklist Information Model. The section numbers listed in parentheses in the Module Group and Module Name columns reference DICOM Standard PS 3.3 (Information Object Definitions).

TABLE 3-1
MODALITY WORKLIST INFORMATION MODEL MODULES

Module Group (PS 3.3)	Module Name (PS 3.3)	Reference
General Modules (C.12)	SOP Common (C.12.1)	3.2.1
Study Modules (C.4)	Scheduled Procedure Step (C.4.10)	3.2.2
Study Modules (C.4)	Requested Procedure (C.4.11)	3.2.3
Study Modules (C.4)	Imaging Service Request (C.4.12)	3.2.4
Visit Modules (C.3)	Visit Identification (C.3.2)	3.2.5
Visit Modules (C.3)	Visit Status (C.3.3)	3.2.6
Visit Modules (C.3)	Visit Relationship (C.3.1)	3.2.7
Visit Modules (C.3)	Visit Admission (C.3.4)	3.2.8
Patient Modules (C.2)	Patient Relationship (C.2.1)	3.2.9
Patient Modules (C.2)	Patient Identification (C.2.2)	3.2.10
Patient Modules (C.2)	Patient Demographic (C.2.3)	3.2.11
Patient Modules (C.2)	Patient Medical (C.2.4)	3.2.12

Each of the Modules listed above is outlined in detail in the section listed in the Reference column of the table.

3.2 WORKLIST QUERY MODULE DEFINITIONS

This section provides details about each module in the Modality Worklist Information Model and how it is processed and interpreted by Mac-Lab/CardioLab. For more information about matching and return keys, refer to DICOM Standard PS 3.4 (Service Class Specifications). Note that the Mac-Lab/CardioLab does not require values in the response message for any of the Type 2 or Type 3 fields; i.e., blank responses for Type 2 or Type 3 fields are acceptable.

The contents of the Mac-Lab/CardioLab Modality Worklist FIND request are different depending on the purpose of the request. The three request types are:

- Patient Search (**PS**) – Used to find a patient on the Modality Worklist SCP. This request does not retrieve any study information, only patient information.
- Schedule Search (**SS**) – Used to find a scheduled study on the Modality Worklist SCP.
- Get Active Patient (**GAP**) – Used to retrieve the currently active patient and study on the Modality Worklist SCP. This request is used on systems for which the SCP makes a single patient study available to a specific Modality, depending entirely on the AE Title of the SCU to identify the Modality.

All these request types are standard FIND requests. This distinction is provided because the contents of the FIND message will be different depending on the type of request that is needed. These differences are outlined in the following sections and are denoted using the abbreviations shown in parentheses above (**PS**, **SS**, or **GAP**).

For each module outlined in the sections that follow, the Request Value Sent column indicates how the field is populated by the SCU for the FIND request. The Response Disposition column indicates how the SCU processes this field in the response and what is done with the information that is received.

3.2.1 SOP Common Module

TABLE 3-2
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Specific Character Set	(0008,0005)	O	1C	See Note below	See Note below

Note: For request messages, the Specific Character Set (0008,0005) field is set and applied to the request message based on the configured Text Encoding setting for the Modality Worklist Host.

For response messages, the Specific Character Set (0008,0005) value is used to interpret text fields as specified in DICOM Standard PS 3.5.

Refer to Section 2.7 for more information, including a list of supported character sets.

3.2.2 Scheduled Procedure Step Module

TABLE 3-3
SCHEDULED PROCEDURE STEP MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition

Scheduled Procedure Step Sequence	(0040,0100)	R	1	**PS**: Not sent **SS** or **GAP**: Sequence with one item sent	**PS**: Ignored **SS** or **GAP**: Contents of sequence processed as outlined below
>Scheduled Station AE Title	(0040,0001)	R	1	**SS**: AE Title of Mac-Lab/CardioLab or blank (match any) **GAP**: AE Title of Mac-Lab/CardioLab	**SS**: Displayed to operator only **GAP**: Ignored
>Scheduled Station Name	(0040,0010)	O	2	**SS** or **GAP**: Blank (match any)	**SS**: Displayed to operator only **GAP**: Ignored
>Scheduled Procedure Step Location	(0040,0011)	O	2	**SS** or **GAP**: Blank (match any)	**SS** or **GAP**: Stored as Scheduled Procedure Step Location. See Note 1 below.
>Scheduled Procedure Step Start Date	(0040,0002)	R	1	**SS**: Value entered by operator. Single Date or Date Range may be sent. **GAP**: Blank (match any)	**SS**: Displayed to operator only **GAP**: Ignored
>Scheduled Procedure Step Start Time	(0040,0003)	R	1	**SS** or **GAP**: Blank (match any)	**SS**: Displayed to operator only **GAP**: Ignored
>Scheduled Procedure Step End Date	(0040,0004)	O	3	Not sent	Ignored
>Scheduled Procedure Step End Time	(0040,0005)	O	3	Not sent	Ignored
>Scheduled Performing Physician's Name	(0040,0006)	R	2	**SS**: Value entered by operator. Wildcards (“*” or “?”) may be present. **GAP**: Blank (match any)	**SS** or **GAP**: Stored as Scheduled Performing Physician’s Name. See Note 2 below.
>Scheduled Performing Physician Identification Sequence	(0040,000B)	O	3	Not sent	Ignored
>Scheduled Procedure Step Description	(0040,0007)	O	1C	**SS** or **GAP**: Blank (match any)	**SS** or **GAP**: Stored as Scheduled Procedure Step Description. See Note 3 below.
>Scheduled Protocol Code Sequence	(0040,0008)	O	1C	Not sent	Ignored

>Scheduled Procedure Step ID	(0040,0009)	O	1	**SS** or **GAP**: Blank (match any)	**SS** or **GAP**: Stored as Scheduled Procedure Step Identifier. See Note 3 below.
>Scheduled Procedure Step Status	(0040,0020)	O	3	Not sent	Ignored
>Comments on the Scheduled Procedure Step	(0040,0400)	O	3	Not sent	Ignored
>Modality	(0008,0060)	R	1	**SS**: "EPS" (Cardiac Electrophysiology) or "HD" (Hemodynamic Waveform) **GAP**: Blank (match any)	**SS** or **GAP**: Determines type of study to create. Modalities other than "EPS" (EP) and "HD" (Cath) are not supported.
>Requested Contrast Agent	(0032,1070)	O	2C	Not sent	Ignored
>Pre-Medication	(0040,0012)	O	2C	Not sent	Ignored

Note 1: There is no user interface to view the value for Scheduled Procedure Step Location (0040,0011). This value is stored for future use.

Note 2: The Scheduled Performing Physician's Name in Mac-Lab/CardioLab consists of a First (Given) Name and Last (Family) Name. The received Scheduled Performing Physician's Name (0040,0006) is processed and stored using only the first component group (single-byte), and only the supported fields are extracted, as follows:

- First (Given) Name: Up to 32 characters stored
- Last (Family) Name: Up to 32 characters stored

As shown above, name components are truncated as necessary to be stored on the Mac-Lab/CardioLab.

The Scheduled Performing Physician's Name (0040,0006) is displayed on the *Patient Information* window on the *Worklist* tab.

Note 3: The Scheduled Procedure Step Description (0040,0007) and Scheduled Procedure Step ID (0040,0009) fields are displayed on the *Patient Information* window on the *Worklist* tab. If no Scheduled Procedure Step Description (0040,0007) is provided by the SCP, a default description of either "No description provided" (for scheduled procedures) or "Unscheduled procedure" (for unscheduled procedures) will be used.

3.2.3 Requested Procedure Module

TABLE 3-4
REQUESTED PROCEDURE MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition

Requested Procedure ID	(0040,1001)	O	1	**PS**: Not sent **SS** or **GAP**: Blank (match any)	**PS**: Ignored **SS** or **GAP**: Stored as Requested Procedure Identifier. See Note 3 below.
Reason for the Requested Procedure	(0040,1002)	O	3	**PS**: Not sent **SS** or **GAP**: Blank (match any)	**PS**: Ignored **SS** or **GAP**: Stored as Test Reason.
Requested Procedure Comments	(0040,1400)	O	3	**PS**: Not sent **SS** or **GAP**: Blank (match any)	**PS**: Ignored **SS** or **GAP**: Stored as Requested Procedure Comments. See Note 1 below.
Requested Procedure Code Sequence	(0032,1064)	O	1C	Not sent	Ignored
Study Instance UID	(0020,000D)	O	1	**PS**: Not sent **SS** or **GAP**: Blank (match any)	**PS**: Ignored **SS** or **GAP**: Stored as Study Instance UID.
Referenced Study Sequence	(0008,1110)	O	2	Not sent	Ignored
Requested Procedure Description	(0032,1060)	O	1C	**PS**: Not sent **SS** or **GAP**: Blank (match any)	**PS**: Ignored **SS** or **GAP**: Stored as Requested Procedure Description. See Note 3 below.
Requested Procedure Priority	(0040,1003)	O	2	Not sent	Ignored
Patient Transport Arrangements	(0040,1004)	O	2	Not sent	Ignored
Requested Procedure Location	(0040,1005)	O	3	Not sent	Ignored
Confidentiality Code	(0040,1008)	O	3	Not sent	Ignored
Reporting Priority	(0040,1009)	O	3	Not sent	Ignored
Names of Intended Recipients of Results	(0040,1010)	O	3	**PS**: Not sent **SS** or **GAP**: Blank (match any)	**PS**: Ignored **SS** or **GAP**: Stored as Name of Intended Recipient of Results. See Note 2 below.
Intended Recipients of Results Identification Sequence	(0040,1011)	O	3	Not sent	Ignored

Note 1: There is no user interface to view the value for Requested Procedure Comments (0040,1400). This value is stored for future use.

Note 2: The Name of Intended Recipient of Results in Mac-Lab/CardioLab consists of a First (Given) Name and Last (Family) Name. The received Names of Intended Recipients of Results (0040,1010) is processed and stored using only the first component group (single-byte), and only the supported fields are extracted, as follows:

- First (Given) Name: Up to 32 characters stored
- Last (Family) Name: Up to 32 characters stored

As shown above, name components are truncated as necessary to be stored on the Mac-Lab/CardioLab. Also, if multiple names are provided (VM > 1), only the first value is stored.

There is no user interface to view the value for Name of Intended Recipient of Results. This value is stored for future use.

Note 3: The Requested Procedure ID (0040,1001) and Requested Procedure Description (0032,1060) fields are displayed on the *Patient Information* window on the *Worklist* tab. If no Requested Procedure Description (0032,1060) is provided by the SCP, a default description of either "No description provided" (for scheduled procedures) or "Unscheduled procedure" (for unscheduled procedures) will be used.

3.2.4 Imaging Service Request Module

TABLE 3-5
IMAGING SERVICE REQUEST MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Reason for the Imaging Service Request	(0040,2001)	O	3	Not sent	Ignored
Imaging Service Request Comments	(0040,2400)	O	3	Blank (match any)	Stored as Imaging Service Request Comments. Value truncated at 512 characters if needed. See Note 1 below.
Requesting Physician	(0032,1032)	O	2	Blank (match any)	Stored as Requesting Physician Name. See Note 2 below.
Requesting Physician Identification Sequence	(0032,1031)	O	3	Not sent	Ignored
Referring Physician's Name	(0008,0090)	O	2	Blank (match any)	Stored as Referring Physician Name. See Note 2 below.
Referring Physician Identification Sequence	(0008,0096)	O	3	Not sent	Ignored

Requesting Service	(0032,1033)	O	3	Blank (match any)	Stored as Requesting Service. See Note 1 below.
Accession Number	(0008,0050)	O	2	Blank (match any)	Stored as Accession Number, and optionally as Study Number as well. See Note 3 below.
Issue Date of Imaging Service Request	(0040,2004)	O	3	Blank (match any)	Stored as Order Place Date
Issue Time of Imaging Service Request	(0040,2005)	O	3	Blank (match any)	Stored as Order Place Time
Placer Order Number / Imaging Service Request	(0040,2016)	O	3	**SS**: Value entered by operator **PS** or **GAP**: Blank (match any)	Stored as Placer Order Number. See Note 5 below.
Filler Order Number / Imaging Service Request	(0040,2017)	O	3	Not sent	Ignored
Order entered by ...	(0040,2008)	O	3	Blank (match any)	Stored as Placer's Name. See Note 4 below.
Order Enterer's Location	(0040,2009)	O	3	Not sent	Ignored
Order Callback Phone Number	(0040,2010)	O	3	Not sent	Ignored

Note 1: There is no user interface to view the value for Imaging Service Request Comments (0040,2400) or Requesting Service (0032,1033). These values are stored for future use.

Note 2: The Requesting Physician Name and Referring Physician Name in Mac-Lab/CardioLab consist of a First (Given) Name and Last (Family) Name. Both the received Requesting Physician (0032,1032) and Referring Physician's Name (0008,0090) are processed and stored using only the first component group (single-byte), and only the supported fields are extracted, as follows:

- First (Given) Name: Up to 32 characters stored
- Last (Family) Name: Up to 32 characters stored

As shown above, name components are truncated as necessary to be stored on the Mac-Lab/CardioLab.

There is no user interface to view the value for Requesting Physician Name. This value is stored for future use.

The Referring Physician's Name is displayed on the *Patient Information* window on the *Worklist* tab.

Note 3: The Accession Number (0008,0050) in the response message is always stored as the Accession Number in Mac-Lab/CardioLab. It is also optionally stored as the Study Number. Storing the Accession Number as Study Number happens by default, but it can be disabled through a hidden configuration setting.

Note 4: The Placer's Name in Mac-Lab/CardioLab consists of a First (Given) Name, Middle Name, and Last (Family) Name. The received Order entered by ... (0040,2008) is processed and stored using only the first component group (single-byte), and only the supported fields are extracted, as follows:

- First (Given) Name: Up to 32 characters stored
- Middle Name: Up to 16 characters stored
- Last (Family) Name: Up to 32 characters stored

As shown above, name components are truncated as necessary to be stored on the Mac-Lab/CardioLab.

Note 5: The Placer Order Number / Imaging Service Request (0040,2016) response can be blank. Mac-Lab/CardioLab does *not* require a Placer Order Number value in the response, even if the operator entered a value in the Schedule Search (SS) interface that was then sent in the worklist request.

3.2.5 Visit Identification Module

TABLE 3-6
VISIT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Institution Name	(0008,0080)	O	3	Blank (match any)	Ignored
Institution Address	(0008,0081)	O	3	Not sent	Ignored
Institution Code Sequence	(0008,0082)	O	3	Not sent	Ignored
Admission ID	(0038,0010)	O	2	Blank (match any)	Stored as Account Number. Value truncated at 32 characters if needed.
Issuer of Admission ID	(0038,0011)	O	3	Not sent	Ignored

3.2.6 Visit Status Module

TABLE 3-7
VISIT STATUS MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Visit Status ID	(0038,0008)	O	3	Not sent	Ignored
Current Patient Location	(0038,0300)	O	2	Blank (match any)	Stored as Patient Location. See Note below.
Patient's Institution Residence	(0038,0400)	O	3	Not sent	Ignored
Visit Comments	(0038,4000)	O	3	Not sent	Ignored

Note: There is no user interface to view the value for Current Patient Location (0038,0300). This value is stored for future use.

3.2.7 Visit Relationship Module

TABLE 3-8
VISIT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Referenced Study Sequence	(0008,1110)	O	3	Not sent	Ignored
Referenced Patient Sequence	(0008,1120)	O	2	Not sent	Ignored

3.2.8 Visit Admission Module

TABLE 3-9
VISIT ADMISSION MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Referring Physician's Name	(0008,0090)	O	3	Blank (match any)	Stored as Referring Physician Name. See Note 1 below.
Referring Physician's Address	(0008,0092)	O	3	Not sent	Ignored
Referring Physician's Telephone Numbers	(0008,0094)	O	3	Not sent	Ignored
Referring Physician Identification Sequence	(0008,0096)	O	3	Not sent	Ignored
Admitting Diagnoses Description	(0008,1080)	O	3	Blank (match any)	Stored as Admitting Diagnosis. Value truncated at 96 characters if needed.
Admitting Diagnoses Code Sequence	(0008,1084)	O	3	Not sent	Ignored
Route of Admissions	(0038,0016)	O	3	Not sent	Ignored
Admitting Date	(0038,0020)	O	3	**PS**: Value entered by operator. Single Value or Date Range may be sent. **SS** or **GAP**: Blank (match any)	Stored as Admitting Date. See Note 2 below.
Admitting Time	(0038,0021)	O	3	Blank (match any)	Stored as Admitting Time

Note 1: The Referring Physician's Name in Mac-Lab/CardioLab consists of a First (Given) Name and Last (Family) Name. The received Referring Physician's

Name (0008,0090) is processed and stored using only the first component group (single-byte), and only the supported fields are extracted, as follows:

- First (Given) Name: Up to 32 characters stored
- Last (Family) Name: Up to 32 characters stored

As shown above, name components are truncated as necessary to be stored on the Mac-Lab/CardioLab.

The Referring Physician's Name is displayed on the *Patient Information* window on the *Worklist* tab.

Note 2: The Admitting Date (0038,0020) response can be blank or can contain a date that does not match the one sent in the request. Mac-Lab/CardioLab does *not* require an Admitting Date value in the response, even if the operator entered a value in the Patient Search (PS) interface that was then sent in the worklist request.

3.2.9 Patient Relationship Module

TABLE 3-10
PATIENT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Referenced Study Sequence	(0008,1110)	O	3	Not sent	Ignored
Referenced Visit Sequence	(0008,1125)	O	3	Not sent	Ignored
Referenced Patient Alias Sequence	(0038,0004)	O	3	Not sent	Ignored

3.2.10 Patient Identification Module

TABLE 3-11
PATIENT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Patient's Name	(0010,0010)	R	1	**PS** or **SS**: Value entered by operator. Wildcards ("*" or "?") may be present. **GAP**: Blank (match any)	Stored as Patient Name. See Note 1 below.
Patient ID	(0010,0020)	R	1	**PS** or **SS**: Value entered by operator **GAP**: Blank (match any)	Stored as MRN (Medical Record Number). Value truncated at 32 characters if needed.
Issuer of Patient ID	(0010,0021)	O	3	Not sent	Ignored

Other Patient IDs	(0010,1000)	O	3	Blank (match any)	Stored as Other Patient ID. See Note 2 below.
Other Patient Names	(0010,1001)	O	3	Not sent	Ignored
Patient's Birth Name	(0010,1005)	O	3	Not sent	Ignored
Patient's Mother's Birth Name	(0010,1060)	O	3	Not sent	Ignored
Medical Record Locator	(0010,1090)	O	3	Not sent	Ignored

Note 1: A Patient Name in Mac-Lab/CardioLab consists of a First (Given) Name, Middle Name, and Last (Family) Name. The received Patient's Name (0010,0010) is processed and stored using only the first component group (single-byte), and only the supported fields are extracted, as follows:

- First (Given) Name: Up to 32 characters stored
- Middle Name: Up to 16 characters stored
- Last (Family) Name: Up to 32 characters stored

As shown above, name components are truncated as necessary to be stored on the Mac-Lab/CardioLab.

Note 2: There is no user interface to view the value for Other Patient IDs (0010,1000). This value is stored for future use.

3.2.11 Patient Demographic Module

TABLE 3-12
PATIENT DEMOGRAPHIC MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Patient's Age	(0010,1010)	O	3	Blank (match any)	Stored as Patient's Age. See Note 1 below.
Occupation	(0010,2180)	O	3	Not sent	Ignored
Patient Data Confidentiality Constraint Description	(0040,3001)	O	2	Not sent	Ignored
Patient's Birth Date	(0010,0030)	O	2	Blank (match any)	Stored as Patient's Date of Birth.
Patient's Birth Time	(0010,0032)	O	3	Not sent	Ignored
Patient's Sex	(0010,0040)	O	2	Blank (match any)	Stored as Patient's Gender. Only values of "F" and "M" are stored.
Patient's Insurance Plan Code Sequence	(0010,0050)	O	3	Not sent	Ignored
Patient's Primary Language Code Sequence	(0010,0101)	O	3	Not sent	Ignored

Patient's Size	(0010,1020)	O	3	Blank (match any)	Stored as Patient's Height.
Patient's Weight	(0010,1030)	O	2	Blank (match any)	Stored as Patient's Weight.
Patient's Address	(0010,1040)	O	3	Not sent	Ignored
Military Rank	(0010,1080)	O	3	Not sent	Ignored
Branch of Service	(0010,1081)	O	3	Not sent	Ignored
Country of Residence	(0010,2150)	O	3	Not sent	Ignored
Region of Residence	(0010,2152)	O	3	Not sent	Ignored
Patient's Telephone Numbers	(0010,2154)	O	3	Blank (match any)	Stored as Patient's Home Phone Number. Value truncated at 20 characters if needed.
Ethnic Group	(0010,2160)	O	3	Not sent	Ignored
Patient's Religious Preference	(0010,21F0)	O	3	Not sent	Ignored
Patient Comments	(0010,4000)	O	3	Blank (match any)	Stored as Patient Comments. Value truncated at 512 characters if needed. See Note 2 below.

Note 1: The Patient's Age (0010,1010) is stored exactly as it is received in the request, if present. If the age is not received, but the Patient's Birth Date (0010,0030) is received, the age is calculated and stored based on the Birth Date and Study Date.

Note 2: There is no user interface to view the value for Patient Comments (0010,4000). This value is stored for future use.

3.2.12 Patient Medical Module

TABLE 3-13
PATIENT MEDICAL MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Value Sent	Response Disposition
Medical Alerts	(0010,2000)	O	2	Blank (match any)	Stored as Medical Alerts. See Note below.
Contrast Allergies	(0010,2110)	O	2	Not sent	Ignored
Smoking Status	(0010,21A0)	O	3	Not sent	Ignored

Additional Patient History	(0010,21B0)	O	3	Blank (match any)	Stored as Additional Patient History. Value truncated at 512 characters if needed. See Note below.
Pregnancy Status	(0010,21C0)	O	2	Blank (match any)	Stored as Pregnancy Status. See Note below.
Last Menstrual Date	(0010,21D0)	O	3	Not sent	Ignored
Special Needs	(0038,0050)	O	2	Not sent	Ignored
Patient State	(0038,0500)	O	2	Not sent	Ignored

Note: There is no user interface to view the value for Medical Alerts (0010,2000), Additional Patient History (0010,21B0), or Pregnancy Status (0010,21C0). These values are stored for future use.

3.3 PRIVATE DATA ATTRIBUTES

The Modality Worklist SCU supports no Private Attributes.

4. MODALITY PERFORMED PROCEDURE STEP IMPLEMENTATION (SCU)

This section describes details about the Mac-Lab/CardioLab Modality Performed Procedure Step implementation as an SCU. Refer to Section 2.3.1.2.3 for additional information.

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of the Study Management Service Class. Also, refer to DICOM Standard PS 3.3 (Information Object Definitions) for a description of the modules that are part of the Modality Performed Procedure Step Information Object.

4.1 MODALITY PERFORMED PROCEDURE STEP MODULE TABLE

The following table shows the set of modules used for the Modality Performed Procedure Step Information Model. The section numbers listed in the Module Group and Module Name columns reference DICOM Standard PS 3.3 (Information Object Definitions).

TABLE 4-1
MODALITY PERFORMED PROCEDURE STEP INFORMATION MODEL MODULES

Module Group (PS 3.3)	Module Name (PS 3.3)	Reference
General Modules (C.12)	SOP Common (C.12.1)	4.2.1
Study Modules (C.4)	Performed Procedure Step Relationship (C.4.13)	4.2.2
Study Modules (C.4)	Performed Procedure Step Information (C.4.14)	4.2.3
Study Modules (C.4)	Image Acquisition Results (C.4.15)	4.2.4
Study Modules (C.4)	Radiation Dose (C.4.16)	4.2.5
Study Modules (C.4)	Billing and Material Management Code (C.4.17)	4.2.6

Each of the Modules listed above is outlined in detail in the section listed in the Reference column of the table.

4.2 MODALITY PERFORMED PROCEDURE STEP MODULE DEFINITIONS

Please refer to DICOM Standard PS 3.3 (Information Object Definitions) for a description of each of the attributes contained within the Modality Performed Procedure Step Information Object Definition.

4.2.1 SOP Common Module

TABLE 4-2
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Specific Character Set	(0008,0005)	1C	-	See Note below

Note: For request messages, the Specific Character Set (0008,0005) field is set and applied to the request message based on the configured Text Encoding setting for the MPPS Host.

For response messages, the Specific Character Set (0008,0005) value is used to interpret text fields as specified in DICOM Standard PS 3.5.

Refer to Section 2.7 for more information, including a list of supported character sets.

4.2.2 Performed Procedure Step Relationship Module

TABLE 4-3
PERFORMED PROCEDURE STEP RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Patient's Name	(0010,0010)	2	-	Patient's Name sent. See Note 1 below.
Patient ID	(0010,0020)	2	-	Patient's MRN sent
Patient's Birth Date	(0010,0030)	2	-	Patient's Date of Birth sent
Patient's Sex	(0010,0040)	2	-	Patient's Gender sent. Value will always be "F", "M", or blank.
Referenced Patient Sequence	(0008,1120)	2	-	Blank value sent
>Referenced SOP Class UID	(0008,1150)			Not sent
>Referenced SOP Instance UID	(0008,1155)			Not sent
Scheduled Step Attributes Sequence	(0040,0270)	1	-	Sequence with one item sent
>Study Instance UID	(0020,000D)	1	-	Study Instance UID sent
>Referenced Study Sequence	(0008,1110)	2	-	Blank value sent
>>Referenced SOP Class UID	(0008,1150)			Not sent
>>Referenced SOP Instance UID	(0008,1155)			Not sent
>Accession Number	(0008,0050)	2	-	Accession Number sent
>Placer Order Number/Imaging Service Request	(0040,2016)	3	-	Placer Order Number sent
>Filler Order Number/Imaging Service Request	(0040,2017)	3	-	Filler Order Number sent
>Requested Procedure ID	(0040,1001)	2	-	Requested Procedure ID sent. See Note 2 below.
>Requested Procedure Description	(0032,1060)	2	-	Requested Procedure Description sent. See Note 2 below.
>Scheduled Procedure Step ID	(0040,0009)	2	-	Scheduled Procedure Step ID sent. See Note 2 below.

>Scheduled Procedure Step Description	(0040,0007)	2	-	Scheduled Procedure Step Description sent. See Note 2 below.
>Scheduled Protocol Code Sequence	(0040,0008)	2	-	Blank value sent
>> 'Code Sequence Macro'				Not sent

Note 1: A Patient's Name in Mac-Lab/CardioLab consists of a First (Given) Name, Middle Name, and Last (Family) Name. The complete name is always sent using only the first component group (single-byte), even if the name might contain characters that are not truly single-byte (e.g., in Japan or China). Since it is possible for the full Patient's Name in Mac-Lab/CardioLab to be longer than 64 characters, the name that is sent is truncated at 64 characters if necessary.

Note 2: The Requested Procedure ID, Requested Procedure Description, Scheduled Procedure Step ID, and Scheduled Procedure Step Description fields are entered on the *Patient Information* window on the *Worklist* tab.

4.2.3 Performed Procedure Step Information Module

TABLE 4-4
PERFORMED PROCEDURE STEP INFORMATION MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Performed Station AE Title	(0040,0241)	1	-	AE Title of Mac-Lab/CardioLab system sent
Performed Station Name	(0040,0242)	2	-	Performed Station Name sent. See Note below.
Performed Location	(0040,0243)	2	-	Performed Location sent. See Note below.
Performed Procedure Step Start Date	(0040,0244)	1	-	Date on which study is opened is sent
Performed Procedure Step Start Time	(0040,0245)	1	-	Time at which study is opened is sent
Performed Procedure Step ID	(0040,0253)	1	-	Performed Procedure Step ID sent. If no value, then "EP" (for EP study) or "Cath" (for Cath study) sent. See Note below.
Performed Procedure Step End Date	(0040,0250)	2	3	**N-CREATE**: Blank value sent **N-SET**: Date on which study is closed is sent
Performed Procedure Step End Time	(0040,0251)	2	3	**N-CREATE**: Blank value sent **N-SET**: Time at which study is closed is sent
Performed Procedure Step Status	(0040,0252)	1	3	**N-CREATE**: "IN PROGRESS" sent **N-SET**: "COMPLETED" sent
Performed Procedure Step Description	(0040,0254)	2	3	**N-CREATE**: Performed Procedure Step Description sent. If no value, then "EP" (for EP study) or "Cath" (for Cath study) sent. See Note below. **N-SET**: Not sent
Comments on the Performed Procedure Step	(0040,0280)	3	3	Not sent
Performed Procedure Type Description	(0040,0255)	2	3	**N-CREATE**: Performed Procedure Type Description sent. If no value, then "EP" (for EP study) or "Cath" (for Cath study) sent. See Note below. **N-SET**: Not sent
Procedure Code Sequence	(0008,1032)	2	3	**N-CREATE**: Blank value sent **N-SET**: Not sent
> *'Code Sequence Macro'*				Not sent
Performed Procedure Step Discontinuation Reason Code Sequence	(0040,0281)	3	3	Not sent
> *'Code Sequence Macro'*				Not sent

Note: There is no user interface to enter Performed Station Name, Performed Location, Performed Procedure Step ID, Performed Procedure Step Description, or Performed Procedure Type Description, so unless the field was populated

through some other method (e.g., MWL FIND request) or a value can be generated (as indicated above), no value will be sent. This functionality is provided for future use.

4.2.4 Image Acquisition Results Module

TABLE 4-5
IMAGE ACQUISITION RESULTS MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Modality	(0008,0060)	1	-	"EPS" (for EP study) or "HD" (for Cath study) sent
Study ID	(0020,0010)	2	-	Study Number sent
Performed Protocol Code Sequence	(0040,0260)	2	3	**N-CREATE**: Blank value sent **N-SET**: Not sent
> *'Code Sequence Macro'*				Not sent
Performed Series Sequence	(0040,0340)	2	3	**N-CREATE**: Blank value sent **N-SET**: Sequence with one item sent
>Performing Physician's Name	(0008,1050)	2	2	**N-CREATE**: Not sent **N-SET**: Blank value sent
>Operator's Name	(0008,1070)	2	2	**N-CREATE**: Not sent **N-SET**: Blank value sent
>Protocol Name	(0018,1030)	1	1	**N-CREATE**: Not sent **N-SET**: "EP" (for EP study) or "Cath" (for Cath study) sent
>Series Instance UID	(0020,000E)	1	1	**N-CREATE**: Not sent **N-SET**: Series Instance UID sent
>Series Description	(0008,103E)	2	2	**N-CREATE**: Not sent **N-SET**: Blank value sent
>Retrieve AE Title	(0008,0054)	2	2	**N-CREATE**: Not sent **N-SET**: Blank value sent
>Referenced Image Sequence	(0008,1140)	2	2	**N-CREATE**: Not sent **N-SET**: Blank value sent
>>Referenced SOP Class UID	(0008,1150)	1	1	Not sent
>>Referenced SOP Instance UID	(0008,1155)	1	1	Not sent
>Referenced Non-Image Composite SOP Instance Sequence	(0040,0220)	2	2	**N-CREATE**: Not sent **N-SET**: Blank value sent
>>Referenced SOP Class UID	(0008,1150)	1	1	Not sent
>>Referenced SOP Instance UID	(0008,1155)	1	1	Not sent

4.2.5 Radiation Dose Module

TABLE 4-6
RADIATION DOSE MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Anatomic Structure, Space or Region Sequence	(0008,2229)	3	3	Not sent
> *'Code Sequence Macro'*		3	3	Not sent
Total Time of Fluoroscopy	(0040,0300)	3	3	Not sent
Total Number of Exposures	(0040,0301)	3	3	Not sent
Distance Source to Detector (SID)	(0018,1110)	3	3	Not sent
Distance Source to Entrance	(0040,0306)	3	3	Not sent
Entrance Dose	(0040,0302)	3	3	Not sent
Entrance Dose in mGy	(0040,8302)	3	3	Not sent
Exposed Area	(0040,0303)	3	3	Not sent
Image Area Dose Product	(0018,115E)	3	3	Not sent
Comments on Radiation Dose	(0040,0310)	3	3	Not sent
Exposure Dose Sequence	(0040,030E)	3	3	Not sent
>Radiation Mode	(0018,115A)	3	3	Not sent
>KVp	(0018,0060)	3	3	Not sent
>X-ray Tube Current in μA	(0018,8151)	3	3	Not sent
>Exposure Time	(0018,1150)	3	3	Not sent
>Filter Type	(0018,1160)	3	3	Not sent
>Filter Material	(0018,7050)	3	3	Not sent

4.2.6 Billing and Material Management Codes Module

TABLE 4-7
BILLING AND MATERIAL MANAGEMENT CODES MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Billing Procedure Step Sequence	(0040,0320)	3	3	Not sent
> *'Code Sequence Macro'*		3	3	Not sent
Film Consumption Sequence	(0040,0321)	3	3	Not sent
>Number of Films	(2100,0170)	3	3	Not sent
>Medium Type	(2000,0030)	3	3	Not sent
>Film Size ID	(2010,0050)	3	3	Not sent
Billing Supplies and Devices Sequence	(0040,0324)	3	3	Not sent
>Billing Item Sequence	(0040,0296)	3	3	Not sent

>> 'Code Sequence Macro'		3	3	Not sent
>Quantity Sequence	(0040,0293)	3	3	Not sent
>>Quantity	(0040,0294)	3	3	Not sent
>>Measuring Units Sequence	(0040,0295)	3	3	Not sent
>>> 'Code Sequence Macro'		3	3	Not sent

4.3 PRIVATE DATA ATTRIBUTES

The Modality Performed Procedure Step SCU supports no Private Attributes.

5. MODALITY WORKLIST IMPLEMENTATION (SCP)

This section describes details about the Mac-Lab/CardioLab Modality Worklist implementation as an SCP. Refer to Section 2.3.1.3.1 for additional information.

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of the Basic Worklist Management Service. Also, refer to DICOM Standard PS 3.3 (Information Object Definitions) for a description of the modules that are part of the Modality Worklist Information Object.

5.1 WORKLIST INFORMATION MODEL

The following table shows the set of modules used for the Modality Worklist Information Model. The section numbers listed in parentheses in the Module Group and Module Name columns reference DICOM Standard PS 3.3 (Information Object Definitions).

TABLE 5-1
MODALITY WORKLIST INFORMATION MODEL MODULES

Module Group (PS 3.3)	Module Name (PS 3.3)	Reference
General Modules (C.12)	SOP Common (C.12.1)	5.2.1
Study Modules (C.4)	Scheduled Procedure Step (C.4.10)	5.2.2
Study Modules (C.4)	Requested Procedure (C.4.11)	5.2.3
Study Modules (C.4)	Imaging Service Request (C.4.12)	5.2.4
Visit Modules (C.3)	Visit Identification (C.3.2)	5.2.5
Visit Modules (C.3)	Visit Status (C.3.3)	5.2.6
Visit Modules (C.3)	Visit Relationship (C.3.1)	5.2.7
Visit Modules (C.3)	Visit Admission (C.3.4)	5.2.8
Patient Modules (C.2)	Patient Relationship (C.2.1)	5.2.9
Patient Modules (C.2)	Patient Identification (C.2.2)	5.2.10
Patient Modules (C.2)	Patient Demographic (C.2.3)	5.2.11
Patient Modules (C.2)	Patient Medical (C.2.4)	5.2.12

Each of the Modules listed above is outlined in detail in the section listed in the Reference column of the table.

5.2 WORKLIST QUERY MODULE DEFINITIONS

This section provides details about each module in the Modality Worklist Information Model and how it is processed and interpreted by Mac-Lab/CardioLab. For more information about matching and return keys, refer to DICOM Standard PS 3.4 (Service Class Specifications).

For each module outlined in the sections that follow, the Request Expectations column indicates the expectations that the SCP has regarding the contents of this field in the FIND request. The Response Disposition column indicates how the SCP processes this

field and what value, if any, may be returned. If the Request does not include the field, then the field is not sent in the Response. If the Request contains a Type 2 or Type 3 element and the Response Disposition shows "No value returned" for that field, then the Response will include the field, but the field will have no value (i.e., it will be blank).

5.2.1 SOP Common Module

TABLE 5-2
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Specific Character Set	(0008,0005)	O	1C	See Note below	See Note below

Note: For request messages, the Specific Character Set (0008,0005) value is used to interpret text fields as specified in DICOM Standard PS 3.5.

For response messages, the Specific Character Set (0008,0005) field is set and applied to the response message based on the configured Text Encoding setting for the Imaging System that sent the request.

Refer to Section 2.7 for more information, including a list of supported character sets.

5.2.2 Scheduled Procedure Step Module

TABLE 5-3
SCHEDULED PROCEDURE STEP MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Scheduled Procedure Step Sequence	(0040,0100)	R	1	Sequence Matching supported	Only one sequence will be returned
>Scheduled Station AE Title	(0040,0001)	R	1	Single Value Matching supported.	AE Title configured for X-ray Imaging System or Ultrasound Imaging System sent. See Note 1 below.
>Scheduled Station Name	(0040,0010)	O	2	No matching	No value returned
>Scheduled Procedure Step Location	(0040,0011)	O	2	No matching	No value returned
>Scheduled Procedure Step Start Date	(0040,0002)	R	1	Single Value Matching and Range Matching supported	Study Date sent
>Scheduled Procedure Step Start Time	(0040,0003)	R	1	Single Value Matching supported. Range matching is *not* supported.	Study Time sent

>Scheduled Procedure Step End Date	(0040,0004)	O	3	No matching	No value returned
>Scheduled Procedure Step End Time	(0040,0005)	O	3	No matching	No value returned
>Scheduled Performing Physician's Name	(0040,0006)	R	2	**No matching supported. Field is treated as Return Key Attribute. See Note 3 below.**	Scheduled Performing Physician sent. See Note 2 below.
>Scheduled Performing Physician Identification Sequence	(0040,000B)	O	3	No matching	No value returned
>Scheduled Procedure Step Description	(0040,0007)	O	1C	No matching	Scheduled Procedure Description sent. See Note 2 below.
>Scheduled Protocol Code Sequence	(0040,0008)	O	1C	No matching	No value returned
>Scheduled Procedure Step ID	(0040,0009)	O	1	No matching	Scheduled Procedure Identifier sent. See Note 2 below.
>Scheduled Procedure Step Status	(0040,0020)	O	3	No matching	No value returned
>Comments on the Scheduled Procedure Step	(0040,0400)	O	3	No matching	No value returned
>Modality	(0008,0060)	R	1	Single Value Matching supported.	Modality configured for X-ray Imaging System or Ultrasound Imaging System sent. See Note 1 below.
>Requested Contrast Agent	(0032,1070)	O	2C	No matching	No value returned
>Pre-Medication	(0040,0012)	O	2C	No matching	No value returned

Note 1: The Scheduled Station AE Title (0040,0001) and Modality (0008,0060) fields in the request must either be blank (i.e., match any) or must contain the values that have been configured for either the X-ray Imaging System or the Ultrasound Imaging System on the Mac-Lab/CardioLab. If not, the response will return no matching results. The Mac-Lab/CardioLab will only provide a worklist for the X-ray Imaging System and Ultrasound Imaging System, and the AE Title and Modality for each system is configured in the Mac-Lab/CardioLab.

Note 2: The Scheduled Performing Physician, Scheduled Procedure Description, and Scheduled Procedure Identifier are entered on the *Patient Information* window on the *Worklist* tab. If no Scheduled Procedure Description is available, a default description of either "No description provided" (for scheduled procedures) or "Unscheduled procedure" (for unscheduled procedures) will be used.

Note 3: The Scheduled Performing Physician's Name (0040,0006) field does not support matching. If either a value or a blank entry is sent in the Scheduled Performing Physician's Name (0040,0006) field in the Request, the Scheduled Performing Physician (as entered on the *Worklist* tab) is sent in the Response.

5.2.3 Requested Procedure Module

TABLE 5-4
REQUESTED PROCEDURE MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Requested Procedure ID	(0040,1001)	O	1	No matching	Requested Procedure Identifier sent. See Note below.
Reason for the Requested Procedure	(0040,1002)	O	3	No matching	No value returned
Requested Procedure Comments	(0040,1400)	O	3	No matching	No value returned
Requested Procedure Code Sequence	(0032,1064)	O	1C	No matching	No value returned
Study Instance UID	(0020,000D)	O	1	No matching	Study Instance UID sent
Referenced Study Sequence	(0008,1110)	O	2	No matching	No value returned
Requested Procedure Description	(0032,1060)	O	1C	No matching	Requested Procedure Description sent. See Note below.
Requested Procedure Priority	(0040,1003)	O	2	No matching	No value returned
Patient Transport Arrangements	(0040,1004)	O	2	No matching	No value returned
Requested Procedure Location	(0040,1005)	O	3	No matching	No value returned
Confidentiality Code	(0040,1008)	O	3	No matching	No value returned
Reporting Priority	(0040,1009)	O	3	No matching	No value returned
Names of Intended Recipients of Results	(0040,1010)	O	3	No matching	No value returned
Intended Recipients of Results Identification Sequence	(0040,1011)	O	3	No matching	No value returned

Note: The Requested Procedure Identifier and Requested Procedure Description are entered on the *Patient Information* window on the *Worklist* tab. If no Requested Procedure Description is available, a default description of either "No description provided" (for scheduled procedures) or "Unscheduled procedure" (for unscheduled procedures) will be used.

5.2.4 Imaging Service Request Module

TABLE 5-5
IMAGING SERVICE REQUEST MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Reason for the Imaging Service Request	(0040,2001)	O	3	No matching	No value returned
Imaging Service Request Comments	(0040,2400)	O	3	No matching	No value returned
Requesting Physician	(0032,1032)	O	2	No matching	Requesting Physician sent. See Note 1 below.
Requesting Physician Identification Sequence	(0032,1031)	O	3	No matching	No value returned
Referring Physician's Name	(0008,0090)	O	2	No matching	Referring Physician Name sent. See Note 2 below.
Referring Physician Identification Sequence	(0008,0096)	O	3	No matching	No value returned
Requesting Service	(0032,1033)	O	3	No matching	No value returned
Accession Number	(0008,0050)	O	2	No matching	Accession Number sent. See Note 3 below.
Issue Date of Imaging Service Request	(0040,2004)	O	3	No matching	No value returned
Issue Time of Imaging Service Request	(0040,2005)	O	3	No matching	No value returned
Placer Order Number / Imaging Service Request	(0040,2016)	O	3	No matching	No value returned
Filler Order Number / Imaging Service Request	(0040,2017)	O	3	No matching	No value returned
Order entered by ...	(0040,2008)	O	3	No matching	No value returned
Order Enterer's Location	(0040,2009)	O	3	No matching	No value returned
Order Callback Phone Number	(0040,2010)	O	3	No matching	No value returned

Note 1: There is no user interface to enter a value for the Requesting Physician (0032,1032), so unless the field was populated through some other method, no value will be returned. This functionality is provided for future use.

Note 2: The Referring Physician Name is entered on the *Patient Information* window on the *Worklist* tab.

Note 3: The Accession Number is entered on the *Orders* window.

5.2.5 Visit Identification Module

TABLE 5-6
VISIT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Institution Name	(0008,0080)	O	3	No matching	No value returned
Institution Address	(0008,0081)	O	3	No matching	No value returned
Institution Code Sequence	(0008,0082)	O	3	No matching	No value returned
Admission ID	(0038,0010)	O	2	No matching	No value returned
Issuer of Admission ID	(0038,0011)	O	3	No matching	No value returned

5.2.6 Visit Status Module

TABLE 5-7
VISIT STATUS MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Visit Status ID	(0038,0008)	O	3	No matching	No value returned
Current Patient Location	(0038,0300)	O	2	No matching	No value returned
Patient's Institution Residence	(0038,0400)	O	3	No matching	No value returned
Visit Comments	(0038,4000)	O	3	No matching	No value returned

5.2.7 Visit Relationship Module

TABLE 5-8
VISIT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Referenced Study Sequence	(0008,1110)	O	3	No matching	No value returned
Referenced Patient Sequence	(0008,1120)	O	2	No matching	No value returned

5.2.8 Visit Admission Module

TABLE 5-9
VISIT ADMISSION MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Referring Physician's Name	(0008,0090)	O	3	No matching	Referring Physician Name sent. See Note below.
Referring Physician's Address	(0008,0092)	O	3	No matching	No value returned

Referring Physician's Telephone Numbers	(0008,0094)	O	3	No matching	No value returned
Referring Physician Identification Sequence	(0008,0096)	O	3	No matching	No value returned
Admitting Diagnoses Description	(0008,1080)	O	3	No matching	No value returned
Admitting Diagnoses Code Sequence	(0008,1084)	O	3	No matching	No value returned
Route of Admissions	(0038,0016)	O	3	No matching	No value returned
Admitting Date	(0038,0020)	O	3	No matching	No value returned
Admitting Time	(0038,0021)	O	3	No matching	No value returned

Note: The Referring Physician Name is entered on the *Patient Information* window on the *Worklist* tab.

5.2.9 Patient Relationship Module

TABLE 5-10
PATIENT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Referenced Study Sequence	(0008,1110)	O	3	No matching	No value returned
Referenced Visit Sequence	(0008,1125)	O	3	No matching	No value returned
Referenced Patient Alias Sequence	(0038,0004)	O	3	No matching	No value returned

5.2.10 Patient Identification Module

TABLE 5-11
PATIENT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Patient's Name	(0010,0010)	R	1	Single Value Matching and Wild Card Matching supported. Matching is case insensitive.	Patient’s Name sent. See Note below.
Patient ID	(0010,0020)	R	1	Single Value Matching supported	Patient’s MRN sent
Issuer of Patient ID	(0010,0021)	O	3	No matching	No value returned
Other Patient Ids	(0010,1000)	O	3	No matching	No value returned
Other Patient Names	(0010,1001)	O	3	No matching	No value returned
Patient's Birth Name	(0010,1005)	O	3	No matching	No value returned

Patient's Mother's Birth Name	(0010,1060)	O	3	No matching	No value returned
Medical Record Locator	(0010,1090)	O	3	No matching	No value returned

Note: A Patient's Name (0010,0010) in Mac-Lab/CardioLab consists of a First (Given) Name, Middle Name, and Last (Family) Name. The complete name is always sent using only the first component group (single-byte), even if the name might contain characters that are not truly single-byte (e.g., in Japan or China). Since it is possible for the full Patient's Name in Mac-Lab/CardioLab to be longer than 64 characters, the name that is sent is truncated at 64 characters if necessary.

5.2.11 Patient Demographic Module

TABLE 5-12
PATIENT DEMOGRAPHIC MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Patient's Age	(0010,1010)	O	3	No matching	No value returned
Occupation	(0010,2180)	O	3	No matching	No value returned
Patient Data Confidentiality Constraint Description	(0040,3001)	O	2	No matching	No value returned
Patient's Birth Date	(0010,0030)	O	2	No matching	Patient's Date of Birth sent
Patient's Birth Time	(0010,0032)	O	3	No matching	No value returned
Patient's Sex	(0010,0040)	O	2	No matching	Patient's Gender sent. Value will always be "F", "M", or blank.
Patient's Insurance Plan Code Sequence	(0010,0050)	O	3	No matching	No value returned
Patient's Primary Language Code Sequence	(0010,0101)	O	3	No matching	No value returned
Patient's Size	(0010,1020)	O	3	No matching	Patient's Height in meters sent
Patient's Weight	(0010,1030)	O	2	No matching	Patient's Weight in kilograms sent
Patient's Address	(0010,1040)	O	3	No matching	Patient's Address sent. See Note 1 below.
Military Rank	(0010,1080)	O	3	No matching	No value returned
Branch of Service	(0010,1081)	O	3	No matching	No value returned
Country of Residence	(0010,2150)	O	3	No matching	No value returned
Region of Residence	(0010,2152)	O	3	No matching	No value returned

Patient's Telephone Numbers	(0010,2154)	O	3	No matching	Patient's Home Phone Number is sent
Ethnic Group	(0010,2160)	O	3	No matching	No value returned
Patient's Religious Preference	(0010,21F0)	O	3	No matching	No value returned
Patient Comments	(0010,4000)	O	3	No matching	Patient Comments sent. See Note 2 below.

Note 1: A Patient's Address in Mac-Lab/CardioLab is recorded as follows:

- Address Line 1 ("Addr1")
- Address Line 2 ("Addr2")
- City
- State
- Postal Code ("PostalCode")
- Country

To return this value in the Patient's Address (0010,1040) field, the individual fields are concatenated together using space separators to form a single value as follows:

- *Addr1 Addr2 City State PostalCode Country*

Because the Patient's Address (0010,1040) field is limited to 64 characters, this field is truncated if necessary. If it is truncated, the rightmost portion (first Country, then PostalCode, then State, etc.) of the address string is lost.

Note 2: There is no user interface to enter a value for the Patient Comments (0010,4000), so unless the field was populated through some other method (e.g., MWL FIND request), no value will be returned. This functionality is provided for future use.

5.2.12 Patient Medical Module

TABLE 5-13
PATIENT MEDICAL MODULE ATTRIBUTES

Attribute Name	Tag	Matching Key Type	Return Key Type	Request Expectations	Response Disposition
Medical Alerts	(0010,2000)	O	2	No matching	Medical Alerts sent. See Note below.
Contrast Allergies	(0010,2110)	O	2	No matching	No value returned
Smoking Status	(0010,21A0)	O	3	No matching	No value returned
Additional Patient History	(0010,21B0)	O	3	No matching	Additional Patient History sent. See Note below.
Pregnancy Status	(0010,21C0)	O	2	No matching	Pregnancy Status sent. See Note below.

Last Menstrual Date	(0010,21D0)	O	3	No matching	No value returned
Special Needs	(0038,0050)	O	2	No matching	No value returned
Patient State	(0038,0500)	O	2	No matching	No value returned

Note: There is no user interface to enter a value for Medical Alerts (0010,2000), Additional Patient History (0010,21B0), or Pregnancy Status (0010,21C0), so unless the field was populated through some other method (e.g., MWL FIND request), no value will be returned. This functionality is provided for future use.

5.3 PRIVATE DATA ATTRIBUTES

The Modality Worklist SCP supports no Private Attributes.

6. MODALITY PERFORMED PROCEDURE STEP IMPLEMENTATION (SCP)

This section describes details about the Mac-Lab/CardioLab Modality Performed Procedure Step implementation as an SCP. Refer to Section 2.3.1.3.2 for additional information.

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of the Study Management Service Class. Also, refer to DICOM Standard PS 3.3 (Information Object Definitions) for a description of the modules that are part of the Modality Performed Procedure Step Information Object.

6.1 MODALITY PERFORMED PROCEDURE STEP MODULE TABLE

The following table shows the set of modules used for the Modality Performed Procedure Step Information Model. The section numbers listed in the Module Group and Module Name columns reference DICOM Standard PS 3.3 (Information Object Definitions).

TABLE 6-1
MODALITY PERFORMED PROCEDURE STEP INFORMATION MODEL MODULES

Module Group (PS 3.3)	Module Name (PS 3.3)	Reference
General Modules (C.12)	SOP Common (C.12.1)	6.2.1
Study Modules (C.4)	Performed Procedure Step Relationship (C.4.13)	6.2.2
Study Modules (C.4)	Performed Procedure Step Information (C.4.14)	6.2.3
Study Modules (C.4)	Image Acquisition Results (C.4.15)	6.2.4
Study Modules (C.4)	Radiation Dose (C.4.16)	6.2.5
Study Modules (C.4)	Billing and Material Management Code (C.4.17)	6.2.6

Each of the Modules listed above is outlined in detail in the section listed in the Reference column of the table.

6.2 MODALITY PERFORMED PROCEDURE STEP MODULE DEFINITIONS

Please refer to DICOM Standard PS 3.3 (Information Object Definitions) for a description of each of the attributes contained within the Modality Performed Procedure Step Information Object Definition.

6.2.1 SOP Common Module

TABLE 6-2
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Specific Character Set	(0008,0005)	1C	-	See Note below

Note: The Specific Character Set (0008,0005) value is used to interpret text fields in the request message as specified in DICOM Standard PS 3.5. Refer to Section 2.7 for more information, including a list of supported character sets.

6.2.2 Performed Procedure Step Relationship Module

TABLE 6-3
PERFORMED PROCEDURE STEP RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Patient's Name	(0010,0010)	2	-	Value is not processed
Patient ID	(0010,0020)	2	-	Value is not processed
Patient's Birth Date	(0010,0030)	2	-	Value is not processed
Patient's Sex	(0010,0040)	2	-	Value is not processed
Referenced Patient Sequence	(0008,1120)	2	-	Value is not processed
>Referenced SOP Class UID	(0008,1150)			Value is not processed
>Referenced SOP Instance UID	(0008,1155)			Value is not processed
Scheduled Step Attributes Sequence	(0040,0270)	1	-	Value is not processed
>Study Instance UID	(0020,000D)	1	-	Value is compared against SOP Instance UID for current study. If values do not match, the request is discarded.
>Referenced Study Sequence	(0008,1110)	2	-	Value is not processed
>>Referenced SOP Class UID	(0008,1150)			Value is not processed
>>Referenced SOP Instance UID	(0008,1155)			Value is not processed
>Accession Number	(0008,0050)	2	-	Value is not processed
>Placer Order Number/Imaging Service Request	(0040,2016)	3	-	Value is not processed
>Filler Order Number/Imaging Service Request	(0040,2017)	3	-	Value is not processed
>Requested Procedure ID	(0040,1001)	2	-	Value stored as Requested Procedure ID. See Note below.
>Requested Procedure Description	(0032,1060)	2	-	Value stored as Requested Procedure Description. See Note below.
>Scheduled Procedure Step ID	(0040,0009)	2	-	Value stored as Scheduled Procedure Step ID. See Note below.
>Scheduled Procedure Step Description	(0040,0007)	2	-	Value stored as Scheduled Procedure Step Description. See Note below.
>Scheduled Protocol Code Sequence	(0040,0008)	2	-	Value is not processed

>> 'Code Sequence Macro'				Value is not processed

Note: Values are stored for the noted field, but there is no user interface provided to view the stored values. This functionality is provided for future use.

6.2.3 Performed Procedure Step Information Module

TABLE 6-4
PERFORMED PROCEDURE STEP INFORMATION MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Performed Station AE Title	(0040,0241)	1	-	Value stored as Performed Station AE Title. See Note below.
Performed Station Name	(0040,0242)	2	-	Value stored as Performed Station Name. See Note below.
Performed Location	(0040,0243)	2	-	Value stored as Performed Location. See Note below.
Performed Procedure Step Start Date	(0040,0244)	1	-	Value stored as Performed Procedure Step Start Date. See Note below.
Performed Procedure Step Start Time	(0040,0245)	1	-	Value stored as Performed Procedure Step Start Time. See Note below.
Performed Procedure Step ID	(0040,0253)	1	-	Value stored as Performed Procedure Step ID. See Note below.
Performed Procedure Step End Date	(0040,0250)	2	3	Value stored as Performed Procedure Step End Date. See Note below.
Performed Procedure Step End Time	(0040,0251)	2	3	Value stored as Performed Procedure Step End Time. See Note below.
Performed Procedure Step Status	(0040,0252)	1	3	Value stored as Performed Procedure Step Status. See Note below.
Performed Procedure Step Description	(0040,0254)	2	3	Value stored as Performed Procedure Step Description. See Note below.
Comments on the Performed Procedure Step	(0040,0280)	3	3	Value is not processed
Performed Procedure Type Description	(0040,0255)	2	3	Value stored as Performed Procedure Type Description. See Note below.
Procedure Code Sequence	(0008,1032)	2	3	Value is not processed
> 'Code Sequence Macro'				Value is not processed
Performed Procedure Step Discontinuation Reason Code Sequence	(0040,0281)	3	3	Value is not processed
> 'Code Sequence Macro'				Value is not processed

Note: Values are stored for the noted field, but there is no user interface provided to view the stored values. This functionality is provided for future use.

6.2.4 Image Acquisition Results Module

TABLE 6-5
IMAGE ACQUISITION RESULTS MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Modality	(0008,0060)	1	-	Value is compared against configured Modality for the X-ray Imaging System. If values do not match, the request is discarded.
Study ID	(0020,0010)	2	-	Value is not processed
Performed Protocol Code Sequence	(0040,0260)	2	3	Value is not processed
> *'Code Sequence Macro'*				Value is not processed
Performed Series Sequence	(0040,0340)	2	3	Value is not processed
>Performing Physician's Name	(0008,1050)	2	2	Value is not processed
>Operator's Name	(0008,1070)	2	2	Value is not processed
>Protocol Name	(0018,1030)	1	1	Value is not processed
>Series Instance UID	(0020,000E)	1	1	Value is not processed
>Series Description	(0008,103E)	2	2	Value is not processed
>Retrieve AE Title	(0008,0054)	2	2	Value is not processed
>Referenced Image Sequence	(0008,1140)	2	2	Value is not processed
>>Referenced SOP Class UID	(0008,1150)	1	1	Value is not processed
>>Referenced SOP Instance UID	(0008,1155)	1	1	Value is not processed
>Referenced Non-Image Composite SOP Instance Sequence	(0040,0220)	2	2	Value is not processed
>>Referenced SOP Class UID	(0008,1150)	1	1	Value is not processed
>>Referenced SOP Instance UID	(0008,1155)	1	1	Value is not processed

6.2.5 Radiation Dose Module

TABLE 6-6
RADIATION DOSE MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Anatomic Structure, Space or Region Sequence	(0008,2229)	3	3	Value is not processed
> *'Code Sequence Macro'*		3	3	Value is not processed
Total Time of Fluoroscopy	(0040,0300)	3	3	Value stored in database as Total Fluoro Time. See Note below.
Total Number of Exposures	(0040,0301)	3	3	Value stored in database as Total Runs. See Note below.

Distance Source to Detector (SID)	(0018,1110)	3	3	Value is not processed
Distance Source to Entrance	(0040,0306)	3	3	Value is not processed
Entrance Dose	(0040,0302)	3	3	Value is not processed
Entrance Dose in mGy	(0040,8302)	3	3	Value is not processed
Exposed Area	(0040,0303)	3	3	Value is not processed
Image Area Dose Product	(0018,115E)	3	3	Value stored in database as Exam Total DAP. See Note below.
Comments on Radiation Dose	(0040,0310)	3	3	Value is not processed
Exposure Dose Sequence	(0040,030E)	3	3	Value is not processed
>Radiation Mode	(0018,115A)	3	3	Value is not processed
>KVp	(0018,0060)	3	3	Value is not processed
>X-ray Tube Current in µA	(0018,8151)	3	3	Value is not processed
>Exposure Time	(0018,1150)	3	3	Value is not processed
>Filter Type	(0018,1160)	3	3	Value is not processed
>Filter Material	(0018,7050)	3	3	Value is not processed

Note: The Total Time of Fluoroscopy (0040,0300), Total Number of Exposures (0040,0301), and Image Area Dose Product (0018,115E) fields are stored using either *Overwrite* mode or *Append* mode. In *Overwrite* mode, when a value is received for one of these fields, the existing stored value, if any, is overwritten with the new value. In *Append* mode, the existing value is incremented by the new value. Unless the Mac-Lab/CardioLab system is reconfigured, the mode is *Overwrite*. *Append Mode* can be toggled on or off from the *Remote Hosts* tab on the *Connectivity* page of the *System Settings* window.

6.2.6 Billing and Material Management Codes Module

TABLE 6-7
BILLING AND MATERIAL MANAGEMENT CODES MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Billing Procedure Step Sequence	(0040,0320)	3	3	Value is not processed
> 'Code Sequence Macro'		3	3	Value is not processed
Film Consumption Sequence	(0040,0321)	3	3	Value is not processed
>Number of Films	(2100,0170)	3	3	Value is not processed
>Medium Type	(2000,0030)	3	3	Value is not processed
>Film Size ID	(2010,0050)	3	3	Value is not processed
Billing Supplies and Devices Sequence	(0040,0324)	3	3	Value is not processed
>Billing Item Sequence	(0040,0296)	3	3	Value is not processed
>> 'Code Sequence Macro'		3	3	Value is not processed

>Quantity Sequence	(0040,0293)	3	3	Value is not processed
>>Quantity	(0040,0294)	3	3	Value is not processed
>>Measuring Units Sequence	(0040,0295)	3	3	Value is not processed
>>> *'Code Sequence Macro'*		3	3	Value is not processed

6.3 STANDARD EXTENDED AND PRIVATE DATA ATTRIBUTES

The Product supports the Private Attributes defined in the following sections in Standard Extended MPPS Instances as Type 3 data elements in the N-SET request.

6.3.1 Private Group GEMS_DL_STUDY_01

Private Group GEMS_DL_STUDY_01 is modeled as part of the Modality Performed Procedure Step Information Entity.

TABLE 6-8
PRIVATE GROUP GEMS_DL_STUDY_01

Attribute Name	Tag	VR	VM	Attribute Description and Use
Private Creator Identification	(0015,00xx)	LO	1	GEMS_DL_STUDY_01
Fluoro DAP (Dose Area Product)	(0015,xx82)	DS	1	Value stored in database as Fluoro DAP. Units are $dGycm^2$. See Note below.
Cine DAP	(0015,xx84)	DS	1	Value stored in database as Cine DAP. Units are $dGycm^2$. See Note below.

Note: The Fluoro DAP (Dose Area Product) (0015,xx82) and Cine DAP (0015,xx84) fields are stored using either *Overwrite* mode or *Append* mode. In *Overwrite* mode, when a value is received for one of these fields, the existing stored value, if any, is overwritten with the new value. In *Append* mode, the existing value is incremented by the new value. Unless the Mac-Lab/CardioLab system is reconfigured, the mode is *Overwrite*. *Append Mode* can be toggled on or off from the *Remote Hosts* tab on the *Connectivity* page of the *System Settings* window.

6.3.2 Private Group GEMS_DLX_DOSE_01

Private Group GEMS_DLX_DOSE_01 is modeled as part of the Modality Performed Procedure Step Information Entity.

TABLE 6-9
PRIVATE GROUP GEMS_DLX_DOSE_01

Attribute Name	Tag	VR	VM	Attribute Description and Use
Private Creator Identification	(0027,00xx)	LO	1	GEMS_DLX_DOSE_01
Private Radiation Dose Sequence	(0027,xx01)	SQ	1	One sequence for each image run acquired. The set of data is stored for each acquired image run. See Note below.
>Run Number	(0027,xx02)	IS	1	Stored in database as image Run
>Run Time	(0027,xx03)	TM	1	Stored in database as image Time

>Number of Frames	(0027,xx04)	IS	1	Stored in database as image Frames
>Frames per Second	(0027,xx05)	DS	1	Stored in database as image FPS
>Plane	(0027,xx06)	CS	1	Stored in database as image Plane. Enumerated values are “FR” and “LT”.
>KV	(0027,xx07)	DS	1	Stored in database as image kV
>MA	(0027,xx08)	DS	1	Stored in database as image mA. Value is rounded to nearest integer.
>Mas	(0027,xx09)	DS	1	Stored in database as image mAs. Value is rounded to nearest integer. There is no user interface to view this value.
>Ms	(0027,xx10)	DS	1	Stored in database as image mS. Value is rounded to nearest integer.
>Angulation	(0027,xx11)	DS	1	Stored in database as image Angulation (RAO/LAO). Value is rounded to nearest integer.
>Rotation	(0027,xx12)	DS	1	Stored in database as image Rotation (CRA/CAU). Value is rounded to nearest integer.
>Focal Distance	(0027,xx13)	DS	1	Stored in database as image SID. Units are centimeters. Value is rounded to nearest integer.
>Image Intensifier Mode	(0027,xx14)	DS	1	Stored in database as image FOV. Units are centimeters. Value is rounded to nearest integer.

Note: The set of attributes for each image run will be stored using either *Overwrite* mode or *Append* mode. In *Overwrite* mode, all existing image run data is discarded and replaced with the new information. In *Append* mode, the new image run information is added to any existing image run information. Unless the Mac-Lab/CardioLab system is reconfigured, the mode is *Overwrite*. *Append Mode* can be toggled on or off from the *Remote Hosts* tab on the *Connectivity* page of the *System Settings* window.

6.4 STANDARD EXTENDED AND PRIVATE CONTEXT GROUPS

The Mac-Lab/CardioLab supports no coded terminology using Standard Extended, Private, and Configurable Context Groups.

7. MODALITY PERFORMED PROCEDURE STEP NOTIFICATION IMPLEMENTATION (SCP)

This section describes details about the Mac-Lab/CardioLab Modality Performed Procedure Step Notification implementation as an SCP. Refer to Section 2.3.1.2.4 for additional information.

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of the Procedure Step SOP Classes. Also, refer to DICOM Standard PS 3.3 (Information Object Definitions) for a description of the modules that are part of the Modality Performed Procedure Step Notification Information Object.

7.1 MODALITY PERFORMED PROCEDURE STEP NOTIFICATION MODULE TABLE

There are no modules associated with the Modality Performed Procedure Step Notification SOP Class. The N-EVENT-REPORT notification message sent by the Mac-Lab/CardioLab system consists of only a few essential fields, which will be described in the next section.

7.2 MODALITY PERFORMED PROCEDURE STEP NOTIFICATION MODULE DEFINITIONS

As noted above, there are no modules associated with the Modality Performed Procedure Step Notification SOP Class. This section will describe only the contents of the N-EVENT-REPORT request message, as described in DICOM Standard PS 3.7, Section 10.1.1 "N-EVENT-REPORT SERVICE", and Section 10.3.1 "N-EVENT-REPORT PROTOCOL".

7.2.1 N-EVENT-REPORT Request

TABLE 7-1
N-EVENT-REPORT-RQ ATTRIBUTES

Message Field	Tag	Req/Ind	Use
Message ID	(0000,0110)	M	Value that identifies this message.
Affected SOP Class UID	(0000,0002)	M	Always "1.2.840.10008.3.1.2.3.5".
Affected SOP Instance UID	(0000,1000)	M	UID value for the SOP Instance.
Event Type ID	(0000,1002)	M	Always 1 ("Performed Procedure Step In Progress").
Event Information	(no tag)	U	No additional event information sent.

Note: In the table above, for the "Req/Ind" column, "M" means the field is mandatory, and "U" means the field is optional (user option).

The Response message is not described here, as only the Status field is examined in the response, as detailed in 2.3.1.2.4.2.1.

7.3 STANDARD EXTENDED AND PRIVATE DATA ATTRIBUTES

The Modality Performed Procedure Step Notification SCP supports no Private Attributes.