GE Healthcare

Technical Publications

Direction DOC1164744
Revision 1

Centricity Cardio Workflow V5.0
DICOM CONFORMANCE STATEMENT

CONFORMANCE STATEMENT OVERVIEW

The Centricity Cardio Workflow DICOM Service (CCW-DicomServer) is a software solution to integrate DICOM-based medical devices into the Centricity Cardio Workflow CVIS cardiological department solution.

The Centricity Cardio Workflow DICOM Service is an open system, with all of its interfaces defined by international and industry standards. DICOM is the fundamental standard through which the Centricity Cardio Workflow DICOM Service communicates with other devices. DICOM protocols are used for sending demographic data to and receiving study data from the connected devices.

Table 0.1 provides an overview of the network services supported by Centricity Cardio Workflow.

Table 0.1 – NETWORK SERVICES

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

GE Healthcare

TABLE OF CONTENTS

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

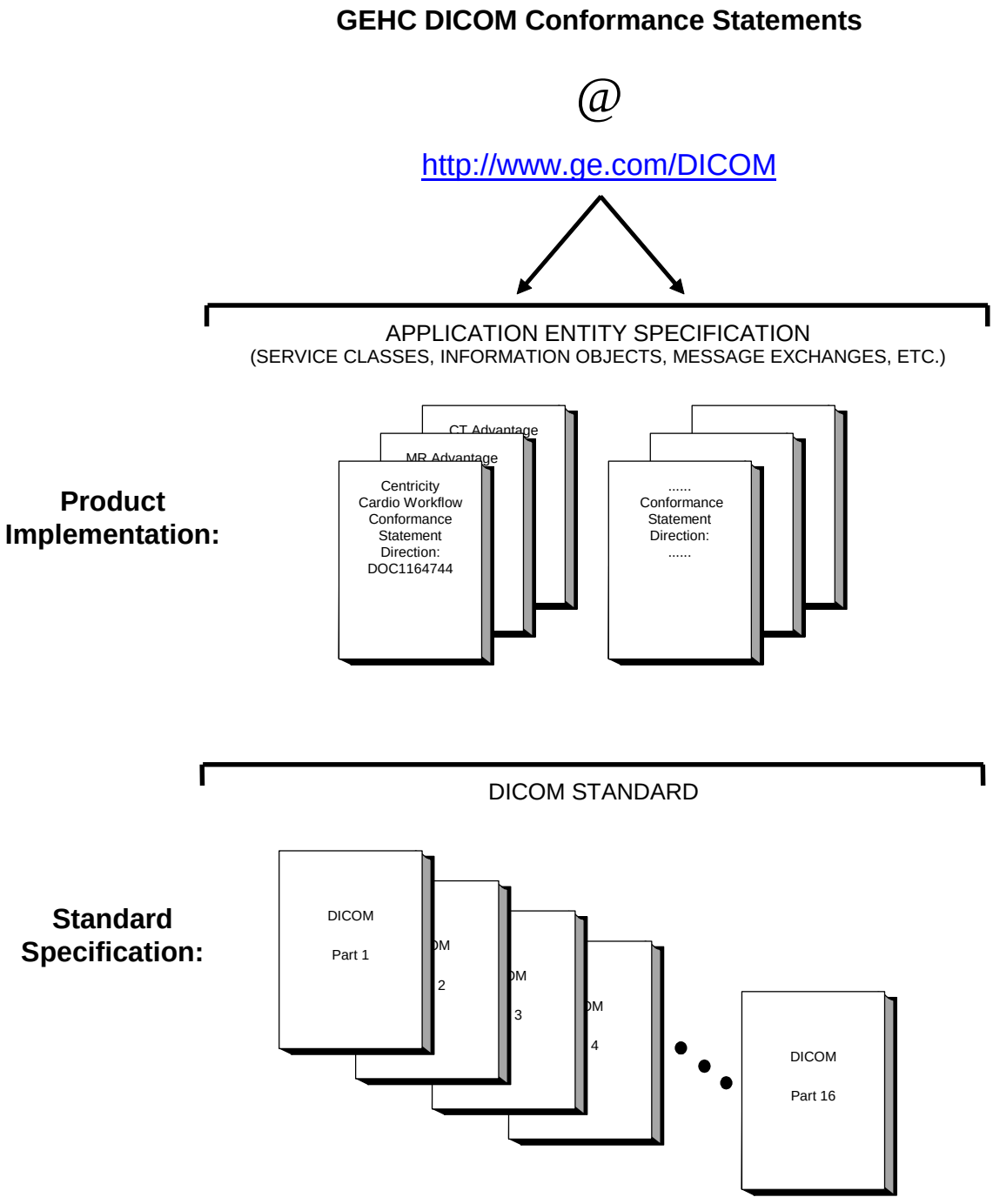
Section 2 (Network Conformance Statement), which specifies the GE Healthcare equipment compliance to the DICOM requirements for the implementation of Networking features.

Section 3 (Modality Worklist Information Model), which specifies the GE Healthcare equipment compliance to DICOM requirements for the implementation of the Modality Worklist Query/Retrieve service.

Section 4 (Modality Performed Procedure Step), which specifies the GE Healthcare equipment compliance to DICOM requirements for the implementation of a Modality Performed Procedure Step Service.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GE Healthcare Conformance Statements and their relationship with the DICOM Conformance Statements is shown in the Illustration below.



This document specifies the DICOM implementation. It is entitled:

Centricity Cardio Workflow V5.0

Conformance Statement for DICOM
Direction DOC1164744

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 definitons 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
DICOM	Digital Imaging and Communications in Medicine
DHCP	Dynamic Host Configuration Protocol
HIS	Hospital Information System
HL7	Health Level 7 Standard
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO	International Organization for Standards
JPEG	Joint Photographic Experts Group
MPEG	Moving Picture Experts Group
MPPS	Modality Performed Procedure Step
MR	Magnetic Resonance Imaging
MSPS	Modality Scheduled Procedure Step
MWL	Modality Worklist
OSI	Open Systems Interconnection
PACS	Picture Archiving and Communication System
RIS	Radiology Information System
SC	Secondary Capture
SCP	Service Class Provider

SCU	Service Class User
SOP	Service-Object Pair
SPS	Scheduled Procedure Step
SR	Structured Reporting
TCP/IP	Transmission Control Protocol/Internet Protocol
US	Ultrasound
VR	Value Representation
XA	X-ray Angiography
CCW-DicomServer	Centricity Cardio Workflow DICOM Service

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant **Networking** features on this GE Healthcare product.

2.2 IMPLEMENTATION MODEL

2.2.1 Application Data Flow Diagram

The Basic and Specific Application models for this device are shown in the following Illustration:

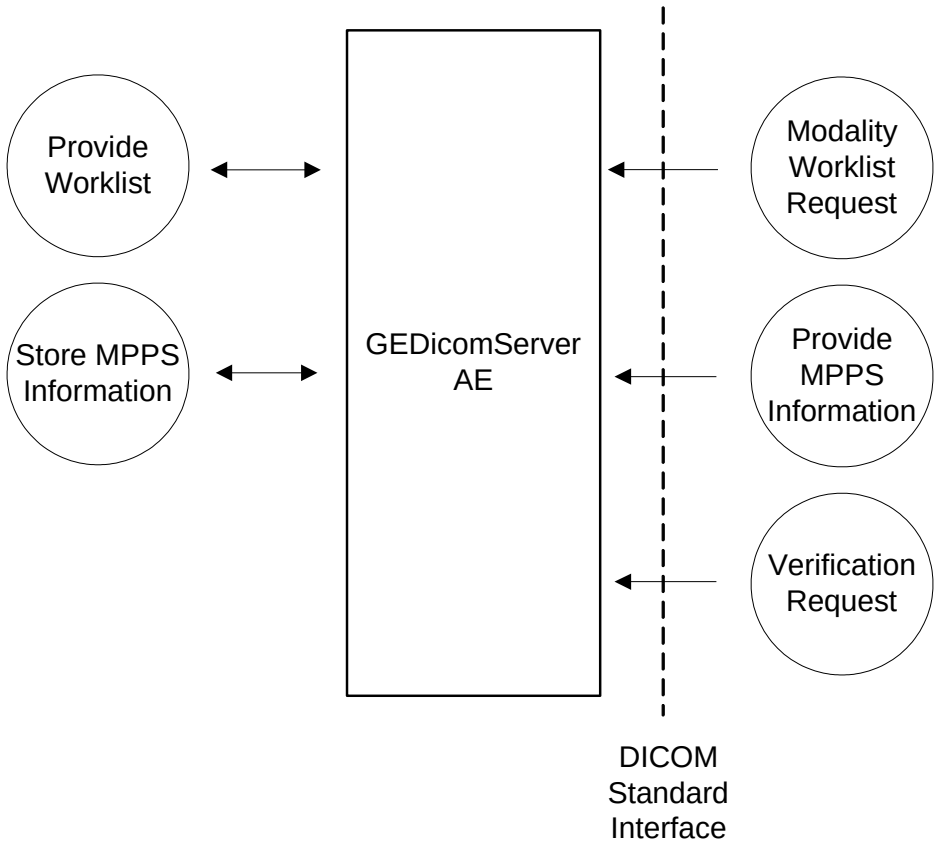


FIGURE 1 CENTRICITY CARDIO WORKFLOW SERVICE V5.0 IMPLEMENTATION MODEL DATA FLOW DIAGRAM

The CCW-DicomServer Application Entity (AE) is an application, which handles DICOM protocol communication. CCW-DicomServer is part of the Centricity Cardio Workflow – System.

All remote DICOM AEs must be manually configured at the Centricity Cardio Workflow DICOM Service, usually during software installation, by a GE field engineer.

If any of the configured AE's asks for a worklist, the Centricity Cardio Workflow DICOM Service provides a list with all Scheduled Procedures. This list will be built up based on the query details of the MWL request.

For backwards compatibility, the DICOM worklist functionality for a certain AE may be limited, by configuration, as follows:
If any of the configured AE's asks for a worklist, the Centricity Cardio Workflow DICOM Service sends a list with the actually planned patient for this AE. At any time in the Centricity Cardio Workflow –System, there is only one or no patient scheduled for this AE. So, all query – input from an AE is ignored and only the AE Title counts. Every worklist includes a maximum of one patient/Requested Procedure.

If an AE has retrieved/selected a patient (Requested Procedure) from the worklist and after the examination was performed, dosage information can be sent from the AE via MPPS to the Centricity Cardio Workflow DICOM Service. The data gets stored in the Centricity Cardio Workflow database, then.

2.2.2 Functional Definition of AEs

The CCW-DicomServer Application Entity supports the following three SCP functions:

1. Send Worklist
    - Verify the configuration for the requesting AE in the internal database
    - Accept a DICOM association to receive a worklist request
    - Search for scheduled Examinations (Requests)
    - Build a DICOM formatted basic worklist management response
    - Send the response message to the remote AE
2. Store MPPS Information
    - Verify the configuration for the requesting AE in the internal database
    - Accept a DICOM MPPS N-CREATE message
    - Verify the StudyInstanceUID
    - Create a local database entry for the study data (status / dosage information)
    - Send the response – message to the AE
    - Accept multiple DICOM MPPS-N-SET commands
    - Verify the configuration for this AE
    - Verify the StudyInstanceUID
    - Check the MPPS – state
    - IF "IN PROGRESS": Update the local status of the examination.

- IF "COMPLETE" or "DISCONTINUED": Update the local status of the examination in the Centricity Cardio Workflow database and import dosage information (if available).

3. Verification

- Responds to incoming C-ECHO-RQ messages by returning a C-ECHO-RSP message with a related status (e.g. SUCCESS).

2.2.3 Sequencing of Real-World Activities

Non Applicable.

2.3 AE SPECIFICATIONS

2.3.1 CCW-DicomServer AE Specification

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

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

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 negotiation is included in all association establishment requests.

The maximum length PDU for an association initiated by CCW-DicomServer is:

Maximum Length PDU	>16K

The default setting of the maximum PDU Size: 64234

The SOP Class Extended Negotiation is not supported.

The maximum number of Presentation Context Items that will be proposed is 8

The user information Items sent by this product are:

- Maximum PDU Length
- Implementation UID
- Implementation Version Name

2.3.1.1.2 Number of Associations

The Centricity Cardio Workflow DICOM Service supports multiple associations as an SCP. By default, the maximum number of simultaneous associations is 24.

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:

CCW-DicomServer Implementation UID	1.2.840.113619.6.121

The Implementation Version Name for this DICOM Implementation is:

CCW-DicomServer Implementation Version Name	MSPDICOM_V300

2.3.1.2 Association Initiation Policy

Not applicable

2.3.1.3 Association Acceptance Policy

The default association acceptance parameters like timeouts or the TCP/IP port are configurable. Details can be found in the installation and setup manual of the CCW-DicomServer.

The default timeout value for association request/reply, network connect and network inactivity is set to 45 seconds.

2.3.1.3.1 Real-World Activity Modality Worklist Request

2.3.1.3.1.1 Associated Real-World Activity

The CCW-DicomServer Application Entity will accept an association from a remote Application Entity to query the CCW-DicomServer Application Entity for information about Scheduled Patients / Requested Procedures for the requesting Application Entity.

2.3.1.3.1.2 Accepted Presentation Context Table

Presentation Context Table - Accepted			
Abstract Syntax	**Transfer Syntax**	**Role**	**Extended**

Name	UID	Name List	UID List		Negotiation
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 Modality Worklist Information Model - FIND SOP Class

Following are the status codes the Application may send back to the SCU Equipment after performing the requested Worklist Query:

Service Status	Status Codes	Further Meaning	Status Code Explanation	Related Fields Sent Back to the SCU
Failure	C001	Unable to process	Requesting AE not configured Database Error Cannot Build Response	None
Success	0000	Matching is complete - No final identifier is supplied		None
Pending	FF00	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	None
Cancel	FE00	Matching terminated due to a cancel request.	Matching terminated due to a cancel request from the SCU.	None

2.3.1.3.1.3 Presentation Context Acceptance Criterion

There are no special criteria for accepting Query/Retrieve Presentation Contexts.

2.3.1.3.1.4 Transfer Syntax Selection Policies

Within each Presentation Context, the Centricity Cardio Workflow Dicom Service Application Entity will accept the first proposed transfer syntax that is supported.

2.3.1.3.2 Real-World Activity Modality Performed Procedure Step

2.3.1.3.2.1 Associated Real-World Activity

The CCW-DicomServer Application Entity will accept an association from a remote Application Entity (SCU) to create an instance of the Modality Performed Procedure Step SOP Class and to provide information about a specific real-world Performed Procedure Step that is under control of the SCU. For this purpose the N-CREATE and N-SET commands are used.

2.3.1.3.2.2 Accepted Presentation Context Table

Presentation Context Table – Accepted by CCW-DicomServer for Modality Performed Procedure Step					
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 Modality Performed Procedure Step SOP Class

The AE includes attributes in the Modality Performed Procedure Step N-CREATE / N-SET as described in section 4.2.1.1. For details about command specific behavior refer to section 4.2.1.2.

SOP Class	SOP Class UID	DIMSE Service Element	SCP Usage
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	N-CREATE	Used (Mandatory)
		N-SET	Used (Mandatory)

Following are the status codes the Application may send back to the SCU after processing the MPPS requests:

Service Status	Status Codes	Further Meaning	Status Code Explanation
Success	0000	Successful operation	Message successfully processed.
Failure	0110H	Internal processing Error	Internal errors in the Network-Subsystem (e.g. database not available). The Association is rejected.
	0120H	Missing Type-1 Arguments	The Centricity Cardio Workflow – System cannot store the study data in the database.

2.3.1.3.2.3 Presentation Context Acceptance Criterion

There are no special criteria for accepting MPPS Presentation Contexts.

2.3.1.3.2.4 Transfer Syntax Selection Policies

Within each Presentation Context, the Centricity Cardio Workflow DICOM Service AE will accept the first proposed transfer syntax that is supported.

2.3.1.3.3 Real-World Activity for Verification

2.3.1.3.3.1 Associated Real-World Activity

The CCW-DicomServer Application Entity will accept an association from a remote Application Entity to verify whether a DICOM association can be established between CCW-DicomServer and the remote application.

2.3.1.3.3.2 Accepted Presentation Context Table

Presentation Context Table - Accepted					
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
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

2.3.1.3.3.2.1 SOP Specific DICOM Conformance Statement for the Verification SOP Class

CCW-DicomServer provides standard conformance.

2.3.1.3.3.3 Presentation Context Acceptance Criterion

There are no special criteria for accepting Verification Presentation Contexts.

2.3.1.3.3.4 Transfer Syntax Selection Policies

Within each Presentation Context, the Centricity Cardio Workflow Dicom Service Application Entity will accept the first proposed transfer syntax that is supported.

2.4 COMMUNICATION PROFILES

2.4.1 Supported Communication Stacks (PS 3.8)

DICOM Upper Layer (PS 3.8) is supported using TCP/IP.

2.4.2 TCP/IP Stack

The TCP/IP stack is inherited from a Windows NT Server Operating System.

2.4.2.1 API

Not applicable to this product.

2.4.2.2 Physical Media Support

DICOM is indifferent to the Physical medium over which TCP/IP executes (e.g. Ethernet V2.0, IEEE 802.3, ATM, FDDI)

2.4.3 Additional Protocols

No additional protocols for system management such as DHCP are used.

2.4.4 IPv4 and IPv6 Support

This product only supports IPv4.

2.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

2.5.1 Standard Extended /Specialized/Private SOPs

2.5.1.1 Standard Extended/Specialized/Private MPPS SOP Class

Additional private Tags could be configured to be recognized by the Centricity Cardio Workflow Dicom Service.

2.6 CONFIGURATION

2.6.1 AE Title/Presentation Address Mapping

n.a

2.6.2 Configurable Parameters

The following fields are configurable for this AE (local):

- Local AE Title
- Local Listening Port Number

The following fields are configurable for every remote DICOM AE:

- Remote AE Title

The following fields are configurable:

- Maximum Length PDU
- Number of simultaneous associations
- Additional private tags in the MPPS SOP-Class

Note: A GE Field Engineer must perform all configurations.

2.7 SUPPORT OF EXTENDED CHARACTER SETS

The Centricity Cardio Workflow DICOM Service supports the ISO_IR 100 (ISO 8859-1:1987 Latin alphabet N 1. supplementary set) and the ISO_IR 192 (ISO 10646-1, 10646-2, and their associated supplements and extensions for Unicode character set as extended character sets. Any incoming SOP instance that is encoded using another extended character set will be stored in the local database but data may be unreadable because of the foreign character set.

2.8 CODES AND CONTROLLED TERMINOLOGY

2.8.1 Configurable Coded Terminology

The product allows configuration of the following sets of coded terminology:

Context Group	Default Value Set	Use
Acquisition Protocol Equipment Settings	None	Value of Scheduled Protocol Code Sequence (0040,0008) from selected Modality Worklist Scheduled Procedure Step is matched to this group for protocol-assisted equipment set-up. Selected value from this group is used in Modality Performed Procedure Step Performed Protocol Code Sequence (0040,0260)
Discontinuation Reason Codes	CID 9300	Selected value from this group is used in Modality Performed Procedure Step Performed Procedure Step Discontinuation Reason Code Sequence (0040,0281)

Procedures for configuring these Context Groups are found in the product Service Manual.

2.9 SECURITY PROFILES

The product does not conform to any defined DICOM Security Profiles.

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)).

3. MODALITY WORKLIST INFORMATION MODEL DEFINITION

3.1 INTRODUCTION

This section specifies the use of the DICOM Modality Worklist Information Model used to organize data and against which a Modality Worklist Query will be performed. The contents of this section are:

3.2 - Information Model Description

3.3 - Information Model Entity-Relationship Model

3.4 - Information Model Module Table

3.5- Information Model Keys

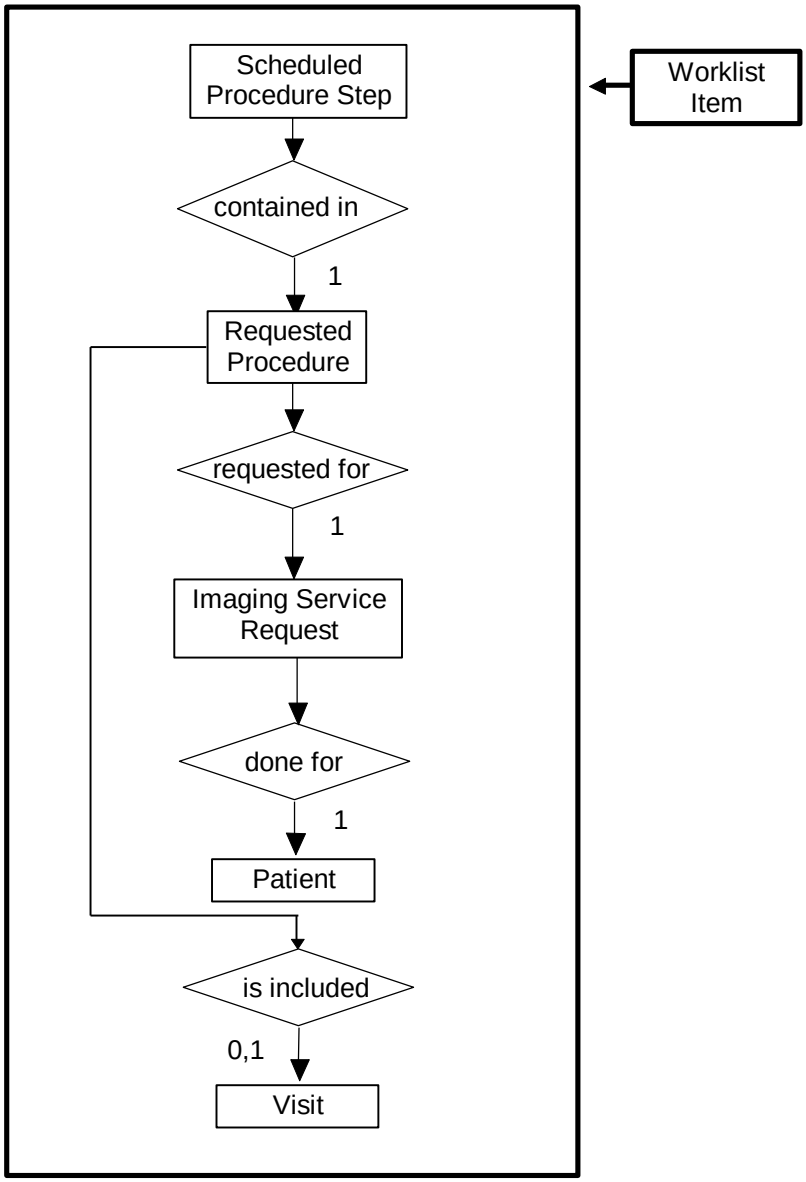
3.2 MODALITY WORKLIST INFORMATION MODEL DESCRIPTION

3.3 MODALITY WORKLIST INFORMATION MODEL ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the Modality Worklist Information Model schema is shown in Illustration 3.3-1. It represents the information that composes a Worklist Item. In this figure, the following diagrammatic convention is established to represent the information organization:

- each entity is represented by a rectangular box
- each relationship is represented by a diamond shaped box.
- the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

ILLUSTRATION 3.3-1
MODALITY WORKLIST INFORMATION MODEL E/R DIAGRAM



3.3.1 ENTITY DESCRIPTIONS

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) and PS 3.4 (Service Class Specifications) for a description of each of the Entities contained within the Modality Worklist Information Model.

3.3.2 Centricity Cardio Workflow DICOM Service Mapping of DICOM entities

TABLE 3.3.2-1
MAPPING OF DICOM ENTITIES TO CENTRICITY CARDIO WORKFLOW DICOM SERVICE ENTITIES

DICOM	Centricity Cardio Workflow DICOM Service Entity
Scheduled Procedure Step	Examination
Requested Procedure	Examination
Imaging Service Request	Examination
Visit	Admission

Patient	Patient

3.4 INFORMATION MODEL MODULE TABLE

Within an entity of the DICOM Modality Worklist Information Model, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets.

Table 3.3.2-1 identifies the defined modules within the entities, which comprise the DICOM Modality Worklist Information Model. Modules are identified by Module Name.

See DICOM PS 3.3 and PS 3.4 for a complete definition of the entities, modules, and attributes.

TABLE 3.3.2-1
MODALITY WORKLIST INFORMATION MODEL MODULES

Entity Name	Module Name	Reference
Scheduled Procedure Step	SOP Common	3.5.2.1
	Scheduled Procedure Step	3.5.2.2
Requested Procedure	Requested Procedure	3.5.3.1
Imaging Service Request	Imaging Service Request	3.5.4.1
Visit	Visit Identification	3.5.5.1
	Visit Status	3.5.5.2
	Visit Relationship	3.5.5.3
Patient	Patient Identification	3.5.6.1
	Patient Demographic	3.5.6.2
	Patient Medical	3.5.6.3

3.5 INFORMATION MODEL KEYS

The following Module descriptions are included to specify what data elements are supported and what type of matching can be applied. It should be noted that they are the same ones as defined in the DICOM Standard PS 3.4 (Service Class Specifications).

3.5.1 Supported Matching

Following matching types are supported according to the Attribute description in the tables below:

- Single Value Matching
- Wild Card Matching (* and ?)
- Range Matching

3.5.2 Scheduled Procedure Step Entity

3.5.2.1 SOP Common Module

TABLE 3.5.2-1
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Specific Character Set	(0008,0005)	-	1C	Supported: "ISO_IR 100" and "ISO_IR 192"

3.5.2.2 Scheduled Procedure Step Module

TABLE 3.5.2-2
SCHEDULED PROCEDURE STEP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Scheduled Procedure Step Sequence	(0040,0100)	R	1	
>Scheduled Station AE Title	(0040,0001)	R	1	Query Matching: • Single Value Matching
>Scheduled Procedure Step Start Date	(0040,0002)	R	1	Query Matching: • Single Value Matching • Range Matching
>Scheduled Procedure Step Start Time	(0040,0003)	R	1	Query Matching: • Single Value Matching • Range Matching
>Modality	(0008,0060)	R	1	Query Matching: • Single Value Matching
>Scheduled Performing Physician's Name	(0040,0006)	R	2	= Centricity Cardio Workflow "1st Physician" Query Matching (case insensitive): • Single Value Matching Wild Card Matching
>Scheduled Procedure Step Description	(0040,0007)	O	1C	
>Scheduled Station Name	(0040,0010)	O	2	
>Scheduled Procedure Step Location	(0040,0011)	O	2	= Centricity Cardio Workflow "Room"
>Scheduled Protocol Code Sequence	(0040,0008)	O	1C	
>>Code Value	(0008,0100)	O	1C	
>>Coding Scheme Version	(0008,0103)	O	3	
>>Coding Scheme Designator	(0008,0102)	O	1C	
>>Code Meaning	(0008,0104)	O	3	
>Pre-Medication	(0040,0012)	O	2C	Not supported
>Scheduled Procedure Step ID	(0040,0009)	O	1	
>Requested Contrast Agent	(0032,1070)	O	2C	Not supported

>Scheduled Procedure Step Status	(0040,0020)	O	3	Not supported

3.5.3 Requested Procedure Entity

3.5.3.1 Requested Procedure Module

TABLE 3.5.3-1
REQUESTED PROCEDURE MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Requested Procedure ID	(0040,1001)	O	1	Query Matching: • Single Value Matching • Wild Card Matching = Centricity Cardio Workflow Examination No.
Requested Procedure Description	(0032,1060)	O	1C	
Requested Procedure Code Sequence	(0032,1064)	O	1C	
>Code Value	(0008,0100)	O	1C	
>Coding Scheme Designator	(0008,0102)	O	1C	
>Coding Scheme Version	(0008,0103)	O	3	
>Code Meaning	(0008,0104)	O	3	
Study Instance UID	(0020,000D)	O	1	
Referenced Study Sequence	(0008,1110)	O	2	Not supported
>Referenced SOP Class UID	(0008,1150)	O	1C	-
>Referenced SOP Instance UID	(0008,1155)	O	1C	-
Requested Procedure Priority	(0040,1003)	O	2	Not supported
Patient Transport Arrangements	(0040,1004)	O	2	Not supported

3.5.4 Imaging Service Request Entity

3.5.4.1 Imaging Service Request Module

TABLE 3.5.4-1
IMAGING SERVICE REQUEST MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Accession Number	(0008,0050)	O	2	Query Matching: • Single Value Matching = Filler Order Number
Requesting Physician	(0032,1032)	O	2	= Centricity Cardio Workflow ”Requested By”
Referring Physician's Name	(0008,0090)	O	2	= Centricity Cardio Workflow “Referring Institution”

Placer Order Number / Imaging Service Request	(0040,2016)	O	2	Placer Order Number = Filler Order Number

3.5.5 Visit Entity

3.5.5.1 Visit Identification

TABLE 3.5.5-1
VISIT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Admission ID	(0038,0010)	O	2	= Centricity Cardio Workflow Admission No.

3.5.5.2 Visit Status

TABLE 3.5.5-2
VISIT STATUS MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Current Patient Location	(0038,0300)	O	2	Always empty

3.5.5.3 Visit Relationship

TABLE 3.5.5-3
VISIT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Referenced Patient Sequence	(0008,1120)	O	2	Always empty

3.5.6 Patient Entity

3.5.6.1 Patient Identification

TABLE 3.5.6-1
PATIENT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Patient's Name	(0010,0010)	R	1	Query Matching: • Single Value Matching • Wild Card Matching "Lastname^Firstname^…" or "Lastname, Firstname" for Philips Inturis
Patient ID	(0010,0020)	R	1	Query Matching: • Single Value Matching = Centricity Cardio Workflow Patient ID
Issuer of Patient ID	(0010,0021)	O	3	
Issuer of Patient ID Qualifiers Sequence	(0010,0024)	O	3	Not supported
Other Patient IDs	(0010,1000)	O	3	NHS Number (UK) or BSN number (Netherlands), if present.

3.5.6.2 Patient Demographic

TABLE 3.5.6-2
PATIENT DEMOGRAPHIC MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Patients Birth Date	(0010,0030)	O	2	
Patient's Sex	(0010,0040)	O	2	"M", "F" or "O"
Patient's Weight	(0010,1030)	O	2	Weight [kg]
Patient's Size	(0010,1020)	O	2	Size [m]

3.5.6.3 Patient Medical

TABLE 3.5.6-3
PATIENT MEDICAL MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Note
Patient State	(0038,0500)	O	2	Always empty
Pregnancy Status	(0010,21C0)	O	2	Always empty
Medical Alerts	(0010,2000)	O	2	Always empty
Contrast Allergies	(0010,2110)	O	2	Always empty
Special Needs	(0038,0050)	O	2	Always empty

4. MODALITY PERFORMED PROCEDURE STEP SOP CLASS DEFINITION

4.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the supported Modality Performed Procedure Step SOP Classes, the optional attributes and service elements supported, the valid range of values for mandatory and optional attributes, and the status code behavior.

This section contains:

4.2 – Modality Performed Procedure Step SOP Class

4.2 MODALITY PEFORMED PROCEDURE STEP SOP CLASS DEFINITIONS

4.2.1 Modality Performed Procedure Step SOP Class

4.2.1.1 IOD Description

4.2.1.1.1 IOD modules

Module	Reference	Module Description
SOP Common	4.2.1.1.2	Contains SOP Common information
Performed Procedure Step Releationship	4.2.1.1.3	References the related SOPs and IEs.
Performed Procedure Step Information	4.2.1.1.4	Includes identifying and status information as well as place and time
Image Acquisition Result	4.2.1.1.5	Identifies Series and Images related to this PPS and specific image acquisition conditions.
Radiation Dose Module	4.2.1.1.6	Contains radiation dose information related to this Performed Procedure Step.
Radiation Dose Module	4.2.1.1.6	Contains radiation dose information related to this Performed Procedure Step.

All other optional modules are ignored.

4.2.1.1.2 SOP Common

Attribute Name	Tag	N-CREATE	N-SET	Attribute Description
Specific Character Set	(0008,0005)	X	-	

4.2.1.1.3 Performed Procedure Step Relationship

Attribute name	Tag	N-CREATE	N-SET	Attribute Description
Scheduled Step Attribute Sequence	(0040,0270)	X	-	
>Study Instance UID	(0020,000D)	X	-	
>Referenced Study Sequence	(0008,1110)	X	-	
>>Referenced SOP Class UID	(0008,1150)	X	-	
>>Referenced SOP Instance UID	(0008,1155)	X	-	
>Accession Number	(0008,0050)	X	-	
>Requested Procedure ID	(0040,1001)	X	-	
>Requested Procedure Description	(0032,1060)	X	-	
>Scheduled Procedure Step ID	(0040,0009)	X	-	
>Scheduled Procedure Step Description	(0040,0007)	X	-	
>Scheduled Action Item (Protocol) Code Sequence	(0040,0008)	X	-	
>>Code Value	(0008,0100)	X	-	
>>Coding Scheme designator	(0008,0101)	X	-	
>>Coding Scheme Version	(0008,0103)	X	-	
>> Code Meaning	(0008,0104)	X	-	
Patient's Name	(0010,0010)	X	-	
Patient ID	(0010,0020)	X	-	
Issuer of Patient ID	(0010,0021)	-	-	
Issuer of Patient ID Qualifiers Sequence	(0010,0024)	-	-	
Patient's Birth Date	(0010,0030)	X	-	
Patient's Sex	(0010,0040)	X	-	
Referenced Patient Sequence	(0008,1120)	X	-	
>Referenced SOP Class UID	(0008,1150)	X	-	
>Referenced Instance UID	(0008,1155)	X	-	

4.2.1.1.4 Performed Procedure Step Information

Attribute Name	Tag	N-CREATE	N-SET	Attribute Description
Performed Procedure Step ID	(0040,0253)	X	-	
Performed Station AE Title	(0040,0241)	X	-	
Performed Station Name	(0040,0242)	X	-	
Parformed Location	(0040,0243)	X	-	
Performed Procedure Start Date	(0040,0244)	X	-	
Performed Procedure Start Time	(0040,0245)	X	-	
Performed Procedure Step Status	(0040,0252)	X	X	
Performed Procedure Step Description	(0040,0254)	X	X	
Performed Procedure Type Description	(0040,0255)	X	X	
Procedure Code Sequence	(0008,1032)	X	X	

>Code Value	(0008,0100)	X	X	
>Coding Scheme Designator	(0008,0102)	X	X	
>Coding Scheme Version	(0008,0103)	X	X	
>Code Meaning	(0008,0004)	X	X	
Performed Procedure Step End Date	(0040,0250)	X	X	
Performed Procedure Step End Time	(0040,0251)	X	X	
Comments on the Performed Procedure Step	(0040,0280)	X	X	
Performed Procedure Step Discontinuation Reason Code Sequence	(0040, 0281)	X	X	
>Code Value	(0008,0100)	X	X	
>Coding Scheme Designator	(0008,0102)	X	X	
>Coding Scheme Version	(0008,0103)	X	X	
>Code Meaning	(0008,0104)	X	X	

4.2.1.1.5 Image Acquisition Result

Attribute Name	Tag	N-CREATE	N-SET	Attribute Description
Modality	(0008,0060)	X	-	
Study Id	(0020,0010)	X	-	
Performed Action Item (Protocol) Code Sequence	(0040,0260)	X	X	
>Code Value	(0008,0100)	X	X	
>Coding Scheme Designator	(0008,0102)	X	X	
>Coding Scheme Version	(0008,0103)	X	X	
>Code Meaning	(0008,0004)	X	X	
Performed Series Sequence	(0040,0340)	X	X	
>Performed Physician's Name	(0008,1050)	X	X	
>Protocol Name	(0018,1030)	X	X	
>Operators's Name	(0008,1070)	X	X	
>Series Instance UID	(0020,000E)	X	X	
>Series Description	(0008,103E)	X	X	
>Retrieve AE title	(0008,0054)	X	X	
>Referenced Image Sequence	(0008,1140)	X	X	
>>Referenced SOP Class UID	(0008,1150)	X	X	
>>Referenced SOP Instance UID	(0008,1155)	X	X	
>Referenced Standalone SOP Instance Sequence	(0040,0220)	X	X	
>>Referenced SOP Class	(0008,1150)	X	X	
>>Referenced SOP Instance UID	(0008,1155)	X	X	

4.2.1.1.6 Radiation Dose Module

Attribute Name	Tag	N-CREATE	N-SET	Attribute Description
Total Time of Fluoroscopy	(0040,0300)	X	X	
Total Number of Exposures	(0040,0301)	X	X	
Distance Source to Detector (SID)	(018,1110)	X	X	
Distance Source to entrance	(0040,0306)	X	X	
Entrance Dose	(0040,0302)	X	X	Entrance DOSE in dGy Total dose delivered to the patient during the Performed Procedure Step.
Entrance Dose in mGy	(0040,8302)	X	X	Entrance DOSE in mGy Total dose delivered to the patient during the Performed Procedure Step.
Exposed area	(0040,0303)	X	X	
Image and Fluoroscopy Area Dose Product	(0018,115E)	X	X	
Comments on Radiation Dose	(040,0310)	X	X	

4.2.1.2 DIMSE Service Group

DIMSE Service Element	Usage SCP
N-CREATE	M
N-SET	M

4.2.1.2.1 N-CREATE

4.2.1.2.1.1 Status

Service Status	Status Codes	Further Meaning	Status Code Explanation
Success	0000H	Successful operation	Message successfully processed.
Failure	0110H	Internal processing Error	Internal errors in the Network-Subsystem (e.g. database not available). The Association is rejected.
	0120H	Missing Type-1 Arguments	The Centricity Cardio Workflow – System cannot store the study in the database

4.2.1.2.1.2 Behavior

The Centricity Cardio Workflow DICOM Service creates a local database to store the Modality Performed Procedure Step SOP Instance received by an N-CREATE command. The data is stored in the global Centricity Cardio Workflow – System when receiving an N-SET with a Status equal to "COMPLETED" or "DISCONTINUED".

For each SCU unlimited Modality Performed Procedure Step SOP Instances may exist at the SCP. Every time the Centricity Cardio Workflow DICOM Service receives an N-CREATE command, a new Instance gets created and all data related to this instance stored in a local database.

There is no limitation about sending an MPPS for a study more than once, but it can be configured at the Centricity Cardio Workflow – System to disable the overwriting of existing data (Dose information).

If the Performed Procedure Step Status (0040,0252) is not "IN PROGRESS", an error is tracked without any further action, but without a following N-SET the data will not be transferred to the Centricity Cardio Workflow – System.

The N-SET SOP instance for a created MPPS SOP instance can be sent and gets processed at any time after the creation, even if it takes a very long time. But, when the regarding examination in the Centricity Cardio Workflow – System has already been locked or completed, any existing data (Dose information) cannot be overwritten any longer.

4.2.1.2.2 N-SET

4.2.1.2.2.1 Status

Service Status	Status Codes	Further Meaning	Status Code Explanation
Success	0000H	Successful operation	Message successfully processed.
Failure	0110H	Internal processing Error, e.g. procedure state not found.	The data is rejected.
	0112H	N_SET without leading N_CREATE.	The data is rejected.
	0105H	No such attribute.	Failed to read the requested SOP Instance UID. The data is rejected.
	0106H	Invalid attribute value; e.g. Attribute value is NULL.	The data is rejected.
	0211H	Unrecognized operation. Unknown Procedure State.	The Centricity Cardio Workflow-System cannot store the study in the database.

4.2.1.2.2.2 Behavior

The Centricity Cardio Workflow DICOM Service updates all attributes in the local database when receiving an N-SET. As long as the Performed Procedure Step Status (0040,0252) is "IN PROGRESS", the SCU may continue to send N-SET – commands to update the attributes in the current instance.

If Performed Procedure Step Status (0040,0252) is "COMPLETED" or "DISCONTINUED", the data is stored to the Centricity Cardio Workflow – System. At this time, the Modality Performed Procedure Step SOP Instance is destroyed.