



Novarad DICOM Conformance Statement

Version: 2.0

This DICOM Conformance Statement applies to Novarad NovaPACS Version: 9.x

Date: June 2026

1 CONFORMANCE STATEMENT OVERVIEW

The NovaPACS is a self-contained networked computer system used for routing and archiving diagnostic medical images. It receives DICOM objects, such as images, from external systems for permanent storage, allows the retrieval of information about such images, and provides a retrieval mechanism for the images themselves. The system conforms to the DICOM standard to allow the sharing of medical information with other digital imaging systems.

**TABLE 1-1
SUPPORTED NETWORKING DICOM SERVICE (SOP) CLASSES**

Networking Service Class	Initiator or User of Service	Provider of Service
Transfer		
Verification	Yes	Yes
US Image Storage (Retired)	Yes	Yes
US Image Storage	Yes	Yes
US Multi-frame Storage (Retired)	Yes	Yes
US Multi-frame Storage	Yes	Yes
Computed Radiography Image Storage	Yes	Yes
CT Image Storage	Yes	Yes
MR Image Storage	Yes	Yes
Secondary Capture Image Storage	Yes	Yes
Visible Light Photographic Image Storage	Yes	Yes
Digital X-Ray Image Storage – For Presentation	Yes	Yes
Digital X-Ray Image Storage – For Processing	Yes	Yes
Digital Mammography X-Ray Image Storage – For Presentation	Yes	Yes
Digital Mammography X-Ray Image Storage – For Processing	Yes	Yes
Digital Intra-oral X-Ray Image Storage – For Presentation	Yes	Yes
Digital Intra-oral X-Ray Image Storage – For Processing	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	Yes	Yes
Multi-frame Grayscale Word Secondary Capture Image Storage	Yes	Yes
12-lead ECG Waveform Storage	Yes	Yes
Ambulatory ECG Waveform Storage	Yes	Yes
Grayscale Softcopy Presentation State Storage SOP Class	Yes	Yes
X-Ray Angiographic Image Storage	Yes	Yes
X-Ray Radiofluoroscopic Image Storage	Yes	Yes
Nuclear Medicine Image Storage (Retired)	Yes	Yes



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Networking Service Class	Initiator or User of Service	Provider of Service
Nuclear Medicine Image Storage	Yes	Yes
RT Image Storage	Yes	Yes
Positron Emission Tomography Image Storage	Yes	Yes
Breast Tomosynthesis Image Storage	Yes	Yes
Mammography CAD Structured Report	Yes	Yes
Encapsulated PDF Storage	Yes	Yes
Workflow Management		
Modality Worklist Information Model – FIND	No	Yes
Storage Commitment Push Model	Yes	Yes
Query/Retrieve		
Patient Root Query/Retrieve Information Model – FIND	Yes	Yes
Patient Root Query/Retrieve Information Model – MOVE	Yes	Yes
Study Root Query/Retrieve Information Model – FIND	Yes	Yes
Study Root Query/Retrieve Information Model – MOVE	Yes	Yes
Patient/Study Only Query/Retrieve Information Model - FIND	Yes	Yes
Patient/Study Only Query/Retrieve Information Model - MOVE	Yes	Yes

NOTE: Relational Queries are not supported either as an SCU or SCP.

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3 Introduction

3.1 REVISION HISTORY

Document Version	Date	Author	Description
1.0	Mar 2, 2004	HJO	First revision
1.1	Aug 29, 2008	MLS	Update first revision
1.2			
1.3			
1.4	May 6, 2015	PEC	Update to reflect 8.3 PACS and RIS Added Storage Commitment Push Model
1.5	February 6, 2019	DPJ	Updated to reflect 8.6.14 PACS and RIS support for Breast Tomosynthesis Image Storage, Mammography CAD Structured Report, and Encapsulated PDF Storage SOP Classes. Update to reflect 8.6.14 PACS and RIS support for JPEG Lossless Transfer Syntax.
2.0	June 2026	Sean Clements	Updated to reflect NovaPACS 9.x. Expanded SOP Class list to reflect current DICOM framework. Updated Transfer Syntaxes: removed Explicit VR Big Endian; replaced single JPEG Lossless entry with explicit UIDs; added JPEG-LS Lossless and JPEG-LS Lossy. Updated Implementation Version Name to NovaRad 9.0. Updated Implementation Class UID to 1.2.840.114051. Removed retired Hardcopy and Stored Print SOP Classes. Corrected stored image export language. Removed inaccurate default Transfer Syntax note.

3.2 AUDIENCE

This document is intended for hospital staff, health system integrators, software designers or implementers. It is assumed that the reader has a working understanding of DICOM.

3.3 REMARKS

The scope of this Conformance Statement is to facilitate communication between the NOVARAD-SERVER and other DICOM systems. The Conformance Statement should be read and understood in conjunction with the DICOM Standard. However, by itself it is not guaranteed to ensure the desired interoperability and a successful interconnectivity.

The user should be aware of the following important issues:

- The comparison of different Conformance Statements is the first step towards assessing interconnectivity between NOVARAD-SERVER and other DICOM conformant equipment.
- This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended.
- Test procedures should be defined to validate the desired level of connectivity.

3.4 ABBREVIATIONS AND ACRONYMS:

AE	Application Entity
CR	Computerized radiography
CT	Computerized Tomography
DICOM	Digital Imaging and Communications in Medicine
IE	Information Entity
IOD	Information Object Definition
ISO	International Standards Organization
MR	Magnetic Resonance
NM	Nuclear Medicine
PDU	Protocol Data Unit
PET	Positron Emission Tomography
RF	RadioFluoroscopy
RT	Radiation Therapy
SC	Secondary Capture
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
US	Ultrasound
VL	Visible Light
VM	Value Multiplicity
VR	Value Representation
XA	X-Ray Angiography

4 NETWORKING

4.1 IMPLEMENTATION MODEL

4.1.1 Application Data Flow

The NOVARAD-SERVER consists of two Application Entities, one that deals with the Image communication and Verification, and one that implements the worklist functionality.

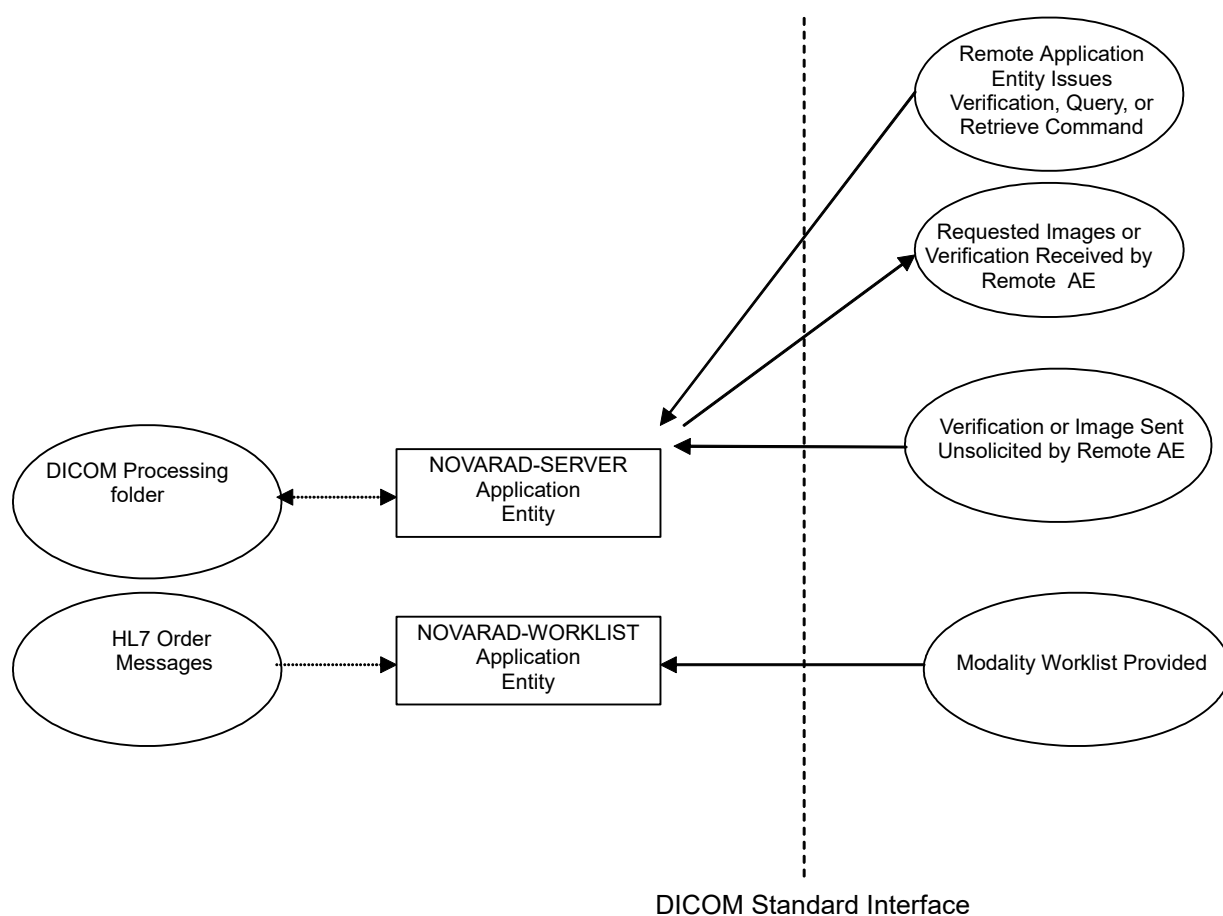


Figure 4.1-1
NOVARAD-SERVER DICOM DATA FLOW DIAGRAM

- A Postgres database is used to store and retrieve information.
- The archive will accept DICOM C-Find and C-Move requests from any other authorized DICOM sources.
- If a Novarad workstation is setup to use a Novarad archive, it synchronizes with that server for both retrieving images as well as saving images modified with annotations. The interactions between a Novarad viewer and server are proprietary for performance and functionality reasons.

4.1.2 Functional Definition of AEs

4.1.2.1 Functional Definition of NOVARAD-SERVER Application Entity

The NOVARAD-SERVER AE listens for incoming DICOM connections on port 104. When an image is received, it is stored in a folder as a source for processing DICOM files. Another process monitors that folder and processes the images stored there. The processing includes verifying the file for validity, extracting DICOM information to store in the database, compressing it and moving it into the archive.

All other processes running on the server computer will interact directly with the database including, but not limited to, the web server, router, and archive.

4.1.2.2 Functional Definition of NOVARAD-WORKLIST Application Entity

The NOVARAD WORKLIST AE listens to the incoming HL7 messages for applicable orders and provides the Modality Worklist to modalities upon a FIND request.

4.1.3 Sequencing of Real-World Activities

There are no Sequencing constraints for the NOVARAD-SERVER or NOVARAD-WORKLIST Application Entities.

4.2 AE SPECIFICATIONS

4.2.1 NOVARAD-SERVER Application Entity Specification

4.2.1.1 SOP Classes

The NOVARAD-SERVER AE provides Standard Conformance to the following DICOM SOP Classes:

**TABLE 4.2-1
SOP CLASSES FOR NOVARAD-SERVER AE**

SOP Class Name	SOP Class UID	SCU	SCP
Verification			
Verification	1.2.840.10008.1.1	Yes	Yes
Storage Commitment	1.2.840.10008.1.20.1	Yes	Yes
Image and Waveform Transfer			
US Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	Yes	Yes
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	Yes
US Multi-frame Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	Yes	Yes
US Multi-frame Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	Yes
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes	Yes
Nuclear Medicine Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.5	Yes	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	Yes
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes	Yes
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes	Yes
Digital Mammography X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Yes	Yes
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	Yes
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Yes	Yes
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes	Yes
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Yes	Yes
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Yes	Yes
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Yes	Yes
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	Yes
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Yes	Yes
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Yes	Yes
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3	Yes	Yes
Mammography CAD Structured Report	1.2.840.10008.5.1.4.1.1.88.50	Yes	Yes
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	Yes
CT - Enhanced			
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	Yes	Yes
Legacy Converted Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.2	Yes	Yes
MR - Enhanced			
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Yes	Yes
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	Yes	Yes
Enhanced MR Color Image Storage	1.2.840.10008.5.1.4.1.1.4.3	Yes	Yes
Legacy Converted Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.4	Yes	Yes

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SOP Class Name	SOP Class UID	SCU	SCP
Ultrasound - Enhanced			
Enhanced US Volume Storage	1.2.840.10008.5.1.4.1.1.6.2	Yes	Yes
Secondary Capture - Additional			
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	Yes	Yes
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	Yes
X-Ray - Enhanced and 3D			
Enhanced XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1	Yes	Yes
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1	Yes	Yes
X-Ray Angiographic Bi-Plane Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.12.3	Yes	Yes
X-Ray 3D Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.13.1.1	Yes	Yes
X-Ray 3D Craniofacial Image Storage	1.2.840.10008.5.1.4.1.1.13.1.2	Yes	Yes
Breast - Additional			
Breast Projection X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.13.1.4	Yes	Yes
Breast Projection X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.13.1.5	Yes	Yes
Intravascular OCT			
Intravascular OCT Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.14.1	Yes	Yes
Intravascular OCT Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.14.2	Yes	Yes
VL - Additional			
VL Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.77.1	Yes	Yes
VL Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.77.2	Yes	Yes
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	Yes
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Yes	Yes
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	Yes
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	Yes	Yes
VL Slide Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Yes	Yes
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Yes	Yes

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SOP Class Name	SOP Class UID	SCU	SCP
VL Whole Slide Microscopy Image Storage	1.2.840.10008.5.1.4.1.1.77.1.6	Yes	Yes
Ophthalmic			
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	Yes	Yes
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2	Yes	Yes
Stereometric Relationship Storage	1.2.840.10008.5.1.4.1.1.77.1.5.3	Yes	Yes
Ophthalmic Tomography Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.4	Yes	Yes
Wide Field Ophthalmic Photography Stereographic Projection Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.5	Yes	Yes
Wide Field Ophthalmic Photography 3D Coordinates Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.6	Yes	Yes
Ophthalmic Visual Field Static Perimetry Measurements Storage	1.2.840.10008.5.1.4.1.1.80.1	Yes	Yes
Ophthalmic Thickness Map Storage	1.2.840.10008.5.1.4.1.1.81.1	Yes	Yes
Corneal Topography Map Storage	1.2.840.10008.5.1.4.1.1.82.1	Yes	Yes
Lensometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.1	Yes	Yes
Autorefractive Measurements Storage	1.2.840.10008.5.1.4.1.1.78.2	Yes	Yes
Keratometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.3	Yes	Yes
Subjective Refraction Measurements Storage	1.2.840.10008.5.1.4.1.1.78.4	Yes	Yes
Visual Acuity Measurements Storage	1.2.840.10008.5.1.4.1.1.78.5	Yes	Yes
Spectacle Prescription Report Storage	1.2.840.10008.5.1.4.1.1.78.6	Yes	Yes
Ophthalmic Axial Measurements Storage	1.2.840.10008.5.1.4.1.1.78.7	Yes	Yes
Intraocular Lens Calculations Storage	1.2.840.10008.5.1.4.1.1.78.8	Yes	Yes
Macular Grid Thickness and Volume Report	1.2.840.10008.5.1.4.1.1.79.1	Yes	Yes
Waveforms - Additional			
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Yes	Yes
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1	Yes	Yes
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1	Yes	Yes
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1	Yes	Yes
General Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.2	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP
Arterial Pulse Waveform Storage	1.2.840.10008.5.1.4.1.1.9.5.1	Yes	Yes
Respiratory Waveform Storage	1.2.840.10008.5.1.4.1.1.9.6.1	Yes	Yes
Presentation States - Additional			
Color Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.2	Yes	Yes
Pseudo-Color Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.3	Yes	Yes
Blending Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.4	Yes	Yes
XA/XRF Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.5	Yes	Yes
Grayscale Planar MPR Volumetric Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.6	Yes	Yes
Compositing Planar MPR Volumetric Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.7	Yes	Yes
Structured Reports			
Basic Text Structured Report	1.2.840.10008.5.1.4.1.1.88.11	Yes	Yes
Enhanced Structured Report	1.2.840.10008.5.1.4.1.1.88.22	Yes	Yes
Comprehensive Structured Report	1.2.840.10008.5.1.4.1.1.88.33	Yes	Yes
Comprehensive 3D SR Storage	1.2.840.10008.5.1.4.1.1.88.34	Yes	Yes
Extensible SR Storage	1.2.840.10008.5.1.4.1.1.88.35	Yes	Yes
Procedure Log	1.2.840.10008.5.1.4.1.1.88.40	Yes	Yes
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Yes	Yes
Chest CAD Structured Report	1.2.840.10008.5.1.4.1.1.88.65	Yes	Yes
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	Yes	Yes
Radiopharmaceutical Radiation Dose SR Storage	1.2.840.10008.5.1.4.1.1.88.68	Yes	Yes
Colon CAD SR	1.2.840.10008.5.1.4.1.1.88.69	Yes	Yes
Implantation Plan SR Document Storage	1.2.840.10008.5.1.4.1.1.88.70	Yes	Yes
Acquisition Context SR Storage	1.2.840.10008.5.1.4.1.1.88.71	Yes	Yes
Simplified Adult Echo SR Storage	1.2.840.10008.5.1.4.1.1.88.72	Yes	Yes
PET - Enhanced			
Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.130	Yes	Yes
Legacy Converted Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.128.1	Yes	Yes



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SOP Class Name	SOP Class UID	SCU	SCP
RT - Additional			
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Yes	Yes
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Yes	Yes
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	Yes	Yes
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Yes	Yes
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6	Yes	Yes
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7	Yes	Yes
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8	Yes	Yes
RT Ion Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.9	Yes	Yes
RT Beams Delivery Instruction Storage	1.2.840.10008.5.1.4.34.7	Yes	Yes
RT Brachy Application Setup Delivery Instruction Storage	1.2.840.10008.5.1.4.34.10	Yes	Yes
Encapsulated Documents - Additional			
Encapsulated CDA Storage	1.2.840.10008.5.1.4.1.1.104.2	Yes	Yes
Spatial / Segmentation / Registration			
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes	Yes
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1	Yes	Yes
Spatial Fiducials Storage	1.2.840.10008.5.1.4.1.1.66.2	Yes	Yes
Deformable Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.3	Yes	Yes
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4	Yes	Yes
Surface Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.5	Yes	Yes
Tractography Results Storage	1.2.840.10008.5.1.4.1.1.66.6	Yes	Yes
Real World Value Mapping Storage	1.2.840.10008.5.1.4.1.1.67	Yes	Yes
Surface Scan Mesh Storage	1.2.840.10008.5.1.4.1.1.68.1	Yes	Yes
Surface Scan Point Cloud Storage	1.2.840.10008.5.1.4.1.1.68.2	Yes	Yes
Parametric Map Storage	1.2.840.10008.5.1.4.1.1.30	Yes	Yes
Miscellaneous			
Content Assessment Results Storage	1.2.840.10008.5.1.4.1.1.90.1	Yes	Yes
Basic Structured Display Storage	1.2.840.10008.5.1.4.1.1.131	Yes	Yes
CT Performed Procedure Protocol Storage	1.2.840.10008.5.1.4.1.1.200.2	Yes	Yes
Retired Legacy Support			
Standalone Overlay Storage (Retired)	1.2.840.10008.5.1.4.1.1.8	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP
Standalone Curve Storage (Retired)	1.2.840.10008.5.1.4.1.1.9	Yes	Yes
Standalone Modality LUT Storage (Retired)	1.2.840.10008.5.1.4.1.1.10	Yes	Yes
Standalone VOI LUT Storage (Retired)	1.2.840.10008.5.1.4.1.1.11	Yes	Yes
Standalone PET Curve Storage (Retired)	1.2.840.10008.5.1.4.1.1.129	Yes	Yes
Query/Retrieve			
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	Yes
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	Yes
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	Yes
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	Yes
Patient/Study Only Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.2	Yes	Yes
Patient/Study Only Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.3	Yes	Yes

4.2.1.2 Association Establishment Policies

4.2.1.2.1 General

The DICOM standard Application Context Name for DICOM 3.0 is always proposed:

TABLE 4.2-2
DICOM APPLICATION CONTEXT FOR NOVARAD-SERVER AE

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

4.2.1.2.2 Number of Associations

TABLE 4.2-3
NUMBER OF ASSOCIATIONS AS A SCU/SCP FOR NOVARAD-SERVER AE

Maximum number of simultaneous Associations	See note
---	----------

Note: The number of simultaneous Associations is in principle unlimited; there is no configurable parameter or anything equivalent. It is practically limited by the available computing resources of the NOVARAD-Server.

4.2.1.2.3 Asynchronous Nature

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

**TABLE 4.2-4
ASYNCHRONOUS NATURE AS A SCU/SCP FOR NOVARAD-SERVER AE**

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)
---	----------------------

4.2.1.2.4 Implementation Identifying Information

**TABLE 4.2-5
DICOM IMPLEMENTATION CLASS AND VERSION FOR NOVARAD-SERVER AE**

Implementation Class UID	1.2.840.114051
Implementation Version Name	NovaRad 9.0

The NOVARAD-SERVER AE and NOVARAD-WORKLIST AE use the same Implementation Class UID. All NOVARAD-SERVER AE's use the same Implementation Version Name.

4.2.1.3 Association Initiation Policy

4.2.1.3.1 Activity – Send Images Requested by an External Peer AE

4.2.1.3.1.1 Description and Sequencing of Activity

The NOVARAD-SERVER AE will initiate a new Association when an external AE requests the NOVARAD-SERVER AE to transmit images upon receiving a valid C-MOVE Request. An Association Request is sent to the specified C-MOVE Destination AE and upon successful negotiation of the required Presentation Context the image transfer is started. The Association will be released when all the images have been sent. If an error occurs during transmission over an open Association then the image transfer is halted.

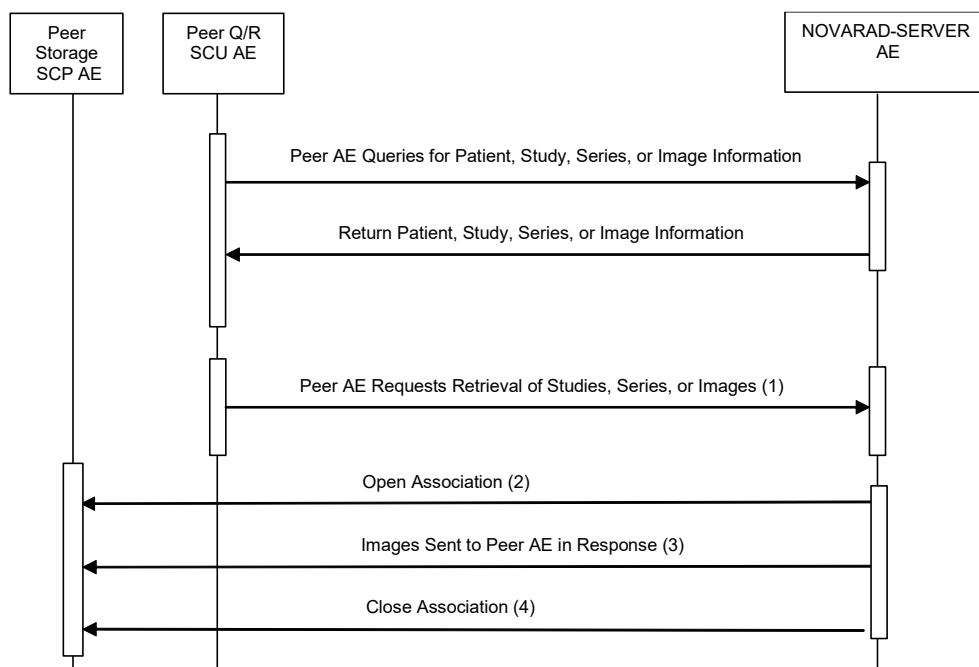


Figure 4.2-1
SEQUENCING OF ACTIVITY - SEND IMAGES REQUESTED BY AN EXTERNAL PEER AE

The following sequencing constraints illustrated in the figure above apply to the NOVARAD-SERVER AE:

1. Peer AE requests retrieval of Study, Series, or Images from NOVARAD-SERVER AE (C-MOVE-RQ)- see note.
2. NOVARAD-SERVER AE opens a new Association with the indicated C-MOVE Destination AE (the destination AE could be the same as the Peer Q/R AE).
3. NOVARAD-SERVER AE sends the indicated Composite SOP Instances.
4. NOVARAD-SERVER AE closes the Association.

Note: The NOVARAD-SERVER AE will determine, depending on the information in its host table, whether the peer AE is authorized to receive images.

4.2.1.3.1.2 Proposed Presentation Contexts

NOVARAD-SERVER AE will propose Presentation Contexts as shown in the following table:

TABLE 4.2-6
PROPOSED PRESENTATION CONTEXTS BY THE NOVARAD-SERVER AE

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
All SOP Classes listed in Table 4.2-1 marked as	All corresponding	Implicit VR Little Endian: Default	1.2.840.10008.1.2	SCU	None

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Verification and Image and Waveform Transfer	UID's listed in Table 4.2-1	Transfer Syntax for DICOM			
All SOP Classes listed in Table 4.2-1 marked as Verification and Image and Waveform Transfer	All UID's listed in Table 4.2-1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
All SOP Classes listed in Table 4.2-1 marked as Verification and Image and Waveform Transfer	All UID's listed in Table 4.2.1	JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50	SCU	None
All SOP Classes listed in Table 4.2-1 marked as Verification and Image and Waveform Transfer	All UID's listed in Table 4.2.1	JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90	SCU	None
All SOP Classes listed in Table 4.2-1 marked as Verification and Image and Waveform Transfer	All UID's listed in Table 4.2.1	JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91	SCU	None
All SOP Classes listed in Table 4.2-1 marked as Verification and Image and Waveform Transfer	All UID's listed in Table 4.2.1	JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57	SCU	None
All SOP Classes listed in Table 4.2-1 marked as Verification and Image and Waveform Transfer	All UID's listed in Table 4.2.1	JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70	SCU	None
All SOP Classes listed in Table 4.2-1 marked as Verification and Image and Waveform Transfer	All UID's listed in Table 4.2.1	JPEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80	SCU	None
All SOP Classes listed in Table 4.2-1 marked as Verification and Image and Waveform Transfer	All UID's listed in Table 4.2.1	JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81	SCU	None

The NOVARAD-SERVER AE proposes all of the listed transfer syntaxes.

4.2.1.3.1.3 SOP Specific Conformance for Image SOP Classes

Composite DICOM SOP Instances are maintained as DICOM Part 10 compliant files in the NOVARAD-SERVER archive. The entire set of tags received with the image will be saved; this includes all Private and SOP Extended Elements. When a SOP Instance is selected for export from NOVARAD-SERVER, its content will be exported in its stored format.

If any error occurs during DICOM communication then appropriate messages are written to an error log which can be accessed by a system administrator.

All Status Codes indicating an error or refusal are treated as a permanent failure.

The NOVARAD-SERVER AE will exhibit the following Behavior according to the Status Code value returned in a C-STORE Response from a destination C-STORE SCP:

TABLE 4.2-7
NOVARAD-SERVER AE C-STORE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has successfully stored the exported SOP Instance. The NOVARAD-SERVER AE will send the appropriate PENDING or SUCCESS Status in the C-MOVE Response.
Refused	Out of Resources	A700 – A7FF	This is treated as a permanent Failure. The Association is released. The NOVARAD-SERVER AE will send an appropriate Status in the C-MOVE Response. Error indication message is output to the error log and can be retrieved by a system administrator.
Error	Data Set does not match SOP Class	A900 – A9FF	Treated as a permanent failure
Error	Cannot Understand	C000 - CFFF	Treated at permanent failure
Warning	Coercion of Data Elements	B000	Ignored
Warning	Data Set does not match SOP Class	B007	Ignored
Warning	Elements Discarded	B006	Ignored
Warning	Attribute List Error	0107	Ignored
Warning	Attribute Value Out of Range	0116	Ignored

Service Status	Further Meaning	Error Code	Behavior
*	*	Any other status code.	Ignored

TABLE 4.2-8
NOVARAD-SERVER AE Communication Failure Behavior

Exception	Behavior
Timeout expiry for an expected DICOM Message Response (DIMSE level timeout).	The Association is aborted using a DICOM A-ABORT and a message is sent to the AE indicating an export failure. The AE will send an appropriate Status in the C-MOVE Response. The information is logged in the log file.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT and a message is sent to the AE indicating an export failure. The AE will send an appropriate Status in the C-MOVE Response. The information is logged in the log file.
Association A-ABORTed by the SCP or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	The Association is aborted using a DICOM A-ABORT and a message is sent to the AE indicating an export failure. The AE will send an appropriate Status in the C-MOVE Response. The information is logged in the log file.

4.2.1.3.2 Activity – Send Verification

4.2.1.3.2.1 Description and Sequencing of Activity

The NOVARAD-SERVER AE will initiate an Association and issue a C-Echo command initiated using a service utility feature.

4.2.1.4 Association Acceptance Policy

4.2.1.4.1 Activity – Handling Query and Retrieval Requests

4.2.1.4.1.1 Description and Sequencing of Activity

The NOVARAD-SERVER AE accepts Associations only if they have valid Presentation Contexts. If none of the requested Presentation Contexts are accepted then the Association Request itself is rejected. The NOVARAD-SERVER AE only accept Associations from those hosts (using TCP/IP address) and/or Application Entity Titles that are configured in the “approved” list.

If NOVARAD-SERVER AE receives a query (C-FIND) request then the response(s) will be sent over the same Association used to send the C-FIND-Request.

If NOVARAD-SERVER AE receives a retrieval (C-MOVE) request then the responses will be sent over the same Association used to send the C-MOVE-Request. The NOVARAD-SERVER will send the requested SOP Instances to the C-MOVE Destination. The NOVARAD-SERVER sends a C-MOVE

Response indicating this status after each attempt to send the SOP Instance. Once the NOVARAD-SERVER AE has finished attempting to transfer all the requested SOP Instances, the NOVARAD-SERVER AE sends a final C-MOVE Response indicating the overall status of the attempted retrieval.

The following sequencing constraints illustrated in the figure below apply to the NOVARAD-SERVER AE for handling queries (C-FIND-Requests):

1. Peer AE opens an Association with the NOVARAD-SERVER AE.
2. Peer AE sends a C-FIND-RQ Message
3. NOVARAD-SERVER AE returns a C-FIND-RSP Message to the peer AE with matching information. A C-FIND-RSP is sent for each entity matching the identifier specified in the C-FIND-RQ. A final C-FIND-RSP is sent indicating that the matching is complete.
4. Peer AE closes the Association. Note that the peer AE does not have to close the Association immediately. Further C-FIND or C-MOVE Requests can be sent over the Association before it is closed.

The following sequencing constraints illustrated in the figure below apply to the NOVARAD-SERVER AE for handling retrievals (C-MOVE-Requests):

1. Peer AE opens an Association with the NOVARAD-SERVER AE.
2. Peer AE sends a C-MOVE-RQ Message
3. NOVARAD-SERVER AE sends the Composite SOP Instances to the peer C-MOVE Destination AE as indicated in the C-MOVE-RQ.
4. After attempting to send a SOP Instance, the NOVARAD-SERVER AE indicates whether the transfer succeeded or failed and returns a C-MOVE-RSP indicating this success or failure.
5. Once the NOVARAD-SERVER AE has completed all attempts to transfer the SOP Instances to the C-MOVE Destination AE, or the first failure occurred, it sends a final C-MOVE-RSP indicating the overall success or failure of the retrieval.
6. Peer AE closes the Association. Note that the peer AE does not have to close the Association immediately. Further C-FIND or C-MOVE Requests can be sent over the Association before it is closed.

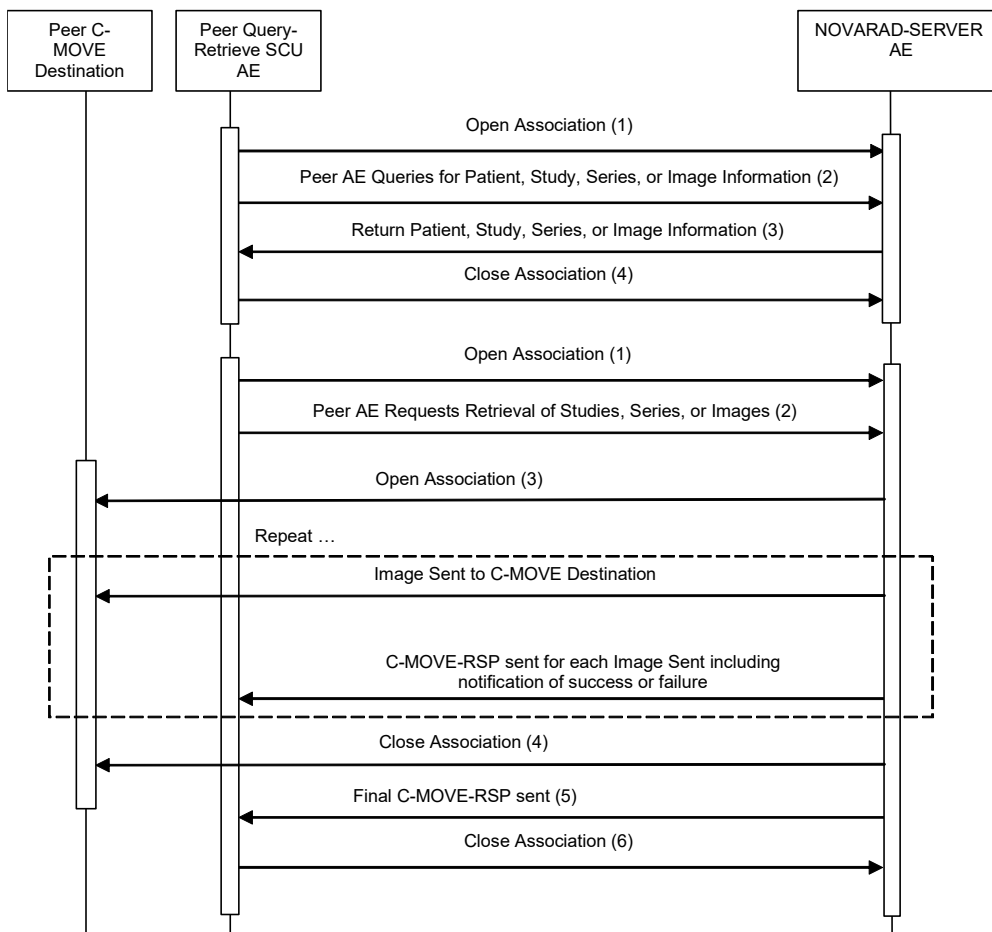


Figure 4.2-2
SEQUENCING OF ACTIVITY – HANDLING QUERY AND RETRIEVAL REQUESTS

The NOVARAD-SERVER AE may reject Association attempts as shown in the table below. The Result, Source and Reason/Diag columns represent the values returned in the corresponding fields of an ASSOCIATE-RJ PDU (see PS 3.8, Section 9.3.4). The following abbreviations are used in the Source column:

- a. 1 – DICOM UL service-user
- b. 2 – DICOM UL service-provider (ASCE related function)
- c. 3 – DICOM UL service-provider (Presentation related function)

TABLE 4.2-9
Association Rejection Reasons

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

4.2.1.4.1.2 Accepted Presentation Contexts

NOVARAD-SERVER AE will accept Presentation Contexts as shown in the following table:

TABLE 4.2-10
ACCEPTED PRESENTATION CONTEXTS BY THE NOVARAD-SERVER AE

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Patient Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Patient Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Study Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Study Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Patient Study Only Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Patient Study Only Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

4.2.1.4.1.3 SOP Specific Conformance for Query SOP Classes

The QUERY-RETRIEVE-SCP AE supports hierarchical queries and does not support relational queries. Only those attributes requested in the query identifier are returned. Query responses always return values from the NOVARAD-SERVER database.

Patient Root Information Model:

All required search keys on each of the four levels (Patient, Study, Series, and Image) are supported.

Study Root Information Model:

All the required search keys on each of the three levels (Study, Series, and Image) are supported.

Patient/Study Only Information Model:

All the required search keys on the Patient and Study levels are supported.

TABLE 4.2-11
Patient Root C-FIND SCP Supported Elements

Level Name Attribute Name	Tag	VR	Types of Matching
SOP Common			

Level Name Attribute Name	Tag	VR	Types of Matching
Specific Character Set	0008,0005	CS	NONE
Patient Level			
Patient's Name	0010,0010	PN	S,*,U
Patient ID	0010,0020	LO	S,*,U
Patient's Birth Date	0010,0030	DA	S,U
Patient's Sex	0010,0040	CS	S,U
Other Patient IDs	0010,1000	LO	NONE
Other Patient Names	0010,1001	PN	NONE
Study Level			
Study Date	0008,0020	DA	S,R,U
Study Time	0008,0030	TM	R,U
Accession Number	0008,0050	SH	S,*,U
Study ID	0020,0010	SH	S,*,U
Study Instance UID	0020,000D	UI	S,U,L
Referring Physician's Name	0008,0090	PN	S,*,U
Study Description	0008,1030	LO	S,*,U
Series Level			
Modality	0008,0060	CS	S,U
Series Number	0020,0011	IS	S,*,U
Series Instance UID	0020,000E	UI	S,U,L
Operator's Name	0008,1070	PN	NONE
Image Level			
Instance Number	0020,0013	IS	S,*,U
SOP Instance UID	0008,0018	UI	S,U,L

TABLE F.4.2-12
Study Root C-FIND SCP Supported Elements

Level Name Attribute Name	Tag	VR	Types of Matching
SOP Common			
Specific Character Set	0008,0005	CS	NONE
Study Level			
Patient's Name	0010,0010	PN	S,*,U
Patient ID	0010,0020	LO	S,*,U
Patient's Birth Date	0010,0030	DA	S,U
Patient's Sex	0010,0040	CS	S,U
Other Patient IDs	0010,1000	LO	NONE
Other Patient Names	0010,1001	PN	NONE

Level Name Attribute Name	Tag	VR	Types of Matching
Study Date	0008,0020	DA	S,R,U
Study Time	0008,0030	TM	R,U
Accession Number	0008,0050	SH	S,*,U
Study ID	0020,0010	SH	S,*,U
Study Instance UID	0020,000D	UI	S,U,L
Referring Physician's Name	0008,0090	PN	S,*,U
Study Description	0008,1030	LO	S,*,U
Series Level			
Modality	0008,0060	CS	S,U
Series Number	0020,0011	IS	S,*,U
Series Instance UID	0020,000E	UI	S,U,L
Operator's Name	0008,1070	PN	NONE
Image Level			
Instance Number	0020,0013	IS	S,*,U
SOP Instance UID	0008,0018	UI	S,U,L

TABLE 4.2-13
Patient/Study Only Root C-FIND SCP Supported Elements

Level Name Attribute Name	Tag	VR	Types of Matching
SOP Common Specific Character Set	0008,0005	CS	NONE
Patient Level			
Patient's Name	0010,0010	PN	S,*,U
Patient ID	0010,0020	LO	S,*,U
Patient's Birth Date	0010,0030	DA	S,U
Patient's Sex	0010,0040	CS	S,U
Other Patient IDs	0010,1000	LO	NONE
Other Patient Names	0010,1001	PN	NONE
Study Level			
Study Date	0008,0020	DA	S,R,U
Study Time	0008,0030	TM	R,U
Accession Number	0008,0050	SH	S,*,U
Study ID	0020,0010	SH	S,*,U
Study Instance UID	0020,000D	UI	S,U,L
Referring Physician's Name	0008,0090	PN	S,*,U
Study Description	0008,1030	LO	S,*,U

The tables should be read as follows:

Attribute Name: Attributes supported for returned C-FIND Responses.

Tag: Appropriate DICOM tag for this attribute.

VR: Appropriate DICOM VR for this attribute.

Types of Matching: The types of Matching supported by the C-FIND SCP. A "S" indicates the identifier attribute can specify Single Value Matching, a "R" will indicate Range Matching, a "*" will denote wildcard matching, an 'U' will indicate universal matching, and 'L' will indicate that UID lists are supported for matching. "NONE" indicates that no matching is supported, but that values for this Element in the database can be returned.

TABLE 4.2-14
QUERY-RETRIEVE-SCP AE C-FIND Response Status Return Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	Matching is complete. No final identifier is supplied.
Refused	Out of Resources	A700	System reached the limit in disk space or memory usage.

Service Status	Further Meaning	Error Code	Behavior
			Error message is output to the Service Log.
Failed	Identifier does not match SOP Class	A900	The C-FIND query identifier contains invalid Elements or values, or is missing mandatory Elements or values for the specified SOP Class. Error message is output to the Service Log.
	Unable to process	C001	The C-FIND query identifier is valid for the specified SOP Class but cannot be used to query the database. For example, this can occur if a Patient Level query is issued but the identifier has only empty values for both the Patient ID and the Patient Name. Error message is output to the Service Log.
Cancel	Matching terminated due to Cancel Request	FE00	The C-FIND SCU sent a Cancel Request. This has been acknowledged and the search for matches has been halted.
Pending	Matches are continuing and current match is supplied.	FF00	Indicates that the search for further matches is continuing. This is returned when each successful match is returned and when further matches are forthcoming. This status code is returned if all Optional keys in the query identifier are actually supported.
	Matches are continuing but one or more Optional Keys were not supported.	FF01	Indicates that the search for further matches is continuing. This is returned when each successful match is returned and when further matches are forthcoming. This status code is returned if there are Optional keys in the query identifier that are not supported.

4.2.2.4.1.4 SOP Specific Conformance for Retrieval SOP Classes

A C-MOVE Response will be sent after each C-Store.

TABLE 4.2-15
NOVARAD-SERVER AE C-MOVE Response Status Return Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Sub-operations complete – No Failures	0000	All the Composite SOP Instances have been successfully sent to the C-MOVE Destination AE.

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of Resources – Unable to calculate number of matches	A701	Number of matches cannot be determined due to system failure. Returned if the server's database is not functioning so the search for matches to the C-MOVE Request cannot be found. Error message is output as an alert to the Service Log.
	Out of Resources – Unable to perform sub-operations	A702	C-STORE sub-operations cannot be performed due to failure to access Composite SOP Instances in archive, or failure of a C-STORE Request. Error message is output as an alert to the Service Log.
	Move destination unknown	A801	The Destination Application Entity named in the C-MOVE Request is unknown to Query-Retrieve SCP AE. Error message is output to the Service Log.
Failed	Identifier does not match SOP Class	A900	The C-MOVE identifier contains invalid Elements or values, or is missing mandatory Elements or values for the specified SOP Class or retrieval level. Error message is output to the Service Log.
Cancel	Matching terminated due to Cancel Request	FE00	The C-MOVE SCU sent a Cancel Request. This has been acknowledged and the export of Composite SOP Instances to the C-MOVE Destination AE has been halted.
Pending	Sub-operations are continuing	FF00	A Response with this Status Code is sent every time a Composite SOP Instance has been successfully sent to the C-MOVE Destination AE.
	Matches are continuing but one or more Optional Keys were not supported.	FF01	Indicates that the search for further matches is continuing. This is returned when each successful match is returned and when further matches are forthcoming. This status code is returned if there are Optional keys in the query identifier that are not supported.

TABLE 4.2-16
QUERY-RETRIEVE-SCP AE Communication Failure Behavior

Exception	Behavior
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout). I.e. The QUERY-RETRIEVE-SCP AE is waiting for the next C-FIND or C-MOVE Request on an open Association but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. Error message is output to the Service Log.

Exception	Behavior
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout). I.e. The QUERY-RETRIEVE-SCP AE is waiting for the next message PDU but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. Error message is output to the Service Log.
Association aborted by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	Error message is output to the Service Log.

4.2.3.3.1.5 SOP Specific Conformance for Verification SOP Class

Standard conformance is provided to the DICOM Verification Service Class as an SCU. The Verification Service as an SCU is supported as a diagnostic service tool for network communication issues.

4.2.1.4.2 Activity – Receive Images

4.2.1.4.2.1 Description and Sequencing of Activity

The STORAGE-SCP AE accepts Associations only if they have valid Presentation Contexts. If none of the requested Presentation Contexts are accepted then the Association Request itself is rejected. It can be configured to only accept Associations with certain hosts (using TCP/IP address) and/or Application Entity Titles.

The STORAGE-SCP AE may reject Association attempts as shown in the Table below. The Result, Source and Reason/Diag columns represent the values returned in the corresponding fields of an ASSOCIATE-RJ PDU (see PS 3.8, Section 9.3.4). The following abbreviations are used in the Source column:

- 1 – DICOM UL service-user
- 2 – DICOM UL service-provider (ASCE related function)
- 3 – DICOM UL service-provider (Presentation related function)

TABLE 4.2-17
Association Rejection Reasons

Result	Source	Reason/Diag	Explanation
2 – rejected-transient	c	2 – local-limit-exceeded	The (configurable) maximum number of simultaneous Associations has been reached. An Association request with the same parameters may succeed at a later time.
2 – rejected-transient	c	1 – temporary-congestion	No Associations can be accepted at this time due to the real-time requirements of higher priority activities (e.g. during image acquisition no Associations will be accepted) or because insufficient resources are available (e.g. memory, processes, threads). An Association request with the same parameters may succeed at a later time.

Result	Source	Reason/Diag	Explanation
1 – rejected-permanent	a	2 – application-context-name-not-supported	The Association request contained an unsupported Application Context Name. An association request with the same parameters will not succeed at a later time.
1 – rejected-permanent	a	7 – called-AE-title-not-recognized	The Association request contained an unrecognized Called AE Title. An Association request with the same parameters will not succeed at a later time unless configuration changes are made. This rejection reason normally occurs when the Association initiator is incorrectly configured and attempts to address the Association acceptor using the wrong AE Title.
1 – rejected-permanent	a	3 – calling-AE-title-not-recognized	The Association request contained an unrecognized Calling AE Title. An Association request with the same parameters will not succeed at a later time unless configuration changes are made. This rejection reason normally occurs when the Association acceptor has not been configured to recognize the AE Title of the Association initiator.
1 – rejected-permanent	b	1 – no-reason-given	The Association request could not be parsed. An Association request with the same format will not succeed at a later time.

4.2.1.4.2.2 Accepted Presentation Contexts

The default Behavior of the STORAGE-SCP AE is to support the Implicit VR Little Endian and Explicit VR Little Endian Transfer Syntaxes for all Associations.

If multiple Transfer Syntaxes are proposed for a Presentation Context then Implicit VR Little Endian is accepted. Any of the Transfer Syntaxes shown in the following table are acceptable to the STORAGE-SCP AE for receiving images.

TABLE 4.2-18
ACCEPTED TRANSFER SYNTAXES FOR STORAGE-SCP AE

Name	UID
Implicit Vr Little Endian	1.2.840.10008.1.2
Explicit Vr Little Endian	1.2.840.10008.1.2.1
RLE Lossless	1.2.840.10008.1.2.5
JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50
JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57
JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70
JPEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80
JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81
JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90
JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91

4.2.1.4.2.3 SOP Specific Conformance for Verification SOP Class

The STORAGE-SCP AE provides standard conformance to the Verification SOP Class as an SCP.

4.2.1.4.2.4 SOP Specific Conformance for Storage SOP Classes

The images are stored as they are received (i.e. all the Attributes are left intact, including private Attributes) in the form of "PART-10" files by the NOVARAD-Server, i.e. the DICOM File Meta information as defined for DICOM exchange media in PS 3.10 is added.

Patient demographics, study, series and image information such as UIDs, IDs, Study Date, etc. are stored in the database. If UIDs are missing, they are generated from other identifiable information in a study and saved to the file in order to work with older modalities that might not provide these required fields.

There is no immediate processing of the image file contents when receiving the image file, resulting in a positive acknowledgment to the sending modality.

If the Patient ID, Name, or Exam Date is missing, the file will not be added to the archive/database. An error is written to the log, and the file is saved to the invalid image directory.

For the purposes of image display the system supports the following photometric interpretations: MONOCHROME1, MONOCHROME2, PALETTE_COLOR, RGB, YBR_FULL_422.

There is no requirement for devices to send their Studies over a single Association, they can be sent over multiple, different Associations.

TABLE 4.2-19
NOVARAD-SERVER AE C-STORE RESPONSE STATUS RETURN REASONS

Service Status	Further Meaning	Error Code	Reason
Success	Success	0000	The Composite SOP Instance was successfully received, verified, and stored in the system database.
Refused	Out of Resources	A700	Indicates that there was not enough disk space to store the image. Error message is output to the Service Log. The SOP Instance will not be saved.
Error	Data Set does not match SOP Class	A900	Indicates that the Data Set does not encode a valid instance of the SOP Class specified. Error message is output to the Service Log.
	Cannot understand	C000	Indicates that the STORAGE-SCP AE cannot parse the Data Set into Elements. Error message is output to the Service Log.

The Behavior of the NOVARAD-SERVER AE during communication failure is summarized in the following table:

TABLE 4.2-20
NOVARAD-SERVER AE STORAGE SERVICE COMMUNICATION FAILURE REASONS

Exception	Reason
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout). I.e. The STORAGE-SCP AE is waiting for the next C-STORE Request on an open Association but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. Error message is output to the Service Log. The images that were sent prior to this error are kept in the database/archive.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout). I.e. The STORAGE-SCP AE is waiting for the next C-STORE Data Set PDU but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. Error message is output to the Service Log. The images that were sent prior to this error are kept in the database/archive.
Association aborted by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	Error message is output to the Service Log. The images that were sent prior to this error are kept in the database/archive.

4.2.1.4.3 Activity - Remote AE Requests Verification

4.2.1.4.3.1 Description and Sequencing of Activities

A remote AE sends an Echo Request to verify that NOVARAD-WORKLIST is awake and listening. NOVARAD-WORKLIST responds with success status as long as the request can be parsed.

4.2.1.4.3.2 Accepted Presentation Contexts

Table 4.2-21
Acceptable Presentation Contexts for AE NOVARAD-WORKLIST and
Real-World Activity Configured AE Requests Verification

Presentation Context Table					
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		

4.2.1.4.3.3 SOP Specific Conformance

NOVARAD-WORKLIST provides Standard conformance to the DICOM Verification service class.

4.2.1.4.3.4 Presentation Context Acceptance criterion

Depending on configuration, NOVARAD-WORKLIST may or may not accept multiple presentation contexts containing the same abstract syntax.

4.2.1.4.3.5 Transfer Syntax Selection Policy

Transfer Syntaxes in addition to the default Implicit VR Little Endian may be configured for a given Abstract Syntax. When this is done, the first Transfer Syntax encountered in the configuration file, which matches a Transfer Syntax offered for a given Presentation Context, will be selected as the accepted Transfer Syntax for that Presentation Context.

4.2.2 NOVARAD-WORKLIST AE Specification

4.2.2.1 SOP Classes

This application provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 4.2-22
SOP Classes for AE DICOMSRV

SOP Class Name	SOP Class UID	SCU	SCP
Modality Worklist	1.2.840.10008.5.1.4.31	No	Yes

4.2.2.2 Association Establishment Policies

4.2.2.2.1 General

The Application Context Name for DICOM 3.0 is the only Application Context accepted.

TABLE 4.2-23
DICOM APPLICATION CONTEXT

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

4.2.2.2.2 Number of Associations

NOVARAD-WORKLIST will support as many simultaneous associations as SCP as are requested by Workflow SCUs.

Table 4.2-24
Number of Associations as an SCP for AE NOVARAD-WORKLIST

Maximum number of simultaneous associations	In principle unlimited, determined by system resources
---	--

4.2.2.2.3 Asynchronous Nature

Asynchronous communication (multiple outstanding transactions over a single association) is not supported.

TABLE 4.2-25
ASYNCHRONOUS NATURE AS A SCU/SCP FOR NOVARAD-SERVER AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)
---	----------------------

4.2.2.2.4 Implementation Identifying Information

Table 4.2-26
DICOM Implementation Class and Version for NOVARAD-WORKLIST

Implementation Class UID	1.2.840.114051
Implementation Version Name	NovaRad 9.0

4.2.2.3 Association Initiation Policy

NOVARAD-WORKLIST does not initiate Associations.

4.2.2.4 Association Acceptance Policy

NOVARAD-WORKLIST will accept associations for the MWL SOP Class as an SCP.

4.2.2.4.1 Activity – Remote AE Requests MWL Query

4.2.2.4.1.1 Description and Sequencing of Activities

The relationship between the Image Service Request (ISR) and Requested Procedure is 1:1. That means that there will be single Requested Procedure ID (0040,1001) for a specific Accession Number (0008,0050). The Accession Number is used to associate reports from a HIS/RIS to the study.

The scheduled procedures will be added to the worklist when an ORM HL7 event is received.

When a ORU is received containing the final report, the procedure is removed from the worklist. In addition, procedures that are more than two days old will also be removed from the worklist.

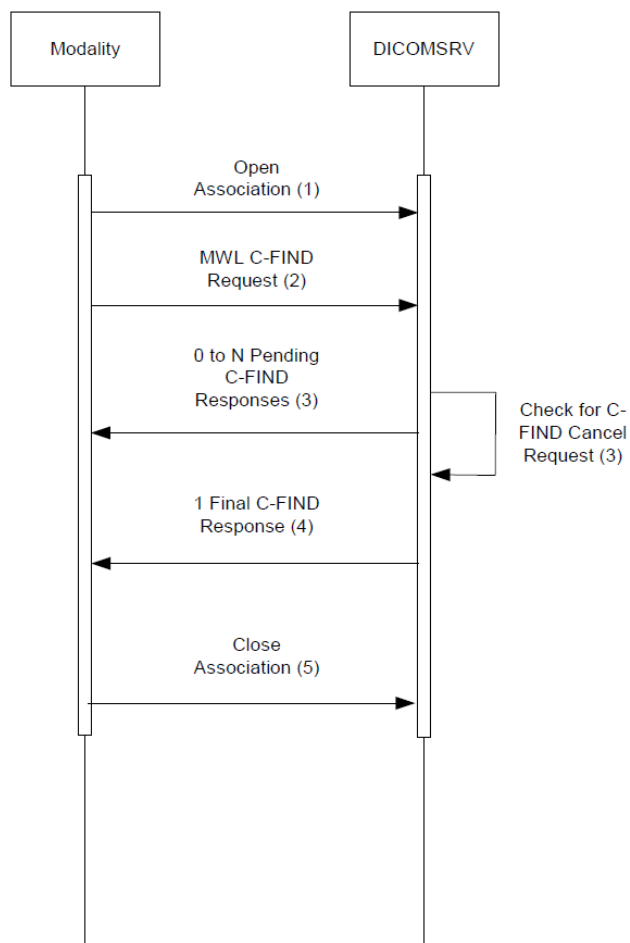


FIGURE 4.2-3
SEQUENCING DIAGRAM FOR ACTIVITY: CONFIGURED AE REQUESTS MWL QUERY

The figure above is a possible sequence of messages between a Modality Worklist SCU and NOVARAD-WORKLIST.

1. The Modality opens an Association with NOVARAD-WORKLIST for the purpose of querying for a Modality Worklist
2. The Modality sends an MWL C-FIND query to NOVARAD-WORKLIST
3. NOVARAD-WORKLIST queries its database using the attributes from the C-FIND Request and returns 0 to N C-FIND responses depending on matches returned from the database.
4. NOVARAD-WORKLIST sends the final C-FIND response

5. The Modality closes the Association

The NOVARAD-WORKLIST will check for a C-FIND CANCEL after each individual C-FIND response (3).

4.2.2.4.1.2 Accepted Presentation Contexts

Table 4.2-27
Acceptable Presentation Contexts for AE NOVARAD-WORKLIST

Presentation Context Table					
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	1.2.840.10008.1.2	SCP	None

4.2.2.4.1.2.1 Presentation Context Acceptance Criterion

NOVARAD-WORKLIST will only accept one single Presentation Contexts containing the same Abstract Syntax.

4.2.2.4.1.2.2 Transfer Syntax Selection Policy

NOVARAD-WORKLIST's only accepted Transfer Syntax is Implicit VR Little Endian.

4.2.1.4.1.3 SOP Specific Conformance for Modality Worklist SOP Class

The Matching of the WORKLIST is NOT case sensitive, which means that lower/upper case is ignored for the purpose of returning information.

NOVARAD-WORKLIST supports return key attributes as described in the table below.

TABLE 4.2-28
MODALITY WORKLIST OPTIONAL RETURN KEYS SUPPORTED

Description/Module	Tag	Remark
Scheduled Procedure Step		
ScheduledProcedureStepSequence	(0040,0100)	
>Modality	(0008,0060)	
>ScheduledStationAETitle	(0040,0001)	
>ScheduledProcedureStepStartDate	(0040,0002)	
>ScheduledProcedureStepStartTime	(0040,0003)	
>ScheduledPerformingPhysiciansName	(0040,0006)	

Description/Module	Tag	Remark
>ScheduledProcedureStepDescription	(0040,0007)	
>ScheduledStationName	(0040,0010)	
>ScheduledProcedureStepLocation	(0040,0011)	
Requested Procedure		
RequestedProcedureDescription	(0032,1060)	
RequestingPhysician	(0032,1032)	
RequestedProcedureID	(0040,1001)	
Imaging Service Request		
AccessionNumber	(0008,0050)	
StudyInstanceUID	(0020,000D)	Generated by NOVARAD-WORKLIST
Patient Identification		
PatientID	(0010,0020)	
Patient Demographic		
PatientsName	(0010,0010)	
PatientsBirthDate	(0010,0030)	
PatientsSex	(0010,0040)	
SOP Common		
SpecificCharacterSet	(0008,0005)	Always ISO_IR 100

NOVARAD-WORKLIST returns C-FIND response statuses as specified below.

Table 4.2-29
MWL C-FIND Response Status Reasons

Service Status	Further Meaning	Error Code	Reasons
Success	Matching is complete	0000	Successful matching occurred
Failure	Out of resources	A700	If the number of matches exceeds a configurable maximum this error code is returned. An error comment describing the error is also returned. The response status code and meaning are logged in the error log file.
	Identifier does not match SOP class	A900	This status is returned if the C-FIND request specifies query or Return keys that are not specified as part of the Modality Worklist Information Model – FIND SOP Class. The response status code and meaning are logged in the error log file.

Service Status	Further Meaning	Error Code	Reasons
	Unable to process	C001	This status is returned due to internal errors within NOVARAD-WORKLIST such as a processing failure response on a query of the Server database. The response status code and meaning are logged in the error log file.
Canceled	Matching terminated due to cancel request	FE00	This status is returned if a Cancel Request is received from the SCU during the processing of a Modality Worklist request. The response status code and meaning are logged in the error log file.
Pending	Matching is continuing	FF00	The status is returned with each matching response. A message is logged for each pending response.

4.3 NETWORK INTERFACES

4.3.1 Physical Network Interface

The NOVARAD-SERVER supports the following network interfaces:

TABLE 4.3-1
Supported Physical Network Interfaces

Gigabit/sec Ethernet
Ethernet 100baseT
Ethernet 10baseT

4.3.2 Additional Protocols

NOVARAD-SERVER conforms to the System Management Profiles listed in Table 4.3-2. All requested transactions for the listed profiles and actors are supported. It does not support any optional transactions.

TABLE 4.3-2
Supported System Management Profiles

Profile Name	Actor	Protocols Used	Optional Transactions	Security Support
Network Address Management	DHCP Client	DHCP	N/A	
	DNS Client	DNS	N/A	

4.3.2.1 DHCP

DHCP can be used to obtain TCP/IP network configuration information. The network parameters obtainable via DHCP are shown in Table 4.3-3. If DHCP is not in use, TCP/IP network configuration information can be manually configured via the Service/Installation Tool.

TABLE 4.3-3
Supported DHCP Parameters

DHCP Parameter	Default Value
IP Address	Yes supported, but no default values are assumed. They can be configured per site. IP addresses are used as an added measure of security.
Hostname	See above
List of NTP servers	See above
List of DNS servers	See above
Routers	See above
Static routes	See above
Domain name	See above
Subnet mask	See above
Broadcast address	See above
Default router	See above
Time offset	See above
MTU	See above
Auto-IP permission	No

4.3.2.2 DNS

DNS can be used for address resolution. If DHCP is not in use or the DHCP server does not return any DNS server addresses, the identity of a DNS server can be configured via the Service/Installation Tool. If a DNS server is not in use, local mapping between hostname and IP address can be manually configured via the Service/Installation Tool.

4.4 CONFIGURATION

4.4.1 AE Title/Presentation Address Mapping

4.4.1.1 Local AE Titles

The mapping from AE Title to TCP/IP addresses and ports is configurable and set at the time of installation by Installation Personnel.

TABLE 4.4-1
Default Application Entity Characteristics

Application Entity	Role	Default AE Title	Default TCP/IP Port
NOVARAD-SERVER AE	SCU/SCP	novarad	104

Application Entity	Role	Default AE Title	Default TCP/IP Port
NOVARAD-WORKLIST AE	SCP	NovaWorklist	1003

The NOVARAD-SERVER and NOVARAD-WORKLIST Application Entities need to have a different AE Title.

4.4.1.2 Remote AE Title/Presentation Address Mapping

The mapping of external AE Titles to TCP/IP addresses and ports is configurable and set at the time of installation by Installation Personnel. This mapping is necessary for resolving the IP address and port of C-MOVE Destination Application Entities.

4.4.2 Parameters

TABLE 4.4-2
Configuration Parameters

Parameter	Configurable	Default Value
General Parameters		
Maximum PDU size that can be received	No	16384
Maximum PDU size that can be sent	No	16384
Time-out waiting for response to TCP/IP connect() request. (Low-level timeout)	No	
Time-out waiting for A-ASSOCIATE RQ PDU on open TCP/IP connection. (ARTIM timeout)	No	
Time-out waiting for acceptance or rejection response to an Association Open Request. (Application Level timeout)	No	
Time-out waiting for acceptance of a TCP/IP message over the network. (Low-level timeout)	No	
Time-out for waiting for data between TCP/IP packets. (Low-level timeout)	No	
The Windows NT TCP/IP socket buffer size is set to 1,342,177 bytes in order to improve image data throughput performance.	No	
NOVARAD-SERVER AE Parameters		
Number of retries for image transfer after error occurred	Yes	5
Interval time for retry when error occurred	Yes	30 sec
NOVARAD-SERVER AE time-out waiting for a Response to a C-STORE-RQ. (DIMSE timeout)	No	
Maximum PDU Size as a SCP	No	



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Parameter	Configurable	Default Value
QUERY-RETRIEVE-SCP AE time-out waiting on an open Association for the next message (C-FIND-RQ, C-MOVE-RQ, Association Close Request. etc.) (DIMSE timeout)	No	
NOVARAD-WORKLIST AE Parameters		
Maximum PDU Size	No	
NOVARAD-WORKLIST-SCP AE time-out waiting on an open Association for the next message (C-FIND-RQ, Association Close Request. etc.) (DIMSE timeout)	No	

5 MEDIA STORAGE

NOVARAD-SERVER does not support Media Storage.

6 SUPPORT OF EXTENDED CHARACTER SETS

All NOVARAD-SERVER DICOM applications support the following:

ISO_IR 100 (ISO 8859-1:1987 Latin Alphabet No. 1 supplementary set)

No extended character sets are supported.

7 SECURITY

7.1 ASSOCIATION LEVEL SECURITY

The AE can be configured to accept Association Requests from only a limited list of Calling AE Titles and IP addresses.

8 DICOM TAG REQUIREMENTS

8.1 TAGS REQUIRED FOR PROCESSING OF DATASET DATA

STUDY_INSTANCE_UID (0020, 000d)
SERIES_INSTANCE_UID (0020, 000e)
SOP_CLASS_UID (0008, 0016)
SOP_INSTANCE_UID (0008, 0018)
STUDY_DATE (0008, 0020)
PATIENT_ID (0010, 0020)

8.2 TAGS REQUIRED FOR IMAGE VIEWING

PHOTOMETRIC_INTERPRETATION (0028, 0004)
PIXEL_REPRESENTATION (0028, 0103)
ROWS (0028, 0010)
COLUMNS (0028, 0011)
HIGH_BIT (0028, 0102)
BITS_ALLOCATED (0028, 0100)
BITS_STORED (0028, 0101)
PIXEL_DATA (7fe0, 0010)