



Empowering Healthcare

Horizon
Medical Imaging 11.8

**DICOM CONFORMANCE
STATEMENT**

Medical Imaging Group

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1. CONFORMANCE STATEMENT OVERVIEW

Horizon Medical Imaging™ 11.8 is a self-contained, networked computer system used for receiving, archiving, and displaying diagnostic medical images. It is also capable of creating derived images using Multi-Planar Reconstruction (MPR). It can create DICOM Secondary Capture Image objects from documents scanned directly into HMI. The MPR and Secondary Capture Image objects can both be exported via the Query/Retrieve or Storage Services. The system conforms to the DICOM 3.0 standard to allow the sharing of medical information with other digital imaging systems.

Table 1 provides an overview of the network services supported by Horizon Medical Imaging™ 11.8.

Table 1: Network Services

DICOM SOP Class Name	User of Service (SCU)	Provider of Service (SCP)
Verification		
Verification	No	Yes
Transfer		
12-lead ECG Waveform	Yes	Yes
Ambulatory ECG Waveform	Yes	Yes
Basic Voice Audio Waveform	Yes	Yes
Cardiac Electrophysiology Waveform	Yes	Yes
Basic Text Structured Report	Yes	Yes
Comprehensive Structured Report	Yes	Yes
Enhanced Structured Report	Yes	Yes
Key Object Selection Document	Yes	Yes
Chest CAD SR	Yes	Yes
Mammography CAD Structured Report	Yes	Yes
Encapsulated PDF	Yes	Yes
Computed Radiography Image	Yes	Yes
CT Image	Yes	Yes
Digital X-Ray Image (Presentation)	Yes	Yes
Digital X-Ray Image (Processing)	Yes	Yes
Digital Mammography Image (Presentation)	Yes	Yes
Digital Mammography Image (Processing)	Yes	Yes
Digital Intra-oral X-Ray Image (Presentation)	Yes	Yes
Digital Intra-oral X-Ray Image (Processing)	Yes	Yes
General ECG Waveform	Yes	Yes
Grayscale Softcopy Presentation State	Yes	Yes
Hardcopy Color Image	Yes	Yes
Hardcopy Grayscale Image	Yes	Yes
Hemodynamic Waveform	Yes	Yes
Multi-frame Single Bit Secondary Capture Image	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image	Yes	Yes
Multi-frame Grayscale Word Secondary Capture Image	Yes	Yes
Multi-frame True Color Secondary Capture Image	Yes	Yes
MR Image	Yes	Yes
Nuclear Medicine Image	Yes	Yes
Nuclear Medicine Image (Retired)	Yes	Yes
Positron Emission Tomography Image	Yes	Yes
Raw Data	Yes	Yes
RT Beams Treatment Record	Yes	Yes

DICOM SOP Class Name	User of Service (SCU)	Provider of Service (SCP)
RT Brachy Treatment Record	Yes	Yes
RT Dose	Yes	Yes
RT Image	Yes	Yes
RT Plan	Yes	Yes
RT Structure Set	Yes	Yes
RT Treatment Summary Record	Yes	Yes
Secondary Capture Image	Yes	Yes
Stand-alone Curve	Yes	Yes
Stand-alone Modality LUT	Yes	Yes
Stand-alone Overlay	Yes	Yes
Stand-alone VOI LUT	Yes	Yes
Standalone PET Curve	Yes	Yes
Stored Print	Yes	Yes
Ultrasound Image	Yes	Yes
Ultrasound Image (Retired)	Yes	Yes
Ultrasound Multi-frame Image	Yes	Yes
Ultrasound Multi-frame Image (Retired)	Yes	Yes
VL Endoscopic Image	Yes	Yes
VL Microscopic Image	Yes	Yes
VL Slide-Coordinates Microscopic Image	Yes	Yes
VL Photographic Image	Yes	Yes
VL Image (Retired)	Yes	Yes
VL Multi-frame Image (Retired)	Yes	Yes
X-Ray Angiographic Bi-Plane Image (retired)	Yes	Yes
X-Ray Angiographic Image	Yes	Yes
X-Ray Radiofluoroscopic Image	Yes	Yes
Query/Retrieve		
Patient Root Q/R – FIND	Yes	Yes
Patient Root Q/R – MOVE	Yes	Yes
Study Root Q/R – FIND	Yes	Yes
Study Root Q/R – MOVE	Yes	Yes
Patient Study Only – FIND	Yes	Yes
Patient Study Only – MOVE	Yes	Yes
Workflow Management		
Storage Commitment Push Model	No	Yes
Modality Worklist	Yes	Yes
Modality Performed Procedure Step	Yes	Yes
Study Content Notification	Yes	No
Detached Study Management	No	Yes
Print Management		
Basic Grayscale Print Management	Yes	No
Basic Color Print Management	Yes	No

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

Horizon Rad Station™ 11.8 cannot actually support the display of all of the Composite SOP Classes listed in Table 1. Please refer to Table 133: Supported Composite Image SOP Classes for Display and Table 134: Unsupported Composite SOP Classes for Display for lists of those SOP Classes that can and cannot be displayed.

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Table 2 provides an overview of the Media Storage Application Profiles supported by Horizon Medical Imaging™ 11.8.

Table 2: Media Storage Application Profiles

Media Storage Application Profile	Write Files (FSC or FSU)	Read Files (FSR)
Compact Disk – Recordable		
General Purpose CD-R	Yes	Yes
Ultrasound Image Display Single Frame	Yes	Yes
Ultrasound Spatial Calibration Single Frame	Yes	Yes
Ultrasound Combined Calibration Single Frame	Yes	Yes
Ultrasound Image Display Single and Multi-Frame	Yes	Yes
Ultrasound Spatial Calibration Single and Multi-Frame	Yes	Yes
Ultrasound Combined Calibration Single and Multi-Frame	Yes	Yes

NOTE: For the system to act as an FSC or FSU of the STD-GEN-CD Application Profile it must be equipped with the necessary hardware option for writing to CD media. This is not a standard feature of all Horizon Medical Imaging™ systems. Horizon Medical Imaging™ systems can also support these Ultrasound Application Profiles for MOD media if equipped with the necessary hardware.

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8. REVIEWERS122

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2. INTRODUCTION

2.1 AUDIENCE

This document is the DICOM 3.0 Conformance Statement for Horizon Medical Imaging™¹ 11.8. It is intended for hospital staff, health system integrators, and software designers or implementers. It is assumed that the reader has a working understanding of DICOM.

2.2 REMARKS

Horizon Medical Imaging™ is a self-contained, networked computer system used for receiving, archiving, and displaying diagnostic medical images. The system conforms to the DICOM 3.0 standard to allow the sharing of medical information with other digital imaging systems.

DICOM, by itself, does not guarantee interoperability. However, the Conformance Statement facilitates a first-level validation for interoperability between different applications supporting the same DICOM functionality.

This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information.

The scope of this Conformance Statement is to facilitate communication between HMI 11.8 and other DICOM systems. The Conformance Statement should be read and understood in conjunction with the DICOM Standard [DICOM]. 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 HMI 11.8 and other DICOM conformant equipment.
- Test procedures should be defined to validate the desired level of connectivity.

2.3 DEFINITIONS, TERMS AND ABBREVIATIONS

AE	Application Entity
CPI	IHE Consistent Presentation of Images Profile
DICOM	Digital Imaging and Communications in Medicine
IE	Information Entity
FSC	File Set Creator
FSR	File Set Reader
HMI	Horizon Medical Imaging™
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
ISO	International Standards Organization
MPR	Multi-Planar Reconstruction
PDU	Protocol Data Unit
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier

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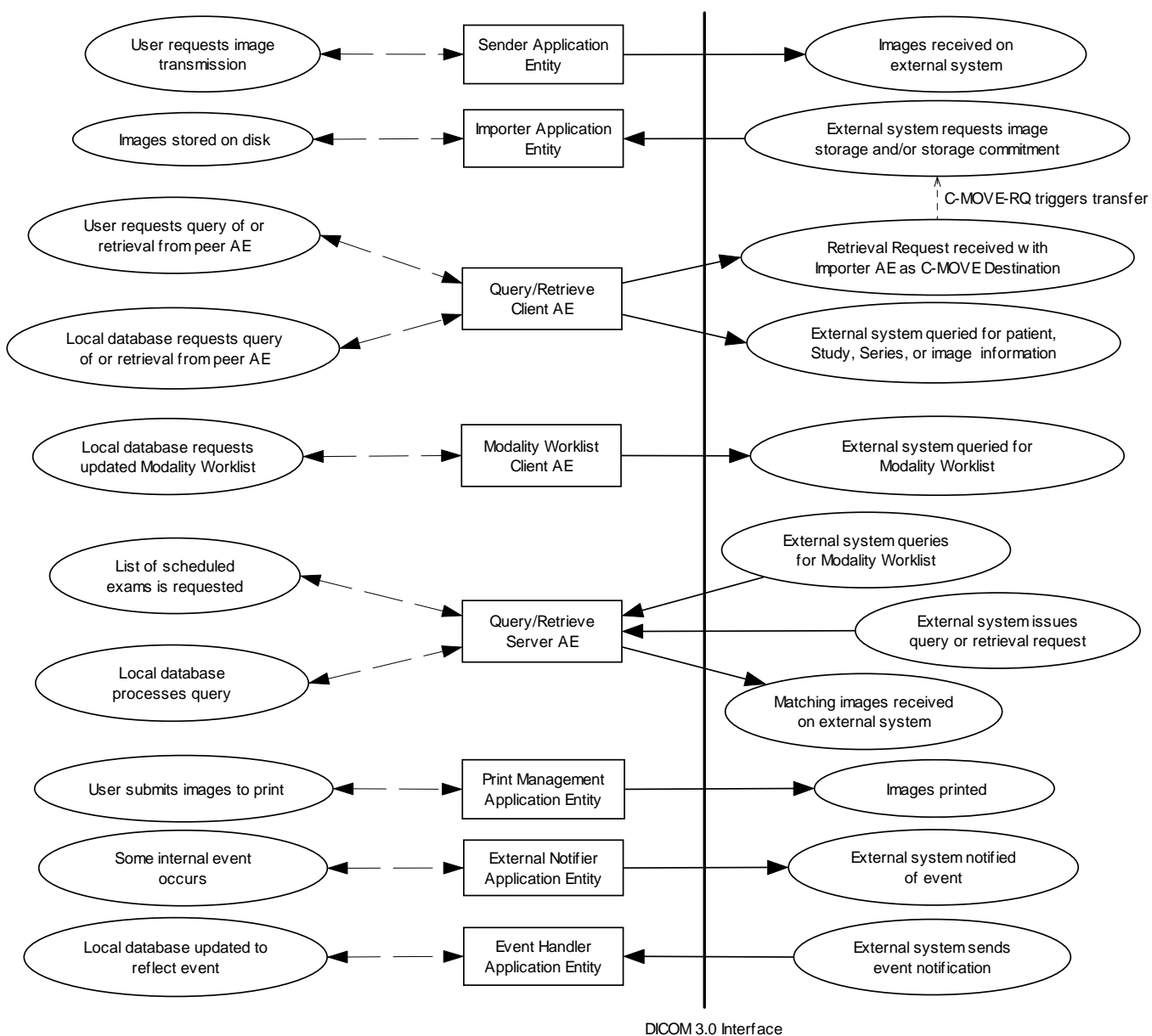
VM Value Multiplicity
 VR Value Representation

3. NETWORKING

3.1 Implementation Model

3.1.1 Application Data Flow Diagram

Figure 1: Horizon Medical Imaging™ DICOM Network Data Flow Diagram



DICOM 3.0 Interface

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The Sender AE can send Storage Image objects as a C-STORE SCU. It receives requests from a Horizon Medical Imaging™ user to transmit a list of images to a specific DICOM destination.

The Importer AE can receive Storage Image objects as a C-STORE SCP. As an SCP it can respond to external Storage Requests which are either unsolicited or a result of DICOM C-MOVE requests. It can also receive Storage Commitment Push Model N-ACTION Requests from the SCU. The Importer can send all N-EVENT Reports over this same Association or open a new Association to the SCU and send the N-EVENT report over the new Association.

The Query/Retrieve Server AE allows external systems to query Horizon Medical Imaging™ for Modality Worklist, patient, study and series demographic queries as a C-FIND SCP. Also, image retrievals will be processed by this AE as a C-MOVE SCP.

The Query/Retrieve Client AE acts as an Association Requestor for sending queries or retrieval requests to a remote AE acting as an SCP for the C-FIND query or C-MOVE retrieval SOP Classes. The Query/Retrieve Client AE can either be triggered directly through the user interface, or when the Horizon Medical Imaging™ system is aware that it must retrieve SOP Instances from a remote AE (i.e. The Horizon Medical Imaging™ database indicates that the data was sent to the remote AE earlier, such as when the remote AE is serving as the primary archive).

The Modality Worklist Client AE acts as an Association Requestor for sending queries to a remote AE acting as an SCP for the Modality Worklist SOP Class. If the Modality Worklist Client AE is enabled then it will automatically query a remote AE repeatedly for the latest Modality Worklist. The time period between queries is configurable.

The Print Management AE enables users to initiate an Association with a DICOM-compliant printer to print a list of selected images.

The External Notifier AE sends notifications of Horizon Medical Imaging™ internal events to external systems. This AE uses Study Content Notification as a C-STORE SCU, Detached Study Management as an N-EVENT-REPORT SCP, and Modality Performed Procedure Step as an N-CREATE and N-SET SCU. Internal events that may be notified to external systems include: a new study is received, a study has been flushed from the RAID, a study has been retrieved to the RAID from the archive, and a study has been marked reported by a radiologist. Also, the External Notifier AE will forward any Modality Performed Procedure Step request received by the Event Handler AE.

The Event Handler AE receives notifications of events from external systems. This AE can receive Modality Performed Procedure Step requests, as well as Detached Study Management SOP Class as an N-EVENT-REPORT SCU for the 'Study Read' event (Event ID 7). When a Detached Study Management message is received, the corresponding study record in the local database is marked as reported.

The Removable Media AE can be used to create and read DICOM removable media. The user can choose to access the image files for individual studies on DICOM removable media. They can also choose to export individual studies that exist in the system's database to removable media.

3.1.2 Functional Definitions of Application Entities

Horizon Medical Imaging™ contains, conceptually, eight local Application Entities (AE's): Sender, Importer, Query/Retrieve Server, Query/Retrieve Client, Modality Worklist Client, Print Management, External Notifier, and Event Handler. The AEs run as background Windows NT tasks.

3.1.2.1 Sender AE

The Sender AE acts as an SCU and implements the Storage. It can transmit images that have been received from prior external DICOM transmissions.

3.1.2.2 Importer AE

The Importer AE acts as an SCP and implements the Storage Service Class operation. It can receive unsolicited image storage requests from external DICOM storage SCUs. It also acts as an SCP for the Storage Commitment Push Model SOP Class.

3.1.2.3 Query/Retrieve Server AE

The Query/Retrieve Server AE implements the Query/Retrieve Service Class as an SCP. The Query/Retrieve Server AE can handle requests from external devices to query the database for worklists, patient, study and series demographics, and image level information. It can also handle C-MOVE Requests from remote AEs for the retrieval of Composite SOP Instances. The Query/Retrieve Server AE can act as an SCU of the Storage Service to transfer the requested Composite SOP Instances.

3.1.2.4 Query/Retrieve Client AE

The Query/Retrieve Client AE implements the Query/Retrieve Service Class as an SCU. It can act as an SCU to query remote AEs for patient, study and series information. It can also request the retrieval of Composite SOP Instances from remote AEs using C-MOVE Requests. When doing so, it always specifies the Importer AE running on the same Horizon Medical Imaging™ system as the C-MOVE Destination AE.

3.1.2.5 Modality Worklist Client AE

The Modality Worklist Client AE implements the Modality Worklist SOP Class as an SCU. It cannot be triggered through the user interface. Instead it will repeatedly query for the latest Modality Worklist, with a configurable delay period between each query.

3.1.2.6 Print Management AE

The Print Management AE implements the Print Management Service Class as an SCU. It supports both the Basic Grayscale Print Management and Basic Color Print Management Classes.

3.1.2.7 External Notifier AE

The External Notifier AE implements the Study Content Notification Service Class, the Detached Study Management Service Class, and the Modality Performed Procedure Step Service Class. It can send Study Content Notification objects, Detached Study Management report messages, or Modality Performed Procedure Step messages whenever a configurable set of system events occurs.

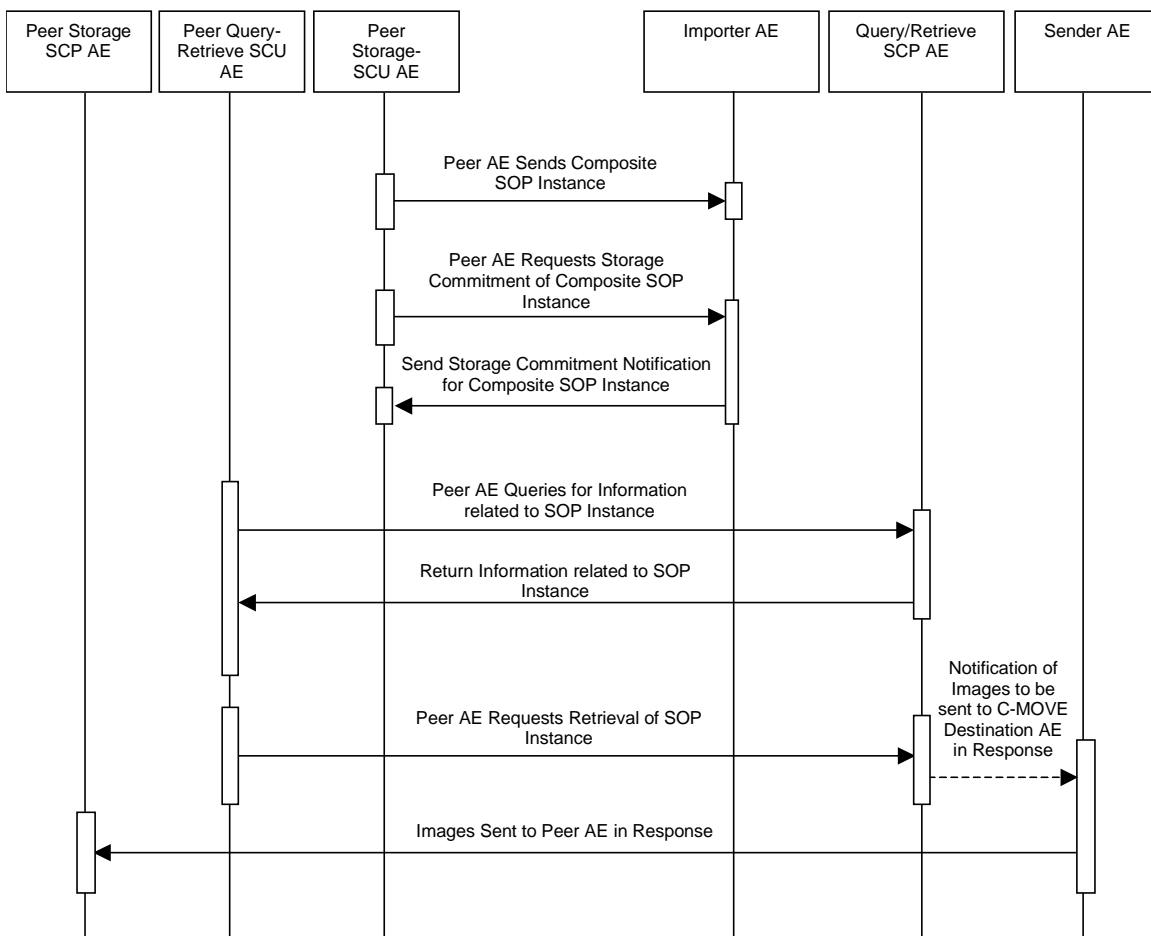
3.1.2.8 Event Handler AE

The Event Handler AE implements full support of the Modality Performed Procedure Step Service Class, as well as a subset of the Detached Study Management Service Class. In particular, this AE only handles N-EVENT-REPORT messages with Event ID 7 for Study Read.

3.1.3 Sequencing of Real-World Activities

The only sequencing constraint that exists across all the Horizon Medical Imaging™ Application Entities is the fact that a Composite SOP Instance must be received by the Importer AE before Storage Commitment Push Model or Query-Retrieve Requests related to this SOP Instance can be successfully handled:

Figure 2: Horizon Medical Imaging™ Sequencing Constraints



Note that the only constraint is for the Composite SOP Instance to be received prior to the other events. For example, it is not necessary for the Storage Commitment Push Model Request to be received prior to receiving Query or Retrieval Requests related to the SOP Instance.

3.2 AE Specifications

3.2.1 Sender AE Specification

3.2.1.1 SOP Classes

The Sender AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 3: SOP Class Conformance of Sender AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Transfer			
12-lead ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.1	Yes	No
Ambulatory ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.3	Yes	No
Basic Voice Audio Waveform	1.2.840.10008.5.1.4.1.1.9.4.1	Yes	No
Cardiac Electrophysiology Waveform	1.2.840.10008.5.1.4.1.1.9.3.1	Yes	No
Basic Text Structured Report	1.2.840.10008.5.1.4.1.1.88.11	Yes	No
Comprehensive Structured Report	1.2.840.10008.5.1.4.1.1.88.33	Yes	No
Enhanced Structured Report	1.2.840.10008.5.1.4.1.1.88.22	Yes	No
Mammography CAD Structured Report	1.2.840.10008.5.1.4.1.1.88.50	Yes	No
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Yes	No
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	Yes	No
Computed Radiography Image	1.2.840.10008.5.1.4.1.1.1	Yes	No
CT Image	1.2.840.10008.5.1.4.1.1.2	Yes	No
Digital X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.1	Yes	No
Digital X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.1.1	Yes	No
Digital Mammography Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.2	Yes	No
Digital Mammography Image (Processing)	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	No
Digital Intra-oral X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.3	Yes	No
Digital Intra-oral X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.3.1	Yes	No
General ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.2	Yes	No
Grayscale Softcopy Presentation State	1.2.840.10008.5.1.4.1.1.11.1	Yes	No
Hardcopy Color Image	1.2.840.10008.5.1.1.30	Yes	No
Hardcopy Grayscale Image	1.2.840.10008.5.1.1.29	Yes	No
Hemodynamic Waveform	1.2.840.10008.5.1.4.1.1.9.2.1	Yes	No
Multi-frame Single Bit Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.1	Yes	No
Multi-frame Grayscale Byte Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.2	Yes	No
Multi-frame Grayscale Word Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.3	Yes	No
Multi-frame True Color Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.4	Yes	No
MR Image	1.2.840.10008.5.1.4.1.1.4	Yes	No
Nuclear Medicine Image	1.2.840.10008.5.1.4.1.1.20	Yes	No
Nuclear Medicine Image (Retired)	1.2.840.10008.5.1.4.1.1.5	Yes	No
Positron Emission Tomography Image	1.2.840.10008.5.1.4.1.1.128	Yes	No
Raw Data	1.2.840.10008.5.1.4.1.1.66	Yes	No
RT Beams Treatment Record	1.2.840.10008.5.1.4.1.1.481.4	Yes	No
RT Brachy Treatment Record	1.2.840.10008.5.1.4.1.1.481.6	Yes	No
RT Dose	1.2.840.10008.5.1.4.1.1.481.2	Yes	No
RT Image	1.2.840.10008.5.1.4.1.1.481.1	Yes	No
RT Plan	1.2.840.10008.5.1.4.1.1.481.5	Yes	No
RT Structure Set	1.2.840.10008.5.1.4.1.1.481.3	Yes	No

DICOM SOP Class Name	SOP Class UID	SCU	SCP
RT Treatment Summary Record	1.2.840.10008.5.1.4.1.1.481.7	Yes	No
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Yes	No
Stand-alone Curve	1.2.840.10008.5.1.4.1.1.9	Yes	No
Stand-alone Modality LUT	1.2.840.10008.5.1.4.1.1.10	Yes	No
Stand-alone Overlay	1.2.840.10008.5.1.4.1.1.8	Yes	No
Stand-alone VOI LUT	1.2.840.10008.5.1.4.1.1.11	Yes	No
Standalone PET Curve	1.2.840.10008.5.1.4.1.1.129	Yes	No
Stored Print	1.2.840.10008.5.1.1.27	Yes	No
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	Yes	No
Ultrasound Image (Retired)	1.2.840.10008.5.1.4.1.1.6	Yes	No
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
Ultrasound Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.3	Yes	No
VL Endoscopic Image	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	No
VL Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	No
VL Slide-Coordinates Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.3	Yes	No
VL Photographic Image	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	No
VL Image (Retired)	1.2.840.10008.5.1.4.1.1.77.1	Yes	No
VL Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.77.2	Yes	No
X-Ray Angiographic Bi-Plane Image (retired)	1.2.840.10008.5.1.4.1.1.12.3	Yes	No
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Yes	No
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	Yes	No

The Sender AE will attempt to send stored DICOM images in the abstract syntax in which they were received. If a negotiated Association to a remote C-STORE SCP does not support the required abstract syntax, the Sender AE will attempt to transform the image object into an abstract syntax that is supported on that Association. The transformations that the Sender AE will attempt depend on the initial abstract syntax of the image.

To send images objects in either the single or multi-frame retired Ultrasound SOP classes across Associations not supporting these classes, the Sender AE first attempts to send the images by transforming them into the matching (single or multi-frame) Ultrasound new SOP classes. Likewise, for Associations not supporting the new Ultrasound classes, the Sender AE will transform the images into the corresponding retired class. If this transformed syntax is still not supported on the Association and if the image is not a multi-frame object, then the Sender AE finally attempts to send the image as a Secondary Capture object. If the Association does not support the Secondary Capture abstract syntax, or if it is a multi-frame object, then the image will fail to be sent.

For images other than the four Ultrasound classes mentioned above and as long as the image is not a multi-frame object (VL Multi-frame), if the SOP class of that image is not supported on an Association then the Sender AE will attempt to transmit the image as a Secondary Capture object. If the Secondary Capture abstract syntax is not supported on the Association then the image cannot be sent.

The Sender AE will attempt to send stored DICOM images in the Transfer Syntax in which they were received. If, however, that Transfer Syntax is not supported on an Association, the Sender AE will transform the Transfer Syntax of the image to the default DICOM Implicit VR Little Endian and send it in that syntax.

The Sender AE represents a single task on a Windows NT machine, with multiple instances of the Sender AE possible on a single host. Each Sender AE is configured to send to a single remote DICOM C-STORE SCP destination. Multiple C-STORE SCP destinations can be implemented by configuring more than one Sender AE. In this case each separate Sender AE acts independently of any others (are implemented as separate processes). In addition, multiple instances of the Sender AE can be configured to send to a single Remote AE.

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3.2.1.2 Association Establishment Policies

3.2.1.2.1 General

The Sender AE will initiate a new Association when the user requests the transmission of a set of images (either a complete study or series, or part thereof). Also, Horizon Medical Imaging™ can be configured to automatically send (i.e. forward) any images that are sent to it (received via the Import AE). An attempt will be made to transmit all the images in the study in a single Association. The Association will be released when all the images have been sent. If the Association is broken or some other Association related error is detected, the Association will be aborted and an attempt will be made to transmit the unsent images in a new Association.

The DICOM Standard Application Context Name is always proposed:

Table 4: DICOM Application Context for Sender AE

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

The maximum PDU size that will be offered is configurable, and by default is 16,384 bytes.

3.2.1.2.2 Number of Associations

Each Sender AE process will only attempt to open one Association at a time to the destination it is configured to send to. By default, each instance of the Sender AE application will send to a different Remote AE, although it is possible to configure multiple Sender AE instances to send to the same Remote AE. However, as multiple destinations can be configured, each with their own Sender AE process, multiple Sender AE connections can be open at one time. Thus, there is no limit on the number of simultaneous Associations that Sender AE can attempt.

Table 5: Number of Simultaneous Associations as an SCU for Sender AE

Maximum number of simultaneous Associations	Unlimited
---	-----------

3.2.1.2.3 Asynchronous Nature

The Sender AE does not provide 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 6: Asynchronous Nature as an SCU for Sender AE

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

3.2.1.2.4 Implementation Identifying Information

Table 7: DICOM Implementation Class and Version for Sender AE

Implementation Class UID	1.2.840.113711.1
Implementation Version Name	V1.0

3.2.1.3 Association Initiation Policy

3.2.1.3.1 Activity – User Requests Transmission of Images

3.2.1.3.1.1 Description and Sequencing of Activity

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The Sender AE attempts to open a new Association for each set of images within a single study it attempts to transfer (i.e. images belonging to separate studies will not be sent over the same Association). This occurs when a user of Horizon Medical Imaging™ requests the transmission of Images. There is no sequencing of this activity.

3.2.1.3.1.2 Proposed Presentation Contexts

The Sender AE may propose any one or more of the following Transfer Syntaxes for each of the abstract syntaxes listed in Table 3. Each proposed **Presentation Context** contains a single Transfer Syntax. Multiple Transfer Syntaxes per abstract syntax would be proposed with multiple Presentation Contexts.

Table 8: Sender AE Proposed Transfer Syntaxes

Transfer Syntax		Role	Extended Negotiation
Name	UID		
DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
DICOM JPEG Baseline Process 1	1.2.840.10008.1.2.4.50	SCU	None
DICOM JPEG Extended Process 2 & 4	1.2.840.10008.1.2.4.51	SCU	None
DICOM JPEG Lossless Proc 14	1.2.840.10008.1.2.4.57	SCU	None
DICOM JPEG Lossless First Order Prediction	1.2.840.10008.1.2.4.70	SCU	None
DICOM JPEG 2000 (Lossless Only)	1.2.840.10008.1.2.4.90	SCU	None
DICOM JPEG 2000	1.2.840.10008.1.2.4.91	SCU	None
DICOM RLE.	1.2.840.10008.1.2.5	SCU	None
ALI Wavelet (Private)	1.2.840.113711.1.2.100.1	SCU	None

Note: The Transfer Syntaxes and supported SOP Classes the Sender AE proposes, as listed above, represent the default behavior. The Sender AE can be configured to propose a subset of these.

Note: The ALI Wavelet private Transfer Syntax is implemented using the Pegasus Imaging Corporation's medical image toolkit.

3.2.1.3.1.3 SOP Specific Conformance as an Association Requestor

3.2.1.3.1.3.1 SOP Specific Conformance – Storage

In the case of a successful C-STORE response from the SCP, the Sender AE will continue to send any unsent images belonging to the same study. The Association will be properly released after all relevant images have been sent.

When an image is sent to the Horizon Medical Imaging™ Importer AE, the entire set of tags received with the image will be saved in Horizon Medical Imaging™. When the object is selected for transmission from Horizon Medical Imaging™, the content of these objects will be as they were originally received unless patient demographic information and/or study-related information is altered. In such cases the latest values in the database will replace the original information in the DICOM image. Thus, the set of optional tags contained in DICOM objects going out from Horizon Medical Imaging™ depends on the information that was received. For the list of patient, study, and series attributes that can be updated by the Sender AE when a SOP Instance is exported please refer to 7.1.4: Sender AE and Query/Retrieve Server AE Element Modification

Horizon Medical Imaging™ can support the display of overlays included in the original DICOM image (either embedded or separate). It can also be configured to automatically create overlays of its own by specifying that certain DICOM header values should be displayed as strings at certain locations on the displayed image. Additional annotations can be added to images using the 'Mark and Measure' tool of Horizon Radiology Station™. The Sender AE can be configured to convert such annotations to a single bit per pixel overlay that is added as a DICOM Overlay to the exported images. The overlay bitmap is added as an

Overlay Data (60xx,3000) Element with the overlay characteristics added to the required Group (60xx) Elements (see DICOM Part 3, Table C.9-2).

The Sender AE can be configured to automatically try resending the SOP Instances if some failure occurs. In addition, the Sender AE can be configured to demote the priority of an export task if export fails a certain number of times. Refer to 3.4.2: Configurable Parameters, for the default values for these settings.

The Sender AE creates files called Service Logs that can be used to monitor its status and diagnose any problems that may arise. If any error occurs during DICOM communication then appropriate messages are always output to these Service Logs. In addition, error messages may be output as alerts to the User Interface in certain cases.

The Sender 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 9: Sender 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. Success indication message is output to the Service Logs. A success indication is posted to the User Interface.
Refused	Out of Resources	A700 – A7FF	This is treated as a failure ² . An error indication is output to the Service Logs. An error indication is also posted to the User Interface.
Error	Data Set does not match SOP Class	A900 – A9FF	This is treated as a failure ² . An error indication is output to the Service Logs. An error indication is also posted to the User Interface.
Error	Cannot Understand	C000 – CFFF	This is treated as a failure ² . An error indication is output to the Service Logs. An error indication is also posted to the User Interface.
Warning	Coercion of Data Elements	B000	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. A success indication is also posted to the User Interface.
Warning	Element Discarded	B006	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. A success indication is also posted to the User Interface.
Warning	Data Set does not match SOP Class	B007	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. A success indication is also posted to the User Interface.
Warning	Attribute List Error	0107	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. A success indication is also posted to the User Interface.
Warning	Attribute Value Out of Range	0116	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. A success indication is also posted to the User Interface.
*	*	Any other status	This is treated as a failure ² . An error indication is output to the Service Logs. An error indication is also posted to the User Interface.

² Sender AE can be configured to treat all failures as either permanent or transient. The default behavior is to consider all failures to be transient and to attempt to resend the SOP Instances up to 20 times.

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Service Status	Further Meaning	Error Code	Behavior
		code	

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3.2.1.3.1.3.2

Association Requestor Communication Failure Behavior

The Behavior of the Sender AE during communication failure is summarized in the following table:

Table 10: Sender 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. This is treated as a failure ² . An error indication is output to the Service Logs. An error indication is also posted to the User Interface.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure ² . An error indication is output to the Service Logs. An error indication is also posted to the User Interface.
Association A-P-ABORTed by the SCP or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure ² . An error indication is output to the Service Logs. An error indication is also posted to the User Interface.

3.2.1.4

Association Acceptance Policy

The Sender AE does not accept Associations.

3.2.2 Importer AE Specification

3.2.2.1 SOP Classes

The Importer AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 11: SOP Class Conformance of Importer AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Verification			
Verification	1.2.840.10008.1.1	No	Yes
Transfer			
12-lead ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.1	No	Yes
Ambulatory ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.3	No	Yes
Basic Voice Audio Waveform	1.2.840.10008.5.1.4.1.1.9.4.1	No	Yes
Cardiac Electrophysiology Waveform	1.2.840.10008.5.1.4.1.1.9.3.1	No	Yes
Basic Text Structured Report	1.2.840.10008.5.1.4.1.1.88.11	No	Yes
Comprehensive Structured Report	1.2.840.10008.5.1.4.1.1.88.33	No	Yes
Enhanced Structured Report	1.2.840.10008.5.1.4.1.1.88.22	No	Yes
Mammography CAD Structured Report	1.2.840.10008.5.1.4.1.1.88.50	No	Yes
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	No	Yes
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	No	Yes
Encapsulated PDF	1.2.840.10008.5.1.4.1.1.104.1	No	Yes
Computed Radiography Image	1.2.840.10008.5.1.4.1.1.1	No	Yes
CT Image	1.2.840.10008.5.1.4.1.1.2	No	Yes
Digital X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.1	No	Yes
Digital X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.1.1	No	Yes
Digital Mammography Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.2	No	Yes
Digital Mammography Image (Processing)	1.2.840.10008.5.1.4.1.1.1.2.1	No	Yes
Digital Intra-oral X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.3	No	Yes
Digital Intra-oral X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.3.1	No	Yes

DICOM SOP Class Name	SOP Class UID	SCU	SCP
General ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.2	No	Yes
Grayscale Softcopy Presentation State	1.2.840.10008.5.1.4.1.1.11.1	No	Yes
Hardcopy Color Image	1.2.840.10008.5.1.1.1.30	No	Yes
Hardcopy Grayscale Image	1.2.840.10008.5.1.1.1.29	No	Yes
Hemodynamic Waveform	1.2.840.10008.5.1.4.1.1.9.2.1	No	Yes
Multi-frame Single Bit Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.1	No	Yes
Multi-frame Grayscale Byte Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.2	No	Yes
Multi-frame Grayscale Word Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.3	No	Yes
Multi-frame True Color Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.4	No	Yes
MR Image	1.2.840.10008.5.1.4.1.1.4	No	Yes
Nuclear Medicine Image (Retired)	1.2.840.10008.5.1.4.1.1.5	No	Yes
Positron Emission Tomography Image	1.2.840.10008.5.1.4.1.1.128	No	Yes
Raw Data	1.2.840.10008.5.1.4.1.1.66	No	Yes
RT Beams Treatment Record	1.2.840.10008.5.1.4.1.1.481.4	No	Yes
RT Brachy Treatment Record	1.2.840.10008.5.1.4.1.1.481.6	No	Yes
RT Dose	1.2.840.10008.5.1.4.1.1.481.2	No	Yes
RT Image	1.2.840.10008.5.1.4.1.1.481.1	No	Yes
RT Plan	1.2.840.10008.5.1.4.1.1.481.5	No	Yes
RT Structure Set	1.2.840.10008.5.1.4.1.1.481.3	No	Yes
RT Treatment Summary Record	1.2.840.10008.5.1.4.1.1.481.7	No	Yes
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	No	Yes
Stand-alone Curve	1.2.840.10008.5.1.4.1.1.9	No	Yes
Stand-alone Modality LUT	1.2.840.10008.5.1.4.1.1.10	No	Yes
Stand-alone Overlay	1.2.840.10008.5.1.4.1.1.8	No	Yes
Stand-alone VOI LUT	1.2.840.10008.5.1.4.1.1.11	No	Yes
Standalone PET Curve	1.2.840.10008.5.1.4.1.1.129	No	Yes
Stored Print	1.2.840.10008.5.1.1.1.27	No	Yes
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	No	Yes
Ultrasound Image (Retired)	1.2.840.10008.5.1.4.1.1.6	No	Yes
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	No	Yes
Ultrasound Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.3	No	Yes
VL Endoscopic Image	1.2.840.10008.5.1.4.1.1.77.1.1	No	Yes
VL Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.2	No	Yes
VL Slide-Coordinates Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.3	No	Yes
VL Photographic Image	1.2.840.10008.5.1.4.1.1.77.1.4	No	Yes
VL Image (Retired)	1.2.840.10008.5.1.4.1.1.77.1	No	Yes
VL Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.77.2	No	Yes
X-Ray Angiographic Bi-Plane Image (retired)	1.2.840.10008.5.1.4.1.1.12.3	No	Yes
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	No	Yes
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	No	Yes
Workflow Management			
Storage Commitment Push Model	1.2.840.10008.1.20.1	No	Yes

These are the default SOP Classes supported. By altering the configuration it is possible to support fewer or more SOP Classes.

The Importer AE will store the DICOM Composite SOP Instances as DICOM Part 10 compliant files using the Transfer Syntax with which they were received.

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The Importer AE will fork a child process to handle each Association requested by a remote AE for the Storage of Composite SOP Instances and/or to send a Storage Commitment Push Model N-ACTION Request.

Horizon Rad Station™ is capable of creating new Derived images by performing Multi-Planar Reconstruction on CT and MR image sets received by the Importer. For the characteristics of these MPR images, refer to 7.1.5: Derived MPR Image Creation.

3.2.2.2 Association Establishment Policies

3.2.2.2.1 General

The Importer AE accepts Associations from external DICOM C-STORE SCUs to provide storage on the Horizon Medical Imaging™ system of DICOM Composite SOP Instances. The Importer AE can send a request for establishing an Association to an SCU if an SCU sends a Storage Commitment request and then drops the Association before the Storage Commitment N-EVENT-REPORT Request can be sent.

The DICOM Standard Application Context Name is always proposed:

Table 12: DICOM Application Context for Importer AE

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

3.2.2.2.2 Number of Associations

The Importer AE places configurable limitations on the number of simultaneous connections it will support. Once the Importer AE accepts an Association, a spawned child task will receive any images transmitted on that Association and store them on the hard drive. The default maximum number of Associations is 10 per connecting host. It is possible to restrict the number of hosts that can connect with the Importer AE so the combination of these settings can restrict the maximum number of Associations.

Table 13: Number of Simultaneous Associations as an Acceptor for Importer AE

Maximum number of simultaneous Associations	Unlimited ³
---	------------------------

The Importer AE can also request new Associations in order to send Storage Commitment N-EVENT-REPORT Requests. The Importer AE cannot request simultaneous Associations with the same remote AE, so the maximum number of simultaneous Associations depends upon the number of remote AEs that the Importer AE will need to open Associations with in order to send the Storage Commitment N-EVENT-REPORT Requests.

Table 14: Number of Simultaneous Associations as a Requestor for Importer AE

Maximum number of simultaneous Associations	Unlimited
---	-----------

3.2.2.2.3 Asynchronous Nature

The Importer AE does not provide 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 15: Asynchronous Nature as an SCP for Importer AE

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

3.2.2.2.4 Implementation Identifying Information

³ Default maximum is 10 per host permitted to connect to the Importer AE.

Table 16: DICOM Implementation Class and Version for Importer AE

Implementation Class UID	1.2.840.113711.9
Implementation Version Name	V1.0

3.2.2.3 Association Initiation Policies

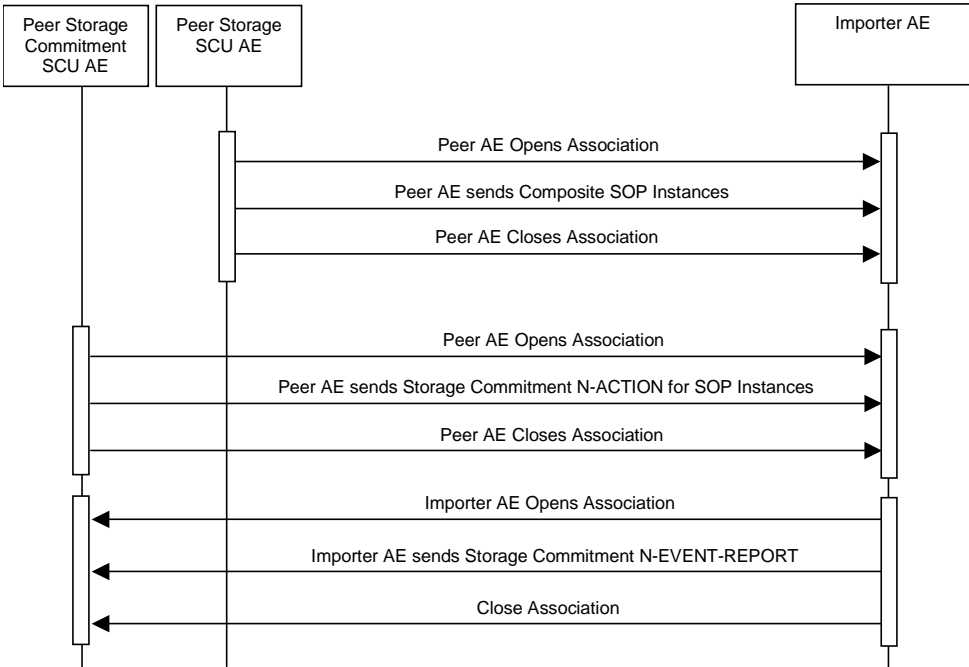
3.2.2.3.1 Activity – Require New Association for Storage Commitment

3.2.2.3.1.1 Description and Sequencing of Activity

The Importer AE can act as an Association Requestor in the case where the SCU issues a Storage Commitment N-ACTION and then immediately drops the Association. The Importer AE can then send a request for establishing an Association to the SCU in order to send the corresponding Storage Commitment N-EVENT-REPORT. The Importer AE can also be configured to always request a new Association to send the Storage Commitment N-EVENT-REPORT rather than trying to send it over the original Association requested by the SCU.

In order to successfully handle Storage Commitment N-ACTION Requests, the Importer AE must have already received the referenced SOP Instances. That is, the Importer AE cannot properly handle a Storage Commitment N-ACTION Request that is sent to it before the SOP Instances it references are sent to the Importer.

Figure 3: Sequencing of Activity – Require New Association for Storage Commitment



Note that the remote Storage Commitment SCU AE and Storage SCU AE could be a single AE, in which case the remote AE could send both the Composite SOP Instances and the Storage Commitment N-ACTION over the same Association. However, the Importer AE would still require that the Composite SOP Instances be sent before the Storage Commitment N-ACTION referencing them is sent.

The following sequencing constraints illustrated in Figure 3 apply to the Importer AE for handling Storage Commitment Push Model Requests using a new Association:

1. Remote AE opens an Association with the Importer AE.

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2. Remote AE requests Storage Commitment of Composite SOP Instance(s) (remote sends N-ACTION-RQ and Importer AE responds with N-ACTION-RSP to indicate that it received the request).
3. Remote AE closes the Association before the Importer AE can successfully send the Storage Commitment Push Model Notification (N-EVENT-REPORT-RQ).
4. Importer AE opens a new Association with the remote AE.
5. Importer AE sends Storage Commitment Push Model Notification (N-EVENT-REPORT). More than one can be sent over a single Association if multiple Notifications are outstanding.
6. Importer AE closes the Association with the remote AE.

3.2.2.3.1.2 Proposed Presentation Contexts

The Importer AE will propose Presentation Contexts as shown in the following table:

Table 17: Importer AE Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Storage Commitment Push Model	1.2.840.10008.1.20.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

3.2.2.3.1.3 SOP Specific Conformance as an Association Requestor

3.2.2.3.1.3.1 SOP Specific Conformance - Storage Commitment

Standard conformance is provided to the DICOM Storage Commitment Push Model SOP Class as an SCP.

The associated activity with the Storage Commitment Push Model Service is the communication by the Importer AE to remote AEs that it has committed to permanently store Composite SOP Instances that have been sent to it. It thus allows remote AEs to determine whether the Horizon Medical Imaging™ system has taken responsibility for the archiving of specific SOP Instances so that they can be flushed from the remote AE system.

By default, the Importer AE will initiate a new Association to a remote AE that sent a Storage Commitment Push Model request only if the original Association over which this was sent is no longer open. Otherwise it will send the N-EVENT-REPORT Request over the original Association requested by the SCU. However, the Importer AE can be configured to always request a new Association to send the N-EVENT-REPORT Request.

The Importer AE creates files called Service Logs that can be used to monitor its status and diagnose any problems that may arise. If any error occurs during DICOM communication then appropriate messages are always output to these Service Logs. In addition, error messages may be output as alerts to the User Interface in certain cases.

If the request by the Importer AE to establish an Association fails for any reason (i.e. fail to connect with remote AE's TCP/IP port, Association Request is Rejected by remote AE, etc.) then the Importer AE will not try again later to send the N-EVENT-REPORT Request. If such a failure occurs then the remote AE will have to resend the Storage Commitment Push Model N-ACTION Request.

The Importer AE will exhibit the following Behavior according to the Status Code value returned in a Storage Commitment Push Model N-EVENT-REPORT Response from a destination SCU:

Table 18: Importer AE N-EVENT-REPORT Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCU has successfully received the Storage Commitment report. Success indication message is output to the Service Logs.

Service Status	Further Meaning	Error Code	Behavior
			No indication is posted to the User Interface.
Refused	Out of Resources	A700 – A7FF	This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Data Set does not match SOP Class	A900 – A9FF	This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Cannot Understand	C000 – CFFF	This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Warning	Attribute List Error	0107	Storage Commitment report transmission is considered successful. A warning indication is output to the Service Logs. No indication is posted to the User Interface.
Warning	Attribute Value Out of Range	0116	Storage Commitment report transmission is considered successful. A warning indication is output to the Service Logs. No indication is posted to the User Interface.
*	*	Any other status code	This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.2.3.1.3.2 Association Requestor Communication Failure Behavior

The Behavior of the Importer AE during communication failure when it is acting as an Association Requestor is summarized in the following table:

Table 19: Importer AE Communication Failure Behavior as an Association Requestor

Exception	Behavior
Timeout expiry for an expected DICOM Message Response (DIMSE level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Association A-P-ABORTed by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.2.4 Association Acceptance Policy

3.2.2.4.1 Activity – Receive Images and Storage Commitment Requests

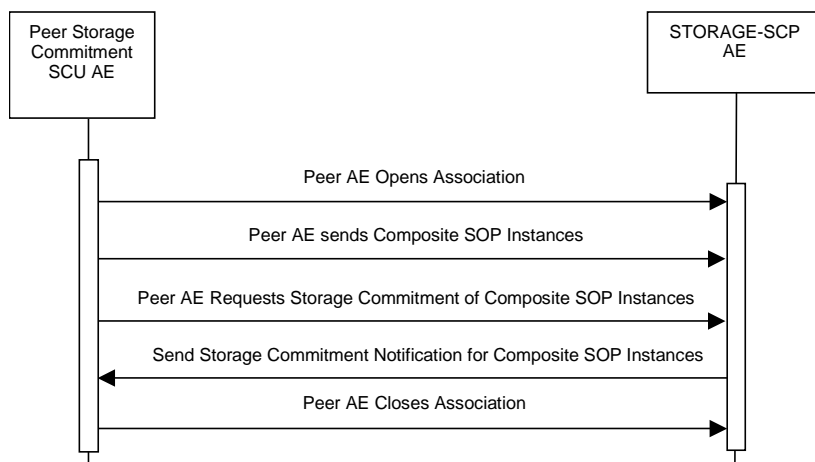
3.2.2.4.1.1 Description and Sequencing of Activity

The Importer AE accepts Association Requests only if they propose one or more Presentation Contexts that the Importer AE actually supports. If none of the requested Presentation Contexts are accepted, then the Association Request itself is rejected. The Importer AE can be configured to only accept Associations requested by certain hosts (using TCP/IP address).

The default behavior of the Importer AE is to always attempt to send a Storage Commitment Push Model Notification (N-EVENT-REPORT) over the same Association opened by the remote AE to send the request (N-ACTION). If the Importer AE receives a request to close the Association either before sending the Notification or before receiving the corresponding N-EVENT-REPORT-RSP, then it will open a new Association to send the Notification. Refer to section 3.2.2.3 for the details.

In order to successfully handle Storage Commitment N-ACTION Requests, the Importer AE must have already received the referenced SOP Instances. That is, the Importer AE cannot properly handle a Storage Commitment N-ACTION Request that is sent to it before the SOP Instances it references are sent to the Importer

Figure 4: Sequencing of Activity – Single Association for Storage and Storage Commitment



The following sequencing constraints illustrated in Figure 4 apply to the Importer AE for handling Storage Commitment Push Model Requests over the original Association:

1. Remote AE opens an Association with the Importer AE.
2. Remote AE sends zero or more Composite SOP Instances.
3. Remote AE requests Storage Commitment of Composite SOP Instance(s) (remote sends N-ACTION-RQ and Importer AE responds with N-ACTION-RSP to indicate that it received the request).
4. STORAGE-SCP AE sends Storage Commitment Push Model Notification request (N-EVENT-REPORT-RQ) and successfully receives Notification response (N-EVENT-REPORT-RSP) from remote AE.
5. Remote AE closes the Association.

If the Importer AE receives a request to close the Association from the remote AE before sending the Notification request (N-EVENT-REPORT-RQ) or when expecting to receive a Notification response (N-EVENT-REPORT-RSP), then it will open a new Association to send (or resend) the Notification. Refer to 3.2.2.2 for the details.

The Importer AE has a configurable timeout value for the maximum amount of time that it will wait on an open Association for a new request from a remote AE. A remote AE can reset this timer by sending a Verification request (C-ECHO-RQ). This can act as a useful mechanism for a remote AE to maintain an active Association if the length of time between sending Storage or Storage Commitment requests is long (such as when using a single Association to send images as they are acquired during an exam).

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The Importer 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 20: Importer AE 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.
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	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. Usually this is only returned if the Importer AE has not been configured to allow the remote AE host to connect.

3.2.2.4.1.2 Accepted Presentation Contexts

The Importer AE will accept any **Presentation Context** containing:

- 1. An abstract syntax selected from Table 11
- 2. One or more Transfer Syntaxes selected from
- 3. Table 21

Table 21: Importer AE Accepted Transfer Syntaxes

Transfer Syntax		Role	Extended Negotiation
Name	UID		
DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
DICOM JPEG Baseline Process 1	1.2.840.10008.1.2.4.50	SCP	None
DICOM JPEG Extended Process 2 & 4	1.2.840.10008.1.2.4.51	SCP	None
DICOM JPEG Lossless Proc 14	1.2.840.10008.1.2.4.57	SCP	None
DICOM JPEG Lossless 1st Order Prediction	1.2.840.10008.1.2.4.70	SCP	None
DICOM JPEG 2000 (Lossless Only)	1.2.840.10008.1.2.4.90	SCP	None
DICOM JPEG 2000	1.2.840.10008.1.2.4.91	SCP	None
DICOM RLE	1.2.840.10008.1.2.5	SCP	None
Wavelet (Private)	1.2.840.113711.1.2.100.1	SCP	None

Note: The Wavelet Transfer Syntax is implemented using the Pegasus Imaging Corporation's Medical Image Toolkit.

3.2.2.4.1.3 SOP Specific Conformance as an Association Acceptor

3.2.2.4.1.3.1 SOP Specific Conformance – Verification

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

3.2.2.4.1.3.2 SOP Specific Conformance – Storage

The Importer AE does not have any dependencies on the number of Associations used to send images to it. Images belonging to more than one study or series can be sent over a single or multiple Associations. Images belonging to a single study or series can also be sent over different Associations. There is no limit

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on either the number of SOP Instances or the maximum amount of total SOP Instance data that can be transferred over a single Association.

The Importer AE provides Level 2 DICOM conformance to the Importing SOP Class. It is configured to retain the original DICOM data in DICOM Part 10 compliant file format. In addition, all Private and SOP Class Extended Elements are maintained in the DICOM format files.

In addition to saving all Elements in files, a subset of the Elements are stored in the Horizon Medical Imaging™ system database to support query and retrieval requests and also allow updating of patient, study, and series information by user input, or demographic and study-related messages. Refer to Table 135: Significant Elements in Received Images in the Annex for the list of Elements that are checked and/or processed upon receiving a Composite SOP Instance.

The associated Real-World Activity with the C-STORE service is the storage of medical imaging data on a designated hard disk. The Importer AE will return a failure status if it is unable to store the Composite SOP Instances onto the hard disk.

For the purposes of display, refer to Table 133: Supported Composite Image SOP Classes for Display in the Annex. In addition, information regarding the support for certain image-related characteristics can be found in Table 135.

It is preferred that optimal Window Center and Width values be specified in the DICOM Image Objects if they have greater than 8 bits of image data stored per sample. If optimal Window Center and Width values cannot be provided, then it is preferred that none are included, as Horizon Medical Imaging™ is capable of estimating values using histogram analysis.

The Importer AE provides support for Storage Commitment Push Model. The Importer AE expects the SCU to open an Association, send one or more images, and then send the Storage Commitment Request for those images. The Importer will then send the N-EVENT Report over this same Association. If it cannot do so, then it will open a new Association with the SCU and send the N-EVENT-REPORT over the new Association.

The Importer AE returns one of the following status codes in a C-STORE Response:

Table 22: Importer AE Returned C-STORE-RSP Status Codes

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The Importer AE has successfully received, parsed, and saved to file the received C-STORE-RQ Composite SOP Instance. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Refused	Out of Resources	A700	The Importer AE does not have enough disk space to store the C-STORE-RQ Composite SOP Instance. The SOP Instance will not be saved. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Data Set does not match SOP Class	A900	The Importer AE has determined that the C-STORE-RQ Composite SOP Instance is missing mandatory Elements specified for the SOP Class. This will only occur if the missing Elements or values prevent the Importer AE from successfully adding the Composite SOP Instance to the system database. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Cannot Understand	C000	Indicates that the Importer AE cannot parse the C-STORE-RQ Data Set. The SOP Instance will not be saved. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Warning	Coercion of Data Elements	B000	Indicates that the Importer AE coerced one or more Element values of the C-STORE-RQ Composite SOP Instance. Refer to Table 135: Significant Elements in

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Service Status	Further Meaning	Error Code	Behavior
			<p>Received Images of the Annex for descriptions of those Elements that can be coerced. Note that return of this status is normally disabled as some SCUs treat it as an Error code rather than a Warning.</p> <p>A warning indication is output to the Service Logs.</p> <p>No indication is posted to the User Interface.</p>

The Importer will never delete any received images that can be successfully parsed and contain all the necessary information to add the image to the database (see the table of significant DICOM elements defined earlier). The images will always be archived to media of some sort (WORM, DLT etc.). Images are only flushed from the hard disk storage if they have been successfully archived to the media.

3.2.2.4.1.3.3 SOP Specific Conformance – Storage Commitment

The associated Activity with the Storage Commitment Push Model service is the communication by the Importer AE to remote AEs that it has committed to permanently store Composite SOP Instances that have been sent to it. It thus allows remote AEs to determine whether the Horizon Medical Imaging™ system has taken responsibility for the archiving of specific SOP Instances so that they can be flushed from the remote AE system.

The Importer AE takes the list of Composite SOP Instance UIDs specified in a Storage Commitment Push Model N-ACTION Request and checks if they are present in the Horizon Medical Imaging™ system database. As long as the Composite SOP Instance UIDs are present in the database, the Importer AE will consider those Composite SOP Instance UIDs to be successfully archived. The Importer AE does not require the Composite SOP Instances to actually be successfully written to archive media in order to commit to responsibility for maintaining these SOP Instances.

Once the Importer AE has checked for the existence of the specified Composite SOP Instances, it will then attempt to send the Notification request (N-EVENT-REPORT-RQ). The default behavior is to attempt to send this Notification over the same Association that was used by the remote AE to send the original N-ACTION Request. If the Association has already been released or Message transfer fails for some reason, then the Importer AE will attempt to send the N-EVENT-REPORT-RQ over a new Association. The Importer AE can be configured to always open a new Association in order to send the Notification request. Refer to 3.2.2.3.1.3 for SOP Specific Conformance when the Importer AE acts as an Association Requestor.

The Importer AE will not cache Storage Commitment Push Model N-ACTION Requests that specify Composite SOP Instances that have not yet been transferred to the Importer AE. If a remote AE sends a Storage Commitment Push Model N-ACTION Request before the specified Composite SOP Instances are later sent, the Importer AE will not commit to responsibility for such SOP Instances.

The Importer AE does not support the optional Storage Media File-Set ID & UID attributes in the N-ACTION Request.

The Horizon Medical Imaging™ system never automatically deletes Composite SOP Instances from the archive. The absolute persistence of SOP Instances and the maximum archiving capacity for such SOP Instances is dependent on the archiving media and capacity used by the Horizon Medical Imaging™ system and is dependent on the actual specifications of the purchased system. It is necessary to check the actual system specifications to determine these characteristics.

The Importer AE will support Storage Commitment Push Model requests for Composite SOP Instances of any of the Storage SOP Classes that are also supported by the Importer AE as an SCP. For a complete listing refer to Table 11: SOP Class Conformance of Importer AE.

The Importer AE returns one of the following status codes in an N-ACTION Response:

Table 23: Importer AE Returned N-ACTION-RSP Status Codes

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The Importer AE has successfully received the Storage Commitment Push Model N-ACTION Request and can process the commitment request for the indicated SOP Instances. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Error	Processing Failure	0110	Indicates that the Storage Commitment Push Model N-ACTION Request cannot be parsed by the Importer AE or it cannot be fully processed due to a database or system failure. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Missing Attribute	0120	Indicates that the Storage Commitment Push Model N-ACTION Request cannot be processed by the Importer AE because a required attribute is missing from the N-ACTION Request Data Set. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Missing Attribute Value	0121	Indicates that the Storage Commitment Push Model N-ACTION Request cannot be processed because a Type 1 attribute in the N-ACTION Request Data Set does not specify a value. An error indication is output to the Service Logs. No indication is posted to the User Interface.

Refer to Table 18: Importer AE N-EVENT-REPORT Response Status Handling Behavior, for the behavior that the Importer AE will exhibit according to the Status Code value returned in a Storage Commitment Push Model N-EVENT-REPORT Response from a destination SCU.

3.2.2.4.1.3.4 Association Acceptor Communication Failure Behavior

If a communication failure occurs while the Importer AE is trying to handle a Verification Service or Storage Service task or just waiting for the next Request Message on an open Association, then the Importer AE will exhibit the following behavior:

Table 24: Importer AE Communication Failure Behavior as an Association Acceptor while handling a Verification or Storage Task

Exception	Behavior
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout). The default timeout for waiting on an open Association to receive the next DICOM Message is 60 minutes.	The Association is aborted using a DICOM A-P-ABORT. This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If any Composite SOP Instances have been successfully received and parsed prior to the failure, then they will still be archived rather than discarded.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout). The default timeout when trying to read from or write to an open socket is 3 minutes.	The Association is aborted using a DICOM A-P-ABORT. This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If any Composite SOP Instances have been successfully received and parsed prior to the failure, then they will still be archived rather than discarded.

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Exception	Behavior
Association A-ABORTed by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If any Composite SOP Instances have been successfully received and parsed prior to the failure, then they will still be archived rather than discarded.

If a communication failure occurs while the Importer AE is trying to handle a Storage Commitment Push Model task (any point after a Storage Commitment N-ACTION-RQ has been received), then the Importer AE will exhibit the following behavior:

Table 25: Importer AE Communication Failure Behavior as an Association Acceptor while handling a Storage Commitment Push Model Task

Exception	Behavior
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout). The default timeout for waiting on an open Association to receive the next DICOM Message is 60 minutes.	The Association is aborted using a DICOM A-P-ABORT. This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If a Storage Commitment N-ACTION-RQ has already been received, then the Importer AE will no longer try to process it, regardless of whether it has already sent the corresponding N-ACTION-RSP or N-EVENT-REPORT-RQ. The remote AE will have to resend the N-ACTION-RQ.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout). The default timeout when trying to read from or write to an open socket is 3 minutes.	The Association is aborted using a DICOM A-P-ABORT. This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If a Storage Commitment N-ACTION-RQ has already been received, then the Importer AE will no longer try to process it, regardless of whether it has already sent the corresponding N-ACTION-RSP or N-EVENT-REPORT-RQ. The remote AE will have to resend the N-ACTION-RQ.
Association A-ABORTed by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If a Storage Commitment N-ACTION-RQ has already been received, then the Importer AE will no longer try to process it, regardless of whether it has already sent the corresponding N-ACTION-RSP or N-EVENT-REPORT-RQ. The remote AE will have to resend the N-ACTION-RQ.

3.2.2.4.1.3.5 Presentation Context Acceptance Criterion

The Importer AE will only accept a Presentation Contexts specified by a SOP Class from Table 11 and having at least one Proposed Transfer Syntax from Table 21. More than one proposed Presentation Context will be accepted for the same Abstract Syntax if the Transfer Syntax is supported, whether or not it is the same as another Accepted Presentation Context.

The Importer AE can be configured to reject valid Presentation Contexts if the host for the remote AE is not listed in a local configuration file. In addition, a valid Presentation Context can be rejected if the maximum limit on the number of simultaneous processes has been reached.

The Importer AE does not check for and will accept duplicate Presentation Contexts.

3.2.2.4.1.3.6 Transfer Syntax Selection Policies

The default behavior of the Importer AE supports the Implicit VR Little Endian and Explicit VR Little Endian Transfer Syntaxes for all Associations. In addition, some explicit JPEG Lossy and JPEG Lossless compression Transfer Syntaxes are supported, as defined in Table 21.

The JPEG 2000 Lossy, JPEG 2000 Lossless, RLE, and Wavelet (Private) Transfer Syntaxes can also be enabled via configuration; however, these are not enabled by default. The Importer AE can be configured to accept a subset of any of these syntaxes, with the inclusion of Implicit VR Little Endian being mandatory. It can also be configured to compress images once they are received using these various compression options.

The default preferred acceptance order for Transfer Syntaxes for the Importer AE (from highest preference to lowest) is: Little Endian Explicit, Little Endian Implicit, JPEG Lossy, JPEG Lossless (if all these contexts are proposed). This order of preference is configurable.

3.2.3 Query/Retrieve Server AE Specification

3.2.3.1 SOP Classes

The Query/Retrieve Server AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 26: SOP Class Conformance of Query/Retrieve Server AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Verification			
Verification	1.2.840.10008.1.1	No	Yes
Query/Retrieve			
Patient Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	No	Yes
Patient Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	No	Yes
Study Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	No	Yes
Study Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	No	Yes
Patient Study Only Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1	No	Yes
Patient Study Only Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2	No	Yes
Workflow Management			
Modality Worklist Information Model	1.2.840.10008.5.1.4.31	No	Yes
Transfer			
12-lead ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.1	Yes	No
Ambulatory ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.3	Yes	No
Basic Voice Audio Waveform	1.2.840.10008.5.1.4.1.1.9.4.1	Yes	No
Cardiac Electrophysiology Waveform	1.2.840.10008.5.1.4.1.1.9.3.1	Yes	No
Basic Text Structured Report	1.2.840.10008.5.1.4.1.1.88.11	Yes	No
Enhanced Structured Report	1.2.840.10008.5.1.4.1.1.88.22	Yes	No
Comprehensive Structured Report	1.2.840.10008.5.1.4.1.1.88.33	Yes	No
Mammography CAD Structured Report	1.2.840.10008.5.1.4.1.1.88.50	Yes	No
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Yes	No
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	Yes	No
Encapsulated PDF	1.2.840.10008.5.1.4.1.1.104.1	Yes	No
Computed Radiography Image	1.2.840.10008.5.1.4.1.1.1	Yes	No
CT Image	1.2.840.10008.5.1.4.1.1.2	Yes	No
Digital X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.1	Yes	No
Digital X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.1.1	Yes	No
Digital Mammography Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.2	Yes	No
Digital Mammography Image (Processing)	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	No
Digital Intra-oral X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.3	Yes	No

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DICOM SOP Class Name	SOP Class UID	SCU	SCP
Digital Intra-oral X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.3.1	Yes	No
General ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.2	Yes	No
Grayscale Softcopy Presentation State	1.2.840.10008.5.1.4.1.1.11.1	Yes	No
Hardcopy Color Image	1.2.840.10008.5.1.1.30	Yes	No
Hardcopy Grayscale Image	1.2.840.10008.5.1.1.29	Yes	No
Hemodynamic Waveform	1.2.840.10008.5.1.4.1.1.9.2.1	Yes	No
Multi-frame Single Bit Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.1	Yes	No
Multi-frame Grayscale Byte Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.2	Yes	No
Multi-frame Grayscale Word Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.3	Yes	No
Multi-frame True Color Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.4	Yes	No
MR Image	1.2.840.10008.5.1.4.1.1.4	Yes	No
Nuclear Medicine Image	1.2.840.10008.5.1.4.1.1.20	Yes	No
Nuclear Medicine Image (Retired)	1.2.840.10008.5.1.4.1.1.5	Yes	No
Positron Emission Tomography Image	1.2.840.10008.5.1.4.1.1.128	Yes	No
Raw Data	1.2.840.10008.5.1.4.1.1.66	Yes	No
RT Beams Treatment Record	1.2.840.10008.5.1.4.1.1.481.4	Yes	No
RT Brachy Treatment Record	1.2.840.10008.5.1.4.1.1.481.6	Yes	No
RT Dose	1.2.840.10008.5.1.4.1.1.481.2	Yes	No
RT Image	1.2.840.10008.5.1.4.1.1.481.1	Yes	No
RT Plan	1.2.840.10008.5.1.4.1.1.481.5	Yes	No
RT Structure Set	1.2.840.10008.5.1.4.1.1.481.3	Yes	No
RT Treatment Summary Record	1.2.840.10008.5.1.4.1.1.481.7	Yes	No
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Yes	No
Stand-alone Curve	1.2.840.10008.5.1.4.1.1.9	Yes	No
Stand-alone Modality LUT	1.2.840.10008.5.1.4.1.1.10	Yes	No
Stand-alone Overlay	1.2.840.10008.5.1.4.1.1.8	Yes	No
Stand-alone VOI LUT	1.2.840.10008.5.1.4.1.1.11	Yes	No
Standalone PET Curve	1.2.840.10008.5.1.4.1.1.129	Yes	No
Stored Print	1.2.840.10008.5.1.1.27	Yes	No
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	Yes	No
Ultrasound Image (Retired)	1.2.840.10008.5.1.4.1.1.6	Yes	No
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
Ultrasound Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.3	Yes	No
VL Endoscopic Image	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	No
VL Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	No
VL Slide-Coordinates Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.3	Yes	No
VL Photographic Image	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	No
VL Image (Retired)	1.2.840.10008.5.1.4.1.1.77.1	Yes	No
VL Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.77.2	Yes	No
X-Ray Angiographic Bi-Plane Image (retired)	1.2.840.10008.5.1.4.1.1.12.3	Yes	No
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Yes	No
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	Yes	No

The Query/Retrieve Server AE implements SOP Classes of the Query/Retrieve Service Class as an SCP. It also supports the Modality Worklist SOP Class as an SCP. The Query/Retrieve Server AE can handle requests from external devices to query the Horizon Medical Imaging™ system database for patient, study and series demographics, and Modality Worklists. It also handles requests for the retrieval of Composite SOP Instances.

The Query/Retrieve Server AE has one main task running on a Horizon Medical Imaging™ system. It acts as an Association Acceptor, waiting for remote AEs acting as SCUs to request an Association. When the main

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task receives a request to open a new Association from a remote AE, it will spawn a child task for handling messages sent by the remote AE. These child tasks will both receive the query or retrieval requests sent by the remote AE and return any necessary responses with the matching information. In addition, a child process will attempt to handle any retrieval request by opening a new Association with the specified C-MOVE Destination AE and send any matching Composite SOP Instances over this Association. Thus, each child task can also act as an Association Requestor in addition to handling Associations requested by a remote AE. After each attempt to send a Composite SOP Instance using a C-STORE Request, a C-MOVE Response is sent to the remote AE that sent the retrieval request (the C-MOVE SCU) indicating whether the transfer was successful or not.

3.2.3.2 Association Establishment Policies

3.2.3.2.1 General

The Query/Retrieve Server AE will accept Associations as an SCP for the Query/Retrieve Service C-FIND, and C-MOVE SOP Classes. It will also accept Associations as an SCP for the Modality Worklist SOP Class.

The Query/Retrieve Server AE will initiate Associations to send Composite SOP Instances in response to a C-MOVE Request. It will attempt to open a new Association with the C-MOVE Destination AE specified in the C-MOVE Request.

The DICOM Standard Application Context Name is always proposed:

Table 27: DICOM Application Context for Query/Retrieve Server AE

Application Context Name	1.2.840.10008.3.1.1.1
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3.2.3.2.2 Number of Associations

Each time the Query/Retrieve Server AE accepts an Association Request, a child process will be spawned to process any query or retrieval requests. The maximum number of child processes, and thus the maximum number of simultaneous Associations that can be processed, is set by configuration.

Table 28: Number of Simultaneous Associations for Query/Retrieve Server AE acting as an SCP

Maximum number of simultaneous Associations	Unlimited ⁴
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If a child process receives a C-MOVE Request, then a new Association will also be requested by the Query/Retrieve Server AE in order to send images to the C-MOVE Destination AE. This means that each child process can also request a new Association and thus the Query/Retrieve Server AE can have multiple simultaneous requested Associations.

Table 29: Number of Simultaneous Associations for Query/Retrieve Server AE acting as an SCU

Maximum number of simultaneous Associations	Unlimited ⁵
---	------------------------

3.2.3.2.3 Asynchronous Nature

Negotiation of multiple outstanding transactions is not supported.

Table 30: Asynchronous Nature for Query/Retrieve Server AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)
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⁴ Default maximum is 10 per host permitted to connect to the Query/Retrieve Server AE.

⁵ Default maximum is 10 per host permitted to connect to the Query/Retrieve Server AE.

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3.2.3.2.4 Implementation Identifying Information

Table 31: DICOM Implementation Class and Version for Query/Retrieve Server AE

Implementation Class UID	1.2.840.113711.3
Implementation Version Name	V1.0

3.2.3.3 Association Initiation Policy

3.2.3.3.1 Activity – Remote AE requests the retrieval of images

3.2.3.3.1.1 Description and Sequencing of Activity

When a remote AE submits a C-MOVE request to Horizon Medical Imaging™, the Query/Retrieve Server AE looks in its database to find any matches for the submitted request. If there are Composite SOP Instances that match the C-MOVE request, then the Query/Retrieve Server AE will attempt to open an Association and transfer the requested SOP Instances. An Association Request is sent to the specified C-MOVE Destination AE and, upon successful negotiation of the required Presentation Context, the transfer is started. In all cases an attempt will be made to transmit all the indicated SOP Instances in a single Association, but this may not always be possible. The Association will be released when all the SOP Instances have been sent. If an error occurs during transmission over an open Association then the transfer is halted. The Query/Retrieve Server AE will not attempt to independently retry the image export.

The Query/Retrieve Server AE does not support the unsolicited sending of SOP Instances using the DICOM Storage Service Class. It will only send SOP Instances in response to a C-MOVE Request from a remote AE.

3.2.3.3.1.2 Proposed Presentation Contexts

The Query/Retrieve Server AE can propose the same Presentation Contexts as the Sender AE when it attempts to transfer Composite SOP Instances in response to a C-MOVE Request. As such, it can propose any one or more of the Transfer Syntaxes in Table 8: Sender AE Proposed Transfer Syntaxes for each of the abstract syntaxes listed in Table 3: SOP Class Conformance of Sender AE (same as SOP Classes with Role of SCU listed in Table 26: SOP Class Conformance of Query/Retrieve Server AE). Each proposed Presentation Context contains a single Transfer Syntax. Multiple Transfer Syntaxes per abstract syntax would be proposed with multiple Presentation Contexts.

3.2.3.3.1.3 SOP Specific Conformance as an Association Requestor

3.2.3.3.1.3.1 SOP Specific Conformance - Storage

The Query/Retrieve Server AE will attempt to transfer all requested SOP Instances to the C-MOVE Destination AE specified in a C-MOVE Request. For each C-STORE Response received from the C-MOVE Destination AE, the Query/Retrieve Server AE will return a C-MOVE Response to the AE that sent the original C-MOVE Request. Each C-MOVE Response will indicate the appropriate Status Code based on the Status Code of the corresponding C-STORE Response. The Association will be properly released after the Query/Retrieve Server AE has attempted to transfer all requested SOP Instances. The Query/Retrieve Server AE will continue to attempt to transfer any remaining SOP Instances even if a failure Status Code is returned in a particular C-STORE Response.

When a Composite SOP Instance is selected for transmission from Horizon Medical Imaging™, the content of the object will be the same as when it was originally received unless patient demographic or study-related information is altered. In such cases, the latest values in the database will replace the original information in the SOP Instance. Thus, the set of optional tags contained in DICOM objects going out from Horizon Medical Imaging™ depends on the information that was received. For the list of patient, study, and series attributes that can be updated by the Query/Retrieve Server AE when a SOP Instance is exported please refer to 7.1.4: Sender AE and Query/Retrieve Server AE Element Modification

The Query/Retrieve Server AE cannot be configured to automatically resend Composite SOP Instances when the Status Code returned in a C-STORE Response is considered to indicate a failure. Failure indications are not output to the User Interface if an error occurs during the handling of a C-MOVE retrieval request.

The Query/Retrieve Server AE will exhibit the following behavior according to the Status Code value returned in a C-STORE Response from the C-STORE SCP (the C-MOVE Destination AE):

Table 32: Query/Retrieve 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. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Refused	Out of Resources	A700 – A7FF	This is treated as a failure. The Query/Retrieve Server AE does not attempt to resend the SOP Instance. However, it will continue trying to send any remaining SOP Instances requested by the C-MOVE-RQ. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Data Set does not match SOP Class	A900 – A9FF	This is treated as a failure. The Query/Retrieve Server AE does not attempt to resend the SOP Instance. However, it will continue trying to send any remaining SOP Instances requested by the C-MOVE-RQ. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Cannot Understand	C000 – CFFF	This is treated as a failure. The Query/Retrieve Server AE does not attempt to resend the SOP Instance. However, it will continue trying to send any remaining SOP Instances requested by the C-MOVE-RQ. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Warning	Coercion of Data Elements	B000	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. No indication is posted to the User Interface.
Warning	Element Discarded	B006	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. No indication is posted to the User Interface.
Warning	Data Set does not match SOP Class	B007	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. No indication is posted to the User Interface.
Warning	Attribute List Error	0107	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. No indication is posted to the User Interface.
Warning	Attribute Value Out of Range	0116	SOP Instance transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCP returning a Warning Status. No indication is posted to the User Interface.
*	*	Any other status code	This is treated as a failure. The Query/Retrieve Server AE does not attempt to resend the SOP Instance. However, it will continue trying to send any remaining SOP Instances requested by the C-MOVE-RQ. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.3.3.1.3.2

Association Requestor Communication Failure Behavior

The Behavior of the Query/Retrieve Server AE during communication failure when acting as an Association Requestor is summarized in the following table:

Table 33: Query/Retrieve Server AE Communication Failure Behavior as an Association Requestor

Exception	Behavior
Timeout expiry for an expected DICOM Message Response (DIMSE level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. The Query/Retrieve Server AE does not attempt to resend any of the SOP Instances that were not successfully transferred. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. The Query/Retrieve Server AE does not attempt to resend any of the SOP Instances that were not successfully transferred. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Association A-P-ABORTed by the SCP or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. The Query/Retrieve Server AE does not attempt to resend any of the SOP Instances that were not successfully transferred. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.3.4 Association Acceptance Policy

3.2.3.4.1 Activity – External system queries Horizon Medical Imaging™

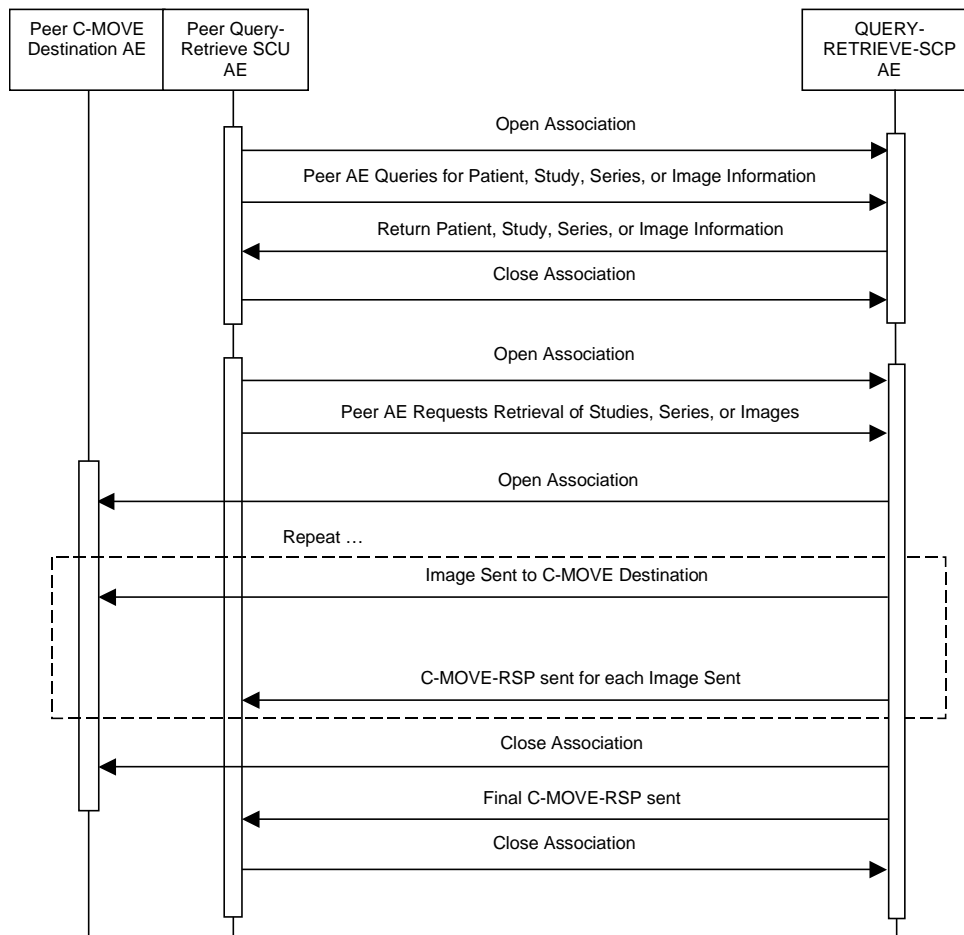
3.2.3.4.1.1 Description and Sequencing of Activity

The Query/Retrieve 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. It can be configured to only accept Associations with certain hosts (using TCP/IP address) and/or Application Entity Titles.

If the Query/Retrieve 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 the Query/Retrieve 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 Query/Retrieve Server AE will send the requested Composite SOP Instances to the C-MOVE Destination AE. After each attempt to send a SOP Instance, the Query/Retrieve Server AE sends a C-MOVE Response indicating whether the transfer was successful or not. Once the Query/Retrieve Server AE has finished attempting to transfer all the requested SOP Instances, it sends a final C-MOVE Response indicating the overall status of the attempted retrieval.

Figure 5: Sequencing of Activity – Handling Query and Retrieval Requests



The following sequencing constraints illustrated in Figure 5 apply to the Query/Retrieve Server AE for handling queries (C-FIND-Requests):

1. Remote AE opens an Association with the Query/Retrieve Server AE.
2. Remote AE sends a C-FIND-RQ Message
3. Query/Retrieve Server AE returns a C-FIND-RSP Message to the remote 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. Remote AE closes the Association. Note that the remote 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 Figure 5 apply to the Query/Retrieve Server AE for handling retrievals (C-MOVE-Requests):

1. Remote AE opens an Association with the Query/Retrieve Server AE.
2. Remote AE sends a C-MOVE-RQ Message
3. Query/Retrieve Server AE sends the Composite SOP Instances to the remote C-MOVE Destination AE as indicated in the C-MOVE-RQ.
4. After each attempt to send a SOP Instance, the Query/Retrieve Server AE returns a C-MOVE-RSP indicating this success or failure of the transfer.
5. Once the Query/Retrieve Server AE has completed all attempts to transfer the SOP Instances to the C-MOVE Destination AE, the Query/Retrieve Server AE sends a final C-MOVE-RSP indicating the overall success or failure of the retrieval.

6. Remote AE closes the Association. Note that the remote 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 Query/Retrieve 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)
- d) 3 – DICOM UL service-provider (Presentation related function)

Table 34: Query/Retrieve Server AE Association Rejection Reasons

Result	Source	Reason/Diag	Explanation
2 – rejected-transient	c	2 – local-limit-exceeded	The (configurable) maximum number of simultaneous Associations for the remote AE host has been reached. 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	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. Usually this is only returned if the Query/Retrieve Server AE has not been configured to allow the remote AE host to connect to it. The Query/Retrieve Server AE can be configured to allow only specific host names to open Associations with it. Note that it cannot currently be configured to only allow specific calling and/or called AE Titles when forming Associations.

3.2.3.4.1.2 Accepted Presentation Contexts

The Query/Retrieve Server AE may accept any one or more of the following Presentation Contexts:

Table 35: Query/Retrieve Server AE Accepted Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Verification	1.2.840.10008.1.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	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
Patient Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
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
Patient Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	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 - FIND	1.2.840.10008.5.1.4.1.2.2.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	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
Study Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	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

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Patient Study Only Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	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
Patient Study Only Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
Modality Worklist Information Model	1.2.840.10008.5.1.4.31	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Modality Worklist Information Model	1.2.840.10008.5.1.4.31	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

3.2.3.4.1.3 SOP Specific Conformance as an Association Acceptor

3.2.3.4.1.3.1 SOP Specific Conformance – Verification

Standard conformance is provided to the DICOM Verification Service Class as an SCP.

3.2.3.4.1.3.2 SOP Specific Conformance – Query (C-FIND)

The Query/Retrieve Server AE supports hierarchical queries and not relational queries. There are no attributes always returned by default. Only those attributes requested in the query identifier are returned. Query responses always return values from the Horizon Medical Imaging™ database. Exported SOP Instances are always updated with the latest values in the database prior to export. Thus, a change in patient demographic information will be contained in both the C-FIND Responses and any Composite SOP Instances exported to a C-MOVE Destination AE.

By default, the Query/Retrieve Server AE is configured to not check for Cancel Requests sent by a remote AE. This is done to improve performance, as it does not have to spend time periodically checking if a remote AE has sent a Cancel Request over the Association. However, if it is known that a remote AE can send Cancel Requests, then the Query/Retrieve Server AE can be configured to handle them properly.

The Query/Retrieve Server AE implements support for the IHE Technical Framework version 5.5 (Year 6). All required attributes are supported at the Patient, Study, and Series levels. At the Instance level, only Image attributes are supported.

The Horizon Medical Imaging™ system database does not store Image Level information. Thus the Image Level values returned in an Image Level C-FIND query will not be accurate if the particular SOP Instances are no longer stored on-line. In such cases, the Query/Retrieve Server AE will create SOP Instance UIDs using the Series Instance UID as a precursor to which is appended the number of each SOP Instance in the series. Thus, if an external DICOM device sends a SOP Instance to Horizon Medical Imaging™ and then later queries for that object, the Image Level information returned by the query may be different than the information contained in the original SOP Instance sent to Horizon Medical Imaging™. If the SOP Instance is then sent in response to a C-MOVE, it will still have the original SOP Instance UID value rather than the value returned by the Query/Retrieve Server AE.

Patient Root Information Model

All required search keys on each of the four levels (Patient, Study, Series, and Image) are supported. However, the Patient ID (0010,0020) key must be fully stated if the Patient's Name (0010,0010) is not present in the query (e.g. Horizon Medical Imaging™ does not support queries for patients having the patient ID of "123*" when this is the only search criterion).

Study Root Information Model

All the required search keys on each of the three levels (Study, Series, and Image) are supported. There is, however, a caveat that applies to the Study Time (0008,0030) — it cannot be used as the only search key on the Study level. If it is used in conjunction with the other supported search keys on the Study level, it can be used in the matching criteria.

Patient/Study Only Information Model

All the required search keys on the Patient and Study levels are supported. The Patient ID (0010,0020) key must be fully stated if the Patient's Name (0010,0010) is not present in the query.

Table 36: Patient Root C-FIND SCP Supported Elements

Description/Module	Tag ID	VR	Types of Matching
Patient Level			
Patient's Name	0010,0010	PN	S,*,U
Patient ID	0010,0020	LO	UNIQUE
Patient's Birth Date	0010,0030	DA	S,U
Patient's Birth Time	0010,0032	TM	S,U
Patient's Sex	0010,0040	CS	S,U
Patient's Weight	0010,1030	DS	NONE
Medical Alerts	0010,2000	LO	NONE
Contrast Allergies	0010,2110	LO	NONE
Pregnancy Status	0010,21C0	US	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	UNIQUE,L
Referring Physician's Name	0008,0090	PN	S,*,U
Study Description	0008,1030	LO	S,*,U
Modalities in Study	0008,0061	CS	S,*,U
Number of Study Related Series	0020,1206	IS	NONE
Number of Study Related Instances	0020,1208	IS	NONE
Series Level			
Modality	0008,0060	CS	S,U
Series Number	0020,0011	IS	S,*,U
Series Instance UID	0020,000E	UI	UNIQUE,L
Number of Series Related Instances	0020,1209	IS	NONE
Performing Physician's Name (see NOTE)	0008,1050	PN	S,*,U
Operator's Name	0008,1070	PN	S,*,U
Series Description	0008,103E	LO	S,*,U
Request Attribute Sequence	0040,0275	SQ	SQ
>Requested Procedure ID	0040,1001	SH	S,*,U
>Scheduled Procedure Step ID	0040,0009	SH	S,*,U
Performed Procedure Step Start Date	0040,0244	DA	S,R,U
Performed Procedure Step Start Time	0040,0245	TM	R,U
Image Level			
SOP Instance UID	0008,0018	UI	UNIQUE,L
SOP Class UID	0008,0016	UI	U,L
Content Date	0008,0023	DA	NONE
Content Time	0008,0033	TM	NONE
Retrieve AE Title	0008,0054	AE	NONE
Referenced Series Sequence	0008,1115	SQ	SQ
>Series Instance UID	0020,000E	UI	NONE
>Referenced Image Sequence	0008,1140	SQ	SQ
>>Referenced SOP Class UID	0008,1150	UI	NONE
>>Referenced SOP Instance UID	0008,1155	UI	NONE
Instance Number	0020,0013	IS	S,U

Rows	0028,0010	US	NONE
Columns	0028,0011	US	NONE
Bits Allocated	0028,0100	US	NONE
Number of Frames	0028,0008	IS	NONE
Observation DateTime	0040,A032	DT	NONE
Concept Name Code Sequence	0040,A043	SQ	SQ
>Code Value	0008,0100	SH	S,*,U
>Coding Scheme Designator	0008,0102	SH	S,*,U
>Coding Scheme Version	0008,0103	SH	NONE
>Code Meaning	0008,0104	LO	NONE
Verifying Observer Sequence	0040,A073	SQ	SQ
>Verifying Organization	0040,A027	LO	NONE
>Verification DateTime	0040,A030	DT	S,R,U
>Verifying Observer Name	0040,A075	PN	S,*,U
>Verifying Observer Identification Code Sequence	0040,A088	SQ	SQ
>>Code Value	0008,0100	SH	NONE
>>Coding Scheme Designator	0008,0102	SH	NONE
>>Coding Scheme Version	0008,0103	SH	NONE
>>Code Meaning	0008,0104	LO	NONE
Referenced Request Sequence	0040,A370	SQ	SQ
>Accession Number	0008,0050	SH	NONE
>Study Instance UID	0020,000D	UI	NONE
>Requested Procedure Code Sequence	0032,1064	SQ	SQ
>>Code Value	0008,0100	SH	NONE
>>Coding Scheme Designator	0008,0102	SH	NONE
>>Coding Scheme Version	0008,0103	SH	NONE
>>Code Meaning	0008,0104	LO	NONE
>Requested Procedure ID	0040,1001	SH	NONE
Completion Flag	0040,A491	CS	S,*,U
Verification Flag	0040,A493	CS	S,*,U
Content Template Sequence	0040,A504	SQ	SQ
>Template Identifier	0040,DB00	CS	NONE
Presentation Label	0070,0080	CS	NONE
Presentation Description	0070,0081	LO	NONE
Presentation Creation Date	0070,0082	DA	NONE
Presentation Creation Time	0070,0083	TM	NONE
Presentation Creator's Name	0070,0084	PN	NONE

Table 37: Study Root C-FIND SCP Supported Elements

Description/Module	Tag ID	VR	Types of Matching
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 Birth Time	0010,0032	TM	S,U
Patient's Sex	0010,0040	CS	S,U
Patient's Weight	0010,1030	DS	NONE
Medical Alerts	0010,2000	LO	NONE
Contrast Allergies	0010,2110	LO	NONE
Pregnancy Status	0010,21C0	US	NONE

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	UNIQUE,L
Referring Physician's Name	0008,0090	PN	S*,U
Study Description	0008,1030	LO	S*,U
Modalities in Study	0008,0061	CS	S*,U
Number of Study Related Series	0020,1206	IS	NONE
Number of Study Related Instances	0020,1208	IS	NONE
Series Level			
Modality	0008,0060	CS	S,U
Series Number	0020,0011	IS	S*,U
Series Instance UID	0020,000E	UI	UNIQUE,L
Number of Series Related Instances	0020,1209	IS	NONE
Performing Physician's Name (see NOTE)	0008,1050	PN	S*,U
Operator's Name	0008,1070	PN	S*,U
Series Description	0008,103E	LO	S*,U
Request Attribute Sequence	0040,0275	SQ	SQ
>Requested Procedure ID	0040,1001	SH	S*,U
>Scheduled Procedure Step ID	0040,0009	SH	S*,U
Performed Procedure Step Start Date	0040,0244	DA	S,R,U
Performed Procedure Step Start Time	0040,0245	TM	R,U
Image Level			
SOP Instance UID	0008,0018	UI	UNIQUE,L
SOP Class UID	0008,0016	UI	U,L
Content Date	0008,0023	DA	NONE
Content Time	0008,0033	TM	NONE
Retrieve AE Title	0008,0054	AE	NONE
Referenced Series Sequence	0008,1115	SQ	SQ
>Series Instance UID	0020,000E	UI	NONE
>Referenced Image Sequence	0008,1140	SQ	SQ
>>Referenced SOP Class UID	0008,1150	UI	NONE
>>Referenced SOP Instance UID	0008,1155	UI	NONE
Instance Number	0020,0013	IS	S,U
Rows	0028,0010	US	NONE
Columns	0028,0011	US	NONE
Bits Allocated	0028,0100	US	NONE
Number of Frames	0028,0008	IS	NONE
Observation DateTime	0040,A032	DT	NONE
Concept Name Code Sequence	0040,A043	SQ	SQ
>Code Value	0008,0100	SH	S*,U
>Coding Scheme Designator	0008,0102	SH	S*,U
>Coding Scheme Version	0008,0103	SH	NONE
>Code Meaning	0008,0104	LO	NONE
Verifying Observer Sequence	0040,A073	SQ	SQ
>Verifying Organization	0040,A027	LO	NONE
>Verification DateTime	0040,A030	DT	S,R,U
>Verifying Observer Name	0040,A075	PN	S*,U
>Verifying Observer Identification Code Sequence	0040,A088	SQ	SQ

>>Code Value	0008,0100	SH	NONE
>>Coding Scheme Designator	0008,0102	SH	NONE
>>Coding Scheme Version	0008,0103	SH	NONE
>>Code Meaning	0008,0104	LO	NONE
Referenced Request Sequence	0040,A370	SQ	SQ
>Accession Number	0008,0050	SH	NONE
>Study Instance UID	0020,000D	UI	NONE
>Requested Procedure Code Sequence	0032,1064	SQ	SQ
>>Code Value	0008,0100	SH	NONE
>>Coding Scheme Designator	0008,0102	SH	NONE
>>Coding Scheme Version	0008,0103	SH	NONE
>>Code Meaning	0008,0104	LO	NONE
>Requested Procedure ID	0040,1001	SH	NONE
Completion Flag	0040,A491	CS	S,*,U
Verification Flag	0040,A493	CS	S,*,U
Content Template Sequence	0040,A504	SQ	SQ
>Template Identifier	0040,DB00	CS	NONE
Presentation Label	0070,0080	CS	NONE
Presentation Description	0070,0081	LO	NONE
Presentation Creation Date	0070,0082	DA	NONE
Presentation Creation Time	0070,0083	TM	NONE
Presentation Creator's Name	0070,0084	PN	NONE

Table 38: Patient/Study Only Root C-FIND SCP Supported Elements

Description/Module	Tag ID	VR	Types of Matching
Patient Level			
Patient's Name	0010,0010	PN	S,*,U
Patient ID	0010,0020	LO	UNIQUE
Patient's Birth Date	0010,0030	DA	S,U
Patient's Birth Time	0010,0032	TM	S,U
Patient's Sex	0010,0040	CS	S,U
Patient's Weight	0010,1030	DS	NONE
Medical Alerts	0010,2000	LO	NONE
Contrast Allergies	0010,2110	LO	NONE
Pregnancy Status	0010,21C0	US	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	UNIQUE,L
Referring Physician's Name	0008,0090	PN	S,*,U
Study Description	0008,1030	LO	S,*,U
Modalities in Study	0008,0061	CS	S,*,U
Number of Study Related Series	0020,1206	IS	NONE
Number of Study Related Instances	0020,1208	IS	NONE
Performing Physician's Name (see NOTE)	0008,1050	PN	S,*,U

The types of Matching supported by the Query/Retrieve Server AE Query (C-FIND) SCP:

- S - indicates Single Value Matching is supported.
- R - indicates Range Matching is supported.

- * - indicates Wildcard Matching is supported.
- U - indicates Universal Matching is supported.
- L - indicates that UID lists Matching are supported.
- SQ - indicates that Sequence Matching is supported.
- NONE - indicates that no matching is supported, but that values for this Element are returned if requested (i.e. universal matching).
- UNIQUE - indicates that this is the Unique Key for that query level, in which case Universal Matching or Single Value Matching is supported depending on the query level.

NOTE: By default, Horizon Medical Imaging™ returns Performing Physician’s Name (0008,1050) at the Series Level. However, it can be configured to return it at the Study Level.

The Query/Retrieve Server AE returns one of the following status codes in a C-FIND Response:

Table 39: Query/Retrieve Server AE Returned C-FIND-RSP Status Codes

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The Query/Retrieve Server AE has successfully finished sending all matches in previous C-FIND-RSPs. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Failed	Data Set does not match SOP Class	A900	The Query/Retrieve Server AE has determined that the C-FIND-RQ query identifier is missing mandatory Elements for the specified SOP Class and Query Level. This will only occur if the missing Elements or values prevent the Query/Retrieve Server AE from successfully querying the Horizon Medical Imaging™ database. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Failed	Unable to Process	C001	The Query/Retrieve Server AE cannot process the C-FIND-RQ because it cannot query the Horizon Medical Imaging™ database for some reason. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Cancel	Sub-operations terminated due to Cancel Indication	FE00	Indicates that the Query/Retrieve Server AE received a Cancel Request from the remote AE. Note that this can only occur if the Query/Retrieve Server AE is configured to actually check for and handle Cancel Requests. A warning indication is output to the Service Logs. No indication is posted to the User Interface.
Pending	Matches are continuing – Current Match is supplied	FF00	The Query/Retrieve Server AE is successfully sending a match in the C-FIND-RSP, and will continue to send further C-FIND-RSPs. Note that the Query/Retrieve Server AE does not check the C-FIND-RQ query identifier to see if there are Optional Elements that it does not support, so it never returns FF01 (Pending) - Matches are continuing but one or more Optional Keys were not supported. Success indication message is output to the Service Logs. No indication is posted to the User Interface.

3.2.3.4.1.3.3 SOP Specific Conformance – Retrieve (C-MOVE)

The Query/Retrieve Server AE will try to establish an Association with a DICOM Application Entity named by the external C-MOVE SCU (through a C-MOVE Destination AE Title) to perform C-STORE operations on requested images. One or more of the Image Storage Presentation Contexts listed in Table 8 will be negotiated.

By default, the Query/Retrieve Server AE is configured to not check for Cancel Requests sent by a remote AE. This is done to improve performance as it does not have to spend time periodically checking if a remote AE has sent a Cancel Request over the Association. However, if it is known that a remote AE can send Cancel Requests, then the Query/Retrieve Server AE can be configured to handle them properly.

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If the Query/Retrieve Server AE cannot handle the received C-MOVE Request, then a C-MOVE Response will be returned with the appropriate error Status Code. If the Request can be handled, then the Query/Retrieve Server AE will return a C-MOVE Response to the C-MOVE SCU after each C-STORE Response from the SCP has been received. The C-MOVE Response reports the number of remaining SOP Instances to transfer, as well as the number of SOP Instances transferred having a successful, failed, or warning status. The Association will be properly released after the Query/Retrieve Server AE has attempted to transfer all requested SOP Instances. The Query/Retrieve Server AE will continue to attempt to transfer any remaining SOP Instances even if a failure Status Code is returned in a particular C-STORE response, or the Association with the C-MOVE SCU has been lost.

The Query/Retrieve Server AE supports the following Elements depending on the Information Model used for the C-MOVE Request:

Table 40: Patient Root C-MOVE SCP Supported Elements

Description/Module	Tag ID	VR	Types of Matching
Patient Level			
Patient ID	0010,0020	LO	UNIQUE
Study Level			
Study Instance UID	0020,000D	UI	UNIQUE, L
Series Level			
Series Instance UID	0020,000E	UI	UNIQUE
Image Level			
SOP Instance UID	0008,0018	UI	UNIQUE

Table 41: Study Root C-MOVE SCP Supported Elements

Description/Module	Tag ID	VR	Types of Matching
Study Level			
Study Instance UID	0020,000D	UI	UNIQUE, L
Series Level			
Series Instance UID	0020,000E	UI	UNIQUE
Image Level			
SOP Instance UID	0008,0018	UI	UNIQUE

Table 42: Patient/Study Only C-MOVE SCP Supported Elements

Description/Module	Tag ID	VR	Types of Matching
Patient Level			
Patient ID	0010,0020	LO	UNIQUE
Study Level			
Study Instance UID	0020,000D	UI	UNIQUE, L

The types of Matching requested by the Query/Retrieve Server AE Retrieve (C-MOVE) SCP:
 L - indicates that UID lists can be sent.
 UNIQUE - indicates that a single Unique Key value can be sent.

Query/Retrieve Server AE returns one of the following status codes in a Query/Retrieve C-MOVE Response:

Table 43: Query/Retrieve Server AE Returned C-MOVE-RSP Status Codes

Service Status	Further Meaning	Error Code	Behavior
Success	Sub-operations complete – No failures	0000	The Query/Retrieve Server AE has successfully finished sending all SOP Instances to the C-MOVE Destination AE and will no longer be sending any additional C-MOVE-RSPs. Success indication message is output to the Service Log.

Service Status	Further Meaning	Error Code	Behavior
			No indication is posted to the User Interface.
Warning	Sub-operations complete – One or more failures	B000	The Query/Retrieve Server AE has finished trying to send all SOP Instances to the C-MOVE Destination AE and will no longer be sending any additional C-MOVE-RSPs. However, one or more of the SOP Instances were not successfully sent to the C-MOVE Destination AE. The C-MOVE Response fields indicate the number of SOP Instances transferred having a successful, failed, or warning status. A warning indication is output to the Service Log. No indication is posted to the User Interface.
Refused	Move destination unknown	A801	The Destination Application Entity named in the C-MOVE Request is unknown to Query-Retrieve Server AE. Error message is output to the Service Log. No indication is posted to the User Interface.
Failed	Identifier does not match SOP Class	A900	The Query/Retrieve Server AE has determined that the C-MOVE-RQ query identifier is missing mandatory Elements for the specified C-MOVE SOP Class and Query Level. This will only occur if the missing Elements or values prevent the Query/Retrieve Server AE from successfully querying the Horizon Medical Imaging™ database for matching SOP Instances. An error indication is output to the Service Log. No indication is posted to the User Interface.
Failed	Unable to Process	C000	The Query/Retrieve Server AE cannot process the C-MOVE-RQ because it could not parse the C-MOVE Request identifier or cannot query the Horizon Medical Imaging™ database for some reason. An error indication is output to the Service Log. No indication is posted to the User Interface.
Cancel	Matching terminated due to Cancel Indication	FE00	Indicates that the Query/Retrieve Server AE received a Cancel Request from the remote AE. Note that this can only occur if the Query/Retrieve Server AE is configured to actually check for and handle Cancel Requests. A warning indication is output to the Service Log. No indication is posted to the User Interface.
Pending	Matches are continuing – Current Match is supplied	FF00	The Query/Retrieve Server AE has attempted to send a SOP Instance to the C-MOVE Destination AE and further C-MOVE Responses will be sent. The C-MOVE Response fields indicates the number of remaining SOP Instances to transfer, as well as the number of SOP Instances transferred having a successful, failed, or warning status. If full tracing is enabled, then the contents of the C-MOVE Response are output to the Service Log. No indication is posted to the User Interface.

3.2.3.4.1.3.4 SOP Specific Conformance – Modality Worklist

Matching on Optional Matching Keys is not supported. Type 3 Return Keys are not supported.

By default, the Query/Retrieve Server AE is configured to not check for Cancel Requests sent by a remote AE. This is done to improve performance, as it does not have to spend time periodically checking if a remote AE has sent a Cancel Request over the Association. However, if it is known that a remote AE can send Cancel Requests, then the Query/Retrieve Server AE can be configured to handle them properly.

The following table lists the Attributes that it can return in a Modality Worklist C-FIND Response. It also specifies the types of matching supported for an Attribute's value, as well as whether a default or actual value is returned for an Attribute. The default values are used only if the scheduling information is entered through the Horizon Medical Imaging™ user interface or the Modality Worklist SCP that Horizon Medical Imaging™ queried for this scheduling data does not return valid values.

Table 44: Significant Worklist Attributes

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Module Name Attribute Name	Tag ID	VR	Types of Matching	Returned Value	Default Value
Scheduled Procedure Step					
Scheduled Procedure Step Sequence	0040, 0100	SQ	U	V	
> Scheduled Station AE Title	0040, 0001	AE	NONE	D	"UNKNOWN"
> Scheduled Procedure Step Start Date	0040, 0002	DA	R,S,*,U	V	
> Scheduled Procedure Step Start Time	0040, 0003	TM	NONE	D	6:00 AM
> Scheduled Procedure Step End Date	0040, 0004	DA	R,S,*,U	V	
> Modality	0008, 0060	CS	S,*,U NONE	D	{}"
> Scheduled Performing Physician's Name	0040, 0006	PN	NONE	D	{}"
> Scheduled Procedure Step Description	0040, 0007	LO	NONE	D	"UNASSIGNED"
> Scheduled Station Name	0040, 0010	SH	NONE	D	{}"
> Scheduled Procedure Step Location	0040, 0011	SH	NONE	D	{}"
> Scheduled Procedure Step ID	0040, 0009	SH	NONE	V	
Requested Procedure					
Requested Procedure ID	0040,1001	SH	NONE	V	
Requested Procedure Description	0032, 1060	LO	NONE	D	"UNASSIGNED"
Study Instance UID	0020, 000D	UI	NONE	V	
Requested Procedure Priority	0040, 1003	SH	NONE	D	{}"
Patient Transport Arrangements	0040, 1004	LO	NONE	D	{}"
Reference Study Sequence	0008, 1110	SQ	NONE	D	Empty Sequence
Imaging Service Request					
Accession Number	0008, 0050	SH	S,U	V	
Referring Physician's Name	0008, 0090	PN	NONE	D	{}"
Visit Identification					
Visit Admission ID	0038, 0010	LO	NONE	D	{}"
Visit Status					
Current Patient Location	0038, 0300	LO	NONE	D	{}"
Patient Identification					
Patient Name	0010, 0010	PN	S,*,U	V	
Patient ID	0010, 0020	LO	S,U	V	
Patient Demographic					
Patient Birth Date	0010, 0030	DA	S,*,U	V	
Patient Gender	0010, 0040	CS	NONE	V	
Patient Weight	0010, 1030	DS	NONE	D	{}"
Patient Confidentiality	0040, 3001	LO	NONE	D	{}"
Referenced Patient Sequence	0008, 1120	SQ	NONE	D	Empty Sequence
Patient Medical					
Patient State	0038, 0500	LO	NONE	D	{}"
Pregnancy Status	0010, 21C0	US	NONE	D	{}"
Patient Medical Alerts	0010, 2000	LO	NONE	D	{}"
Patient Contrast Allergies	0010, 2110	LO	NONE	D	{}"
Patient Special Needs	0038, 0050	LO	NONE	D	{}"

The Types of Matching supported by the Query/Retrieve Server AE Modality Worklist SCP:

- S - indicates Single Value Matching is supported.
- R - indicates Range Matching is supported.
- * - indicates Wildcard Matching is supported.
- U - indicates Universal Matching is supported.
- NONE - indicates that no matching is supported, but that values for this Element are returned if requested (i.e. universal matching).

The Returned Value supported by the Query/Retrieve Server AE Modality Worklist SCP:

- V - indicates a valid value is returned.
- D - indicates a default hard-coded value is returned. The default values are used only if the scheduling information is entered through the Horizon Medical Imaging™ user interface or the Modality Worklist SCP that Horizon Medical Imaging™ queried for this scheduling data does not return valid values.

The Query/Retrieve Server AE returns one of the following status codes in a Modality Worklist C-FIND Response:

Table 45: Query/Retrieve Server AE Returned C-FIND-RSP Status Codes

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The Query/Retrieve Server AE has successfully finished sending all Modality Worklist matches in previous C-FIND-RSPs. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Failed	Data Set does not match SOP Class	A900	The Query/Retrieve Server AE has determined that the C-FIND-RQ query identifier is missing mandatory Elements for the Modality Worklist SOP Class. This will only occur if the missing Elements or values prevent the Query/Retrieve Server AE from successfully querying the Horizon Medical Imaging™ database. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Failed	Unable to Process	C001	The Query/Retrieve Server AE cannot process the Modality Worklist C-FIND-RQ because it cannot query the Horizon Medical Imaging™ database for some reason. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Cancel	Sub-operations terminated due to Cancel Indication	FE00	Indicates that the Query/Retrieve Server AE received a Cancel Request from the remote AE. Note that this can only occur if the Query/Retrieve Server AE is configured to actually check for and handle Cancel Requests. A warning indication is output to the Service Logs. No indication is posted to the User Interface.
Pending	Matches are continuing – Current Match is supplied	FF00	The Query/Retrieve Server AE is successfully sending a match in the C-FIND-RSP, and will continue to send further C-FIND-RSPs. Note that the Query/Retrieve Server AE does not check the C-FIND-RQ query identifier to see if there are Optional Elements that it does not support, so it never returns FF01 (Pending) - Matches are continuing but one or more Optional Keys were not supported. Success indication message is output to the Service Logs. No indication is posted to the User Interface.

3.2.3.4.1.3.5 Association Acceptor Communication Failure Behavior

The Behavior of the Query/Retrieve Server AE during communication failure when it is acting as an Association Acceptor is summarized in the following table:

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Table 46: Query/Retrieve Server AE Communication Failure Behavior

Exception	Behavior
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout). The default timeout for waiting on an open Association to receive the next DICOM Message is 60 minutes.	The Association is aborted using a DICOM A-P-ABORT. This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If Query/Retrieve Server AE is in the process of sending images to a C-MOVE Destination AE, then it will continue to do so even if the Association with the C-MOVE SCU has been lost.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout). The default timeout when trying to read from or write to an open socket is 3 minutes.	The Association is aborted using a DICOM A-P-ABORT. This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If Query/Retrieve Server AE is in the process of sending images to a C-MOVE Destination AE, then it will continue to do so even if the Association with the C-MOVE SCU has been lost.
Association A-ABORTed by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. An error indication is output to the Service Logs. No indication is posted to the User Interface. If Query/Retrieve Server AE is in the process of sending images to a C-MOVE Destination AE, then it will continue to do so even if the Association with the C-MOVE SCU has been lost.

3.2.3.4.1.3.6 Presentation Context Acceptance Criteria

The Query/Retrieve Server AE will only accept the Presentation Contexts specified in Table 35: Query/Retrieve Server AE Accepted Presentation Contexts.

The Query/Retrieve Server AE can be configured to reject valid Presentation Contexts if the external DICOM host is not listed in a local configuration file. In addition, a valid Presentation Context can be rejected if the maximum limit on the number of simultaneous processes has been reached.

The Query/Retrieve Server AE does not check for, and will accept, duplicate Presentation Contexts.

3.2.3.4.1.3.7 Transfer Syntax Selection Policies

The Query/Retrieve Server AE supports only the Implicit VR Little Endian and Explicit VR Little Endian Transfer Syntaxes when acting in the Role of an SCP. If both of these are proposed in a single Presentation Context and the SOP Class is supported, then the default behavior is to accept the Implicit VR Little Endian Transfer Syntax.

3.2.4 Query/Retrieve Client AE Specification

3.2.4.1 SOP Classes

The Query/Retrieve Client AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 47: SOP Class Conformance of Query/Retrieve Client AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Query/Retrieve			
Patient Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	No
Patient Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	No
Study Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No
Study Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No
Patient Study Only Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1	Yes	No
Patient Study Only Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2	Yes	No

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The Query/Retrieve Client AE implements the C-FIND Query and C-MOVE Retrieval SOP Classes as an SCU. It can act as a SCU to query for patient, study and series demographic information as well as retrieve all SOP Instances in a study or series. It can act in direct response to input from the user interface, or when triggered to do so by the Horizon Medical Imaging™ system.

The Query/Retrieve Client AE has one task running on a Horizon Medical Imaging™ system. It acts as an Association Requestor, requesting a new Association when the user of the system requests that a query or retrieval request be sent to a remote AE.

3.2.4.2 Association Establishment Policies

3.2.4.2.1 General

The Query/Retrieve Client AE will initiate a new Association when the user requests that a remote AE be queried for certain patient, study, or series information. It will also initiate a new Association when it is triggered to retrieve all SOP Instances in a study or series from a remote AE.

The DICOM Standard Application Context Name is always proposed:

Table 48: DICOM Application Context for Query/Retrieve Client AE

Application Context Name	1.2.840.10008.3.1.1.1
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3.2.4.2.2 Number of Associations

The Query/Retrieve Client AE will only open one Association at a time with a remote AE.

Table 49: Number of Simultaneous Associations for Query/Retrieve Client AE

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

3.2.4.2.3 Asynchronous Nature

Negotiation of multiple outstanding transactions is not supported.

Table 50: Asynchronous Nature for Query/Retrieve Client AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)
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3.2.4.2.4 Implementation Identifying Information

Table 51: DICOM Implementation Class and Version for Query/Retrieve Client AE

Implementation Class UID	1.2.840.113711.10
Implementation Version Name	V1.0

3.2.4.3 Association Initiation Policy

3.2.4.3.1 Activity – Users Send Query Request to Remote AE

3.2.4.3.1.1 Description and Sequencing of Activity

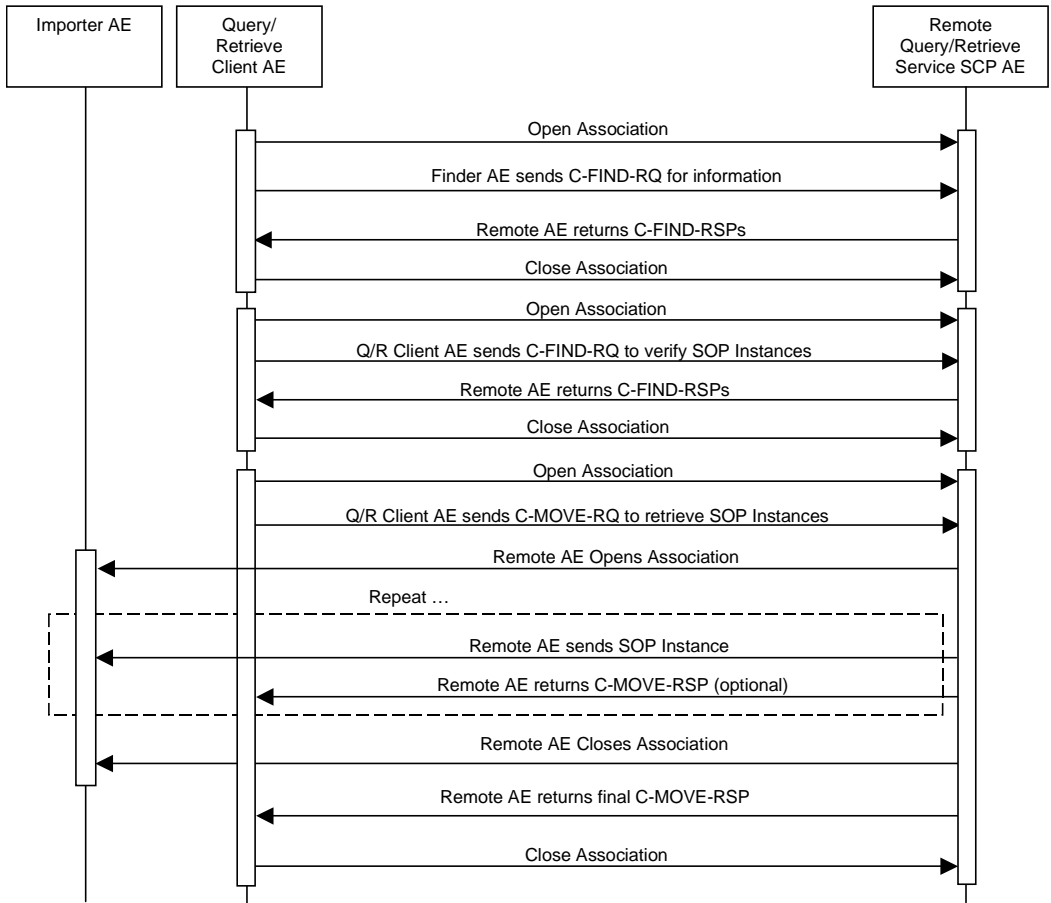
If the user of a Horizon Medical Imaging™ system uses the user interface to specify that a query or retrieval request be sent to a remote AE, then a single attempt will be made. If the query or retrieval request fails, for whatever reason, then no retry will be performed.

In order for the user interface to be used to request the retrieval of SOP Instances from a remote AE, the user must first query the remote AE to get the key values (Patient ID, Study UID, etc.) for the SOP Instances to be retrieved. Once the key values have been identified, then the user interface can be used to request the retrieval.

In addition to the user directly requesting the retrieval of SOP Instances, the Horizon Medical Imaging™ system can do this automatically. This will occur if the user wants to view a certain study and the Horizon Medical Imaging™ system knows that the SOP Instances for the study have to first be retrieved from a remote AE before they can be displayed. This can occur if the Horizon Medical Imaging™ system is configured to use a remote AE as the archive, and the SOP Instances have been flushed from the Horizon Medical Imaging™ system after they were sent to the remote AE.

Before the Query/Retrieve Client AE sends a C-MOVE-RQ to retrieve items, it will first verify that the remote AE really has the SOP Instances to be retrieved. This will occur regardless of whether the retrieval is being triggered directly by the user or automatically by the Horizon Medical Imaging™ system. In some cases this can result in a duplicate C-FIND query being sent to the remote AE, first in response to a query initiated through the user interface, and then a second query to verify that the SOP Instances can really be retrieved.

Figure 6: Sequencing of Activity – Sending Query and Retrieval Requests



3.2.4.3.1.2 Proposed Presentation Contexts

The Query/Retrieve Client AE may propose any one or more of the following Presentation Contexts:

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Table 52: Query/Retrieve Client AE Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
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	SCU	None
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	SCU	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	SCU	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	SCU	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	SCU	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	SCU	None

3.2.4.3.1.3 SOP Specific Conformance as an Association Requestor

3.2.4.3.1.3.1 SOP Specific Conformance – Query (C-FIND)

The Query/Retrieve Client AE provides standard conformance to the supported C-FIND SOP Classes. The Query/Retrieve Client AE does not support Relational Queries.

All three query information models — Patient Root, Study Root, and Patient/Study Only Root — are supported. If more than one information model is negotiated on an Association, and it is possible to use more than one of the negotiated information models to form a query, the following information model will be used (in order of preference):

1. Study Root Information Model
2. Patient Root Information Model
3. Patient/Study Only Information Model

All queries are initiated at the highest level of the information model (the PATIENT or STUDY level depending on the SOP Class used), and then for each response received, recursively repeated at the next lower levels (the STUDY, and then SERIES, and then IMAGE levels, if using the Patient Root query information model), in order to completely elucidate the “tree” of instances available on the remote AE (from which the user may subsequently request a retrieval at any level).

The Query/Retrieve Client AE has a default setting for the maximum number of matching responses it can receive from a remote AE. If the remote AE is going to exceed this number, then the Query/Retrieve Client AE will issue a Cancel Request to the remote AE to stop it from returning further matches. By default, this maximum number is 500.

Unexpected attributes returned in a C-FIND Response (those not requested) are ignored. Requested optional return attributes that are not returned by the SCP are also ignored. Non-matching responses returned by the SCP due to unsupported (hopefully optional) matching keys are not filtered locally by the Query/Retrieve Client AE and thus will still be presented in the browser. The Query/Retrieve Client AE attempts to filter out duplicate responses, but only for responses have duplicate key values. For example, if the Query/Retrieve Client AE issues a Study Root Study Level query, and multiple matching responses have the same Patient ID and Study UID, then the Query/Retrieve Client AE will filter these so that they are presented as a single matching response.

The Query/Retrieve Client AE can be triggered to issue a query either by user input through the user interface or by the Horizon Medical Imaging™ system itself. The responses to a C-FIND query are presented in the user interface only in the case where the user initiated the query.

The Query/Retrieve Client AE can include the following Elements in a C-FIND Request depending on the Query Root model and the Query level:

Table 53: Patient Root C-FIND SCU Requested Elements

Description/Module	Tag ID	VR	Types of Matching
Patient Level			
Patient's Name	0010,0010	PN	S,*,U
Patient ID	0010,0020	LO	UNIQUE
Patient's Birth Date	0010,0030	DA	S,U
Patient's Sex	0010,0040	CS	S,U
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	UNIQUE,L
Referring Physician's Name	0008,0090	PN	S,*,U
Study Description	0008,1030	LO	S,*,U
Modalities in Study	0008,0061	CS	S,*,U
Series Level			
Modality	0008,0060	CS	S,U
Series Number	0020,0011	IS	S,*,U
Series Instance UID	0020,000E	UI	UNIQUE
Request Attribute Sequence	0040,0275	SQ	S,*,U
> Requested Procedure ID	0040,1001	SH	S,*,U
> Scheduled Procedure Step ID	0040,0009	SH	S,*,U
Performed Procedure Step Start Date	0040,0244	DA	S,R,U
Performed Procedure Step Start Time	0040,0245	TM	R,U
Image Level			
Instance Number	0020,0013	IS	S,*,U
SOP Instance UID	0008,0018	UI	UNIQUE

Table 54: Study Root C-FIND SCU Requested Elements

Description/Module	Tag ID	VR	Types of Matching
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
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	UNIQUE,L
Referring Physician's Name	0008,0090	PN	S,*,U
Study Description	0008,1030	LO	S,*,U
Modalities in Study	0008,0061	CS	S,*,U
Series Level			
Modality	0008,0060	CS	S,U
Series Number	0020,0011	IS	S,*,U
Series Instance UID	0020,000E	UI	UNIQUE
Request Attribute Sequence	0040,0275	SQ	S,*,U
> Requested Procedure ID	0040,1001	SH	S,*,U

> Scheduled Procedure Step ID	0040,0009	SH	S,*U
Performed Procedure Step Start Date	0040,0244	DA	S,R,U
Performed Procedure Step Start Time	0040,0245	TM	R,U
Image Level			
Instance Number	0020,0013	IS	S,*U
SOP Instance UID	0008,0018	UI	UNIQUE

Table 55: Patient/Study Only C-FIND SCU Requested Elements

Description/Module	Tag ID	VR	Types of Matching
Patient Level			
Patient's Name	0010,0010	PN	S,*U
Patient ID	0010,0020	LO	UNIQUE
Patient's Birth Date	0010,0030	DA	S,U
Patient's Sex	0010,0040	CS	S,U
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	UNIQUE,L
Referring Physician's Name	0008,0090	PN	S,*U
Study Description	0008,1030	LO	S,*U
Modalities in Study	0008,0061	CS	S,*U

The types of Matching requested by the Query/Retrieve Client AE Query (C-FIND) SCU:

- S - indicates the identifier attribute can specify Single Value Matching.
- R - indicates Range Matching.
- * - indicates Wildcard Matching.
- U - indicates Universal Matching.
- L - indicates that UID lists can be sent.
- NONE - indicates that no matching can be requested, but that values for this Element are requested to be returned (i.e. universal matching).
- UNIQUE - indicates that this is the Unique Key for that query level, in which case Universal Matching or Single Value Matching can be requested depending on the query level.

The Query/Retrieve Client AE will exhibit the following behavior according to the Status Code value returned in a C-FIND Response from the Remote AE acting as the SCP:

Table 56: Query/Retrieve Client AE C-FIND-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully finished sending all matches in previous C-FIND-RSPs. Success indication message is output to the Service Log. If a user directly initiated the query using the user interface, then resulting matching information is output to the user interface. If the Horizon Medical Imaging™ system initiated the query, then matching information is not output to the user interface.
Failed	Identifier does not match SOP Class	A900	This is treated as a failure. The Query/Retrieve Client AE does not attempt to resend the C-FIND-RQ. The Association is closed. An error indication is output to the Service Log. An error indication is posted to the User Interface only if the query was initiated through the user interface. Any previously returned matching information is discarded and not output to the user interface.

Service Status	Further Meaning	Error Code	Behavior
Failed	Unable to Process	C001	This is treated as a failure. The Query/Retrieve Client AE does not attempt to resend the C-FIND-RQ. The Association is closed. An error indication is output to the Service Log. An error indication is posted to the User Interface only if the query was initiated through the user interface. Any previously returned matching information is discarded and not output to the user interface.
Cancel	Sub-operations terminated due to Cancel Indication	FE00	Indicates that the remote AE received a Cancel Request sent by the Query/Retrieve Client AE and will no longer return further matches. A warning indication is output to the Service Logs but not to the user interface. If a user directly initiated the query using the user interface, then resulting matching information is output to the user interface. If the Horizon Medical Imaging™ system initiated the query, then matching information is not output to the user interface.
Pending	Matches are continuing – However one or more Optional Keys were not supported.	FF01	Query/Retrieve Client AE continues to wait for further C-FIND-RSPs. The remote AE has successfully returned a match in the C-FIND-RSP, and will continue to send further C-FIND-RSPs. However, the remote AE does not support one or more Optional Keys in the query identifier of the C-FIND-RQ. Warning indication message is output to the Service Logs. No indication is posted to the User Interface. Matching information will not be displayed until final C-FIND-RSP is returned.
Pending	Matches are continuing – Current Match is supplied	FF00	Query/Retrieve Client AE continues to wait for further C-FIND-RSPs. The remote AE has successfully returned a match in the C-FIND-RSP, and will continue to send further C-FIND-RSPs. Success indication message is output to the Service Logs. No indication is posted to the User Interface. Matching information will not be displayed until final C-FIND-RSP is returned.
*	*	Any other status code	This is treated as a failure. The Query/Retrieve Client AE does not attempt to resend the C-FIND-RQ. The Association is closed. An error indication is output to the Service Logs. An error indication is posted to the User Interface only if the query was initiated through the user interface. Any previously returned matching information is discarded and not output to the user interface.

3.2.4.3.1.3.2 SOP Specific Conformance - Retrieval (C-MOVE)

The Query/Retrieve Client AE provides standard conformance to the supported C-MOVE SOP Classes. All three information models — Patient Root, Study Root, and Patient/Study Only Root — are supported.

A retrieval will be performed at the STUDY, SERIES or IMAGE level depending on what level of entity has been selected by the user in the user interface browser, or by the Horizon Medical Imaging™ to retrieve SOP Instances that have been archived to a remote AE.

The Query/Retrieve Client AE never issues Cancel Requests while retrieving SOP Instances.

The C-MOVE Request is sent to the AE that was specified in the Retrieve AE attribute returned in the related C-FIND-RSP by the remote AE. The instances are retrieved to the Horizon Medical Imaging™ system's database by specifying the C-MOVE Destination AE as the AE Title of the Importer AE. This implies that the remote C-MOVE SCP must be pre-configured to determine the presentation address corresponding to the Importer AE. The Importer AE will have to be configured to either allow any host to send to it, or to allow the host of the Storage Service SCU that the C-MOVE SCP will use.

The Query/Retrieve Client AE completely ignores whatever activities are taking place in relation to the Importer AE that is receiving the retrieved SOP Instances. There is no attempt by the Query/Retrieve Client AE to confirm that SOP Instances have actually been successfully received or stored.

Whether or not completely or partially successfully retrievals are made available on the Horizon Medical Imaging™ system to the user is purely dependent on the success or failure of the C-STORE sub-operations,

not on any explicit action by the Query/Retrieve Client AE. Whether or not the remote AE attempts to retry any failed C-STORE sub-operations is beyond the control of the Query/Retrieve Client AE.

If the Association on which the C-MOVE-RQ was issued is aborted for any reason, whether or not the C-STORE sub-operations continue is dependent on the remote AE; the Importer AE will continue to accept Associations and Storage operations regardless.

Table 57: Patient Root C-MOVE SCU Requested Elements

Description/Module	Tag ID	VR	Types of Matching
Patient Level			
Patient ID	0010,0020	LO	UNIQUE
Study Level			
Study Instance UID	0020,000D	UI	UNIQUE
Series Level			
Series Instance UID	0020,000E	UI	UNIQUE
Image Level			
SOP Instance UID	0008,0018	UI	UNIQUE

Table 58: Study Root C-MOVE SCU Requested Elements

Description/Module	Tag ID	VR	Types of Matching
Study Level			
Study Instance UID	0020,000D	UI	UNIQUE
Series Level			
Series Instance UID	0020,000E	UI	UNIQUE
Image Level			
SOP Instance UID	0008,0018	UI	UNIQUE

Table 59: Patient/Study Only C-MOVE SCU Requested Elements

Description/Module	Tag ID	VR	Types of Matching
Patient Level			
Patient ID	0010,0020	LO	UNIQUE
Study Level			
Study Instance UID	0020,000D	UI	UNIQUE

The types of Matching requested by the Query/Retrieve Client AE Retrieve (C-MOVE) SCU:

- L - indicates that UID lists can be sent.
- UNIQUE - indicates that a single Unique Key value can be sent.

The Query/Retrieve Client AE will exhibit the following behavior according to the Status Code value returned in a C-MOVE Response from the Remote AE acting as the SCP:

Table 60: Query/Retrieve Client AE C-MOVE-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Sub-operations complete – No failures	0000	The remote AE has successfully finished sending all SOP Instances to the C-MOVE Destination AE and will no longer be sending any additional C-MOVE-RSPs Success indication message is output to the Service Log. If a user directly initiated the retrieval using the user interface, then the retrieved SOP Instances will be displayed in the user interface. If the Horizon Medical Imaging™ system initiated the retrieval, then the retrieved SOP Instances are not automatically displayed in the user interface.

Service Status	Further Meaning	Error Code	Behavior
Warning	Sub-operations complete – One or more failures	B000	<p>The remote AE has finished trying to send all SOP Instances to the C-MOVE Destination AE and will no longer be sending any additional C-MOVE-RSPs. However, one or more of the SOP Instances were not successfully sent to the C-MOVE Destination AE. The C-MOVE Response fields indicate the number of SOP Instances transferred having a successful, failed, or warning status.</p> <p>A warning indication is output to the Service Log.</p> <p>If a user directly initiated the retrieval using the user interface, then the retrieved SOP Instances will be displayed in the user interface along with a warning that some SOP Instances were not successfully retrieved. If the Horizon Medical Imaging™ system initiated the retrieval, then the retrieved SOP Instances are not automatically displayed in the user interface.</p>
Refused	Move destination unknown	A801	<p>This is treated as a failure. The Query/Retrieve Client AE does not automatically attempt to resend the C-MOVE-RQ. The Association is closed.</p> <p>An error indication is output to the Service Log.</p> <p>An error indication is posted to the User Interface only if the retrieval was initiated through the user interface. Any successfully retrieved SOP Instances will not be discarded and will be displayed in the user interface if the user initiated the retrieval.</p>
Failed	Identifier does not match SOP Class	A900	<p>This is treated as a failure. The Query/Retrieve Client AE does not automatically attempt to resend the C-MOVE-RQ. The Association is closed.</p> <p>An error indication is output to the Service Log.</p> <p>An error indication is posted to the User Interface only if the retrieval was initiated through the user interface. Any successfully retrieved SOP Instances will not be discarded and will be displayed in the user interface if the user initiated the retrieval.</p>
Failed	Unable to Process	C000	<p>This is treated as a failure. The Query/Retrieve Client AE does not automatically attempt to resend the C-MOVE-RQ. The Association is closed.</p> <p>An error indication is output to the Service Log.</p> <p>An error indication is posted to the User Interface only if the retrieval was initiated through the user interface. Any successfully retrieved SOP Instances will not be discarded and will be displayed in the user interface if the user initiated the retrieval.</p>
Cancel	Matching terminated due to Cancel Indication	FE00	<p>This is treated as a failure because the the Query/Retrieve Client AE never issues Cancel Requests for C-MOVE Requests. The Query/Retrieve Client AE does not automatically attempt to resend the C-MOVE-RQ. The Association is closed.</p> <p>An error indication is output to the Service Log.</p> <p>An error indication is posted to the User Interface only if the retrieval was initiated through the user interface. Any successfully retrieved SOP Instances will not be discarded and will be displayed in the user interface if the user initiated the retrieval.</p>
Pending	Matches are continuing – Current Match is supplied	FF00	<p>The Query/Retrieve Client AE continues to wait for further C-MOVE-RSPs.</p> <p>If full tracing is enabled, then the contents of the C-MOVE Response are output to the Service Log.</p> <p>No indication is posted to the User Interface.</p>
*	*	Any other status code	<p>This is treated as a failure. The Query/Retrieve Client AE does not attempt to resend the C-MOVE-RQ. The Association is closed.</p> <p>An error indication is output to the Service Logs.</p> <p>An error indication is posted to the User Interface only if the retrieval was initiated through the user interface. Any successfully retrieved SOP Instances will not be discarded and will be displayed in the user interface if the user initiated the retrieval.</p>

3.2.4.3.1.3.3

Association Requestor Communication Failure Behavior

The Behavior of the Query/Retrieve Client AE during communication failure when acting as an Association Requestor is summarized in the following table:

Table 61: Query/Retrieve Client 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. This is treated as a failure. The Query/Retrieve Client AE does not automatically attempt to resend the C-FIND-RQ or C-MOVE-RQ. An error indication is output to the Service Logs. An error indication is posted to the User Interface only if the query was initiated through the user interface. If this occurs while waiting for a C-FIND-RSP, then any previously returned matching information is discarded and not output to the user interface. If this occurs while waiting for a C-MOVE-RSP, then any previously retrieved SOP Instances are not discarded.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. The Query/Retrieve Client AE does not automatically attempt to resend the C-FIND-RQ or C-MOVE-RQ. An error indication is output to the Service Logs. An error indication is posted to the User Interface only if the query was initiated through the user interface. If this occurs while waiting for a C-FIND-RSP, then any previously returned matching information is discarded and not output to the user interface. If this occurs while waiting for a C-MOVE-RSP, then any previously retrieved SOP Instances are not discarded.
Association A-P-ABORTed by the SCP or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. The Query/Retrieve Client AE does not automatically attempt to resend the C-FIND-RQ or C-MOVE-RQ. An error indication is output to the Service Logs. An error indication is posted to the User Interface only if the query was initiated through the user interface. If this occurs while waiting for a C-FIND-RSP, then any previously returned matching information is discarded and not output to the user interface. If this occurs while waiting for a C-MOVE-RSP, then any previously retrieved SOP Instances are not discarded.

3.2.4.4 Association Acceptance Policy

The Query/Retrieve Client AE does not accept Associations.

3.2.5 Modality Worklist Client AE Specification

3.2.5.1 SOP Classes

The Modality Worklist Client AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 62: SOP Class Conformance of Modality Worklist Client AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Workflow Management			
Modality Worklist Information Model	1.2.840.10008.5.1.4.31	Yes	No

The Modality Worklist Client AE implements the Modality Worklist SOP Class as an SCU. The Modality Worklist Client AE can query a remote AE for a Modality Worklist.

The Modality Worklist Client AE is a single task running on a Horizon Medical Imaging™ system. It acts as an Association Requestor, opening a new Association when it is triggered to query a remote AE for the latest Modality Worklist. If enabled, it will be triggered periodically by the Horizon Medical Imaging™ system to query a remote AE for the Modality Worklist.

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3.2.5.2 Association Establishment Policies

3.2.5.2.1 General

The Modality Worklist Client AE will initiate a new Association when it is triggered to query a remote AE for the Modality Worklist.

The DICOM Standard Application Context Name is always proposed:

Table 63: DICOM Application Context for Modality Worklist Client AE

Application Context Name	1.2.840.10008.3.1.1.1
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3.2.5.2.2 Number of Associations

The Modality Worklist Client AE will only open one Association at a time with a remote AE to be queried.

Table 64: Number of Simultaneous Associations for Modality Worklist Client AE

Maximum number of simultaneous Associations	1
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3.2.5.2.3 Asynchronous Nature

Negotiation of multiple outstanding transactions is not supported.

Table 65: Asynchronous Nature for Modality Worklist Client AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)
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3.2.5.2.4 Implementation Identifying Information

Table 66: DICOM Implementation Class and Version for Modality Worklist Client AE

Implementation Class UID	1.2.840.113711.12
Implementation Version Name	V1.0

3.2.5.3 Association Initiation Policy

3.2.5.3.1 Activity – Update Modality Worklist

3.2.5.3.1.1 Description and Sequencing of Activity

The request for an updated Modality Worklist is automatically initiated at specific configurable time intervals. By default, a query to update the Modality Worklist is initiated every 15 minutes.

By default, the Modality Worklist Client AE only queries for the Scheduled Procedure Steps on the day the query is sent. However, it can be configured to also query for those Steps scheduled for future days.

Upon initiation of the request, the Modality Worklist Client AE will build an identifier for the C-FIND Request, initiate an Association to send it, and wait for the Modality Worklist C-FIND Responses. After retrieval of all C-FIND Responses, the Modality Worklist Client AE will access the local Horizon Medical Imaging™ database to add or update patient demographic and study data.

To protect the system from overflow, the Modality Worklist Client AE will limit the number of processed Modality Worklist C-FIND Responses to a configurable maximum. The default maximum value is 200. Once this amount has been reached, the Modality Worklist Client AE will send a Cancel Request to the remote AE acting as the Modality Worklist SCP. The results of a Modality Worklist query are never displayed directly to

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a user of the Horizon Medical Imaging™ system as the information is only used to update the database and/or to provide this same information if the Horizon Medical Imaging™ Query Server AE is configured to act as a Modality Worklist SCP.

3.2.5.3.1.2 Proposed Presentation Contexts

The Modality Worklist Client AE may propose the following Presentation Context:

Table 67: Modality Worklist Client AE Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Modality Worklist Information Model	1.2.840.10008.5.1.4.31	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.2.5.3.1.3 SOP Specific Conformance as an Association Requestor

3.2.5.3.1.3.1 SOP Specific Conformance - Modality Worklist

The following table lists the Attributes that the Modality Worklist Client AE can include in a Modality Worklist C-FIND Request identifier. It also specifies whether a matching value can be specified and the type of matching. Unexpected Attributes returned in a C-FIND Response are ignored.

Table 68: Modality Worklist Client AE Requested Elements

Module Name Attribute Name	Tag ID	VR	Types of Matching
Scheduled Procedure Step			
Scheduled Procedure Step Sequence	0040, 0100	SQ	NONE
> Scheduled Station AE Title	0040, 0001	AE	S,*,U
> Scheduled Procedure Step Start Date	0040, 0002	DA	R,S,*,U
> Scheduled Procedure Step Start Time	0040, 0003	TM	NONE
> Scheduled Procedure Step End Date	0040, 0004	DA	NONE
> Modality	0008, 0060	CS	S,*,U
> Scheduled Performing Physician's Name	0040, 0006	PN	S,*,U
> Scheduled Procedure Step Description	0040, 0007	LO	S,*,U
> Scheduled Station Name	0040, 0010	SH	S,*,U
> Scheduled Procedure Step Location	0040, 0011	SH	S,*,U
> Scheduled Procedure Step ID	0040, 0009	SH	NONE
Requested Procedure			
Requested Procedure ID	0040,1001	SH	NONE
Requested Procedure Description	0032, 1060	LO	NONE
Study Instance UID	0020, 000D	UI	NONE
Requested Procedure Priority	0040, 1003	SH	NONE
Patient Transport Arrangements	0040, 1004	LO	NONE
Reference Study Sequence	0008, 1110	SQ	NONE
Imaging Service Request			
Accession Number	0008, 0050	SH	NONE
Referring Physician's Name	0008, 0090	PN	NONE
Visit Identification			
Visit Admission ID	0038, 0010	LO	NONE
Visit Status			
Current Patient Location	0038, 0300	LO	NONE
Patient Identification			
Patient Name	0010, 0010	PN	NONE

Patient ID	0010, 0020	LO	NONE
Patient Demographic			
Patient Birth Date	0010, 0030	DA	NONE
Patient Gender	0010, 0040	CS	NONE
Patient Weight	0010, 1030	DS	NONE
Patient Confidentiality	0040, 3001	LO	NONE
Referenced Patient Sequence	0008, 1120	SQ	NONE
Patient Medical			
Patient State	0038, 0500	LO	NONE
Pregnancy Status	0010, 21C0	US	NONE
Patient Medical Alerts	0010, 2000	LO	NONE
Patient Contrast Allergies	0010, 2110	LO	NONE
Patient Special Needs	0038, 0050	LO	NONE

The types of Modality Worklist Matching that can be requested by the Modality Worklist Client AE:

- S - indicates the identifier attribute can specify Single Value Matching.
- R - indicates Range Matching.
- * - indicates Wildcard Matching.
- U - indicates Universal Matching.
- L - indicates that UID lists can be sent.
- NONE - indicates that no matching can be requested, but that values for this Element are requested to be returned (i.e. universal matching).

The Modality Worklist Client AE will exhibit the following behavior according to the Status Code value returned in a C-FIND Response from the Remote AE acting as the SCP:

Table 69: Modality Worklist Client AE C-FIND-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully finished sending all matches in previous C-FIND-RSPs. Success indication message is output to the Service Log. Resulting matching information is output to the user interface.
Failed	Data Set does not match SOP Class	A900	This is treated as a failure. The Modality Worklist Client AE does not attempt to resend the C-FIND-RQ. The Association is closed. An error indication is output to the Service Log. No indication is posted to the User Interface.
Failed	Unable to Process	C001	This is treated as a failure. The Modality Worklist Client AE does not attempt to resend the C-FIND-RQ. The Association is closed. An error indication is output to the Service Log. No indication is posted to the User Interface.
Cancel	Sub-operations terminated due to Cancel Indication	FE00	Indicates that the remote AE received a Cancel Request sent by the Modality Worklist Client AE and will no longer return further matches. A warning indication is output to the Service Logs but not to the user interface. Resulting matching information is output to the user interface.
Pending	Matches are continuing – However one or more Optional Keys were not supported.	FF01	Modality Worklist Client AE continues to wait for further C-FIND-RSPs. The remote AE has successfully returned a match in the C-FIND-RSP, and will continue to send further C-FIND-RSPs. However, the remote AE does not support one or more Optional Keys in the query identifier of the C-FIND-RQ. Warning indication message is output to the Service Logs. No indication is posted to the User Interface.
Pending	Matches are continuing – Current Match is supplied	FF00	Modality Worklist Client AE continues to wait for further C-FIND-RSPs. The remote AE has successfully returned a match in the C-FIND-RSP, and will continue to send further C-FIND-RSPs. Success indication message is output to the Service Logs.

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Service Status	Further Meaning	Error Code	Behavior
			No indication is posted to the User Interface.
*	*	Any other status code	This is treated as a failure. The Modality Worklist Client AE does not attempt to resend the C-FIND-RQ. The Association is closed. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.5.3.1.3.2 Association Requestor Communication Failure Behavior

The Behavior of the Modality Worklist Client AE during communication failure when acting as an Association Requestor is summarized in the following table:

Table 70: Modality Worklist Client 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. This is treated as a failure. The Modality Worklist Client AE does not automatically attempt to resend the C-FIND-RQ. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. The Modality Worklist Client AE does not automatically attempt to resend the C-FIND-RQ. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Association A-P-ABORTed by the SCP or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. The Modality Worklist Client AE does not automatically attempt to resend the C-FIND-RQ. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.5.4 Association Acceptance Policy

The Modality Worklist Client AE does not accept Associations.

3.2.6 Print Management AE Specification

The Print Management AE provides Standard Conformance to the following DICOM V3.0 Meta SOP Classes:

Table 71: Meta SOP Class Conformance of Print Management AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Print Management			
Basic Grayscale Print Management	1.2.840.10008.5.1.1.9	Yes	No
Basic Color Print Management	1.2.840.10008.5.1.1.18	Yes	No

This corresponds to conformance to the following SOP Classes:

Table 72: SOP Class Conformance of Print Management AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Print Management			
Basic Film Session	1.2.840.10008.5.1.1.1	Yes	No
Basic Film Box	1.2.840.10008.5.1.1.2	Yes	No
Basic Grayscale Image Box	1.2.840.10008.5.1.1.4	Yes	No

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DICOM SOP Class Name	SOP Class UID	SCU	SCP
Basic Color Image Box	1.2.840.10008.5.1.1.4.1	Yes	No
Printer SOP Class	1.2.840.10008.5.1.1.16	Yes	No

In addition, the Print Management AE supports the following optional SOP Classes:

Table 73: Optional SOP Class Conformance of Print Management AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Print Management			
Basic Annotation Box	1.2.840.10008.5.1.1.15	Yes	No

The Print Management AE will try to use the Basic Color Print Management SOP Class for color images and the Basic Grayscale Print Management SOP Class for grayscale images. However, if the printer only supports one of these SOP Classes, then image data will be converted if necessary so that it can still be sent to the printer. In addition, if both color and grayscale images need to be printed to the same piece of film, then the Print Management AE will try to use the Basic Color Print Management SOP Class and convert the color images to grayscale if this SOP Class is actually supported.

The Print Management AE can be configured to propose the Basic Annotation Box SOP Class. If a printer supports this, then the Print Management AE can specify text annotations to be printed on the film with the image(s).

There can be one Print Management AE per DICOM printer that Horizon Medical Imaging™ is configured to use. Thus, the Print Management AE can print simultaneously to multiple printers; However, it cannot simultaneously send multiple print tasks to a single DICOM printer.

3.2.6.1 Association Establishment Policies

3.2.6.1.1 General

The Print Management AE will initiate a new Association when the user requests that certain image(s) be printed. Also, Horizon Medical Imaging™ can be configured to automatically print any images that are sent to it (received via the Importer AE). If the Association is broken or some other Association related error is detected, the Association will be aborted. The Print Management AE can be configured to automatically resend images to the printer if such an error occurs.

The DICOM Standard Application Context Name is always proposed:

Table 74: DICOM Application Context for Print Management AE

Application Context Name	1.2.840.10008.3.1.1.1
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The maximum PDU size that will be offered is configurable, and by default is 16,384 bytes.

3.2.6.1.2 Number of Associations

There can be one Print Management AE process per DICOM printer on the network. Each Print Management AE process is configured to send only to a single DICOM printer and each process can only attempt to open one Association at a time. Thus, the maximum possible number of simultaneous Associations is limited to the number of DICOM printers that the Horizon Medical Imaging™ is configured to use.

Table 75: Number of Simultaneous Associations for Print Management AE

Maximum number of simultaneous Associations	(number of configured DICOM printers)
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3.2.6.1.3 Asynchronous Nature

The Print Management AE does not provide 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 76: Asynchronous Nature for Print Management AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)
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3.2.6.1.4 Implementation Identifying Information

Table 77: DICOM Implementation Class and Version for Print Management AE

Implementation Class UID	1.2.840.113711.2
Implementation Version Name	V1.0

3.2.6.2 Association Initiation Policy

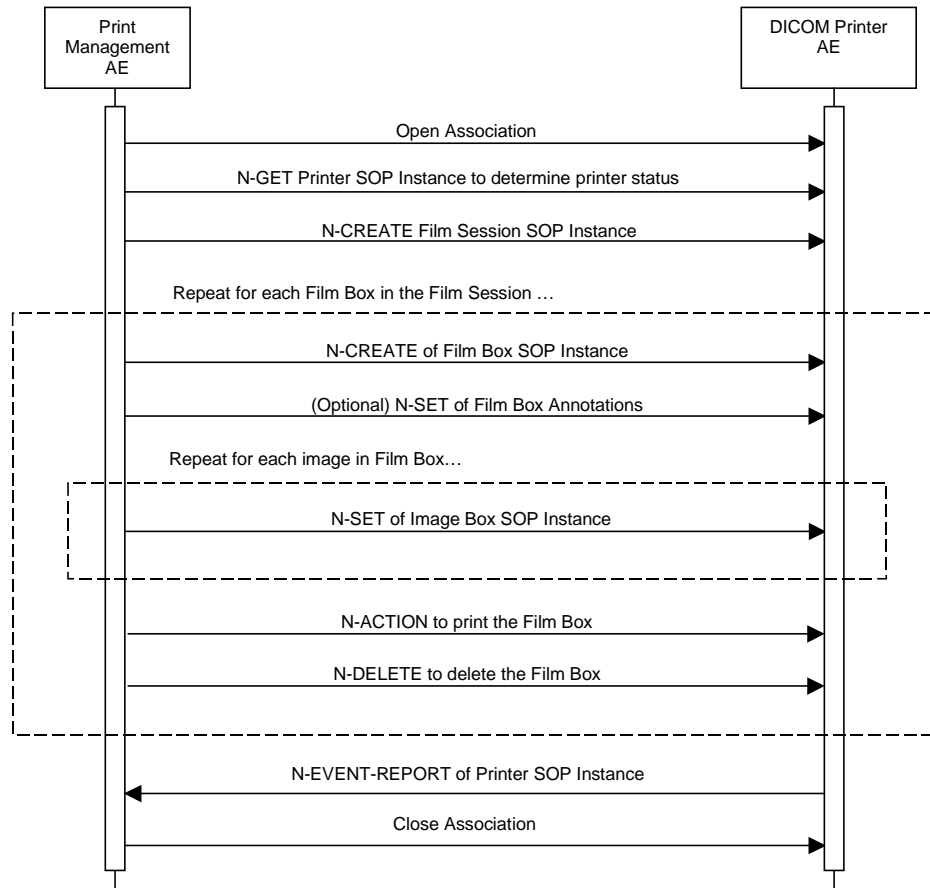
3.2.6.2.1 Activity – Images Sent to Printer

3.2.6.2.1.1 Description and Sequencing of Activity

An Association is initiated with the named DICOM printer either when a Horizon Medical Imaging™ user selects images to be printed and submits the list of images to the Print Management AE, or when the Horizon Medical Imaging™ is configured to automatically print received images. If the user initiates the printing of images, then they can specify how the image should be processed by using the workstation’s image processing tools. In addition, they can select the desired film format and number of copies. If Horizon Medical Imaging™ is configured to automatically print the images, then the default configured image processing, film format, and number of copies will be used.

A new Association will be opened for each print job. The following figure shows the sequencing of the DICOM Messaging involved. The Print Management AE can support N-EVENT-REPORT Requests that are sent by a DICOM Printer at any time over the open Association, even when actually expecting a Response Message of some sort.

Figure 7: Sequencing of Activity – Images Sent to Printer



3.2.6.2.1.2 Proposed Presentation Contexts

The Print Management AE may propose the following Presentation Contexts:

Table 78: Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Basic Grayscale Print Management	1.2.840.10008.5.1.1.9	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management	1.2.840.10008.5.1.1.18	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Annotation Box	1.2.840.10008.5.1.1.15	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.2.6.2.1.3 SOP Specific Conformance as an Association Requestor

The following sections detail the SOP Specific Conformance of the Print Management AE as an Association Requestor for each of the SOP Classes that make up the Basic Grayscale and Basic Color Print Management Meta SOP Classes. In addition, there is a section explaining the SOP Specific Conformance for the Basic Annotation Box SOP Class.

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If an error or warning condition is detected during a print-job, then an error is posted to the Examine Print Jobs status window of the Horizon Medical Imaging™ user interface. The Print Management AE can be configured to automatically retry a number of times to complete a print-job if some failure occurs.

The tables in this section can use the following terms for Presence of Value of an Attribute:

- VNAP - Value Not Always Present (Attribute is present but value can be zero length)
- ANAP - Attribute Not Always Present
- ALWAYS - Always present with a value
- EMPTY - Attribute is sent without a value

The tables in this section can use the following terms for Source of an Attribute's value:

- USER - Attribute value source is from User input (if user initiates print-job)
- AUTO - Attribute value is generated automatically
- CONFIG - Attribute value is Configurable
- PRINTER - Attribute value will be returned by the Printer

3.2.6.2.1.3.1 SOP Specific Conformance - Printer SOP Class

The Print Management AE uses the Printer SOP Class to obtain information about the current printer status by sending an N-GET Request before even attempting to create a Film Session. This way, it can abort the print task and notify the user of any problems if the printer indicates there is a problem of some sort. The attributes obtained via N-GET are listed in the Table below:

Table 79: Print Management AE Printer SOP Class N-GET-RQ Attributes

Attribute Name	Tag ID	VR	Value	Presence of Value ⁶	Source
Printer Status	2110, 0010	CS	To be returned by Printer	EMPTY	PRINTER
Printer Status Info	2110, 0020	CS	To be returned by Printer	EMPTY	PRINTER
Printer Name	2110, 0030	LO	To be returned by Printer	EMPTY	PRINTER
Manufacturer	0008, 0070	LO	To be returned by Printer	EMPTY	PRINTER
Manufacturer Model	0008, 1090	LO	To be returned by Printer	EMPTY	PRINTER
Device Serial Number	0018, 1000	LO	To be returned by Printer	EMPTY	PRINTER
Software Version	0018, 1020	LO	To be returned by Printer	EMPTY	PRINTER
Date of Last Calibration	0018, 1200	DA	To be returned by Printer	EMPTY	PRINTER
Time of Last Calibration	0018, 1201	TM	To be returned by Printer	EMPTY	PRINTER

It is mandatory for the SCP to return a value for the Printer Status (2110,0010). The returned value will be handled as follows:

- NORMAL - The print-job continues to be printed.
- FAILURE - The print-job is aborted. Error message is output to the Service Log. If initiated by the user, then an error indication is posted to the Examine Print Jobs status window.
- WARNING - The print-job continues to be printed. Warning is output to the Service Log. The Examine Print Jobs status window does not currently support warning indications.

The Print Management AE will exhibit the following behavior according to the Status Code value returned in an N-GET Response from the Remote AE acting as the Print Management SCP:

Table 80: Print Management AE N-GET-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully returned the printer status information. Success indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
*	*	Any	This is treated as a failure. The print-job is aborted and the Association is

⁶ Attributes do not have a value in the N-GET-RQ. It is up to the DICOM printer to return values in the N-GET-RSP.

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Service Status	Further Meaning	Error Code	Behavior
		other status code	Released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

The Print Management AE is capable of receiving an N-EVENT-REPORT Request from the Print Management SCP at any time over an open Association.

The Print Management AE will exhibit the following behavior according to the Event Type ID value specified in an N-EVENT-REPORT Request from the Remote AE acting as the Print Management SCP:

Table 81: Print Management AE N-EVENT-REPORT-RQ Event Type ID Behavior

Event Type Name	Event Type ID	Behavior
Normal	1	The Print Management AE continues completing the print-job. Success indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	2	The Print Management AE continues completing the print-job. Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Failure	3	This is treated as a failure. The print-job is aborted and the Association is Released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
*	*	This is treated as a failure. The print-job is aborted and the Association is Released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

3.2.6.2.1.3.2 SOP Specific Conformance - Film Session SOP Class

The Print Management AE does not use collation, so it does not send N-ACTION or N-DELETE Requests for a Film Session. Thus, it only sends N-CREATE Requests for Film Sessions. The Attributes supplied in an N-CREATE Request for a Film Session are listed below:

Table 82: Print Management AE Film Session SOP Class N-CREATE-RQ Attributes

Attribute Name	Tag ID	VR	Value	Presence of Value ⁷	Source
Number of Copies	2000, 0010	IS	1 to N if User, 1 if Config	ALWAYS	USER, CONFIG
Print Priority	2000, 0020	CS	HIGH, MED	ALWAYS	USER, CONFIG
Medium Type	2000, 0030	CS	BLUE FILM, CLEAR FILM, PAPER	ALWAYS	CONFIG
Film Destination	2000, 0040	CS	MAGAZINE, PROCESSOR	ALWAYS	CONFIG

The Print Management AE will exhibit the following behavior according to the Status Code value returned in a Film Session N-CREATE Response from the Remote AE acting as the Print Management SCP:

Table 83: Print Management AE Film Session N-CREATE-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully created the Film Session.

⁷ Attributes do not have a value in the N-GET-RQ. It is up to the DICOM printer to return values in the N-GET-RSP.

Service Status	Further Meaning	Error Code	Behavior
			Success indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute Value Out of Range	0116	The remote AE has created the Film Session. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute List Error	0107	The remote AE has created the Film Session. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Memory allocation not supported	B600	The remote AE has created the Film Session. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
*	*	Any other status code	This is treated as a failure. The print-job is aborted. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

3.2.6.2.1.3.3 SOP Specific Conformance - Film Box SOP Class

The Print Management AE does not use collation, so it must send an N-ACTION Request to print each Film Box and an N-DELETE Request to delete each Film Box. In addition, it must of course send an N-CREATE Request to create each Film Box.

The Attributes supplied in an N-CREATE Request for a Film Box are listed below:

Table 84: Print Management AE Film Box SOP Class N-CREATE-RQ Attributes

Attribute Name	Tag ID	VR	Value	Presence of Value ⁸	Source
Image Display Format	2010, 0010	CS	STANDARD\1,1 STANDARD\2,2 STANDARD\3,3 STANDARD\3,4 ...	ALWAYS	USER, CONFIG
Referenced Film Session Sequence	2010, 0500	SQ		ALWAYS	AUTO
>Referenced SOP Class UID	0008, 1150	UI	1.2.840.10008.5.1.1.1	ALWAYS	AUTO
>Referenced SOP Instance UID	0008, 1155	UI	From created Film Session SOP Instance	ALWAYS	AUTO
Film Orientation	2010, 0040	CS	PORTRAIT, LANDSCAPE	ALWAYS	USER, CONFIG
Film Size ID	2010, 0050	CS	14INX17IN, 14INX14IN, 11INX14IN, 11INX11IN, 85INX11IN, 8INX10IN	ALWAYS	CONFIG
Magnification Type	2010, 0060	CS	REPLICATE, BILINEAR, CUBIC, NONE	VNAP	CONFIG
Smoothing Type	2010, 0080	CS	Supported values are defined in printer's Conformance Statement	VNAP	CONFIG
Border Density	2010, 0100	CS	BLACK, WHITE, 0 ... N (100ths of OD)	VNAP	CONFIG
Empty Image Density	2010, 0110	CS	BLACK, WHITE, 0 ... N (100ths of OD)	VNAP	CONFIG
Min Density	2010, 0120	US	0 ... N	VNAP	CONFIG
Max Density	2010, 0130	US	0 ... N	VNAP	CONFIG

⁸ Attributes do not have a value in the N-GET-RQ. It is up to the DICOM printer to return values in the N-GET-RSP.

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Trim	2010, 0140	CS	YES, NO	VNAP	CONFIG
Configuration Information	2010, 0150	ST	Supported values are defined in printer's Conformance Statement	VNAP	CONFIG
Illumination	2010, 015E	US	0 ... N	VNAP	CONFIG
Reflective Ambient Light	2010, 0160	US	0 ... N	VNAP	CONFIG

The Print Management AE will exhibit the following behavior according to the Status Code value returned in a Film Box N-CREATE Response from the Remote AE acting as the Print Management SCP:

Table 85: Print Management AE Film Box N-CREATE-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully created the Film Box. Success indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute Value Out of Range	0116	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute List Error	0107	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Requested Min Density or Max Density outside of printer's operating range	B605	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
*	*	Any other status code	This is treated as a failure. The print-job is aborted. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

An N-ACTION Request is issued to instruct the Remote AE acting as the Print Management SCP to print the contents of the Film Box. The SOP Instance UID of the Film Box is automatically included in the N-ACTION Request. The Action Reply argument in the N-ACTION Response is not evaluated.

The Print Management AE will exhibit the following behavior according to the Status Code value returned in a Film Box N-ACTION Response from the Remote AE acting as the Print Management SCP:

Table 86: Print Management AE Film Box N-ACTION-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully accepted the film for printing. Success indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute Value Out of Range	0116	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute List Error	0107	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Film Box SOP Instance hierarchy does not contain Image Box SOP Instances (empty)	B603	The remote AE has accepted the film for printing. Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.

Service Status	Further Meaning	Error Code	Behavior
	page)		
Warning	Image size is larger than Image Box size. The image has been de-magnified.	B604	The remote AE has accepted the film for printing. Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Image size is larger than Image Box size. The image has been cropped to fit.	B609	The remote AE has accepted the film for printing. Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Image size or Combined Print Image Size is larger than Image Box size. The image has been decimated to fit.	B60A	The remote AE has accepted the film for printing. Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Failure	Unable to create Print Job SOP Instance; print queue is full.	C602	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
Failure	Image size is larger than Image Box size.	C603	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
Failure	Combined Print Image Size is larger than Image Box size.	C613	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
*	*	Any other status code	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

An N-DELETE Request is issued to instruct the Remote AE acting as the Print Management SCP to delete the contents of the Film Box. The SOP Instance UID of the Film Box is automatically included in the N-DELETE Request.

The Print Management AE will exhibit the following behavior according to the Status Code value returned in a Film Box N-ACTION Response from the Remote AE acting as the Print Management SCP:

Table 87: Print Management AE Film Box N-DELETE-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully deleted the Film Box. Success indication message is output to the Service Log. This has no impact on the Examine Print Jobs status window
*	*	Any other status code	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

3.2.6.2.1.3.4

SOP Specific Conformance - Basic Annotation SOP Class

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The Print Management AE can send N-SET Requests specifying text labels for a Film Box. In order to do this, the Print Management SCP must support the Basic Annotation Box SOP Class. The DICOM Standard does not specify exactly how a printer must implement support for the Basic Annotation Box, so even if it is supported, the DICOM Conformance Statement for the printer must be reviewed in order to determine what support is offered and how the Print Management AE must be configured to make use of this support.

For each Annotation Box that the SCP can support, the Print Management AE can be configured to send the following values in a text string:

- %% - A '%' character
- %x - Today's date
- %N - Patient's full name (lastname, firstname)
- %I - Patient's medical ID
- %e - Exam date
- %t - Exam type
- %P - Page number
- %T - Total number of pages

The Attributes supplied in an N-CREATE Request for a Basic Annotation Box are listed below:

Table 88: Print Management AE Basic Annotation Box SOP Class N-SET-RQ Attributes

Attribute Name	Tag ID	VR	Value	Presence of Value ⁹	Source
Image Display Format	2010, 0010	CS	STANDARD\1,1 STANDARD\2,2 STANDARD\3,3 STANDARD\3,4 ...	ALWAYS	USER, CONFIG
Referenced Film Session Sequence	2010, 0500	SQ		ALWAYS	AUTO
>Referenced SOP Class UID	0008, 1150	UI	1.2.840.10008.5.1.1.1	ALWAYS	AUTO
>Referenced SOP Instance UID	0008, 1155	UI	From created Film Session SOP Instance	ALWAYS	AUTO
Film Orientation	2010, 0040	CS	PORTRAIT, LANDSCAPE	ALWAYS	USER, CONFIG
Film Size ID	2010, 0050	CS	14INX17IN, 14INX14IN, 11INX14IN, 11INX11IN, 85INX11IN, 8INX10IN	ALWAYS	CONFIG
Magnification Type	2010, 0060	CS	REPLICATE, BILINEAR, CUBIC, NONE	VNAP	CONFIG
Smoothing Type	2010, 0080	CS	Supported values are defined in printer's Conformance Statement	VNAP	CONFIG
Border Density	2010, 0100	CS	BLACK, WHITE, 0 ... N (100ths of OD)	VNAP	CONFIG
Empty Image Density	2010, 0110	CS	BLACK, WHITE, 0 ... N (100ths of OD)	VNAP	CONFIG
Min Density	2010, 0120	US	0 ... N	VNAP	CONFIG
Max Density	2010, 0130	US	0 ... N	VNAP	CONFIG
Trim	2010, 0140	CS	YES, NO	VNAP	CONFIG
Configuration Information	2010, 0150	ST	Supported values are defined in printer's Conformance Statement	VNAP	CONFIG
Illumination	2010, 015E	US	0 ... N	VNAP	CONFIG
Reflective Ambient Light	2010, 0160	US	0 ... N	VNAP	CONFIG

⁹ Attributes do not have a value in the N-GET-RQ. It is up to the DICOM printer to return values in the N-GET-RSP.

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The Print Management AE will exhibit the following behavior according to the Status Code value returned in a Film Box N-CREATE Response from the Remote AE acting as the Print Management SCP:

Table 89: Print Management AE Film Box N-CREATE-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully created the Film Box. Success indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute Value Out of Range	0116	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute List Error	0107	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Requested Min Density or Max Density outside of printer's operating range	B605	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
*	*	Any other status code	This is treated as a failure. The print-job is aborted. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

An N-ACTION Request is issued to instruct the Remote AE acting as the Print Management SCP to print the contents of the Film Box. The SOP Instance UID of the Film Box is automatically included in the N-ACTION Request. The Action Reply argument in the N-ACTION Response is not evaluated.

The Print Management AE will exhibit the following behavior according to the Status Code value returned in a Film Box N-ACTION Response from the Remote AE acting as the Print Management SCP:

Table 90: Print Management AE Film Box N-ACTION-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully accepted the film for printing. Success indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute Value Out of Range	0116	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Attribute List Error	0107	The remote AE has created the Film Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Film Box SOP Instance hierarchy Does not contain Image Box SOP Instances (empty page)	B603	The remote AE has accepted the film for printing. Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Image size is larger than Image Box size. The image has been de-magnified.	B604	The remote AE has accepted the film for printing. Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Image size is larger than Image	B609	The remote AE has accepted the film for printing.

Service Status	Further Meaning	Error Code	Behavior
	Box size. The image has been cropped to fit.		Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Image size or Combined Print Image Size is larger than Image Box size. The image or combined Print Image has been decimated to fit.	B60A	The remote AE has accepted the film for printing. Warning indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Failure	Unable to create Print Job SOP Instance; print queue is full.	C602	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
Failure	Image size is larger than Image Box size.	C603	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
Failure	Combined Print Image Size is larger than Image Box size.	C613	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
*	*	Any other status code	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

An N-DELETE Request is issued to instruct the Remote AE acting as the Print Management SCP to delete the contents of the Film Box. The SOP Instance UID of the Film Box is automatically included in the N-DELETE Request.

The Print Management AE will exhibit the following behavior according to the Status Code value returned in a Film Box N-ACTION Response from the Remote AE acting as the Print Management SCP:

Table 91: Print Management AE Film Box N-DELETE-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully deleted the Film Box. Success indication message is output to the Service Log. This has no impact on the Examine Print Jobs status window
*	*	Any other status code	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

3.2.6.2.1.3.5 SOP Specific Conformance - Image Box SOP Classes

The Print Management AE can send N-SET Requests specifying image data for a Basic Grayscale Image Box or a Basic Color Image Box.

The Attributes supplied in an N-SET Request for a Basic Grayscale Image Box are listed below:

Table 92: Print Management AE Basic Grayscale Image Box SOP Class N-SET-RQ Attributes

Attribute Name	Tag ID	VR	Value	Presence of Value ¹⁰	Source
Image Position	2020, 0010	US	1 to number of images in the Film Box	ALWAYS	AUTO
Basic Grayscale Image Sequence	2020, 0110	SQ		ALWAYS	AUTO
>Samples Per Pixel	0028, 0002	US	1	ALWAYS	AUTO
>Photometric Interpretation	0028, 0004	CS	MONOCHROME2	ALWAYS	AUTO
>Rows	0028, 0010	US	Rows in original image being printed	ALWAYS	AUTO
>Columns	0028, 0011	US	Columns in original image being printed	ALWAYS	AUTO
>Bits Allocated	0028, 0100	US	8	ALWAYS	AUTO
>Bits Stored	0028, 0101	US	8	ALWAYS	AUTO
>High Bit	0028, 0102	US	7	ALWAYS	AUTO
>Pixel Representation	0028, 0103	US	0	ALWAYS	AUTO
>Pixel Data	7FE0, 0010	OB	Processed image data	ALWAYS	AUTO
Magnification Type	2010, 0060	CS	REPLICATE, BILINEAR, CUBIC, NONE	VNAP	CONFIG
Smoothing Type	2010, 0080	CS	Supported values are defined in printer's Conformance Statement	VNAP	CONFIG
Polarity	2020, 0020	CS	NORMAL, REVERSE	VNAP	CONFIG
Requested Image Size	2020, 0030	DS	Width in mm of the image to be printed. See comments below for details.	VNAP	AUTO

The image data will be processed if necessary so that it has the characteristics defined in Table 92. If the original image pixel data being printed is not MONOCHROME2 (i.e. is MONOCHROME1, RGB, or ...), then it will be converted to have this Photometric Interpretation. The pixel data will also be converted to unsigned values if they are not already.

If a Modality LUT, Slope and Intercept, VOI LUT, and/or Window and Level values are specified in the DICOM header for the image, then these will be applied during processing. If the image to be printed is currently displayed on the Horizon Medical Imaging™ workstation, then the same processing parameters used to process the image for display will be used to process the image prior to sending it to the printer. If the original image has greater than 8 Bits Allocated per pixel, then it must be scaled down to 8 Bits Allocated per pixel before sending it to the printer. If no VOI LUT or Window and Level values are specified in the DICOM header or through the user interface, then the Print Management AE will estimate Window and Level values using histogram analysis of the pixel values.

Horizon Medical Imaging™ systems can support the display of overlays included in the original DICOM image (either embedded or separate). Horizon Medical Imaging™ can also be configured to automatically create overlays of its own by specifying that certain DICOM header values should be displayed as strings at certain locations on the displayed image. The Print Management AE will automatically 'burn in' all these types of overlays into the processed pixel data before it is sent to the DICOM printer. In addition, if the user adds graphic annotations to a displayed image on the Horizon Medical Imaging™ workstation, then these annotations will also be 'burned into' the pixel data sent to the printer if the user chooses to print the image.

A value for the Requested Image Size (2020, 0030) is only sent if 'True Size' printing is configured. In order to actually calculate a value for this, the DICOM header for the image being printed must specify the size of each pixel in one of the following Attributes:

- (0028,0030) - Pixel Spacing
- (0018,1164) - Imager Pixel Spacing
- (0018,2010) - Nominal Scanned Pixel Spacing
- (3002,0011) - Image Plane Pixel Spacing

¹⁰ Attributes do not have a value in the N-GET-RQ. It is up to the DICOM printer to return values in the N-GET-RSP.

The DICOM Standard does not define exactly what a printer must do if the Requested Image Size (2020, 0030) is too large for the Image Box. The Print Management AE can be configured with the Image Box sizes that will be available on a printer for all combinations of Film Size and Image Display Format. It can be configured to not send a value for the Requested Image Size if the image will not fit in the Image Box. This will prevent the printer from taking some unwanted action if the Requested Image Size is too large.

The Print Management AE will exhibit the following behavior according to the Status Code value returned in an Image Box N-SET Response from the Remote AE acting as the Print Management SCP:

Table 93: Print Management AE Image Box N-SET-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully set the Image Box. Success indication message is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Image size is larger than Image Box size. The image has been de-magnified.	0116	The remote AE has set the Image Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Requested Min Density or Max Density outside of printer's operating range.	B605	The remote AE has set the Image Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Image size is larger than Image Box size. The image has been cropped to fit.	B609	The remote AE has set the Image Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Warning	Image size or Combined Print Image Size is larger than Image Box size. The image or combined Print Image has been decimated to fit.	B60A	The remote AE has set the Image Box. A warning indication is output to the Service Log. Examine Print Jobs status window shows print-job as being in-progress.
Failure	Image size is larger than Image Box size.	C603	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
Failure	Insufficient memory in printer to store the image.	C605	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
Failure	Combined Print Image Size is larger than Image Box size.	C613	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window
*	*	Any other status code	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

3.2.6.2.1.3.6

Association Requestor Communication Failure Behavior

The Behavior of the Print Management AE during communication failure when acting as an Association Requestor is summarized in the following table:

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Table 94: Print Management 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. This is treated as a failure. The Print Management AE can be configured to automatically retry a number of times to complete a print-job if some failure occurs. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. The Print Management AE can be configured to automatically retry a number of times to complete a print-job if some failure occurs. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Association A-P-ABORTed by the SCP or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. The Print Management AE can be configured to automatically retry a number of times to complete a print-job if some failure occurs. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.6.3 Association Acceptance Policy

The Print Management AE does not accept Associations.

3.2.7 External Notifier AE Specifications

The External Notifier AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 95: SOP Class Conformance of External Notifier AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Workflow Management			
Basic Study Content Notification	1.2.840.10008.1.9	Yes	No
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Yes	No
Detached Study Management ¹¹	1.2.840.10008.3.1.2.3.1	No	Yes

The External Notifier AE sends notifications of Horizon Medical Imaging™ internal workflow management events to external systems. Internal events that may trigger notification of external systems include: a new study has been received, a study has been flushed from the RAID, a study has been retrieved to the RAID from the archive, and a study has been marked reported by a radiologist. Also, the External Notifier AE will forward any Modality Performed Procedure Step Requests received by the Event Handler AE.

3.2.7.1 Association Establishment Policies

3.2.7.1.1 General

The External Notifier AE can issue Notifications for any number of configurable events.

For each event that occurs, an Association to a subscribed third party device will be opened, and a Study Content Notification SOP Instance, a Detached Study Management N-EVENT-REPORT, or a Modality Performed Procedure Step SOP Instance will be sent.

Table 96: DICOM Application Context for External Notifier AE

¹¹ The External Notifier AE supports only the N-EVENT-REPORT operation, and not N-GET and N-SET Requests for this SOP Class. Thus it is not fully conformant as an SCP for this SOP Class.

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Application Context Name	1.2.840.10008.3.1.1.1
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The maximum PDU size that will be offered is configurable, and by default is 16,384 bytes

3.2.7.1.2 Number of Associations

One Association is opened for every destination configured to receive notifications.

The External Notifier AE can request one open Association to each Remote AE that it is configured to send notifications to, and keep these Associations open simultaneously.

Table 97: Number of Simultaneous Associations for External Notifier AE

Maximum number of simultaneous Associations	One per Remote AE receiving notifications
---	---

3.2.7.1.3 Asynchronous Nature

The External Notifier AE does not provide 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 98: Asynchronous Nature for External Notifier AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)
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3.2.7.1.4 Implementation Identifying Information

Table 99: DICOM Implementation Class and Version for External Notifier AE

Implementation Class UID	1.2.840.113711.14
Implementation Version Name	V1.0

3.2.7.2 Association Initiation Policy

3.2.7.2.1 Activity – Event Occurs that Requires Notification of a Remote AE

3.2.7.2.1.1 Description and Sequencing of Activity

An Association is initiated with the external DICOM system when a Horizon Medical Imaging™ internal event occurs. There is no sequencing of this activity.

3.2.7.2.1.2 Proposed Presentation Contexts

The External Notifier AE may propose the following Presentation Contexts:

Table 100: External Notifier AE Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Basic Study Content Notification	1.2.840.10008.1.9	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Detached Study Management	1.2.840.10008.3.1.2.3.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

3.2.7.2.1.3 SOP Specific Conformance as an Association Requestor

The External Notifier AE can be configured to use different SOP Classes to send notifications to different Remote AEs for different types of Events. For example, the External Notifier AE can be configured to use the Study Content Notification SOP Class to notify Remote AE 'A' whenever a study is completed, or use the Detached Study Management SOP Class to notify Remote AE 'B' whenever a study is reported. In addition, it can notify Remote AE 'C' whenever an Modality Performed Procedure Step is created or set by forwarding the MPPS Messages (acting as an IHE Performed Procedure Step Manager).

Currently, the events listed in the following table are supported:

Table 101: External Notifier AE Supported Events

Event Type	Meaning
NEWSTUDY	A new study is received
STUDYCOMPLETED	A new study has been completed
STUDYFLUSHED	A study has been flushed from the local RAID
STUDYRETRIEVED	A study has been retrieved from archive media
STUDYREPORTED	A study has been marked as "Reported"
STUDYREVIEWED	A study has been reviewed
STUDYNEEDSOVERREAD	A study needs to be over read
STUDYDICTATED	A study has been dictated
STUDYTRANSCRIBED	A study has been transcribed
STUDYPASSEDQA	A study has passed Quality Assurance
NEWIMAGES	New Images have been appended to an existing study
MPPSCREATE	A Modality Performed Procedure Step request has been received (N-CREATE)
MPPSSET	A Modality Performed Procedure Step has been updated (N-SET)
PATIENTMERGED	A patient record has been merged
PATIENTMODIFIED	A patient record has been modified
STUDYMOVED	A study has been moved
STUDYMODIFIED	A study has been modified
STUDYCANCELLED	A study has been cancelled
SERIESMODIFIED	A series has been modified

The tables in this section can use the following terms for Presence of Value of an Attribute:

VNAP	- Value Not Always Present (Attribute is present but value can be zero length)
ANAP	- Attribute Not Always Present
ALWAYS	- Always present with a value
EMPTY	- Attribute is sent without a value

The tables in this section can use the following terms for Source of an Attribute's value:

USER	- Attribute value source is from User input
AUTO	- Attribute value is generated automatically
CONFIG	- Attribute value is Configurable
MWL	- Attribute value is from Modality Worklist
IMAGE	- Attribute value is obtained from Image or other type of Composite SOP Instance belonging to the study.

3.2.7.2.1.3.1 SOP Specific Conformance - Modality Performed Procedure Step

The External Notifier AE does not independently generate MPPS requests. It simply forwards all requests received by the Event Handler AE as-is to its configured destinations. Therefore, the attributes sent by the External Notifier AE in both the N-CREATE and N-SET messages depend solely on the originating source of the MPPS request. This behavior implements the IHE Technical Framework requirements for the Performed Procedure Step Manager Actor.

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The External Notifier AE will exhibit the following behavior according to the Status Code value returned in a MPPS N-CREATE Response from the Remote AE acting as the MPPS SCP:

Table 102: External Notifier AE MPPS N-CREATE-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully created the MPPS. Success indication message is output to the Service Log. No indication is posted to the User Interface.
Warning	Attribute Value Out of Range	0116	The remote AE is considered to have created the MPPS. A warning indication is output to the Service Log. No indication is posted to the User Interface.
Warning	Attribute List Error	0107	The remote AE is considered to have created the MPPS. A warning indication is output to the Service Log. No indication is posted to the User Interface.
Warning	Memory allocation not supported	B600	The remote AE is considered to have created the MPPS. A warning indication is output to the Service Log. No indication is posted to the User Interface.
*	*	Any other status code	This is treated as a failure. External Notifier AE will re-attempt to create the MPPS SOP Instance a configurable maximum number of times. An error indication is output to the Service Logs. No indication is posted to the User Interface.

The External Notifier AE will exhibit the following behavior according to the Status Code value returned in a MPPS N-SET Response from the Remote AE acting as the MPPS SCP:

Table 103: External Notifier AE MPPS N-SET-RSP Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully set the MPPS. Success indication message is output to the Service Log. No indication is posted to the User Interface.
Warning	Attribute Value Out of Range	0116	The remote AE is considered to have set the MPPS. A warning indication is output to the Service Log. No indication is posted to the User Interface.
Warning	Attribute List Error	0107	The remote AE is considered to have set the MPPS. A warning indication is output to the Service Log. No indication is posted to the User Interface.
Warning	Performed Procedure Step Object may no longer be updated.	A710	The remote AE is considered to have set the MPPS. A warning indication is output to the Service Log. No indication is posted to the User Interface.
Warning	Memory allocation not supported	B600	The remote AE is considered to have set the MPPS. A warning indication is output to the Service Log. No indication is posted to the User Interface.
*	*	Any other status code	This is treated as a failure. The print-job is aborted and the Association is released. An error indication is output to the Service Logs. An error indication is posted to the Examine Print Jobs status window

3.2.7.2.1.3.2 SOP Specific Conformance - Study Content Notification

The External Notifier AE can be configured to use the Study Content Notification SOP Class to send a notification to a Remote AE if any event occurs that is listed in Table 101: External Notifier AE Supported

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Events. Typically, however, the Study Content Notification SOP Class is only used for these events: STUDYCOMPLETED, STUDYFLUSHED, and STUDYRETRIEVED.

The task of sending the Basic Study Descriptor SOP Instance will be re-queued a configurable maximum number of times if it fails. The default maximum number is 10.

The External Notifier AE include the following Attributes in a Basic Study Descriptor SOP Instance:

Table 104: External Notifier AE Basic Study Descriptor SOP Instance Attributes

Module Name Attribute Name	Tag ID	VR	Value	Presence of Value	Source
Patient Summary					
Patient's Name	0010, 0010	PN	From Modality Worklist (queried from remote AE or entered by a user) or from Imaging Composite SOP Instances for the Study.	VNAP	MWL, IMAGE
Patient ID	0010, 0020	LO	From Modality Worklist (queried from remote AE or entered by a user) or from Imaging Composite SOP Instances for the Study. If there is no value, then Importer AE will create one using configurable rules.	ALWAYS	MWL, IMAGE, CONFIG
Study Content					
Study ID	0020, 0010	SH	From Modality Worklist (queried from remote AE or entered by a user) or from Imaging Composite SOP Instances for the Study.	VNAP	MWL, IMAGE
Study Instance UID	0020, 000D	UI	From Modality Worklist (queried from remote AE or entered by a user) or from Imaging Composite SOP Instances for the Study.	ALWAYS	MWL, IMAGE
Referenced Series Sequence	0008, 1115	SQ			
> Series Instance UID	0020, 000E	UI	From Imaging Composite SOP Instance	ALWAYS	IMAGE
> Retrieve AE Title	0008, 0054	AE	AE Title for Query/Retrieve Server AE	ALWAYS	AUTO
> Referenced Image Sequence	0008, 1140	SQ			
>> Referenced SOP Class UID	0008, 1150	UI	From Imaging Composite SOP Instance	ALWAYS	IMAGE
>> Referenced SOP Instance UID	0008, 1155	UI	From Imaging Composite SOP Instance	ALWAYS	IMAGE
SOP Common					
SOP Class UID	0008, 0016	UI	From Imaging Composite SOP Instance	ALWAYS	IMAGE
SOP Instance UID	0008, 0018	UI	From Imaging Composite SOP Instance	ALWAYS	IMAGE

The External Notifier AE will exhibit the following Behavior according to the Status Code value returned in a C-STORE Response from the Remote AE acting as the Study Content Notification SCP:

Table 105: External Notifier AE C-STORE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Complete Study Content exists on system supporting SCP	0000	The SCP has successfully received the exported Basic Study Descriptor SOP Instance. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Success	Partial Study Content exists on system supporting SCP	0001	The SCP has successfully received the exported Basic Study Descriptor SOP Instance. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Success	None of the Study Content exists on the system supporting SCP	0002	The SCP has successfully received the exported Basic Study Descriptor SOP Instance. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Success	It is unknown whether or not Study Content exists on the system supporting SCP	0003	The SCP has successfully received the exported Basic Study Descriptor SOP Instance. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Failed	Failed operation	Cxxx	This is treated as a failure. Notification task is re-queued so that an attempt will be made to send the Basic Study Descriptor SOP Instance again. There are a configured maximum number of times that a notification task can be re-queued. An error indication is output to the Service Logs. No indication is posted to the User Interface.
*	*	Any other status code	This is treated as a failure. Notification task is re-queued so that an attempt will be made to send the Basic Study Descriptor SOP Instance again. There is a configured maximum number of times that a notification task can be re-queued. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.7.2.1.3.3 SOP Specific Conformance – Detached Study Management

The External Notifier AE can be configured to use the Detached Study Management SOP Class as an SCP to send a notification to a Remote AE. Currently, it can only support the STUDYREPORTED (A Study has been marked as “Reported”) event, in which case it will send an N-EVENT-REPORT Request with an Event Type ID value of 7 (Study Read).

The External Notifier AE supports only the N-EVENT-REPORT operation, and not the N-GET and N-SET DIMSE Service Elements. Thus, it is not fully conformant to this SOP Class.

The task of sending the Detached Study Management N-EVENT-REPORT will be re-queued a configurable maximum number of times if it fails. The default maximum number is 10.

The External Notifier AE uses the following values in the N-EVENT-REPORT Request Message Fields: with an Event Type ID value of 7 (Study Read). In addition, it can include the following Attributes in the Request:

Table 106: External Notifier AE Detached Study Management N-EVENT-REPORT-RQ Message Fields

Message Field	Tag ID	VR	Value	Presence of Value	Source
Affected SOP Class UID	0000, 0002	UI	1.2.840.10008.3.1.2.3.1 (Detached Study Management SOP Class UID)	ALWAYS	AUTO
Affected SOP Instance UID	0000, 1000	UI	The Study Instance UID	ANAP	AUTO
Event Type ID	0000, 1002	US	7 (Study Read)	ALWAYS	AUTO

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The External Notifier AE can include the following Attributes in the N-EVENT-REPORT Request:

Table 107: External Notifier AE Detached Study Management N-EVENT-REPORT-RQ Data Set Attributes

Attribute Name	Tag ID	VR	Value	Presence of Value	Source
Study Read Date	0032, 0034	DA	Date the user marks the study as "Reported".	ALWAYS	AUTO
Study Read Time	0032, 0035	TM	Time the user marks the study as "Reported".	ALWAYS	AUTO
Study Status ID	0032, 000A	CS	READ	ALWAYS	AUTO
Physician(s) of Record	0008, 1048	PN	Names of physician(s) having read the study.	ANAP	AUTO

The External Notifier AE will exhibit the following Behavior according to the Status Code value returned in a Detached Study Management N-EVENT-REPORT Response from a destination SCU:

Table 108: External Notifier AE N-EVENT-REPORT Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCU has successfully received the Detached Study Management report. Success indication message is output to the Service Logs. No indication is posted to the User Interface.
Refused	Out of Resources	A700 – A7FF	This is treated as a failure. External Notifier AE will attempt to resend the N-EVENT-REPORT a configurable maximum number of times. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Data Set does not match SOP Class	A900 – A9FF	This is treated as a failure. External Notifier AE will attempt to resend the N-EVENT-REPORT a configurable maximum number of times. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Error	Cannot Understand	C000 – CFFF	This is treated as a failure. External Notifier AE will attempt to resend the N-EVENT-REPORT a configurable maximum number of times. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Warning	Requested Optional Attributes are not supported	0001	Detached Study Management report transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCU returning a Warning Status. No indication is posted to the User Interface.
Warning	Attribute List Error	0107	Detached Study Management report transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCU returning a Warning Status. No indication is posted to the User Interface.
Warning	Attribute Value Out of Range	0116	Detached Study Management report transmission is considered successful. A warning indication is output to the Service Logs so that there is a record of the SCU returning a Warning Status. No indication is posted to the User Interface.
*	*	Any other status code	This is treated as a failure. External Notifier AE will attempt to resend the N-EVENT-REPORT a configurable maximum number of times. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.7.2.1.3.4

Association Requestor Communication Failure Behavior

The Behavior of the External Notifier AE during communication failure is summarized in the following table:

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Table 109: External Notifier 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. This is treated as a failure. Notification task is re-queued so that an attempt will be made to repeat it. There is a configured maximum number of times that a notification task can be re-queued. An error indication is output to the Service Logs. An error indication is also posted to the User Interface.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. Notification task is re-queued so that an attempt will be made to repeat it. There are a configured maximum number of times that a notification task can be re-queued. An error indication is output to the Service Logs. An error indication is also posted to the User Interface.
Association A-P-ABORTed by the SCP or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. Notification task is re-queued so that an attempt will be made to repeat it. There are a configured maximum number of times that a notification task can be re-queued. An error indication is output to the Service Logs. An error indication is also posted to the User Interface.

3.2.7.3 Association Acceptance Policy

The External Notifier AE does not accept Associations.

3.2.8 Event Handler AE

The Event Handler AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 110: SOP Class Conformance of Event Handler AE

DICOM SOP Class Name	SOP Class UID	SCU	SCP
Verification			
Verification	1.2.840.10008.1.1	No	Yes
Workflow Management			
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	No	Yes
Detached Study Management	1.2.840.10008.3.1.2.3.1	Yes	No

The Event Handler AE receives notifications of events from external systems. This AE can receive Modality Performed Procedure Step requests, as well as Detached Study Management SOP Class N-EVENT-REPORT Requests for the 'Study Read' event (Event ID 7). When a Detached Study Management message is received, the corresponding study record in the local database is marked as reported. If an MPPS Request is received, then it can be forwarded to the External Notifier AE so that it can be relayed to other Remote AEs. In addition, Scheduled Procedure Steps can be removed from the Modality Worklist provided by the Query/Retrieve Server AE if a received MPPS Message indicates that it is in progress.

3.2.8.1 Association Establishment Policies

3.2.8.1.1 General

The Event Handler AE accepts Associations from external DICOM devices to receive event notifications.

The DICOM Standard Application Context Name is always supported:

Table 111: DICOM Application Context for Sender AE

Application Context Name	1.2.840.10008.3.1.1.1
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The maximum PDU size that will be offered is configurable, and by default is 16,384 bytes

3.2.8.1.2 Number of Associations

The Event Handler AE places configurable limitations on the number of simultaneous connections it will support. Once the event Handler AE accepts an Association, a spawned child task will receive any messages transmitted on that Association. The default maximum number of Associations is 10 per connecting host. It is possible to restrict the number of hosts that can connect with the Event Handler AE so the combination of these settings can restrict the maximum number of Associations.

Table 112: Number of Simultaneous Associations as an Acceptor for Importer AE

Maximum number of simultaneous Associations	Unlimited ¹²
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3.2.8.1.3 Asynchronous Nature

The Event Handler AE does not provide 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 113: Asynchronous Nature as an SCP for Importer AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)
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3.2.8.1.4 Implementation Identifying Information

Table 114: DICOM Implementation Class and Version for Event Handler AE

Implementation Class UID	1.2.840.113711.15
Implementation Version Name	V1.0

3.2.8.2 Association Initiation Policies

The Event Handler AE does not initiate Associations.

3.2.8.3 Association Acceptance Policies

3.2.8.3.1 Activity – External system sends notification of an event

3.2.8.3.1.1 Description and Sequencing of Activity

The Event Handler AE accepts Association Requests only if they propose one or more Presentation Contexts that the Event Handler AE actually supports. If none of the requested Presentation Contexts are accepted, then the Association Request itself is rejected. The Event Handler AE can be configured to only accept Associations requested by certain hosts (using TCP/IP address).

The Event Handler AE currently only actually acts on information of a Detached Study Management N-EVENT-REPORT if it has an Event Type ID of 7 (Study Read). If such a Message is received, then the matching study record in local database will be marked reported.

If the Event Handler AE receives an MPPS SOP Class Request Message from a Remote AE, then it can forward this Request to the External Notifier AE. The External Notifier AE can then forward the Request Message to other Remote AEs acting as an SCP for the MPPS SOP Class. In addition, under certain

¹² Default maximum is 10 per host permitted to connect to the Event Handler AE.

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circumstances, any Scheduled Procedure Step corresponding to the MPPS can be removed from the Modality Worklist.

The Event Handler AE has a configurable timeout value for the maximum amount of time that it will wait on an open Association for a new request from a remote AE. A remote AE can reset this timer by sending a Verification request (C-ECHO-RQ). This can act as a useful mechanism for a remote AE to maintain an active Association if the length of time between sending Detached Study Management or MPPS Requests is long (such as when using a single Association to send the initial Message to create an MPPS and then later Messages to update its status and information).

The Event Handler 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:

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

Table 115: Event Handler AE 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.
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	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. Usually this is only returned if the Event Handler AE has not been configured to allow the remote AE host to connect to it. The Event Handler AE can be configured to allow only specific host names to open Associations with it. Note that it cannot currently be configured to only allow specific calling and/or called AE Titles when forming Associations.

3.2.8.3.1.2 Accepted Presentation Contexts

The Event Handler AE may accept any one or more of the following Presentation Contexts:

Table 116: Event Handler AE Accepted Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Detached Study Management	1.2.840.10008.3.1.2.3.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.2.8.3.1.3 SOP Specific Conformance as an Association Acceptor

3.2.8.3.1.3.1 SOP Specific Conformance – Modality Performed Procedure Step

If the Event Handler AE receives an MPPS N-CREATE or N-SET Request Message from a Remote AE, then it can forward this to the External Notifier AE. The External Notifier AE can then forward an exact copy of the Request Message to other Remote AEs acting as an SCP for the MPPS SOP Class. This behavior implements the IHE Technical Framework requirements for the Performed Procedure Step Manager Actor.

In addition, under certain circumstances, any Scheduled Procedure Step corresponding to the MPPS can be removed from the Modality Worklist.

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The Event Handler AE can pass all Attributes and values of an MPPS N-CREATE Request to the External Notifier AE; However, it retains only the following Attribute values in the Horizon Medical Imaging™ database:

Table 117: MPPS N-CREATE-RQ Attribute Values Retained by Event Handler

Attribute Name	Tag ID	VR
Performed Procedure Step ID	(0040,0253)	SH
Performed Procedure Step UID / Affected SOP Instance UID	(0000,1000)	UI
Performed Procedure Step Start Date	(0040,0244)	DA
Performed Procedure Step Start Time	(0040,0245)	TM
Performed Procedure Step Status	(0040,0252)	CS

Upon receipt of a MPPS N-CREATE “IN PROGRESS” request, the corresponding Scheduled Procedure Step entry, if it exists, will be removed from the Modality Worklist. Future Modality Worklist queries will not return the removed entry.

The Event Handler AE returns one of the following status codes in a MPPS N-CREATE Response:

Table 118: Event Handler AE MPPS N-CREATE-RSP Status Codes

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The Event Handler AE has successfully created the MPPS. Success indication message is output to the Service Log. No indication is posted to the User Interface.
Failure	Processing Failure	0110	The Event Handler AE failed to properly parse or handle the MPPS N-CREATE Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.

The Event Handler AE can pass all Attributes and values of an MPPS N-SET Request to the External Notifier AE; However, it retains only the following Attribute values in the Horizon Medical Imaging™ database:

Table 119: MPPS N-SET-RQ Attributes Updated by Event Handler

Attribute Name	Tag ID	VR
Performed Procedure Step Status	(0040,0252)	CS

Attributes may only be modified when the MPPS entry's status is “IN PROGRESS”. If the status is “DISCONTINUED” or “COMPLETED”, modification via an N-SET Request is not possible.

An MPPS SOP Instance will not be automatically removed from the Horizon Medical Imaging™ system. Removal of MPPS SOP Instances requires human intervention. Once an MPPS SOP Instance has been removed, then any subsequent N-SET Requests for the SOP Instance will be rejected and an Error Status will be returned in the corresponding N-SET Response.

The Event Handler AE returns one of the following status codes in a MPPS N-CREATE Response:

Table 120: Event Handler AE MPPS N-SET-RSP Status Codes

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote AE has successfully set the MPPS. Success indication message is output to the Service Log. No indication is posted to the User Interface.

Service Status	Further Meaning	Error Code	Behavior
Failure	Processing Failure	0110	The Event Handler AE failed to properly parse or handle the MPPS N-SET Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.8.3.1.3.2 SOP Specific Conformance - Detached Study Management

The Event Handler AE currently only actually acts on information of a Detached Study Management N-EVENT-REPORT Request if it has an Event Type ID of 7 (Study Read). If such a Message is received, and the Affected SOP Instance UID matches an existing Study in the database, then that Study is marked as being reported. The Study Read Date and Study Read Time attributes are preserved in the Horizon Medical Imaging™ database.

If a Detached Study Management N-EVENT-REPORT Request has an Event Type ID not equal to 7 (Study Read), then its contents are ignored. However an N-EVENT-REPORT Response with Status of Success will still be returned. If the N-EVENT-REPORT Request does not have an Event Type ID of 7, then it will not be processed and the Event Handler AE will abort the Association by directly closing the TCP/IP Socket.

The Event Handler AE does not currently support N-CREATE or N-SET Requests for Detached Study Management. These types of Messages are User Optional for an SCU of this SOP Class, so this implementation is still DICOM Conformant as an SCU.

The Event Handler AE returns one of the following status codes in a Detached Study Management N-EVENT-REPORT Response:

Table 121: Event Handler AE Detached Study Management N-EVENT-REPORT-RSP Status Codes

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The N-EVENT-REPORT Request was successfully handled. Success indication message is output to the Service Log. No indication is posted to the User Interface.
Failure	Processing Failure	0110	The Event Handler AE failed to properly parse or handle the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.8.3.1.3.3 Association Acceptor Communication Failure Behavior

The Behavior of the Event Handler AE during communication failure when it is acting as an Association Requestor is summarized in the following table:

Table 122: Event Handler AE Communication Failure Behavior as an Association Acceptor

Exception	Behavior
Timeout expiry for an expected DICOM Message Response (DIMSE level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.

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Exception	Behavior
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT. This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.
Association A-P-ABORTed by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	This is treated as a failure. Importer AE does not attempt to resend the N-EVENT-REPORT Request. An error indication is output to the Service Logs. No indication is posted to the User Interface.

3.2.8.3.1.3.4 Presentation Context Acceptance Criterion

The Event Handler AE will only accept the Presentation Contexts specified in Table 116.

The Event Handler AE does not check for, and will accept, duplicate Presentation Contexts.

3.2.8.3.1.3.5 Transfer Syntax Selection Policies

The Event Handler AE supports only the Implicit VR Little Endian Transfer Syntax.

3.3 Network Interfaces

3.3.1 Physical Network Interface

Horizon Medical Imaging™ 11.8 supports a single network interface. One of the following physical network interfaces will be available depending on installed hardware options:

Table 123: Supported Physical Network Interfaces

Ethernet 100baseT
Ethernet 10baseT

3.3.2 Additional Protocols

Horizon Medical Imaging™ 11.8 conforms to the System Management Profiles listed in the Table below. All requested transactions for the listed profiles and actors are supported. Support for optional transactions is listed in the Table below:

Table 124: Supported System Management Profiles

Profile Name	Actor	Protocols Used	Optional Transactions	Security Support
Network Address Management	DHCP Client	DHCP	N/A	N/A
	DNS Client	DNS	N/A	N/A
Time Synchronization	NTP Client ¹³	NTP	N/A	N/A

3.3.2.1 DHCP

DHCP can be used to obtain TCP/IP network configuration information. The network parameters obtainable via DHCP are shown in the Table below. The Default Value column of the table shows the default used if the DHCP server does not provide a value. Values for network parameters set in the Service/Installation tool take precedence over values obtained from the DHCP server. Support for DHCP can be configured via the Service/Installation Tool. The Service/Installation tool can be used to configure the machine name. If DHCP

¹³ Horizon Medical Imaging™ 11.8 uses NetTime™ 2.0 for time synchronization, which uses NTP.

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is not in use, TCP/IP network configuration information can be manually configured by McKesson MIG Service or Installation staff.

Table 125: Supported DHCP Parameters

DHCP Parameter	Default Value
IP Address	None
Hostname	Requested machine name
List of NTP servers	Empty list
List of DNS servers	Empty list
Routers	Empty list
Static routes	None
Domain name	None
Subnet mask	Derived from IP Address (see service manual)
Broadcast address	Derived from IP Address (see service manual)
Default router	None
Time offset	Site configurable (from Time Zone)
MTU	Network Hardware Dependent
Auto-IP permission	No permission

3.3.2.2 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 by McKesson MIG Service or Installation staff.

3.4 Configuration

3.4.1 AE Title/Presentation Address Mapping

3.4.1.1 Local AE Titles

All Horizon Medical Imaging™ 11.8 Application Entities use configured AE Titles and TCP/IP Ports. These are assigned default values at the time of installation; However, these can be modified. The AE Title used by each individual application can be configured independently of the AE Title used by other applications on an individual Horizon Medical Imaging™ 11.8 system.

By default, all Application Entities that only act as an Association Requestor are given the same AE Title, whereas those that can act as an Association Acceptor are all given unique AE Titles. It is possible to assign all Horizon Medical Imaging™ 11.8 applications the same AE Title. However, this is not recommended as a single Horizon Medical Imaging™ 11.8 system has multiple DICOM TCP/IP listening ports and associating multiple listening ports with a single AE Title can result in connectivity problems with other systems.

Table 126: AE Title Configuration

Application Entity	Default AE Title	Default TCP/IP Port
Sender	ALI_SCU	Not Applicable
Importer	ALI_STORE_SCP	4000
Query/Retrieve Server	ALI_QUERY_SCP	5000
Query/Retrieve Client	ALI_SCU	Not Applicable
Modality Worklist Client	ALI_SCU	Not Applicable
Print Management	ALI_SCU	Not Applicable
External Notifier	ALI_SCU	Not Applicable

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Event Handler	ALI_EVENT_SCP	6000
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3.4.1.2 Remote AE Title/Presentation Address Mapping

The AE Title, host names and port numbers of remote applications can be configured in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff.

3.4.1.2.1 Sender AE

The AE Titles, TCP/IP port-numbers, and host-names for the remote Storage SCPs must be defined in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff. Multiple remote Storage SCPs can be defined.

3.4.1.2.2 Importer AE

The AE Titles, TCP/IP port-numbers, host-names and capabilities for the remote Storage SCUs and Storage Commitment Push Model SCUs must be defined in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff.

The Importer AE can be configured to only accept Associations from systems having specific host-names. The Importer AE cannot presently be configured to check the Calling and Called AE Titles.

3.4.1.2.3 Query/Retrieve Server AE

The AE Titles, TCP/IP port-numbers, host-names and capabilities for the remote Query/Retrieve SCUs, Storage SCPs (C-MOVE Destination AEs), and Modality Worklist SCUs must be defined in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff. In addition, a mapping must be configured that links a possible C-MOVE Destination AE Title with a specific Presentation Address (host-name and TCP/IP port-number). Otherwise, the Query/Retrieve Server AE will not know where to send the SOP Instances in response to a C-MOVE Request.

The Query/Retrieve Server AE can be configured to only accept Associations from systems having specific host-names. The Query/Retrieve Server AE cannot presently be configured to check the Calling and Called AE Titles.

3.4.1.2.4 Query/Retrieve Client AE

The AE Titles, TCP/IP port-numbers, and host-names for the remote Query/Retrieve SCPs must be defined in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff. Multiple remote Query/Retrieve SCPs can be defined.

3.4.1.2.5 Modality Worklist Client AE

The AE Titles, TCP/IP port-numbers, and host-names for the remote Modality Worklist SCPs must be defined in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff. Only a single Modality Worklist SCP can be defined per Horizon Medical Imaging™ 11.8 system.

3.4.1.2.6 Print Management AE

The AE Titles, TCP/IP port-numbers, and host-names for the remote Print Management SCPs must be defined in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff. Multiple remote Print Management SCPs can be defined.

3.4.1.2.7 External Notifier AE

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The AE Titles, TCP/IP port-numbers, and host-names for the remote Basic Study Content Notification SCPs, Modality Performed Procedure Step SCPs, and Detached Study Management SCUs must be defined in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff. Multiple remote AEs for each supported SOP Class can be defined.

3.4.1.2.8 Event Handler AE

The AE Titles, TCP/IP port-numbers, host-names and capabilities for the remote Modality Performed Procedure Step SCUs, and Detached Study Management SCPs must be defined in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff.

The Query/Retrieve Server AE can be configured to only accept Associations from systems having specific host-names. The Query/Retrieve Server AE cannot presently be configured to check the Calling and Called AE Titles.

3.4.2 Configurable Parameters

A large number of parameters related to acquisition and general operation can be specified in the Horizon Medical Imaging™ 11.8 configuration files by McKesson MIG Service or Installation staff. The Table below only shows those configuration parameters relevant to DICOM communication. Users of Horizon Medical Imaging™ 11.8 must contact McKesson Service or Installation personnel if they wish to change any of these settings.

Table 127: Configuration Parameters

Parameter	Configurable (Yes/No)	Default Value
General Parameters		
Maximum Exported PDU Size (Larger PDUs will never be sent, even if the receiver supports a larger Max PDU Receive Size. If the receiver supports a smaller Max PDU Receive Size, then the Max PDU Send Size will be reduced accordingly for the duration of the Association. Max PDU Receive Size information is exchanged during DICOM Association Negotiation in the Maximum Length Sub-Item of the A-ASSOCIATION-RQ and A-ASSOCIATE-AC)	No	2 ³²
Time-out waiting for a acceptance or rejection response to an Association Request (Application Level Timeout)	No	180s
Time-out waiting for a response to an Association release request (Application Level Timeout)	No	180s
Time-out waiting for completion of a TCP/IP connect request (Low-level timeout)	No	180s
Time-out awaiting a Response to a DIMSE Request (Low-Level Timeout)	No	180s
Time-out for waiting for data between TCP/IP-packets (Low Level Timeout)	No	180s
Sender AE Parameters		
Supported SOP Classes	Yes	SOP Classes listed in Table 3: SOP Class Conformance of Sender AE
Supported Transfer Syntaxes	Yes	Transfer Syntaxes listed in Table 8: Sender AE Proposed Transfer Syntaxes.
Level of tracing for Service Logs (LOW, MEDIUM, HIGH). HIGH means the least amount of tracing. LOW means the most amount of tracing, including output of all DICOM Message content to the Service Logs.	Yes	HIGH
Remote Modality Worklist SCP AE to be queried by Modality Worklist Client AE. Includes AE Title, host-name, TCP/IP port number, etc.	Yes	NONE

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Time-out waiting for a response to a C-STORE-RQ	No	180s
Number of Sender AE application instances that send to a single Storage SCP Remote AE.	Yes	1
Number of times a failed send job may be retried	Yes	20
Number of times a failed send job may be retried before demoting the send job's priority	Yes	5
CompressImage Attempt to compress all images before exporting them. If set to 'YES', and neither JPEG Lossy or Wavelet compression is enabled then the images will be JPEG Lossless compressed.	Yes	NO
ConvertLosslessToLossy If both this parameter and 'CompressImage' are configured to be 'YES', then the Sender AE will attempt to JPEG Lossy compress images before exporting them using 'CompressionRatio' and 'CineCompressionRatio'.	Yes	NO
ConvertLosslessToWavelet If both this parameter and 'CompressImage' are configured to be 'YES', then the Sender AE will attempt to Wavelet compress images before exporting them using 'CompressionRatio' and 'CineCompressionRatio'. If Wavelet compression fails and 'ConvertLosslessToLossy' is 'YES', then Sender AE will attempt to JPEG Lossy compress images before exporting them.	Yes	NO
ExcludeWaveletForModalities If 'ConvertLosslessToWavelet' is YES, then the images of modalities contained in this list will not be wavelet compressed.	Yes	US, XA
The desired lossy compression ratio for single frame images	Yes	10 : 1
The desired lossy compression ratio for cine images	Yes	30 : 1
Modify or add a configurable set of DICOM Elements in a SOP Instance before it is exported. The set of Elements and the values to assign them are also configurable.	Yes	NO
Process and send any cine files to Remote AE, including decompression if necessary.	Yes	YES
Importer AE Parameters		
Supported SOP Classes	Yes	SOP Classes listed in Table 11: SOP Class Conformance of Importer AE
Supported Transfer Syntaxes	Yes	Transfer Syntaxes listed in Table 21: Importer AE Accepted Transfer Syntaxes
Level of tracing for Service Logs (LOW, MEDIUM, HIGH, APP). HIGH means the least amount of tracing. LOW means the most amount of tracing, including output of all DICOM Message content to the Service Logs.	Yes	HIGH
Allow any Remote AE on another system to open an Association with the Importer AE. Enable only for demonstration purposes.	Yes	NO
List of host-names that are allowed to open an Association with the Importer AE.	Yes	NONE
Time-out waiting for a response to an N-ACTION-RQ or N-EVENT-RQ	No	180s
Number of Associations that can be active per Remote AE host.	Yes	10
Time to wait on an open Association for the next command (i.e. max time to wait for first C-STORE-RQ after a new Association has been opened).	Yes	3600s
Compression type to be used on received single frame images of a specific Modality Type	Yes	JPEG Lossless (US, CT, MR, CR, NM, RF) NONE (XA)
Compression type to be used on received multi-frame images	Yes	NONE (US)

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of a specific Modality Type		
Compression type to be used if one is not defined for the type of Modality of an image.	Yes	JPEG Lossless
The desired lossy compression ratio for single frame images	Yes	10 : 1
The desired lossy compression ratio for cine images	Yes	30 : 1
List of host-names for which the original SOP Instance UID should be kept even though the images are lossy compressed.	Yes	NONE
Allow a Warning Status Code value to be returned in C-STORE-RSP.	Yes	NO
Create new SOP Instance UIDs for SOP Instances received from the specified Remote AE host-names.	Yes	NO
Receive and parse DICOM SOP Instances in memory rather than immediately writing each received PDU to a file (increases throughput performance but uses more memory resources).	Yes	YES
List of host-names that the Importer AE should always request a new Association with when sending a Storage Commitment N-EVENT-REPORT Request.	Yes	NONE
List of modalities to create a DICOMDIR for each group of SOP Instances received over an Association.	Yes	NONE
Query/Retrieve Server AE		
Supported SOP Classes as an SCU	Yes	SOP Classes listed in Table 11: SOP Class Conformance of Importer AE
Supported Transfer Syntaxes as an SCU	Yes	Transfer Syntaxes listed in Table 21: Importer AE Accepted Transfer Syntaxes
Supported Presentation Contexts as an SCP	Yes	Presentation Contexts listed in Table 35: Query/Retrieve Server AE Accepted Presentation Contexts
Enable IHE Image Manager compliance (full support for Image Level queries and return of additional Elements).	Yes	NO
Level of tracing for Service Logs (LOW, MEDIUM, HIGH, APP). APP means the least amount of tracing. LOW means the most amount of tracing, including output of all DICOM Message content to the Service Logs.	Yes	HIGH
Allow any Remote AE on another system to open an Association with the Query/Retrieve Server AE. Enable only for demonstration purposes.	Yes	NO
List of host-names that are allowed to open an Association with the Query/Retrieve Server AE.	Yes	NONE
Time to wait on an open Association for the next command (i.e. max time to wait for first C-FIND-RQ after a new Association has been opened).	Yes	600s
Allow queries with no identifier Attribute values	Yes	NO
Permit Image Level queries	Yes	NO
Whether the Requestor's AE title should be matched against the C-MOVE Destination AE title. If YES, and if the AE Titles are identical, then matching images will be routed to the Requestor's host. If NO, the C-MOVE Destination AE to Host Mapping table (listed below) will be used to resolve AE titles.	Yes	YES
C-MOVE Destination AE to Host Mapping table (Provides AE Title, TCP/IP port number, and host-name for C-MOVE Destination AEs).	Yes	NONE
Number of Associations that can be active per Remote AE host.	Yes	10
List of remote C-MOVE Destination AEs for which images will be compressed before export. If compression is enabled then JPEG Lossless will be used unless some other type is enabled.	Yes	NONE
List of remote C-MOVE Destination AEs for which images will	Yes	NONE

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be JPEG Lossy compressed before export.		
List of remote C-MOVE Destination AEs for which images will be Wavelet compressed before export. ¹⁴	Yes	NONE
The desired lossy compression ratio for single frame images	Yes	10 : 1
The desired lossy compression ratio for cine images	Yes	30 : 1
Check for Cancel Requests from Remote AE	Yes	NO
List of remote AE Titles to which cine files should not be sent.	Yes	NONE
Query/Retrieve Client AE		
Supported Presentation Contexts as an SCU	Yes	Presentation Contexts listed in Table 52: Query/Retrieve Client AE Proposed Presentation Contexts
Level of tracing for Service Logs (LOW, MEDIUM, HIGH, APP). APP means the least amount of tracing. LOW means the most amount of tracing, including output of all DICOM Message content to the Service Logs.	Yes	HIGH
Remote Query/Retrieve SCP AEs to be queried by Query/Retrieve Client AE. Includes AE Title, host-name, TCP/IP port number, etc.	Yes	NONE
Maximum number of query matches to be returned before Query/Retrieve Client AE issues a Cancel Request.	Yes	500
Modality Worklist Client AE		
Supported Presentation Contexts as an SCU	Yes	Presentation Contexts listed in Table 67: Modality Worklist Client AE Proposed Presentation Contexts
Level of tracing for Service Logs (LOW, MEDIUM, HIGH, APP). APP means the least amount of tracing. LOW means the most amount of tracing, including output of all DICOM Message content to the Service Logs.	Yes	APP
Remote Modality Worklist SCP AE to be queried by Modality Worklist Client AE. Includes AE Title, host-name, TCP/IP port number, etc.	Yes	NONE
Time interval between queries of Modality Worklist SCP.	Yes	900s
Maximum number of query matches to be returned before Query/Retrieve Client AE issues a Cancel Request.	Yes	200
Time interval, in seconds, to wait for the Modality Worklist SCP to return a C-FIND-RSP.	Yes	120s
Print Management AE		
Supported Presentation Contexts as an SCU	Yes	Presentation Contexts listed in Table 78: Proposed Presentation Contexts
Level of tracing for Service Logs (LOW, MEDIUM, HIGH, APP). APP means the least amount of tracing. LOW means the most amount of tracing, including output of all DICOM Message content to the Service Logs.	Yes	HIGH
Remote DICOM Printer AE (AE Title, host-name, TCP/IP port number, etc.).	Yes	NONE
Number of times to retry completing a print-job if some failure occurs.	Yes	0
External Notifier AE		
Supported Presentation Contexts as an SCU	Yes	Presentation Contexts listed in Table 100: External Notifier AE Proposed Presentation Contexts
Level of tracing for Service Logs (LOW, MEDIUM, HIGH, APP). APP means the least amount of tracing. LOW means the most amount of tracing, including output of all DICOM Message content to the Service Logs.	Yes	HIGH

¹⁴ If Wavelet and JPEG Lossy compression are both enabled then Wavelet compression will take precedence. If that fails then JPEG Lossy compression will be used if enabled. If that in turn fails then JPEG Lossless will be used.

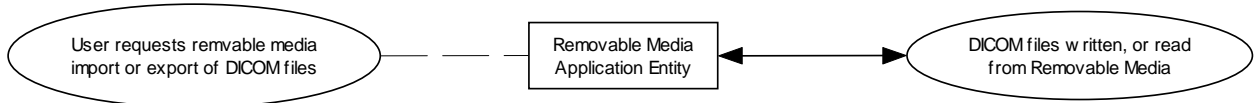
Remote DICOM AE to be notified (AE Title, host-name, TCP/IP port number, etc.).	Yes	NONE
Number of times to retry sending a notification after a failure.	Yes	10
Time to wait before retrying a notification after a failure occurs.	Yes	60s
Event Handler AE		
Supported Presentation Contexts as an SCP	Yes	Presentation Contexts listed in Table 116: Event Handler AE Accepted Presentation Contexts
Level of tracing for Service Logs (LOW, MEDIUM, HIGH, APP). APP means the least amount of tracing. LOW means the most amount of tracing, including output of all DICOM Message content to the Service Logs.	Yes	HIGH
Time to wait on an open Association for the next command (i.e. max time to wait for first C-FIND-RQ after a new Association has been opened).	Yes	300s
Number of Associations that can be active per Remote AE host.	Yes	10
Allow any Remote AE on another system to open an Association with the Event Handler AE. Enable only for demonstration purposes.	Yes	NO
List of host-names that are allowed to open an Association with the Event Handler AE.	Yes	NONE
List of host-names that are allowed to send Messages to Event Handler AE to mark a Study as being Reported.	Yes	NONE
List of host-names that are allowed to send MPPS Messages to Event Handler AE.	Yes	NONE

4. MEDIA INTERCHANGE

4.1 Implementation Model

4.1.1 Application Data Flow

Figure 8: Horizon Medical Imaging™ DICOM Media Data Flow Diagram



The Removable Media AE can export/import DICOM files to/from removable media. A user of Horizon Medical Imaging™ 11.8 can choose to export all DICOM files for a specified study. When importing DICOM files from media, the user can also choose to only import those DICOM files belonging to a specific study. It is not possible to choose to import only particular SOP Instance files or all the files belonging to a particular patient or series.

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4.1.2 Functional Definitions of AEs

4.1.2.1 Removable Media AE

The user can select access to removable media present in the system's media drive. They will then be prompted to choose which studies they wish to import into the system. Alternatively, they can choose the option to export a study to removable media. In either case, the system passes control to the Removable Media AE to actually create, read, or update the DICOM removable media.

4.1.3 Sequencing of Real-World Activities

The operator can insert new media at any time before or after invocation of the Removable Media AE through the user interface tool. The Removable Media AE will wait indefinitely for a media to be inserted before starting to export the specified DICOM files. If no media is available, the export job can be canceled by the user.

4.1.4 File Meta Information Options

The implementation information written to the File Meta Header in each exported DICOM file is as follows:

Table 128: DICOM Implementation Class UID and Version for Media Export

Implementation Class UID	1.2.840.113711.9
Implementation Version Name	V1.0

4.2 AE Specifications

4.2.1 Removable Media AE Specification

The Removable Media AE provides standard Conformance to the DICOM Interchange Option of the Media Storage Service Class. Support for a particular Application Profile and role is dependent upon the type of removable media hardware with which the system is equipped. The table below lists all the Application Profiles and roles that can possibly be supported:

Table 129: Supported Application Profiles, Activities, and Roles

Application Profile	Real World Activity	FSR ¹⁵	FSC	FSU
STD-GEN-CD	General Purpose CD-R Interchange	YES	YES	NO
STD-US-ID-SF-CDR	Ultrasound Image Display Media Interchange, CD-R.	YES	YES	NO
STD-US-SC-SF-CDR	Ultrasound Image Spatial Calibration Media Interchange, CD-R.	YES	YES	NO
STD-US-CC-SF- CDR	Ultrasound Image Combined Calibration Media Interchange, CD-R.	YES	YES	NO
STD-US-ID-MF- CDR	Ultrasound Image and Multi-frame Image Display Media Interchange, CD-R.	YES	YES	NO
STD-US-SC-MF- CDR	Ultrasound Image and Multi-frame Image Spatial Calibration Media Interchange, CD-R.	YES	YES	NO
STD-US-CC-MF- CDR	Ultrasound Image and Multi-frame Image Combined Calibration Media Interchange, CD-R.	YES	YES	NO
STD-US-ID-SF-MOD128	Ultrasound Image Display Media Interchange, 128MB MOD.	YES	YES	NO
STD-US-SC-SF-MOD128	Ultrasound Image Spatial Calibration Media Interchange, 128MB MOD.	YES	YES	NO
STD-US-CC-SF-MOD128	Ultrasound Image Combined Calibration Media Interchange, 128MB MOD.	YES	YES	NO

¹⁵ For the system to act as an FSR or FSC of an Application Profile it must be equipped with the necessary hardware option for writing to the specified media. This is not a standard feature of all Horizon Medical Imaging™ systems.

STD-US-ID-MF-MOD128	Ultrasound Image and Multi-frame Image Display Media Interchange, 128MB MOD.	YES	YES	NO
STD-US-SC-MF-MOD128	Ultrasound Image and Multi-frame Image Spatial Calibration Media Interchange, 128MB MOD.	YES	YES	NO
STD-US-CC-MF-MOD128	Ultrasound Image and Multi-frame Image Combined Calibration Media Interchange, 128MB MOD.	YES	YES	NO
STD-US-ID-SF-MOD230	Ultrasound Image Display Media Interchange, 230MB MOD.	YES	YES	NO
STD-US-SC-SF-MOD230	Ultrasound Image Spatial Calibration Media Interchange, 230MB MOD.	YES	YES	NO
STD-US-CC-SF-MOD230	Ultrasound Image Combined Calibration Media Interchange, 230MB MOD.	YES	YES	NO
STD-US-ID-MF-MOD230	Ultrasound Image and Multi-frame Image Display Media Interchange, 230MB MOD.	YES	YES	NO
STD-US-SC-MF-MOD230	Ultrasound Image and Multi-frame Image Spatial Calibration Media Interchange, 230MB MOD.	YES	YES	NO
STD-US-CC-MF-MOD230	Ultrasound Image and Multi-frame Image Combined Calibration Media Interchange, 230MB MOD.	YES	YES	NO
STD-US-ID-SF-MOD540	Ultrasound Image Display Media Interchange, 540MB MOD.	YES	YES	NO
STD-US-SC-SF-MOD540	Ultrasound Image Spatial Calibration Media Interchange, 540MB MOD.	YES	YES	NO
STD-US-CC-SF-MOD540	Ultrasound Image Combined Calibration Media Interchange, 540MB MOD.	YES	YES	NO
STD-US-ID-MF-MOD540	Ultrasound Image and Multi-frame Image Display Media Interchange, 540MB MOD.	YES	YES	NO
STD-US-SC-MF-MOD540	Ultrasound Image and Multi-frame Image Spatial Calibration Media Interchange, 540MB MOD.	YES	YES	NO
STD-US-CC-MF-MOD540	Ultrasound Image and Multi-frame Image Combined Calibration Media Interchange, 540MB MOD.	YES	YES	NO
STD-US-ID-SF-MOD640	Ultrasound Image Display Media Interchange, 640MB MOD.	YES	YES	NO
STD-US-SC-SF-MOD640	Ultrasound Image Spatial Calibration Media Interchange, 640MB MOD.	YES	YES	NO
STD-US-CC-SF-MOD640	Ultrasound Image Combined Calibration Media Interchange, 640MB MOD.	YES	YES	NO
STD-US-ID-MF-MOD640	Ultrasound Image and Multi-frame Image Display Media Interchange, 640MB MOD.	YES	YES	NO
STD-US-SC-MF-MOD640	Ultrasound Image and Multi-frame Image Spatial Calibration Media Interchange, 640MB MOD.	YES	YES	NO
STD-US-CC-MF-MOD640	Ultrasound Image and Multi-frame Image Combined Calibration Media Interchange, 640MB MOD.	YES	YES	NO

In addition to supporting these Application Profiles, the Removable Media AE can act as an FSR, or FSC for the DICOM Interchange Option of the Media Storage Service Class for any of the Media Storage Standard SOP Classes listed in Table 130. The system can be configured to support any of the following media types: CD-R, 90mm MODs of 128MB, 230MB, 540MB, or 640MB capacity.

Table 130: Media Storage Standard SOP Classes Supported by the Removable Media AE

DICOM SOP Class Name	SOP Class UID
Transfer	
Computed Radiography Image	1.2.840.10008.5.1.4.1.1.1
CT Image	1.2.840.10008.5.1.4.1.1.2
Digital X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography Image (Processing)	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra-oral X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.3

DICOM SOP Class Name	SOP Class UID
Digital Intra-oral X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.3.1
Hardcopy Color Image	1.2.840.10008.5.1.1.30
Hardcopy Grayscale Image	1.2.840.10008.5.1.1.29
Multi-frame Single Bit Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.1
Multi-frame Grayscale Byte Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.2
Multi-frame Grayscale Word Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.3
Multi-frame True Color Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.4
MR Image	1.2.840.10008.5.1.4.1.1.4
Nuclear Medicine Image	1.2.840.10008.5.1.4.1.1.20
Nuclear Medicine Image (Retired)	1.2.840.10008.5.1.4.1.1.5
Positron Emission Tomography Image	1.2.840.10008.5.1.4.1.1.128
RT Image	1.2.840.10008.5.1.4.1.1.481.1
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Image (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1
Ultrasound Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.3
VL Endoscopic Image	1.2.840.10008.5.1.4.1.1.77.1.1
VL Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.2
VL Slide-Coordinates Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.3
VL Photographic Image	1.2.840.10008.5.1.4.1.1.77.1.4
VL Image (Retired)	1.2.840.10008.5.1.4.1.1.77.1
VL Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.77.2
X-Ray Angiographic Bi-Plane Image (retired)	1.2.840.10008.5.1.4.1.1.12.3
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2

4.2.1.1 File Meta Information for the Application Entity

The Source Application Entity Title included in the File Meta Header is configurable (see section 5.4).

4.2.1.2 Real-World Activities

4.2.1.2.1 Activity – User Imports Files from Removable Media

The Removable Media AE can be used as a File Set Reader (FSR): The user inserts DICOM Removable Media into the system and accesses the DICOM Part 10 format files already written to it. The user will be presented with the list of studies present on the media and can then choose to transfer one or more of these to the Horizon Medical Imaging™ database.

4.2.1.2.2 Activity – User Exports Files to Removable Media

The Removable Media AE can be used as a File Set Creator (FSC): The user can choose to create DICOM Removable Media for export of DICOM files already present in the Horizon Medical Imaging™ database. The user will be prompted to insert empty media into the system and can then choose the particular studies to be written to it. A new DICOMDIR will be created for the DICOM Part 10 format files written to the media.

4.2.1.3 Options

In addition to the Media Storage Directory Storage SOP Class listed below, the Removable Media Application Entity supports all the SOP Classes listed in Table 130: Media Storage Standard SOP Classes Supported by the Removable Media AE and Transfer Syntaxes listed in Table 8: Sender AE Proposed

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Transfer Syntaxes. It can export or import any DICOM file having a combination of one of the SOP Classes and one of Transfer Syntaxes supported by the Sender AE.

Table 131: Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax	
Name	UID	Name	UID
Media Storage Directory Storage	1.2.840.10008.1.3.10	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1
All combinations of SOP Classes listed in Table 130: Media Storage Standard SOP Classes Supported by the Removable Media AE and Transfer Syntaxes listed in Table 8: Sender AE Proposed Transfer Syntaxes.			

4.3 Augmented and Private Application Profiles

The Removable Media AE does not support any augmented or private Application Profiles.

4.4 Media Configuration

All local applications use the AE Titles configured via the Service/Installation Tool. The Application Entity Titles configurable for Media Services are listed in the Table below:

Table 132: AE Title Configuration

Parameter	Configurable (Yes/No)	Default Value
Removable Media AE	No	ALI_STORE_SCP

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5. SUPPORT FOR EXTENDED CHARACTER SETS

Horizon Medical Imaging™ 11.8 supports the ISO-IR 100 Latin-1 supplementary character set, and includes this value for the Specific Character Set Attribute (0008,0005).

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6. SECURITY

Horizon Medical Imaging™ 11.8 does not support any specific security measures.

It is assumed that Horizon Medical Imaging™ 11.8 is used within a secured environment. It is assumed that a secured environment includes at a minimum:

- Firewall or router protections to ensure that only approved external hosts have network access to Horizon Medical Imaging™ 11.8.
- Firewall or router protections to ensure that Horizon Medical Imaging™ 11.8 only has network access to approved external hosts and services.
- Any communication with external hosts and services outside the locally secured environment use appropriate secure network channels (e.g. such as a Virtual Private Network (VPN))

Other network security procedures such as automated intrusion detection may be appropriate in some environments. Additional security features may be established by the local security policy and are beyond the scope of this conformance statement.

7. ANNEXES

7.1 IOD Contents

7.1.1 Importer AE Standard Element Use

7.1.1.1 Supported Composite SOP Classes for Display

SOP Instances conforming to the following Composite SOP Classes are fully supported for display on the Horizon Medical Imaging™ system workstation, Horizon Rad Station™. Please note that although Softcopy Presentation State SOP Instances can be archived, and used to support the IHE PGP Profile, HMI cannot yet support the display of annotations they might contain (IHE CPI as Image Display is not supported)..

Table 133: Supported Composite Image SOP Classes for Display

DICOM SOP Class Name	SOP Class UID
Computed Radiography Image	1.2.840.10008.5.1.4.1.1.1
CT Image	1.2.840.10008.5.1.4.1.1.2
Digital X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.2 See note 1
Digital Mammography Image (Processing)	1.2.840.10008.5.1.4.1.1.1.2.1
Mammography CAD Structured Report	1.2.840.10008.5.1.4.1.1.88.50
Digital Intra-oral X-Ray Image (Presentation)	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-Ray Image (Processing)	1.2.840.10008.5.1.4.1.1.1.3.1
Hardcopy Color Image	1.2.840.10008.5.1.1.30
Hardcopy Grayscale Image	1.2.840.10008.5.1.1.29
Multi-frame Grayscale Byte Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.2
Multi-frame Grayscale Word Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.3
Multi-frame True Color Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.4
MR Image	1.2.840.10008.5.1.4.1.1.4
Nuclear Medicine Image	1.2.840.10008.5.1.4.1.1.20
Nuclear Medicine Image (Retired)	1.2.840.10008.5.1.4.1.1.5
Positron Emission Tomography Image	1.2.840.10008.5.1.4.1.1.128
RT Image	1.2.840.10008.5.1.4.1.1.481.1
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7
Stored Print	1.2.840.10008.5.1.1.27
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Image (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1
Ultrasound Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.3
VL Endoscopic Image	1.2.840.10008.5.1.4.1.1.77.1.1
VL Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.2
VL Slide-Coordinates Microscopic Image	1.2.840.10008.5.1.4.1.1.77.1.3
VL Photographic Image	1.2.840.10008.5.1.4.1.1.77.1.4
VL Image (Retired)	1.2.840.10008.5.1.4.1.1.77.1
VL Multi-frame Image (Retired)	1.2.840.10008.5.1.4.1.1.77.2
X-Ray Angiographic Bi-Plane Image (Retired)	1.2.840.10008.5.1.4.1.1.12.3
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2
Encapsulated PDF	1.2.840.10008.5.1.4.1.1.104.1 See note 2

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1. HMI 11.8 supports the display Mammography images and Mammo CAD SR as an Image Display Actor for the IHE Mammography Profile.
2. The PDF content of Encapsulated PDF SOP Instances can be displayed by the HMI 11.8 RadReport reporting application.

7.1.1.2 Unsupported Composite SOP Classes for Display

SOP Instances conforming to the following Composite SOP Classes can be received, archived, and exported, but are not supported for display on Horizon Rad Station™. When a study is opened, any SOP Instances of these particular SOP Classes will not be displayed by the user interface. The contents of some Key Object Selection and Comprehensive SR SOP Instances can be displayed. Refer to the notes below the table for specific details.

Table 134: Unsupported Composite SOP Classes for Display

DICOM SOP Class Name	SOP Class UID
12-lead ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.1
Ambulatory ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.3
Basic Voice Audio Waveform	1.2.840.10008.5.1.4.1.1.9.4.1
Cardiac Electrophysiology Waveform	1.2.840.10008.5.1.4.1.1.9.3.1
Basic Text Structured Report	1.2.840.10008.5.1.4.1.1.88.11
Enhanced Structured Report	1.2.840.10008.5.1.4.1.1.88.22
Comprehensive Structured Report	1.2.840.10008.5.1.4.1.1.88.33 See note 1
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59 See note 2
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65
General ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.2
Grayscale Softcopy Presentation State	1.2.840.10008.5.1.4.1.1.11.1
Hemodynamic Waveform	1.2.840.10008.5.1.4.1.1.9.2.1
Multi-frame Single Bit Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7.1
Raw Data	1.2.840.10008.5.1.4.1.1.66
RT Beams Treatment Record	1.2.840.10008.5.1.4.1.1.481.4
RT Brachy Treatment Record	1.2.840.10008.5.1.4.1.1.481.6
RT Dose	1.2.840.10008.5.1.4.1.1.481.2
RT Plan	1.2.840.10008.5.1.4.1.1.481.5
RT Structure Set	1.2.840.10008.5.1.4.1.1.481.3
RT Treatment Summary Record	1.2.840.10008.5.1.4.1.1.481.7
Stand-alone Curve	1.2.840.10008.5.1.4.1.1.9
Stand-alone Modality LUT	1.2.840.10008.5.1.4.1.1.10
Stand-alone Overlay	1.2.840.10008.5.1.4.1.1.8
Stand-alone VOI LUT	1.2.840.10008.5.1.4.1.1.11
Standalone PET Curve	1.2.840.10008.5.1.4.1.1.129
Stored Print	1.2.840.10008.5.1.1.27

1. HMI 11.8 includes the ability to 'flag' displayed images that are referenced by a Key Object Selection SOP Instance. This is only displayed if a KOS SOP Instance has a Document Title of "Of Interest" or roughly equivalent meaning ("Of Interest", "For Referring Provider", "For Surgery", etc.). For example, no 'flagging' will be displayed for referenced images of a "Rejected for Quality Reasons" KOS SOP Instance.
2. The SonoReport ultrasound reporting package that can be installed on HMI 11.8 is capable of displaying and utilizing (for input to further calculations) the coded content of received Ultrasound OB-Gyn and Vascular Procedure Reports.

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7.1.2 Significant Elements in Received Images

The following Elements of Composite SOP Instances received by the Importer AE are either stored to the permanent Horizon Medical Imaging™ database or are of particular importance in the received images:

Table 135: Significant Elements in Received Images

Module	Attribute Name	Tag ID	Significance
Patient	Patient Name	(0010,0010)	<ul style="list-style-type: none"> - Importing SCP can be configured to apply a default value if there is no value specified. - Value is saved to database as separate first and last names. Only first and last names are entered in the Horizon Medical Imaging™ database. - Names will be parsed correctly if they are in the format of 'lname^fname' or 'lname, fname'. If space separation is used (i.e. 'lname fname'), then the entire name will be treated as the last name. - Horizon Medical Imaging™ can be configured to convert all names to uppercase only.
	Patient ID	(0010,0010)	<ul style="list-style-type: none"> - Importing SCP can be configured to apply a default value if there is no value specified. - The Patient ID must be unique. - Verification on incoming Patient IDs is performed. If an ID already exists but the existing name does not match, then the ID is coerced to the form '<original ID>+1'. - Value is saved to database.
	Patient's Birth Date	(0010,0030)	<ul style="list-style-type: none"> - Importing SCP can be configured to apply a default value if there is no value specified. Value is saved to database.
	Patient's Sex	(0010,0040)	<ul style="list-style-type: none"> - First character must be 'M', 'm', 'F', 'f', 'O', or 'o'. If a different value or not specified then will be entered in the database as 'U', unknown. - Value is saved to database. (The value 'U' is for internal use only, and is updated to 'O' on export).
General Study	Study Date	(0008,0020)	<ul style="list-style-type: none"> - Importing SCP can be configured to apply a default value if there is no value specified. - Value is saved to database.
	Accession Number	(0008,0050)	<ul style="list-style-type: none"> - Importing SCP can be configured to apply a default value if there is no value specified. - Value is saved to database.
	Referring Physician's Name	(0008,0090)	<ul style="list-style-type: none"> - Value is saved to database.
	Study Description	(0008,1030)	<ul style="list-style-type: none"> - Importer AE can be configured to use the Study Description value for the 'exam type' of the received study. If so configured and the value matches value(s) in the Horizon Medical Imaging™ exam type database, then it will be saved to the database as an exam type.
	Study Instance UID	(0020,000D)	<ul style="list-style-type: none"> - Must be provided. - Value is saved to database.
General Series	Series Description	(0008,103E)	<ul style="list-style-type: none"> - Importer AE can be configured to use the Series Description value for the 'exam type' of the received study. If so configured and the value matches value(s) in the Horizon Medical Imaging™ exam type database, then it will be saved to the database as an exam type.
	Modality	(0008,0060)	<ul style="list-style-type: none"> - Importer AE can be configured to apply a default value if there is no value specified.
	Operator's Name	(0008,1070)	<ul style="list-style-type: none"> - If name matches a valid User of Horizon Medical Imaging™, then it will be saved to the database as the sonographer of an ultrasound modality series.
	Body Part Examined	(0018,0015)	<ul style="list-style-type: none"> - Importer AE can be configured to use the Body Part Examined value for the 'exam type' of the received study. If so configured and the value matches value(s) in the Horizon Medical Imaging™ exam type database, then it will be saved to the database as an exam type.

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General Image	Image Type	(0008,0008)	- Importer AE can be configured to use the Image Type value for the 'exam type' of the received study. If so configured and the third value, the modality specific value, matches value(s) in the Horizon Medical Imaging™ exam type database, then it will be saved to the database as an exam type.
Image Plane	Pixel Spacing	(0028,0030)	- Used for automatic scaling of measurement tool if specified in an image SOP Instance. - Also can be used for 'true size' printing if the Horizon Medical Imaging™ system is connected to a DICOM printer that supports such functionality.
US Region Calibration	Sequence of Ultrasound Regions	(0018,6011)	- Used for automatic scaling of measurement tool if specified in an Ultrasound or Ultrasound Multiframe Image SOP Instance. - Also can be used for 'true size' printing of ultrasound images if the Horizon Medical Imaging™ system is connected to a DICOM printer that supports such functionality.
Image Pixel	Photometric Interpretation	(0028,0004)	- The following photometric interpretations are supported for display purposes: MONOCHROME1, MONOCHROME2, RGB, PALETTE_COLOR, YBR_FULL, YBR_FULL_422, YBR_PARTIAL_422, YBR_ICT, and YBR_RCT. - YBR_FULL_422 and YBR_PARTIAL_422 are only supported for JPEG Lossy Transfer Syntaxes. - YBR_ICT and YBR_RCT are only supported for JPEG 2000 Transfer Syntaxes.
	Bits Allocated	(0028,0100)	- Must be 8 or 16 bits for display purposes. (If Bits Allocated is any other value, the image will be received and stored in the database, but cannot be displayed).
	Bits Stored	(0028,0101)	- All values of 16 or fewer are supported for display purposes
Overlay Plane Module ¹⁶	Overlay Rows	(60xx,0010)	- Required in order to display an Overlay included with a DICOM image SOP Instance.
	Overlay Columns	(60xx,0011)	- Required in order to display an Overlay included with a DICOM image SOP Instance.
	Overlay Type	(60xx,0040)	- Required in order to display an Overlay included with a DICOM image SOP Instance. - Overlay data is used only if the value is "G", Graphics. If included in a DICOM image SOP Instance, then it is automatically displayed with the image. "ROI", Region Of Interest, overlay data is not displayed.
	Overlay Origin	(60xx,0050)	- Required in order to display an Overlay included with a DICOM image SOP Instance. - Value must be 1\1 or greater. If either Overlay Origin coordinate is less than 1, then the overlay is not displayed.
	Overlay Bits Allocated	(60xx,0100)	- Required in order to display an Overlay included with a DICOM image SOP Instance. - Should be 8 or 16 if the overlay data is embedded, and 1 if it is not. However, Horizon Medical Imaging™ actually checks whether the Overlay Data is present for the Overlay Group in order to decide whether the overlay data is actually embedded or not.
	Overlay Bit Position	(60xx,0102)	Required in order to display an Overlay included with a DICOM image SOP Instance. Used if the overlay data is embedded. If the data is embedded, then this position must indicate a bit not used by each image pixel sample.
	Overlay Data	(60xx,3000)	Required in order to display a non-embedded Overlay included with a DICOM image SOP Instance. Data present in this Element or embedded in the pixel data is supported for display. If this Element is present for an Overlay Group and has the required number of values, then these values will be used even if the Overlay Bits Allocated and/or Overlay Bit Position indicate that the overlay data should be embedded.

¹⁶ Horizon Medical Imaging™ can support the display of up to 16 overlays included in an image SOP Instance. If multiple Graphic overlays are present then they are all shown in the displayed image. In addition, Horizon Medical Imaging™ can be configured to extract the values from specific DICOM Elements and create a new overlay to display them with an image.

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VOI LUT	Window Center	(0028,1050)	- It is recommended that this value be defined for images that have greater than 8 bits stored per pixel sample for image display.
	Window Width	(0028,1051)	- It is recommended that this value be defined for images that have greater than 8 bits stored per pixel sample for image display.
SOP Common	SOP Instance UID	(0008,0018)	<p>- Must be provided.</p> <p>- Horizon Medical Imaging™ 11.8 can be configured to do one of two things if a received SOP Instance has the same Study Instance UID and SOP Instance UID as an existing SOP Instance. The default behavior is to not save the newly received SOP Instance. It can also be configured to save the newly received SOP Instance, but this can result in multiple SOP Instances having the same SOP Instance UID.</p> <p>- The system can also be configured to either preserve the original SOP Instance UID or assign a new UID if the received image data is lossy compressed prior to archival. The default behavior is to always assign a new SOP Instance UID.</p> <p>- In addition, Horizon Medical Imaging™ 11.8 can be configured to always assign a new SOP Instance UID to any SOP Instances received from a specific host. This should only be enabled if the remote host is known to make errors when assigning SOP Instances (either assigning duplicates or UIDs that are not DICOM Conformant).</p>

7.1.3 Horizon Medical Imaging™ Added Private Elements

The Horizon Medical Imaging™ system may add some or all of the following Private Elements to the SOP Instances that it receives:

Table 136: Private Elements Added by Horizon Medical Imaging™

Tag ID	Attribute Name	VR	VM	Significance
(3711,00xx)	Private Creator ID	LO	1	- The Private Creator ID for this block of added Private Elements. The value is "A.L.I. Technologies, Inc."
(3711,xx01)	Filename	LO	1	- Holds the filename of the original SOP Instance.
(3711,xx02)	Data Blob of a Visit	OB	1	- Holds the Horizon Medical Imaging™ system proprietary database information regarding the 'visit' for which the SOP Instance belongs.
(3711,xx03)	Revision Number	US	1	- The revision number of the extended info image.
(3711,xx04)	Unix Timestamp	UL	1	- The Unix format time-stamp of the creation of the extended info image.
(3711,xx05)	Bag ID	IS	1	- The Horizon Medical Imaging™ Bag ID associated with an image.
(3711,xx0C)	Original Study UID	UI	1	- The original Study UID specified in the SOP Instance
(3711,xx0D)	Overlay Grayscale Value	US	1	- The MONOCHROME2 grayscale value (0 to 255) to use when displaying or printing an overlay for the SOP Instance.
(3711,xx0E)	Anonymization Status	CS	1	- Value of "ANONYMIZED" means that the confidential patient information has been removed or replaced in the DICOM header. Note that this does not guarantee that any confidential information 'burned into' the pixel data has been removed.
(3711,xx0F)	Instance Type	CS	1	- The Instance Type of images created on HMI. Possible values: "MOCK" = "mock" image that is added to zero-image studies "MONTAGE" = image is created by VMC Montage feature
(3711,xx30)	IP Converted Frame	LO	1	This tag will be used as a marker which will be checked when a DICOM attribute collection of NM images is being processed. It can be added with a value of "IPConvertedFrame" when HMI is processing NM images that have multiple frames.

7.1.4 Sender AE and Query/Retrieve Server AE Element Modification

Both the Sender AE and Query/Retrieve Server AE always update SOP Instances with the latest information from the HMI 11.8 database before exporting them. The following table contains a list of all Elements that

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can have a value modified by these AE's at the time of export using the Storage Service depending on the capabilities of the receiving remote AE:

Table 137: Significant Elements in Exported Composite SOP Instances

Module	Attribute Name	Tag ID	Significance
Patient	Patient Name	(0010,0010)	- Will be updated with value stored in database prior to export in case the Patient Name was altered after this SOP Instance was originally received.
	Patient ID	(0010,0010)	- Will be updated with value stored in database prior to export in case the Patient ID was altered after this SOP Instance was originally received.
	Patient's Birth Date	(0010,0030)	- Will be updated with value stored in database prior to export in case the Patient's Birth Date value was altered after this SOP Instance was originally received.
	Patient's Sex	(0010,0040)	- Will be updated with value stored in database prior to export in case the Patient's Sex value was altered after this SOP Instance was originally received.
General Study	Study Date	(0008,0020)	- Will be updated with value stored in database prior to export in case the Study Date value was altered after this SOP Instance was originally received.
	Accession Number	(0008,0050)	- Will be updated with value stored in database prior to export in case the Accession Number value was altered after this SOP Instance was originally received.
	Referring Physician's Name	(0008,0090)	- Will be updated with value stored in database prior to export in case the Referring Physician's Name value was altered after this SOP Instance was originally received.
	Study Description	(0008,1030)	- Will be updated with value stored in database prior to export in case the Study Description value was altered after this SOP Instance was originally received.
	Study Instance UID	(0020,000D)	- Will be updated with value stored in database prior to export in case the Study Instance UID value was altered after this SOP Instance was originally received.
General Series	Series Description	(0008,103E)	- Will be updated with value stored in database prior to export in case the Series Description value was altered after this SOP Instance was originally received.
	Modality	(0008,0060)	- Will be updated with value stored in database prior to export in case the Modality value was altered after this SOP Instance was originally received.
	Operator's Name	(0008,1070)	- Will be updated with value stored in database prior to export in case the Operator's Name value was altered after this SOP Instance was originally received.
VOI LUT	Window Center	(0028,1050)	- Default Window Center value can be configured for a specific destination AE.
	Window Width	(0028,1051)	- Default Window Width value can be configured for a specific external destination AE.
SOP Common	SOP Instance UID	(0008,0018)	- The system can also be configured to either preserve the original SOP Instance UID or assign a new UID if the received image data is lossy compressed prior to archival. The default behavior is to always assign a new SOP Instance UID. - In addition, Horizon Medical Imaging™ 11.8 can be configured to always assign a new SOP Instance UID to any SOP Instances received from a specific host. This should only be enabled if the remote host is known to make errors when assigning SOP Instances (either assigning duplicates or UIDs that are not DICOM Conformant).

7.1.5 Derived MPR Image Creation

Horizon Rad Station™ is capable of creating derived images from CT and MR image sets using Multi-Planar Reconstruction. The created images will belong to the same SOP Class as the images from which they are derived.

7.1.5.1 Derived MPR Image IODs

This section describes the IODs of the derived CT and MR SOP Instances by describing the Modules that will be used for such images.

Table 138 specifies the Modules used in the derived CT SOP Instances created by Multi-Planar Reconstruction of received CT images.

Table 138: IOD of Derived CT SOP Instances

IE	Module	DICOM Reference (PS3.3)	Value Description Table	Presence of Module
Patient	Patient	C.7.1.1	Table 140	ALWAYS
Study	General Study	C.7.2.1	Table 141	ALWAYS
Series	General Series	C.7.3.1	Table 142	ALWAYS
Frame of Reference	Frame of Reference	C.7.4.1	Table 143	ALWAYS
Equipment	General Equipment	C.7.5.1	Table 144	ALWAYS
Image	General Image	C.7.6.1	Table 145	ALWAYS
	Image Plane	C.7.6.2	Table 146	ALWAYS
	Image Pixel	C.7.6.3	Table 147	ALWAYS
	CT Image	C.8.2.1	Table 150	ALWAYS
	VOI LUT	C.11.2	Table 148	ALWAYS
	SOP Common	C.12.1	Table 149	ALWAYS

Table 139 specifies the Modules used in the derived MR SOP Instances created by Multi-Planar Reconstruction of received MR images.

Table 139: IOD of Derived MR SOP Instances

IE	Module	DICOM Reference (PS3.3)	Value Description Table	Presence of Module
Patient	Patient	C.7.1.1	Table 140	ALWAYS
Study	General Study	C.7.2.1	Table 141	ALWAYS
Series	General Series	C.7.3.1	Table 142	ALWAYS
Frame of Reference	Frame of Reference	C.7.4.1	Table 143	ALWAYS
Equipment	General Equipment	C.7.5.1	Table 144	ALWAYS
Image	General Image	C.7.6.1	Table 145	ALWAYS
	Image Plane	C.7.6.2	Table 146	ALWAYS
	Image Pixel	C.7.6.3	Table 147	ALWAYS
	MR Image	C.8.3.1	Table 151	ALWAYS
	VOI LUT	C.11.2	Table 148	ALWAYS
	SOP Common	C.12.1	Table 149	ALWAYS

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7.1.5.2 Derived MPR Image Module Attributes

This section provides information on the Elements that are part of each module present in the derived CT and MR SOP Instances created by Multi-Planar Reconstruction. For each Element, the Value Description column describes the meaning of the element, whether it must be present in the MPR image header, and what the source of the value is.

The tables use the following abbreviations:

The abbreviations in the “Presence of Value” column are:

VNAP	Value not always present (attribute is always present but may not have a value).
ANAP	Attribute not always present.
ALWAYS	Attribute always present and has a value.
EMPTY	Attribute always present but has no value.

The abbreviations in the “Source” column are:

ORIGINAL	Value is copied from an original image.
DB	Value is from the Horizon Medical Imaging™ system database.
AUTO	Value is automatically generated by the Horizon Medical Imaging™ system.

7.1.5.2.1 Derived MPR Image Common Module Attributes

The following tables specify which Elements from Common Modules can be added to the derived MPR images:

Table 140: Patient Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Patient's Name	(0010,0010)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Patient ID	(0010,0020)	2	Copied from original acquisition object or database.	ALWAYS	ORIGINAL/DB
Issuer of Patient ID	(0010,0021)	3	Not present OR copied from original object.	ANAP	ORIGINAL
Patient's Birth Date	(0010,0030)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Patient's Sex	(0010,0040)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Referenced Patient Sequence	(0008,1120)	3	Not present OR copied from original object.	ANAP	ORIGINAL
>Referenced SOP Class UID	(0008,1150)	1C	Not present OR copied from original object.	ANAP	ORIGINAL
>Referenced SOP Instance UID	(0008,1155)	1C	Not present OR copied from original object.	ANAP	ORIGINAL
Patient's Birth Time	(0010,0032)	3	Not present OR copied from original object.	ANAP	ORIGINAL
Other Patient IDs	(0010,1000)	3	Not present OR copied from original object.	ANAP	ORIGINAL
Other Patient Names	(0010,1001)	3	Not present OR copied from original object.	ANAP	ORIGINAL

Ethnic Group	(0010,2160)	3	Not present OR copied from original object.	ANAP	ORIGINAL
Patient Comments	(0010,4000)	3	Not present OR copied from original object.	ANAP	ORIGINAL

Table 141: General Study Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Study Instance UID	(0020,000D)	1	Copied from original acquisition object or database.	ALWAYS	ORIGINAL/DB
Study Date	(0008,0020)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Study Time	(0008,0030)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Referring Physician's Name	(0008,0090)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Study ID	(0020,0010)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Accession Number	(0008,0050)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Study Description	(0008,1030)	3	Not present OR copied from original object or database	ANAP	ORIGINAL/DB
Physician(s) of Record	(0008,1048)	3	Not present OR copied from original object.	ANAP	ORIGINAL
Name of Physician(s) Reading Study	(0008,1060)	3	Not present OR copied from original object.	ANAP	ORIGINAL

Table 142: General Series Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Modality	(0008,0060)	1	Copied from original acquisition object or database.	ALWAYS	ORIGINAL/DB
Series Instance UID	(0020,000E)	1	Empty OR copied from original acquisition object or database.	ALWAYS	ORIGINAL/DB
Series Number	(0020,0011)	2	Copied from original acquisition object or database if a value is specified. Empty otherwise.	VNAP	ORIGINAL/DB
Laterality	(0020,0060)	2C	Not present if attribute is not present in original images. Empty if the attribute is specified in the original images.	ANAP	AUTO
Patient Position	(0018,5100)	2C	Not present if attribute is not present in original images. Empty if the attribute is specified in the original images.	ANAP	AUTO

Table 143: Frame of Reference Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Frame of Reference UID	(0020,0052)	1	Copied from original acquisition object.	ALWAYS	ORIGINAL
Position Reference Indicator	(0020,1040)	2	Copied from original acquisition object if a value is specified. Empty otherwise.	VNAP	ORIGINAL

Table 144: General Equipment Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Manufacturer	(0008,0070)	2	Value specified as "McKesson Medical Imaging Group"	ALWAYS	AUTO

Table 145: General Image Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Instance Number	(0020,0013)	2	Value specified as 1 to n for each subsequent MPR image created for a series.	ALWAYS	AUTO
Image Type	(0008,0008)	3	Value specified as "DERIVED\SECONDARY\MPR".	ALWAYS	AUTO
Derivation Description	(0008,2111)	3	Value specified as "MPR" or will indicate the type of compression used and compression ratio if the pixel data has been compressed.	ALWAYS	AUTO
Image Comments	(0020,4000)	3	Value specified as "MPR Image".	ALWAYS	AUTO
Quality Control Image	(0028,0300)	3	Value specified as "NO".	ALWAYS	AUTO
Burned In Annotation	(0028,0301)	3	Value specified as "NO".	ALWAYS	AUTO
Presentation LUT Shape	(2050,0020)	3	Value specified as "INVERSE" if the Photometric Interpretation is MONOCHROME1. Otherwise, the value is "IDENTITY".	ALWAYS	AUTO

Table 146: Image Plane Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Pixel Spacing	(0028,0030)	1	Calculated based on the values specified in the original images.	ALWAYS	AUTO
Image Orientation	(0020,0037)	1	Calculated based on the orientation of the MPR image relative to that specified for the original images.	ALWAYS	AUTO
Image Position	(0020,0032)	1	Calculated based on the position of the MPR image relative to that specified for the original images.	ALWAYS	AUTO
Slice Thickness	(0018,0050)	2	Copied from original acquisition object if a value is specified. Empty otherwise.	VNAP	ORIGINAL

Table 147: Image Pixel Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Samples per Pixel	(0028,0002)	1	Identical to that of the original images. For CT and MR this must be 1.	ALWAYS	ORIGINAL
Photometric Interpretation	(0028,0004)	1	Identical to that of the original images. For CT and MR this must be MONOCHROME1 or MONOCHROME2.	ALWAYS	ORIGINAL
Rows	(0028,0010)	1	Identical to that of the original images.	ALWAYS	ORIGINAL
Columns	(0028,0011)	1	Identical to that of the original images.	ALWAYS	ORIGINAL
Bits Allocated	(0028,0100)	1	Identical to that of the original images. For CT and MR this must be 16.	ALWAYS	ORIGINAL
Bits Stored	(0028,0101)	1	Identical to that of the original images.	ALWAYS	ORIGINAL
High Bit	(0028,0102)	1	Always specified as Bits Stored minus 1.	ALWAYS	AUTO
Pixel Representation	(0028,0103)	1	Identical to that of the original images.	ALWAYS	ORIGINAL
Pixel Data	(7FE0,0010)	1	The derived pixel data values calculated using Multi-Planar Reconstruction.	ALWAYS	AUTO

Table 148: VOI LUT Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Window Center	(0028,1050)	1	Calculated based on the derived MPR image data.	ALWAYS	AUTO
Window Width	(0028,1051)	1	Calculated based on the derived MPR image data.	ALWAYS	AUTO

Table 149: SOP Common Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
SOP Class UID	(0008,0016)	1	Identical to that of the original images. "1.2.840.10008.5.1.4.1.1.2" (CT) or "1.2.840.10008.5.1.4.1.1.4" (MR).	ALWAYS	ORIGINAL
SOP Instance UID	(0008,0018)	1	New UID generated by the Horizon Rad Station™ system.	ALWAYS	AUTO
Instance Creation Date	(0008,0012)	3	Date on which the MPR image was created.	ALWAYS	AUTO
Instance Creation Time	(0008,0013)	3	Time at which the MPR image was created.	ALWAYS	AUTO
Instance Number	(0020,0013)	3	Value specified as 1 to n for each subsequent MPR image created for a series.	ALWAYS	AUTO

7.1.5.2.2 Derived MPR CT Image Specific Module Attributes

The following table specifies which Elements from CT Image IOD specific Modules can be added to the MPR images derived from original CT images:

Table 150: CT Image Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Image Type	(0008,0008)	1	Value specified as "DERIVED\SECONDARY\MP R".	ALWAYS	AUTO
Samples per Pixel	(0028,0002)	1	Identical to that of the original images. For CT this must be 1.	ALWAYS	ORIGINAL
Photometric Interpretation	(0028,0004)	1	Identical to that of the original images. For CT this must be MONOCHROME1 or MONOCHROME2.	ALWAYS	ORIGINAL
Bits Allocated	(0028,0100)	1	Identical to that of the original images. For CT this must be 16.	ALWAYS	ORIGINAL
Bits Stored	(0028,0101)	1	Identical to that of the original images. For CT this must be 12 to 16.	ALWAYS	ORIGINAL
High Bit	(0028,0102)	1	Always specified as Bits Stored minus 1.	ALWAYS	AUTO
Rescale Intercept	(0028,1052)	1	Identical to that of the original images.	ALWAYS	ORIGINAL
Rescale Slope	(0028,1053)	1	Identical to that of the original images.	ALWAYS	ORIGINAL
KVP	(0018,0060)	2	Copied from original acquisition object if a value is specified. Empty otherwise.	VNAP	ORIGINAL
Acquisition Number	(0020,0012)	2	No value is specified.	EMPTY	AUTO

7.1.5.2.3 Derived MPR MR Image Specific Module Attributes

The following table specifies which Elements from MR Image IOD specific Modules can be added to the MPR images derived from original MR images:

Table 151: MR Image Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Image Type	(0008,0008)	1	Value specified as "DERIVED\SECONDARY\MP R".	ALWAYS	AUTO
Samples per Pixel	(0028,0002)	1	Identical to that of the original images. For MR this must be 1.	ALWAYS	ORIGINAL
Photometric Interpretation	(0028,0004)	1	Identical to that of the original images. For MR this must be MONOCHROME1 or MONOCHROME2.	ALWAYS	ORIGINAL
Bits Allocated	(0028,0100)	1	Identical to that of the original images. For MR this must be 16.	ALWAYS	ORIGINAL
Scanning Sequence	(0018,0020)	1	Identical to that of the original images.	ALWAYS	ORIGINAL

Sequence Variant	(0018,0021)	1	Identical to that of the original images.	ALWAYS	ORIGINAL
Scan Options	(0018,0022)	2	Identical to that of the original images.	VNAP	ORIGINAL
MR Acquisition Type	(0018,0023)	2	Identical to that of the original images.	VNAP	ORIGINAL
Repetition Time	(0018,0080)	2C	Copied from original acquisition object if a value is specified. Empty if attribute is present in original object but has no value. Not present otherwise.	ANAP	ORIGINAL
Echo Time	(0018,0081)	2	Copied from original acquisition object if a value is specified. Empty otherwise.	VNAP	ORIGINAL
Echo Train Length	(0018,0091)	2	Copied from original acquisition object if a value is specified. Empty otherwise.	VNAP	ORIGINAL
Inversion Time	(0018,0082)	2C	Copied from original acquisition object if a value is specified. Empty if attribute is present in original object but has no value. Not present otherwise.	ANAP	ORIGINAL
Trigger Time	(0018,1060)	2C	Copied from original acquisition object if a value is specified. Empty if attribute is present in original object but has no value. Not present otherwise.	ANAP	ORIGINAL

7.1.6 Secondary Capture Image Creation for Scanned Document

Horizon Medical Imaging™ can create DICOM Secondary Capture Image objects from documents scanned directly into HMI. The Secondary Capture Image objects can be exported via the Query/Retrieve or Storage Services.

7.1.6.1 Secondary Capture Image IODs for Scanned Document

This section describes the IODs of the Secondary Capture SOP Instances by describing the Modules that will be used for such images.

Table 152 specifies the Modules used in the creation of Secondary Capture SOP Instances for the Scanned Documents in the Study.

Table 152: IOD of Scanned Document SOP Instances

IE	Module	DICOM Reference (PS3.3)	Value Description Table	Presence of Module
Patient	Patient	C.7.1.1	Table 153	ALWAYS
Study	General Study	C.7.2.1	Table 154	ALWAYS
Series	General Series	C.7.3.1	Table 155	ALWAYS
Equipment	SC Equipment	C.8.6.1	Table 156	ALWAYS
Image	General Image	C.7.6.1	Table 157	ALWAYS
	Image Pixel	C.7.6.3	Table 158	ALWAYS
	SC Image	C.8.6.2	Table 159	ALWAYS

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SOP Common	C.12.1	Table 160	ALWAYS
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7.1.6.1 Secondary Capture Image Module Attributes for Scan Document

This section provides information on the Elements that are part of each module present in the Secondary Capture SOP Instances for scanned documents. For each Element, the Value Description column describes the meaning of the element, whether it must be present in the secondary capture image header, and what the source of the value is.

The tables use the following abbreviations:

The abbreviations in the “Presence of Value” column are:

VNAP	Value not always present (attribute is always present but may not have a value).
ANAP	Attribute not always present.
ALWAYS	Attribute always present and has a value.
EMPTY	Attribute always present but has no value.

The abbreviations in the “Source” column are:

ORIGINAL	Value is copied from an original image.
DB	Value is from the Horizon Medical Imaging™ system database.
AUTO	Value is automatically generated by the Horizon Medical Imaging™ system.
D	indicates a default hard-coded value is set.

7.1.6.1.1 Secondary Capture Image Common Module Attributes

The following tables specify which Elements from Common Modules can be added to the Secondary Capture images:

Table 153: Patient Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Patient's Name	(0010,0010)	2	Copied from database if a value is specified. Empty otherwise.	VNAP	DB
Patient ID	(0010,0020)	2	Copied from database.	ALWAYS	DB
Patient's Birth Date	(0010,0030)	2	Copied from database if a value is specified. Empty otherwise.	VNAP	DB
Patient's Sex	(0010,0040)	2	Copied from database if a value is specified. Empty otherwise.	VNAP	DB

Table 154: General Study Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Study Instance UID	(0020,000D)	1	Copied from database.	ALWAYS	DB
Study Date	(0008,0020)	2	Copied from database if a value is specified. Empty otherwise.	VNAP	DB
Study Time	(0008,0030)	2	Copied from database if a value is specified. Empty otherwise.	VNAP	DB
Referring Physician's Name	(0008,0090)	2	Copied from database if a value is specified. Empty otherwise.	VNAP	DB
Study ID	(0020,0010)	2	Copied from database if a value is specified. Empty otherwise.	VNAP	DB
Accession Number	(0008,0050)	2	Copied from database if a value is specified. Empty otherwise.	VNAP	DB
Study Description	(0008,1030)	3	Not present OR copied from database if a value is specified. Empty otherwise.	ANAP	DB

Table 155: General Series Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Modality	(0008,0060)	1	Override by value in SC Equipment Module. Set to "OT"	ALWAYS	D
Series Instance UID	(0020,000E)	1	Generated on SOP Instance Creation.	ALWAYS	AUTO
Series Number	(0020,0011)	2	Set to "0"	ALWAYS	D
Series Description	(0008,103e)	3	Copied from database if a value is specified. Empty otherwise.	ANAP	DB

Table 156: SC Equipment Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Modality	(0008,0060)	3	Set to "SC"	ALWAYS	D
Conversion Type	(0008,0064)	1	Describes the kind of image conversion. Defined Terms : DV = Digitized Video DI = Digital Interface DF = Digitized Film WSD = Workstation SD = Scanned Document SI = Scanned Image DRW = Drawing SYN = Synthetic Image	ALWAYS	DB

Table 157: General Image Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Instance Number	(0020,0013)	2	Set to "0"	ALWAYS	D
Derivation Description	(0008,2111)	3	Value will indicate the type of compression used and compression ratio if the pixel data has been compressed.	ANAP	AUTO
Lossy Image Compression	(0028,2110)	3	Specifies whether an Image has undergone lossy compression. Enumerated Values: 00 = Image has NOT been subjected to lossy compression. 01 = Image has been subjected to lossy compression.	ANAP	AUTO

Table 158: Image Pixel Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Samples per Pixel	(0028,0002)	1	Number of sample planes in this image Color Images (3) Monochrome2 (1)	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data Possible values: YBR_FULL_422 (default for JPEG lossy images) RGB	ALWAYS	AUTO
Rows	(0028,0010)	1	Depends on Scanned Document JPEG image matrix	ALWAYS	AUTO
Columns	(0028,0011)	1	Depends on Scanned Document JPEG image matrix	ALWAYS	AUTO
Bits Allocated	(0028,0100)	1	8	ALWAYS	D
Bits Stored	(0028,0101)	1	8	ALWAYS	D
High Bit	(0028,0102)	1	7	ALWAYS	D
Pixel Representation	(0028,0103)	1	0000H (unsigned integer)	ALWAYS	D
Pixel Data	(7FE0,0010)	1	The Scanned Document JPEG image will be added as the Pixel Data.	ALWAYS	AUTO

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Planar Configuration	(0028,0006)	1C	Indicates whether the pixel data are sent color-by-plane or color-by-pixel. Required if Samples per Pixel (0028,0002) has a value greater than 1. If the image is in color, it will be added with color-by-pixel (0) as its value.	ANAP	AUTO
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Table 159: SC Image Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
Pixel Spacing	(0028,0030)	1C	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm. Required if the image has been calibrated. May be present otherwise	ANAP	AUTO

Table 160: SOP Common Module Attributes

Attribute Name	Tag	Type	Value Description	Presence of Value	Source
SOP Class UID	(0008,0016)	1	1.2.840.10008.5.1.4.1.1.7(OT)	ALWAYS	D
SOP Instance UID	(0008,0018)	1	Generated UID.	ALWAYS	AUTO

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