DICOM 3.0 Conformance Statement
Odyssey LX – Storage, Storage Commitment, Query/Retrieve

Rev 9.4, Aug. 22, 2002
P/N 453567928021
DICOM transfer software release 9.4

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> This Conformance Statement describes DICOM Storage (Import and Export), Storage Commitment, and Query/Retrieve software release 9.4, for the Philips Odyssey LX Nuclear Medicine systems.

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Introduction

Medical imaging devices claiming conformance to the DICOM 3.0 standard must indicate in sufficient detail the service classes and information objects, as defined by the standard, to which they conform. This document details the conformance of the Philips Medical Systems Odyssey series Nuclear Medicine products to the DICOM 3.0 standard. This document does not attempt to detail any other medical imaging devices manufactured by Philips Medical Systems.

The Odyssey DICOM product is implemented in accordance with the IHE Technical Framework.

System requirements:
- Odyssey LX computer.
- Baseline 9.4 (or higher) software.

1 Implementation model

This implementation provides for simple transfer of images using the DICOM Storage Service Class as both a Service Class User (SCU) and a Service Class Provider (SCP), simple management of images using the DICOM Query/Retrieve Service Class as SCU, and DICOM Storage Commitment Service Class as SCU, and reading some CD-Rs as a File Set Reader (FSR). Transfers from the Odyssey to a remote Application Entity (AE) are initiated by an operator by selecting the appropriate options from the Image Workbench. Similarly, the Odyssey operator may initiate the transfer of images from a remote Application Entity (AE) to the Odyssey, provided that the remote AE also supports the DICOM Query/Retrieve Service Class as an SCP, by selecting the appropriate options from the Image Workbench. No operator action is required on the Odyssey to service Storage requests initiated by a remote Application Entity (AE). Likewise, no operator action is required to initiate, receive, or process Storage Commitment requests or responses.

For diagnostic purposes, this implementation also provides for simple communications testing using the DICOM Verification Service Class, as both SCU and SCP. Verification of communications to a remote AE is initiated by an operator by selecting the appropriate options from the Image Workbench. Verification of communications from a remote AE is handled automatically and requires no operator actions.

1.1 Application Data Flow Diagrams

Image transfers from the Odyssey to a remote AE are started when the user manually selects a set of studies to transfer via the Image Workbench, and then selects the DICOM transfer function.

Storage Commitment requests are automatically initiated after each batch of images has been exported. It sends an N-ACTION request to the Storage Commitment SCP, which may or may not be the same entity that stores images. The N-EVENT-REPORT primitive may be received on the same association as the N-ACTION was requested. However, if no N-EVENT-REPORT is received in a timely fashion the association may be dropped. In this case, the SCP may send an unsolicited N-EVENT-REPORT on a separate association. Selection of whether or not Storage Commitment should be requested is configurable.

Image transfers from a remote AE to the Odyssey can be accomplished in either of two ways. The first is for the Odyssey operator to manually select a set of studies which reside on the remote AE, and transfer them to the Odyssey. Note that the remote AE must also support the DICOM Query/Retrieve Service Class as an SCP (and must support C-MOVE) in order to transfer images in this manner. If it does not, the image transfer cannot be initiated from the Odyssey. The second is for the transfer to be initiated by the remote AE. In this case there is no operator action required on the Odyssey.

Images can also be read from a CD-R. This is accomplished using the same control panels as are used to retrieve images from remote AEs. The DICOM File-set is read, and the directory is displayed for the operator. Selected images can then be read and stored on the Odyssey. Only CT, MR, NM, PET and SC SOP Instances can be read.

Communications to a remote AE can be verified using the C-ECHO request/response primitives of the DICOM Verification Service Class. The C-ECHO request can be sent to a remote AE using the same Image Workbench options, by selecting the verify option, rather than the image send option on the DICOM Image Transfer control panel.

Responses to C-ECHO requests received from remote AEs are handled automatically; the image receiver software also serves as SCP for the Verification Service Class.

Figure 1.1-1. Implementation Model
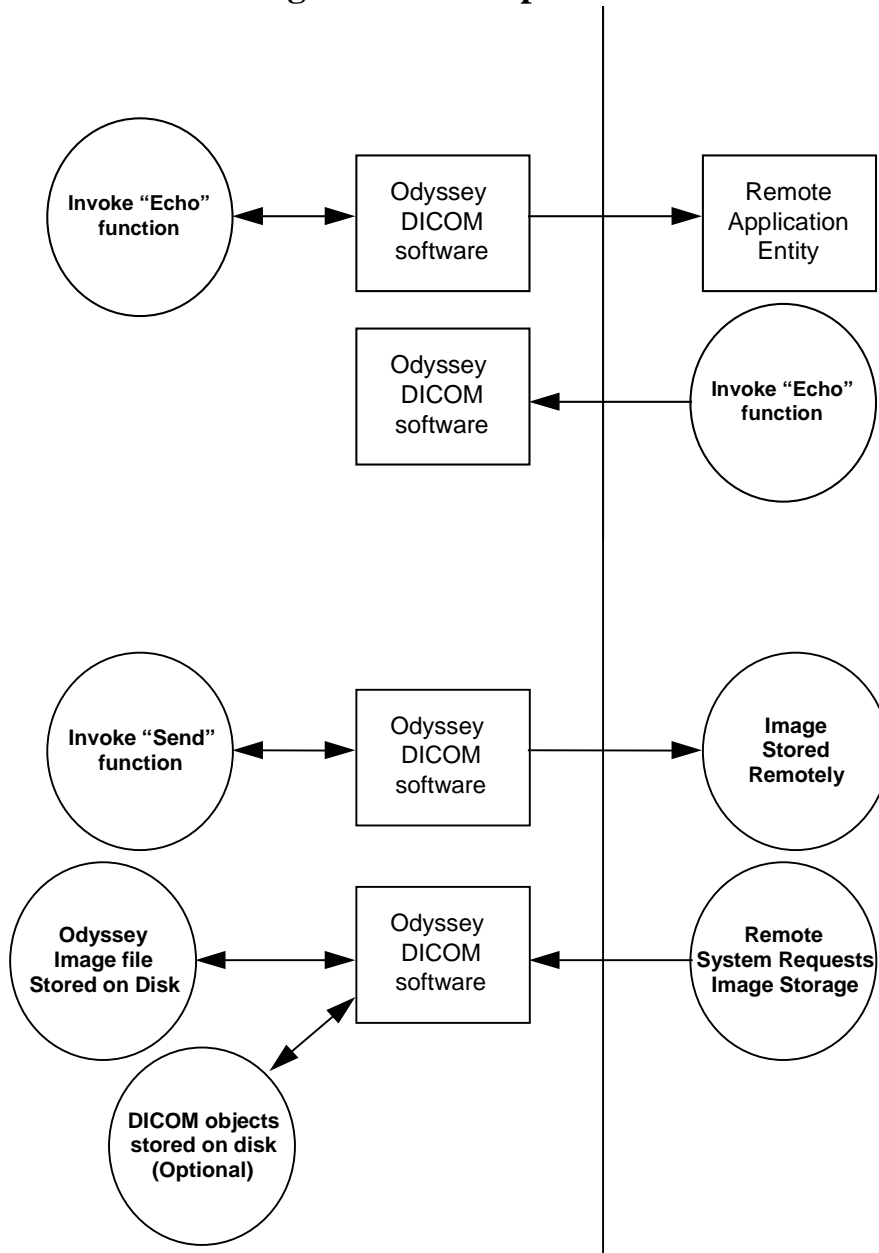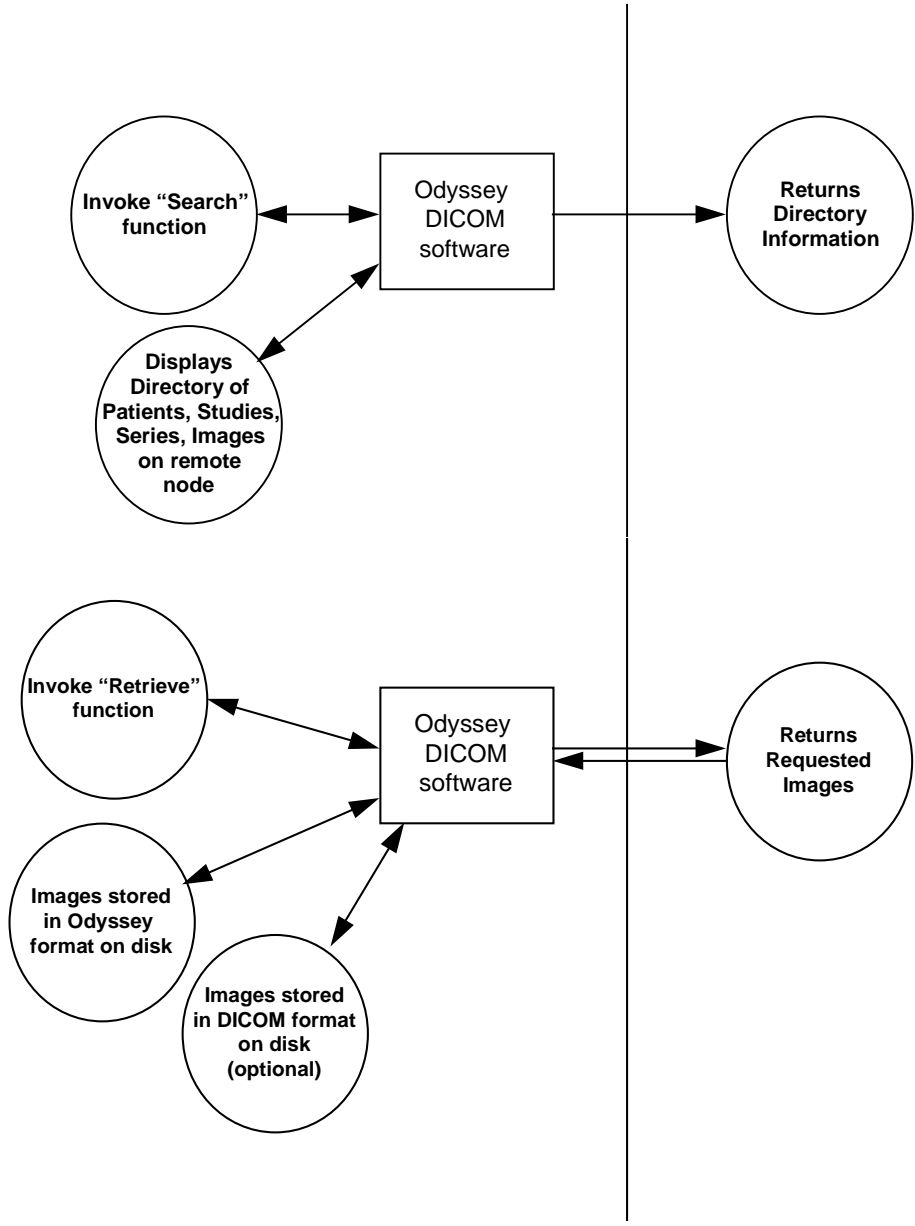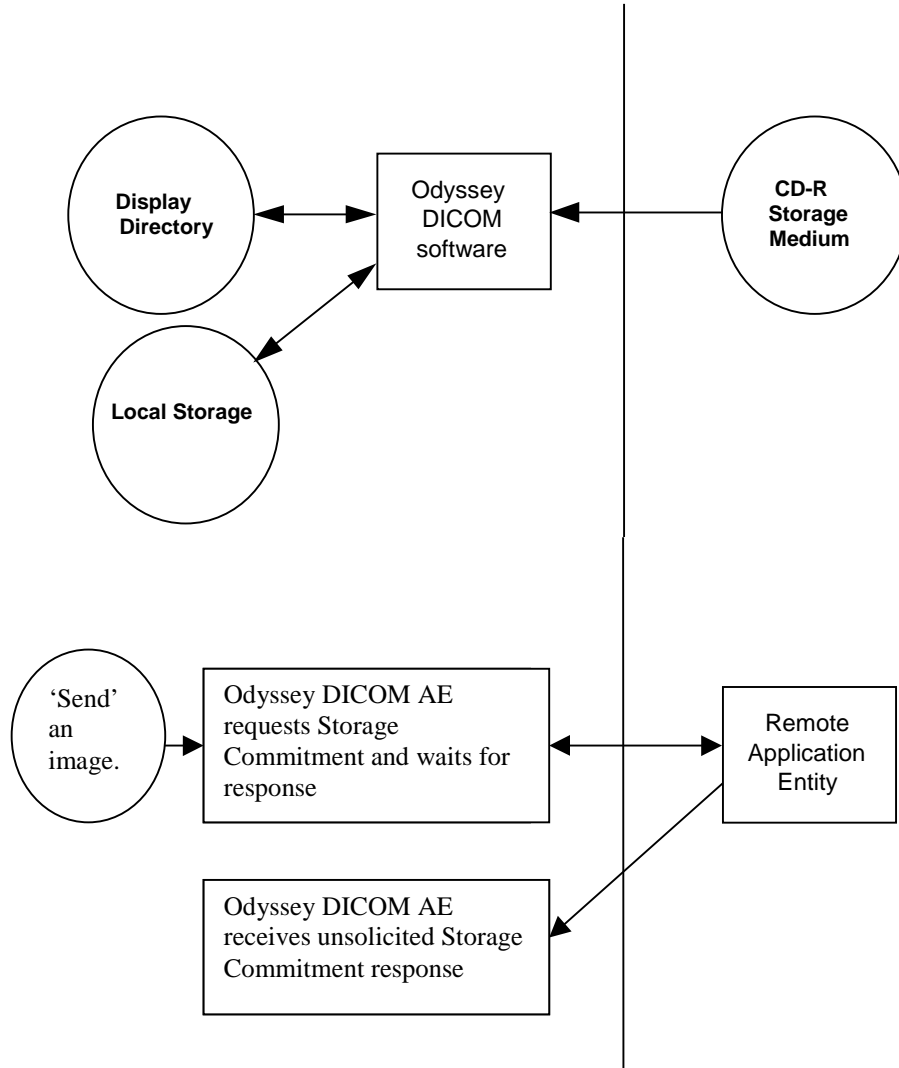
1.2 Functional Definitions of AE's

The DICOM image sending software is started when a study is selected, placed on the workbench and the DICOM transfer function is selected from the Image Workbench. There are three options presented: <Send>, <Echo>, and <Get>.

When 'Send' is pressed, an association which includes a list of Presentation Contexts is proposed to the destination AE. The destination AE determines which of these Presentation Contexts it can support. The image send software then goes through the list of files on the workbench. For each file, it determines the Presentation Context to be used and checks to see if this Presentation Context is supported by the destination AE. If so, the file is transferred. When all files on the workbench have been processed the association is closed.

Next, a new association is (optionally) made to a Storage Commitment SCP (which may or may not be the same AE that received the images) and a Storage Commitment request is sent. This request includes all of the images that were just exported. The export function can process the Storage Commitment response if necessary (and if the Storage Commitment SCP is able to return the response immediately on the same association). However, the usual procedure is for the Storage Commitment response to be returned later on a separate association. The association is then closed.

Any image which originated on the sending Odyssey must be converted into DICOM 3.0 format. This is done at the time of the transfer. Any image originating on the Odyssey is stored in Odyssey file format, not DICOM 3.0 file format. However, it is possible to 'Send' an image to a local directory, in which case a file is created which conforms to DICOM 3.0 file format as described in Part 10. Any image which was previously transferred to the Odyssey via DICOM, and saved in its entirety (see the discussion of the image receiving software later in this section), will be retransmitted in its original form.

Odyssey 'Lightbox' images are transferred as single frame, 8 bit, black and white, Secondary Capture images. All other Odyssey images are transferred as one or more Multi-Frame image objects of the NM Storage SOP Class.

The image receiving software waits for another application to connect at the presentation address configured for its Application Entity Title. The application that connects must be a DICOM application. Associations are accepted with Presentation Contexts for SOP Classes of the Storage Service Class, the Verification Service Class, or the Storage Commitment Service Class. It will receive images on the Storage Service Class Presentation Contexts and create Odyssey image files from them. It can also (optionally) store a complete copy of the original DICOM message. This feature, which can be enabled/disabled during configuration, allows such images to be retransmitted exactly as they were received. The Storage Commitment Service Class is supported in order to receive and process Storage Commitment Results messages for images that were previously exported, and for which Storage Commitment was requested.

Note that the Odyssey is not a Storage Commitment SCP, and will not accept Storage Commitment requests.

The <Echo> function provides an easy way to determine if the remote AE is available. When 'Echo' is pressed, an association which includes a Presentation Context for Verification Class is proposed. A successful response indicates that the remote AE is available. The association is immediately closed.

When <Get> is pressed, an association which includes a list of Presentation Contexts for all DICOM Query/Retrieve information models (i.e. Patient Root, Study Root, and Patient/Study Only) is presented. If more than one is accepted, the model which supports the greatest number of directory levels is used. The operator can then request directory

information at any of these levels. A new association is created for each directory search, and is immediately closed as soon as the requested information is received. The operator may also request that a patient, study, series or image be retrieved from the remote AE by pressing the 'Retrieve' button. A new association is initiated for the request, which remains open until all files have been received. The actual file transfer occurs on a separate association initiated by the remote AE.

The <Get> button is also used to retrieve images from the CD-R, by setting the 'Destination' choice on the DICOM Image Transfer control panel to be the CD-R instead of one of the remote AEs. Directory information is always displayed using the Patient Root model. The <Retrieve> button is used to initiate the transfer of a patient, study, series or image from the CD-R.

1.3 Sequencing of Real-World Activities

Not applicable.

2 AE Specifications

The DICOM software on the Odyssey is divided into two logical entities, one which initiates associations and one which accepts associations. The operational parameters, including AE Title, for each are derived from configuration files in the /prism/site directory. The initiating software can be configured to present a different AE title for each destination, but only one association at a time is allowed. The receiving software will spawn a copy of itself for each new connection, each representing the same Application Entity. In order to simplify this description, these are described as a single Application Entity.

2.1 AE1 - Specification

This Application Entity provides Conformance to the following DICOM V3.0 SOP Classes.

Table 2.1-1 Supported SOP Classes

SOP Class Name	SOP Class UID	Conformance	Role
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Standard	SCU and SCP
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Standard	SCU and SCP
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	Extended	SCU and SCP
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	Standard	SCU and SCP
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	Standard	SCU and SCP
Verification	1.2.840.10008.1.1	Standard	SCU and SCP
Patient/Study Only, Query/Retrieve Information Model, Find	1.2.840.10008.5.1.4.1.2.3.1	Standard	SCU
Patient/Study Only, Query/Retrieve Information Model, Move	1.2.840.10008.5.1.4.1.2.3.3	Standard	SCU
Patient Root, Query/Retrieve Information Model, Find	1.2.840.10008.5.1.4.1.2.1.1	Standard	SCU
Patient Root, Query/Retrieve Information Model, Move	1.2.840.10008.5.1.2.1.2.1.2	Standard	SCU
Study Root, Query/Retrieve Information Model, Find	1.2.840.10008.5.1.4.1.2.2.1	Standard	SCU
Study Root, Query/Retrieve Information Model, Move	1.2.840.10008.5.1.4.1.2.2.2	Standard	SCU
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	Standard	SCU

2.1.1 Association Establishment Policies

2.1.1.1 General

The image transfer software will attempt to establish an association each time any of its functions (Send, Echo, Get, Search directory, Retrieve) are invoked, provided that a valid destination definition has been selected. When sending images, the association is

maintained until all image files on the Workbench have been processed. Those files which cannot be transferred because the receiving AE does not support the required SOP Class are ignored.

The storage commitment request software will attempt to establish an association each time it determines there are more images that have been stored and for which storage commitment should be requested. This is done as soon as the images have been sent for storage. After the Storage Commitment request is sent, the association will remain open for a configurable time limit, to allow the SCP to respond with results. After this time limit the connection is closed and the SCP must open a new association to return results to the Odyssey. These unsolicited responses can be received by the Odyssey at any time.

When sending the verification (Echo) request, or when requesting directory information, the association is immediately closed as soon as the response is received. Each new request is made on a new association.

When a Retrieve request is made, the association remains open until all images have been transferred so that any error reports can be received if there are problems transferring the images. The actual image transfer occurs on a separate association initiated by the remote AE.

The maximum PDU size allowed is separately configurable for associations initiated and accepted by the Odyssey. Choices are 4, 8, 16, or 32K.

2.1.1.2 Number of Associations

The image transfer software will initiate only one association at a time. However, since there can be more than one Image Workbench, it is possible for multiple copies to be invoked simultaneously. There is no synchronization attempted between multiple copies of the transfer software, so there may be a number of associations attempted simultaneously, limited only by the resources available.

The image receiver AE will spawn a separate process for each connection that is established.

2.1.1.3 Asynchronous Nature

There is no asynchronous activity in this implementation.

2.1.1.4 Implementation Identifying Information

The Implementation UID supplied for DICOM 3.0 associations is "2.16.840.1.113662.5".

2.1.2 Association Initiation By Real World Activity

The image receiving software does not initiate any associations.

The image transfer software attempts to initiate an association each time it is invoked. There are five Real World Activities that cause association establishment.
1. Sending an Odyssey image file to a remote AE. If necessary, a second association is automatically established for the purpose of requesting Storage Commitment for the images that were just sent.
2. Sending a Verification request to a remote AE.
3. Requesting directory information (Query) from a remote AE.
4. Requesting that a remote AE send an image object (Retrieve).
5. Automatic archival of image files.

2.1.2.1 Real World Activity 1. Exporting an Odyssey Image File.

2.1.2.1.1 Associated Real World Activity (Export)

The Associated Real World Activity is the attempt to transfer a set of images. This occurs when the operator manually selects a set of images, places them on the workbench and initiates the DICOM Send function.

2.1.2.1.2 Proposed Presentation Contexts (Export)

Table 2.1.2.1.2-1 Proposed Presentation Contexts, exporting images

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
CT Image	1.2.840.10008.5.1.4.1.1.2	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
MR Image	1.2.840.10008.5.1.4.1.1.4	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
NM Image	1.2.840.10008.5.1.4.1.1.20	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
PET Image	1.2.840.10008.5.1.4.1.1.128	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
		DICOM Explicit VR Little Endian Transfer Syntax			
SC Image	1.2.840.10008.5.1.4.1.1.7	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None

2.1.2.1.3 SOP Specific Conformance to Storage SOP Classes (Export)

If the image transfer software is unable to open an association with the selected destination AE, an error message is printed in the console window and an error indicator is displayed in the status window of the DICOM transfer control window.

If the image transfer software is unable to determine the appropriate Abstract Syntax for a file, or if this Abstract Syntax is not supported by the receiving AE, or if a failed, refused, or warning response to the C-STORE operation is received, a warning message is printed in the main console window. It will then attempt to process the next file on the workbench. When all files on the Workbench have been processed, the status window of the DICOM transfer control window will indicate that some or all of the files failed to transfer successfully. The console window messages will give more detail as to which files failed, and why.

There are no special messages displayed when a successful response to the C-STORE operation is received.

The image transfer software does not attempt any extended negotiation.

When transferring files that were previously received from some other remote AE and stored in their entirety (the Save option was turned on), the image transfer software does not delete any elements from the file. Therefore, the set of optional elements depends entirely on the contents of the files specified for transfer.

When transferring files that originate on the Odyssey, the files must first be converted to the appropriate DICOM Image Objects. Odyssey "Lightbox" images are exported as Secondary Capture Image Objects using the following Secondary Capture Image IOD Modules: Patient, General Study, General Series, General Equipment, SC Image Equipment, General Image, Image Pixel, SC Image, VOI LUT, SOP Common. The following optional or conditional attributes may be included:

Table 2.1.2.1.3-1 Optional Elements for SC Images

Tag	Name	Type	Conditions for inclusion
[0008,0005]	Specific Character Set	1C	
[0008,0008]	Image Type	3	Always
[0008,0014]	Instance Creator UID	3	Always
[0008,0020]	Study Date	2	
[0008,0022]	Acquisition Date	3	Always
[0008,0030]	Study Time	2	
[0008,0032]	Acquisition Time	3	Always
[0008,0033]	Image Time	2C	
[0008,0050]	Accession Number	2	
[0008,0060]	Modality	3	Always
[0008,0070]	Manufacturer	2	Always
[0008,0080]	Institution Name	3	Always
[0008,0081]	Institution Address	3	Always
[0008,0090]	Referring Physician's Name	2	
[0008,1010]	Station Name	3	Always
[0008,1030]	Study Description	3	If known
[0008,103e]	Series Description	3	If known
[0008,1060]	Name of Physician(s) Reading Study	3	Always
[0008,1070]	Operator's Name	3	
[0008,1090]	Manufacturer's Model Name	3	Always
[0008,1110]	Referenced Study Sequence	2	If provided by worklist
> [0008,1150]	Referenced SOP Class UID	1C	" "
> [0008,1155]	Referenced SOP Instance UID	1C	" "
[0008,1111]	Referenced Study Component Sequence	3	When supplied by Modality Performed Procedure Step option (MPPS).
> [0008,1150]	Referenced SOP Class UID	1C	" "
> [0008,1155]	Referenced SOP Instance UID	1C	" "
[0010,0010]	Patient's Name	2	
[0010,0020]	Patient ID	2	
[0010,0030]	Patient's Birth Date	2	
[0010,0040]	Patient's Sex	2	
[0018,0015]	Body Part Examined	3	If known
[0018,1000]	Device Serial Number	3	Always
[0018,1020]	Software Version(s)	3	Always
[0020,0010]	Study ID	2	
[0020,0011]	Series Number	2	
[0020,0013]	Image Number	2	

[0020,0020]	Patient Orientation	2C	
[0020,4000]	Image Comments	3	Always
[0028,0106]	Smallest Image Pixel Value	3	Always
[0028,0107]	Largest Image Pixel Value	3	Always
[0028,1050]	Window Center	3	Always
[0028,1051]	Window Width	3	Always
[0028,1101]	Red Palette Color Lookup Table Descriptior	1C	For color images
[0028,1102]	Green Palette Color Lookup Table Descriptior	1C	For color images
[0028,1103]	Blue Palette Color Lookup Table Descriptior	1C	For color images
[0028,1201]	Red Palette Color Lookup Table Data	1C	For color images
[0028,1202]	Green Palette Color Lookup Table Data	1C	For color images
[0028,1203]	Blue Palette Color Lookup Table Data	1C	For color images
[0040,0244]	Performed Procedure Step Start Date	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0040,0245]	Performed Procedure Step Start Time	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0040,0253]	Performed Procedure Step ID	3	If provided by worklist
[0040,0254]	Performed Procedure Step Description	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0040,0260]	Performed Action Item Sequence	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0040,0275]	Request Attributes Sequence	3	If provided by worklist
> [0040,0007]	Scheduled Procedure Step Description	3	If provided by worklist
> [0040,0008]	Scheduled Action Item Code Sequence	3	If provided by worklist
>> [0008,0100]	Code Value	1C	If provided by worklist
>> [0008,0102]	Coding Scheme Designator	1C	If provided by worklist
>> [0008,0104]	Code Meaning	1C	If provided by worklist

The Modality attribute [0008,0060] is normally set to "OT" (other). This is because the 'Lightbox' image from which the Secondary Capture image is created can contain anything on the screen, including control panels, color stripes, images from other modalities, etc. However, many PACS systems do not handle this properly, so the Odyssey can be configured to set the Modality attribute to "NM" for Lightbox (Secondary Capture) images.

The Photometric Interpretation [0028,0004] used for encoding Secondary Capture (Lightbox) images can be either MONOCHROME2 (grayscale) or PALETTE COLOR, and is determined by a configuration option.

The image transfer software provides Standard conformance to the DICOM Secondary Capture (SC) SOP Class.

All other Odyssey image files are converted to grayscale Nuclear Medicine Image Objects using one or more of the following NM Image IOD Modules, as appropriate: Patient, General Study, Patient Study, General Series, NM/PET Patient Orientation, Frame of Reference, General Equipment, General Image, Image Pixel, NM Image Pixel, Multi-frame, NM Multi-frame, NM Image, NM Isotope, NM Detector, NM TOMO Acquisition, NM Multi-gated Acquisition, NM Phase, NM Reconstruction, SOP Common. The following optional or conditional attributes may be included:

Table 2.1.2.1.3-2 Optional Elements for NM Images

Tag	Name	Type	Conditions for inclusion
[0008,0014]	Instance Creator UID	3	Always
[0008,0020]	Study Date	2	
[0008,0022]	Acquisition Date	3	Always
[0008,0023]	Image Date	2C	Always
[0008,0030]	Study Time	2	
[0008,0032]	Acquisition Time	3	Always
[0008,0033]	Image Time	2C	Always
[0008,0050]	Accession Number	2	
[0008,0070]	Manufacturer	2	Always
[0008,0080]	Institution Name	3	Always
[0008,0081]	Institution Address	3	Always
[0008,0090]	Referring Physician's Name	2	
[0008,1010]	Station Name	3	Always
[0008,1030]	Study Description	3	Always
[0008,103E]	Series Description	3	From Odyssey reconstruction ID.
[0008,1030]	Study Description	3	
[0008,1060]	Name of Physician(s) Reading Study	3	Always
[0008,1070]	Operators' Name	3	If available
[0008,1090]	Manufacturer's Model Name	3	Always
[0008,1110]	Referenced Study Sequence	2	If provided by worklist
> [0008,1150]	Referenced SOP Class UID	1C	" "
> [0008,1155]	Referenced SOP Instance UID	1C	" "
[0008,1111]	Referenced Study Component Sequence	3	When supplied by Modality Performed Procedure Step option (MPPS).
> [0008,1150]	Referenced SOP Class UID	1C	" "
> [0008,1155]	Referenced SOP Instance UID	1C	" "
[0010,0010]	Patient's Name	2	
[0010,0020]	Patient ID	2	
[0010,0030]	Patient's Birth Date	2	
[0010,0040]	Patient Sex	2	
[0018,0015]	Body Part Examined	3	If known (from Odyssey Organ field).
[0018,0050]	Slice Thickness	2	For RECON TOMO and RECON GATED TOMO images (from Odyssey ZAP and SLT fields).

[0018,0070]	Counts Accumulated	2	From Odyssey TCA field.
[0018,0071]	Acquisition Termination Condition	3	If known
[0018,0088]	Spacing Between Slices	2	For RECON TOMO and RECON GATED TOMO images.
[0018,1000]	Device Serial Number	3	Always
[0018,1020]	Software Version(s)	3	Always
[0018,1030]	Protocol Name	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0018,1061]	Trigger Source or Type	3	Gated images.
[0018,1062]	Nominal Interval	3	For 'Normal' bin gated images only.
[0018,1063]	Frame Time	3	For 'Normal' bin gated images only.
[0018,1071]	Radiopharmaceutical Volume	3	If known.
[0018,1072]	Radiopharmaceutical Start Time	3	If known (from Odyssey RNI field).
[0018,1074]	Radionuclide Total Dose	3	If known (from Odyssey RNA field).
[0018,1081]	Low R-R Value	3	For 'Normal' bin gated images only.
[0018,1082]	High R-R Value	3	For 'Normal' bin gated images only.
[0018,1083]	Intervals Acquired	3	For 'Normal' bin gated images only.
[0018,1084]	Intervals Rejected	3	For 'Normal' bin gated images only.
[0018,1086]	Skip Beats	3	For 'Normal' bin gated images only.
[0018,1130]	Table Height	3	Always
[0018,1131]	Table Traverse	3	Always
[0018,1142]	Radial Position	3	If available.
[0018,1180]	Collimator/Grid Name	3	If known
[0018,1181]	Collimator Type	2C	Always.
[0018,1182]	Focal Distance	2C	Always.
[0018,1242]	Actual Frame Duration	3	For Static or Whole Body only.
[0018,1300]	Scan Velocity	2C	From Odyssey SVE field, for Whole Body only.

[0018,1301]	Whole Body Technique	3	For Whole Body only.
[0018,1302]	Scan Length	2C	From odyssey SLE field, for Whole Body only.
[0018,5020]	Processing Function	3	Always
[0020,0010]	Study ID	2	
[0020,0011]	Series Number	2	Always
[0020,0012]	Acquisition Number	3	If available
[0020,0013]	Image Number	2	Always
[0020,0032]	Image Position (patient)	2C	For TOMO, GATED TOMO, RECON TOMO and RECON GATED TOMO images only.
[0020,0037]	Image Orientation (patient)	2C	For TOMO, GATED TOMO, RECON TOMO and RECON GATED TOMO images only.
[0020,4000]	Image Comments	3	Always
[0028,0030]	Pixel Spacing	2	Always
[0028,0051]	Corrected Image	3	If applicable
[0028,0106]	Smallest Image Pixel Value	3	Always
[0028,0107]	Largest Image Pixel Value	3	Always
[0028,1050]	Window Center	3	Always
[0040,0244]	Performed Procedure Step Start Date	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0040,0245]	Performed Procedure Step Start Time	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0040,0253]	Performed Procedure Step ID	3	If provided by worklist
[0040,0254]	Performed Procedure Step Description	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0040,0260]	Performed Action Item Sequence	3	When supplied by Modality Performed Procedure Step option (MPPS).
[0040,0275]	Request Attributes Sequence	3	If provided by worklist

> [0040,0007]	Scheduled Procedure Step Description	3	If provided by worklist
> [0040,0008]	Scheduled Action Item Code Sequence	3	If provided by worklist
>> [0008,0100]	Code Value	1C	If provided by worklist
>> [0008,0102]	Coding Scheme Designator	1C	If provided by worklist
>> [0008,0104]	Code Meaning	1C	If provided by worklist
[0054,0010]	Energy Window Vector	1C	When required
[0054,0011]	Number of Energy Windows	1	Always
[0054,0012]	Energy Window Information Sequence	2	Always
> [0054,0013]	Energy Window Range Sequence	3	Always
>> [0054,0014]	Energy Window Lower Limit	3	Always
>> [0054,0015]	Energy Window Upper Limit	3	Always
[0054,0016]	Radiopharmaceutical iinformation Sequence	2	Always
> [0054,0300]	Radionuclide Code Sequence	2C	If known
>> [0008,0100]	Code Value	1C	" "
>> [0008,0102]	Coding Scheme Designator	1C	" "
>> [0008,0104]	Code Meaning	1C	" "
[0054,0020]	Detector Vector	1C	When required.
[0054,0021]	Number of Detectors	1	Always
[0054,0022]	Detector information Sequence	2	Always
[0054,0030]	Phase Vector	1C	When required
[0054,0031]	Number of Phases	1C	When required
[0054,0032]	Phase Information Sequence	2	For Dynamic images only.
[0054,0033]	Number of Frames in Phase	1C	When required.
[0054,0036]	Phase Delay	1C	When required.
[0054,0038]	Pause Between Frames	1C	When required.
[0054,0050]	Rotation Vector	1C	When required.
[0054,0051]	Number of Rotations.	1C	When required.
[0054,0052]	Rotation Information Sequence	2	For TOMO, GATED TOMO, RECON TOMO and RECON GATED TOMO images only.
[0054,0053]	Number of Frames in Rotation	1C	When required.
[0054,0060]	R-R Interval Vector	1C	When required.
[0054,0061]	Number of R-R Intervals.	1C	When required.

[0054,0062]	Gated Information Sequence	2C	For GATED, GATED TOMO and RECON GATED TOMO images only.
[0054,0063]	Data Information Sequence	2C	If available.
[0054,0070]	Time Slot Vector	1C	When required.
[0054,0071]	Number of Time Slots	1C	When required.
[0054,0072]	Time Slot Information Sequence	2C	For GATED, GATED TOMO and RECON GATED TOMO images only.
[0054,0073]	Time Slot Time	3	For GATED, GATED TOMO and RECON GATED TOMO images only.
[0054,0080]	Slice Vector	1C	When required.
[0054,0081]	Number of Slices	1C	When required.
[0054,0090]	Angular View Vector	1C	When required
[0054,0100]	Time Slice Vector	1C	When required
[0054,0200]	Start Angle	1C/3	Always
[0054,0202]	Type of Detector Motion	3	For Tomo images
[0054,0220]	View Code Sequence	3	For reconstructed Tomo images (gated or ungated).
[0054,0304]	Radiopharmaceutical Code Sequence	3	If available
[0054,0400]	Image ID	3	If available
[0054,0410]	Patient Orientation Code Sequence	2	If known
[0054,0412]	Patient Orientation Modifier Code Sequence	2C	If known
[0054,0414]	Patient Gantry Relationship Code Sequence	2	If known

The image transfer software provides Standard Extended conformance to the DICOM Nuclear Medicine SOP Class. The additional Private data elements that may be included have group number 0x7001, and contain Odyssey specific information which could not be encoded in the standard NM IOD, and would be meaningless for non-Odyssey systems (except for element 0x1017). However, some receiving systems may need to be informed of the VR for these private elements in order to properly receive and store them. The following table shows the VR for each of these elements.

Table 2.1.2.1.3-3 Private Elements for NM Images

Tag	VR	Meaning
[7001,0010]	LO	Reserves private attributes (7001,1000) – (7001,10FF).
[7001,1001]	UI	Private
[7001,1002]	OB	Private
[7001,1003]	OB	Private
[7001,1004]	OB	Private
[7001,1005]	OB	Private
[7001,1006]	OB	Private
[7001,1007]	OB	Private
[7001,1008]	OB	Private
[7001,1009]	OB	Private
[7001,1010]	SQ	Private
[7001,1011]	LO	Private
[7001,1012]	OB	Private
[7001,1013]	US	Private
[7001,1014]	OB	Private
[7001,1015]	OB	Private
[7001,1016]	OB	Private
[7001,1017]	LO	Contains a text string that includes some of the same information that appears on the Odyssey Clinical Index (image directory) for this Image.
[7043,0010]	LO	Reserves private attributes (7043,1000) – (7043,10FF).
[7043,1000]	SH	Private.

The Private Creator Data Element [7001,0010], which is used to reserve these private data elements, has value "Picker NM Private Group".

In addition, the NM SOP Class may also be extended by inclusion of the following standard DICOM attributes:

Table 2.1.2.1.3-3 Extended Attributes for NM Images

Tag	Name	Type	Conditions for inclusion
[0008,5101]	View Position	3	If a view description is available for the associated detector.

2.1.2.1.4 SOP Specific Conformance to Storage Commitment Push Model SOP Class

The Odyssey provides standard conformance to the Storage Commitment Push Model SOP Class.

The Odyssey sends a storage commitment request (i.e. generates an N-ACTION primitive) each time an image is exported, provided that the Odyssey is configured to treat the receiving AE is as an archive device and to request Storage Commitment (See section 5.2.1 Export). If several images are exported at once, a single Storage Commitment request is sent after all images have been sent.

Storage Commitment may be requested for any of the image SOP Classes listed in section 2.1.2.1.2 Proposed Presentation Contexts.

The Referenced Study Component Sequence Attribute is not supported in this implementation. It also does not support the Storage Media File-Set ID and UID Attributes in the N-ACTION request.

Transaction UIDs are maintained for 24 hours. If no Storage Commitment response is received within 24 hours, the request is considered to have failed. When this happens, the corresponding image file is re-archived (assuming the automatic archive function is enabled). If a Storage Commitment response is received after this, it is ignored.

If the Odyssey is unable to open an association with the Storage Commitment SCP, an error message is printed in the console window and an error indicator is displayed in the status window of the DICOM transfer control window.

Storage Commitment results are received in the form of N-EVENT-REPORT messages. The Storage Commitment results messages report a list of images for which Storage Commitment has been accepted, and a list of images for which Storage Commitment could not be provided. These lists are matched up with a list of images for which Storage Commitment was previously requested. For those that have been accepted, the Odyssey records the 'archived' status so that these images are now eligible to be deleted. For those that have failed, the Odyssey resets the archive status so that the automatic archive function will try to export the image again. This process will repeat until either the export and Storage Commitment operation are successful, or until the retry count is exceeded.

The Odyssey does not automatically delete images; that is left to the operator. However, the Odyssey can be configured so that it will warn the operator if they attempt to delete an image that has not been archived (See section 5.2.3 Automatic Archive).

2.1.2.2 Real World Activity 2. Sending a Verification Request

2.1.2.2.1 Associated Real World Activity (Send Verification)

The Associated Real World Activity is the attempt to verify communications with a remote AE. This occurs when the operator selects the <Echo> function from the DICOM file transfer control panel.

2.1.2.2.2 Proposed Presentation Contexts (Send Verification)

Table 2.1.2.2.2-1 Proposed Presentation Contexts, Sending Verification Request

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None

2.1.2.2.3 SOP Specific Conformance to Verification SOP Class (Send Verification)

The image transfer software provides standard conformance to the DICOM Verification SOP Class.

2.1.2.3 Real World Activity 3 Requesting Directory Information

2.1.2.3.1 Associated Real World Activity (Query)

The Associated Real World Activity is a request for directory information. This occurs when the operator selects the <Get> or <Keyword Search> functions from the DICOM file transfer control panel.

2.1.2.3.2 Proposed Presentation Contexts (Query)

Table 2.1.2.3.2-1 Proposed Presentation Contexts, Query

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient/ Study Root Find	1.2.840.10008.5.1.4.1.2.3.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
Patient Root Find	1.2.840.10008.5.1.4.1.2.1.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
Study Root Find	1.2.840.10008.5.1.4.1.2.2.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None

2.1.2.3.3 SOP Specific Conformance to Find SOP Classes (Query)

This implementation does not make use of any optional keys. It also does not generate Relational queries or support any extended negotiations.

2.1.2.4 Real World Activity 4. Requesting a File (Move)

2.1.2.4.1 Associated Real World Activity (Move)

The Associated Real World Activity is a request for the remote AE to transfer an object to the Odyssey. This occurs when the operator selects the Retrieve function from the DICOM file transfer control panel.

2.1.2.4.2 Proposed Presentation Contexts (Move)

Table 2.1.2.4.2-1 Proposed Presentation Contexts, Move

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient/ Study Root Move	1.2.840.10008.5.1.4.1.2.3.3	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
Patient Root Move	1.2.840.10008.5.1.4.1.2.1.2	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
Study Root Move	1.2.840.10008.5.1.4.1.2.2.2	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None

2.1.2.4.3 SOP Specific Conformance to Move SOP Classes

This implementation provides Standard conformance as SCU of C-MOVE.

2.1.2.5 Real World Activity 5 – Automatic Archive

When enabled, the Automatic Archive function on the Odyssey will automatically locate all image files that have not yet been archived and send them to the designated archive device. Scheduling of the automatic archive option is configurable, as is the types of files that will be archived, and the archive device to which the files should be sent.

The automatic archive function also provides the 'retry' capability when image export or Storage Commitment requests fail. When either of these occurs, the archive status of the related image file is reset to indicate that the image has not been archived. The automatic archive function will find these images and attempt to archive them again. A retry count is internally maintained. Once the retry count is exceeded, a failed export or Storage Commitment request will cause the image to be marked as 'Failed'. The operator can then take appropriate action to correct the problem and manually archive the image.

When an image is scheduled for archival by the Automatic Archive function, the DICOM activities involved in exporting the image and (optionally) requesting storage commitment are the same as are described in section 2.1.2.1.

2.1.3 Association Acceptance Policy

The image transfer (export) software never accepts associations.

When the image receive (import) software accepts an association, it will receive images or Storage Commitment responses transmitted on that association. Received images are converted to Odyssey format and entered in the Clinical Index for later review. Optionally, the received images are also saved in their original form to preserve all data elements. This option is useful if the images are to be retransmitted to another AE. Storage Commitment responses are processed as described in section 2.1.2.1.4 SOP Specific Conformance to Storage Commitment Push Model SOP Class.

The image receive software places no limitations on who may connect to it. There is also no limitation on the number of simultaneous connections it will support.

A new copy of the image receive software is spawned for each new association.

2.1.3.1 Associated Real-World Activity (Import)

The Real-World Activity associated with the C-STORE operation is the conversion of the image to an Odyssey image file, and the optional storage of the complete DICOM image object.

2.1.3.2 Accepted Presentation Context Table

Table 2.1.3.2-1 Acceptable Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None
CT Image	1.2.840.10008.5.1.4.1.1.2	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
MR Image	1.2.840.10008.5.1.4.1.1.4	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
NM Image	1.2.840.10008.5.1.4.1.1.20	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
PET Image	1.2.840.10008.5.1.4.1.1.128	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
SC Image	1.2.840.10008.5.1.4.1.1.7	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
Storage Commitment Push Model	1.2.840.10008.1.20.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None

2.1.3.3 SOP Specific Conformance

2.1.3.3.1 SOP Specific Conformance to Verification SOP Class

The image receive software provides standard conformance to the DICOM Verification Service Class.

2.1.3.3.2 SOP Specific Conformance to Storage SOP Classes (Import)

When the DICOM image save option is enabled, the complete DICOM image object is stored in a file. This constitutes Level 2 conformance. If this option is not enabled, the original DICOM image is not saved at all. In either case, an Odyssey image file is created using a subset of the elements of the received image. This image is entered in the Clinical Index and is available for viewing using the standard Odyssey image display functions.

If the Odyssey operator chooses to send an image to another AE, the original DICOM object file is used if available. If not available, and the image is an NM image, the Odyssey file is converted to a DICOM image and transmitted. Thus, when the image save option is disabled, the Odyssey image receive software is only providing Level 0 conformance. If the original DICOM image is not available, and the image is not an NM image, it cannot be retransmitted at all. In either case, the operator only has direct access to the Odyssey image file, which constitutes Level 0 conformance.

In the event of a successful C-STORE operation, the image has been successfully written to disk and/or converted to an Odyssey image file.

The image receive software never deletes an image file. The duration of the image storage is determined by the operator.

When Secondary Capture images with photometric interpretation equal to RGB are received, they are converted to black and white. No other color configuration is handled at this time (except those that were originally created in color on an Odyssey).

If the C-STORE operation is unsuccessful, the image receive software will return one of the following status codes:

Table 2.1.3.3.2-1 C-STORE error codes

Status code	Meaning
A700 (Out of Resources)	Indicates that there is not enough room to store or process the image. Recovery is left to the user.
A800 (SOP Class not supported)	Indicates that the SOP Class of the image in the C-STORE operation did not match the Abstract Syntax negotiated for the Presentation Context. This indicates a problem with the SCU of the Service Class.
C204 (System Error)	A system error has occurred while storing or processing the incoming image. Recovery is left to the user.
CF01 (Protocol Error)	Protocol violation detected on the association.

A warning condition will also be returned in certain cases in which the data set does not match the IOD of the SOP class. In this case it will attempt to process the image anyway, but will return the following status:

Table 2.1.3.3.2-2 C-STORE Warnings

Status code	Meaning
B006 (Elements Discarded)	One or more data elements in the received image were not saved. This can occur if the option to save incoming messages in their entirety is turned off.
B007 (Data Set does not match SOP Class)	One or more required data elements were not present in the received image.

2.1.3.3.3 Service Specific Conformance for CD-R Media Storage Class

The Odyssey provides Standard Conformance to the DICOM Data Interchange option of the Media Storage Service Class. The Application Profiles and roles are listed in table 2.1.3.3.3-1.

Table 2.1.3.3.3-1 Supported Application Profiles

Application Profile	Real World Activity	Role	Service Class Option
STD-GEN-CD	Display directory	FSR	Data Interchange
	Read image – copy to local storage.	FSR	Data Interchange

The Media Storage AE acts as a FSR when requested to provide a directory listing. It will read the DICOMDIR file and display a directory of all patient record entries in the File-set.

The Media Storage AE also acts as FSR when copying images from the CD-R to local storage. Only SOP Instances of the CT, MR, NM, PET or SC IODs can be copied.

2.1.3.3.4 SOP Specific Conformance to Storage Commitment Push Model SOP Class

In most situations the import AE is the one that will receive and process Storage Commitment results messages (N-EVENT-REPORT). These are processed as described in section

2.1.3.4 Presentation Context Acceptance Criterion

The image receive software will always accept a Presentation Context for the Verification SOP Class with the DICOM Default Transfer Syntax. It will also accept any of the presentation contexts listed in the table in section 2.1.3.2. The receive software replicates itself for each new association.

2.1.3.5 Transfer Syntax Selection Policies
The image export software supports both Implicit VR Little Endian and Explicit VR Little Endian transfer syntaxes for exporting images (C-STORE). If the destination AE (SCP) also accepts both, then the Odyssey will use the Explicit VR Little Endian transfer syntax.

The image receive software will receive images (C-STORE) using either Implicit VR Little Endian, or Explicit VR little Endian transfer syntax. The sending SCU selects the appropriate transfer syntax.

For Verification (C-ECHO), query/retrieve (C-FIND and C-MOVE), and Storage Commit operations, only the default Implicit VR Little Endian transfer syntax is supported. There is no selection.

3 Communication Profiles

3.1 Supported Communications Stacks (Parts 8,9)

The image transfer and receive software provides DICOM 3.0 TCP/IP Network Communications Support as defined in Part 8 of the DICOM Standard.

3.2 OSI Stack

No OSI stack communications are provided with this implementation.

3.3 TCP/IP Stack

The TCP/IP protocol stack is supported.

3.3.1 Physical Media Supported

The following media are supported:
1) Twisted pair Ethernet
2) Thinnet Ethernet
3) Thicknet Ethernet

3.4 Point to Point Stack

No point to point stack communications are provided with this implementation.

4 Extensions/Specializations/Privatizations

No specializations or privatizations are used in this implementation. The NM SOP Class may be extended as described in section 2.1.2.1.3. Standard conformance is provided for all other supported SOP classes.

5 Configuration

5.1 AE Title/Presentation Address Mapping

Each remote workstation is given a name, which appears on the list of destinations presented to the user when the DICOM file transfer option is selected from the Workbench. Each destination name corresponds to exactly one AE Title/host address pair.

5.2 Configurable Parameters

5.2.1 Export

The following parameters are configurable:

Table 5.2.1-1 Configuration Parameters for export function

Mode:	Determines the amount of diagnostic messages to be displayed as the images are transmitted.
For each destination:	
Protocol:	Determines whether exporting to a remote node using TCP/IP, or to a local disk file.
Port Number:	Port number on which to communicate with destination AE. The standard DICOM port is 104.
Odyssey Application Title:	The Odyssey Application Entity Title to use when opening an association with the destination AE.
Remote Application Title:	Application Entity Title of destination AE.
Remote IP Address:	The IP address of the destination AE.
Remote Node Name:	The Host name of the destination AE.
Workbench Menu Title:	The title of this destination as it will appear in the list of destinations on the DICOM transfer control panel.
Timeout Duration:	Maximum time to wait for a response before timing out.
Use Explicit VR if Supported:	Determines whether or not to propose Explicit VR transfer syntax when establishing an association for the purpose of exporting images (C-STORE).
Maximum PDU Size:	Determines the maximum PDU size to allow when establishing an association.
Modality for Exported Lightboxes:	Determines the 'Modality' designation that will be inserted into Lightbox images when they are exported (as Secondary Capture).
Export Lightboxes in Color:	Determines whether or not Lightbox images are exported as grayscale or color images. At present the only color format supported is PALETTE COLOR.
Query Search Type:	Determines whether or not wildcard characters are automatically added to the search string the operator enters.
Treat this Destination as an Archive:	Determines whether or not this destination is considered to be an archive. If it is not an archive, then images are not marked as 'archived' when they are exported to this destination.
Request Storage Commitment:	Determines whether or not Storage Commitment requests should be attempted when images are exported to this destination.
Remote Storage Commitment Port Number:	The port number to use when communication with the Storage Commitment SCP associated with this destination.

Remote Storage Commitment Application Title:	The Application Entity Title of the Storage Commitment SCP associated with this destination.
Remote Storage Commitment Host IP address:	The IP address of the Storage Commitment SCP.
Remote Storage Commitment Host Name:	The host name of the Storage Commitment SCP.
Remote Storage Commitment Wait Time (sec);	Amount of time the association is held open after the Storage Commitment request is sent, to see if the SCP returns a result right away. This is normally set to 0, as the Storage Commitment SCP will receive the results.

5.2.2 Import

The following parameters are configurable:

Table 5.2.2-1 Configuration Parameters for import function

Mode:	Determines the amount of diagnostic messages to be displayed as the images are received.
Save option:	Determines whether or not the original DICOM image is stored, in addition to the Odyssey file that is created from it.
Port Number:	Port number on which to receive association requests. The standard DICOM port is 104.
AE Title:	Application Entity Title for Odyssey image receive software.
Timeout:	Maximum time to wait for response before timing out.
Maximum PDU Size:	Determines the maximum PDU size to allow when an association is established.
Accept Explicit VR Transfer Syntax	Determines whether or not Explicit VR transfer syntax will be accepted if it is proposed by a storage SCU.
Allow Auto Archive of Imported Images:	Determines whether or not imported images will automatically be exported to an archive.
Allow COR corrections if appropriate:	Determines whether or not the Odyssey will apply COR corrections to incoming TOMO data when there is no indication that the COR corrections have already been applied and a COR correction factor is supplied.

5.2.3 Automatic Archive

The following parameters are configurable:

Table 5.2.3-1 Configuration Parameters for Automatic Archive

Scheduling:	Determines how often the automatic archive function runs.
File Types:	Determines the types of image files that will be automatically archived.
Block Deletion of Files Until Archived:	Determines whether or not files that have not been archived can be deleted.
Do Not Archive These Patients:	Allows specification of a list of patient names that will not be processed.
Auto Archive Destination:	Selects the archive device to which the automatic archive function will export images.
Search Remote (NFS) Disks:	Determines whether or not the automatic archive function will process files that reside on remotely mounted disks.
Mode:	Determines the level of diagnostic messages that will be displayed in the Odyssey console window when the automatic archive function runs.

6 Support of Extended Character Sets

The Latin alphabet No. 1, supplementary character set, identified as ISO_IR 100, is used and supported.