Philips
Medical
Systems

Integrated Digital Interface

Software Version D.1

Technical Data

DICOM
Conformance
Statement

REVISION HISTORY

Production Change Order	Rev	Date	Affected Sections/Pages	Summary of Change(s)
	A	11/25/02		Released D.0
	1	2/04/03		Reflected scheduled corrections and changes for Rev D.1
	2	2/11/03	Table 10	Scheduled Protocol Code Sequence and items are only included if present and valid in the MWL
	4	4/2/03	Table 3	Improved Storage error handling
	B	6/19/03	Cover page	Released D.1

Disclaimer

The specifications contained herein are subject to change.
Philips Medical Systems reserves the right to make any changes without prior notice. Philips Medical Systems, its subsidiaries or employees will not be held liable for incidental or consequential damages in connection with or arising from the use of this document or any of the information described.

Table of Contents

0 Introduction

DICOM (Digital Imaging and Communications in Medicine) is a standard that specifies how images and related clinical information are passed between medical devices that produce or use this data. The DICOM conformance statement is a required document for any device claiming conformance to DICOM.

This document defines the DICOM conformance of Philips Medical Systems ultrasound imaging systems configured with the Integrated Digital Interface (IDI) option. While the DICOM Conformance Statement is not intended to be a complete IDI product specification, some areas of this document will reference system operation where it is necessary to add a context for the discussion or to help explain a capability.

Definitions of Information Object and Communication Protocols are provided in this document.

0.1 References

ACR-NEMA Digital Imaging and Communications in Medicine, DICOM V3.0, 2001

1 Implementation Model

1.1 Application Data Flow Diagram
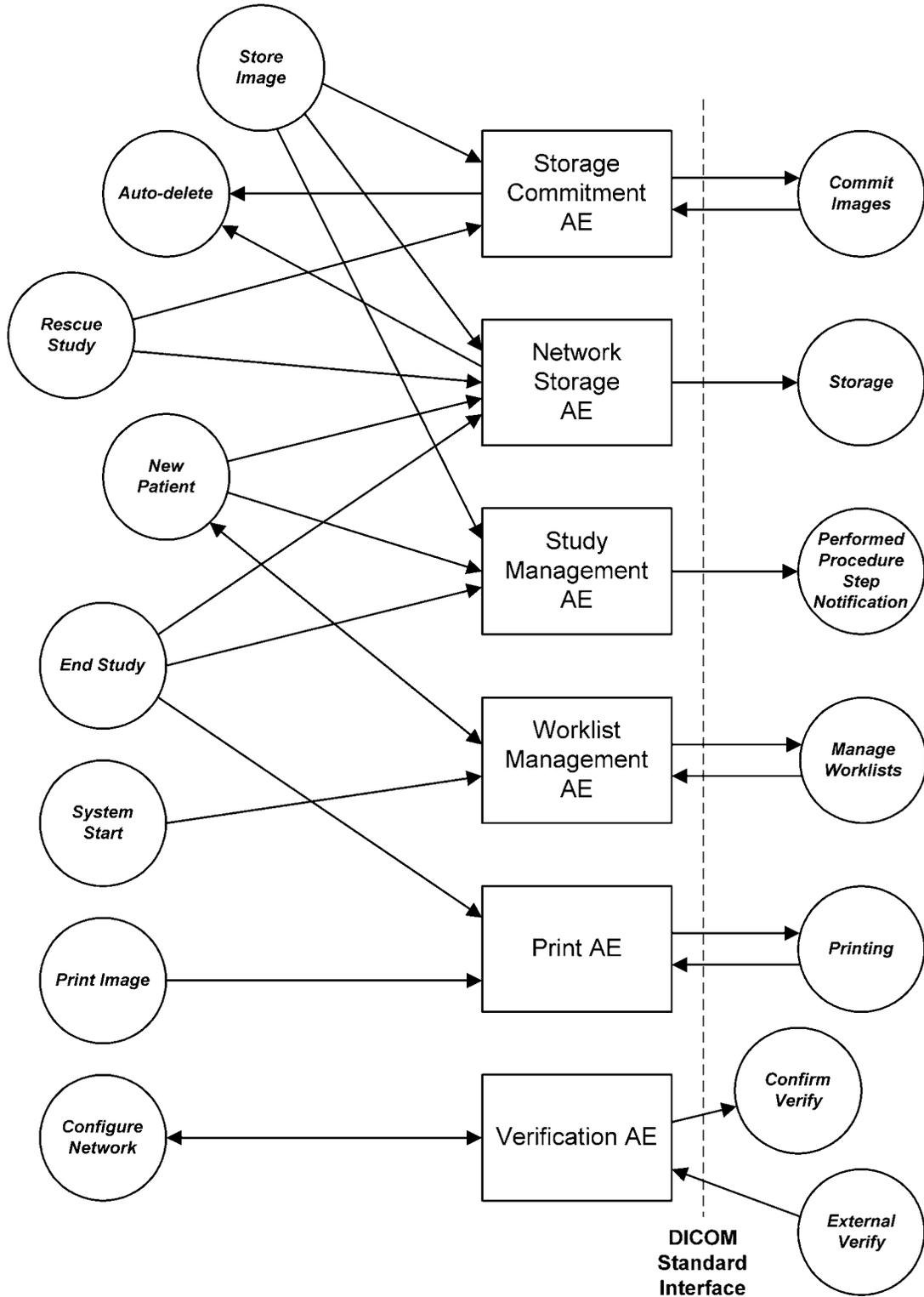
1.2 Functional Definition of Application Entities

1.2.1 Network Storage AE

The ultrasound system provides a set of configuration menus used to set up the network storage options. The configurable options include specification of the DICOM storage server (name, port number, AE title, and timeouts). Note that while IDI configuration determines the set of transfer syntaxes to be proposed, the actual transfer syntax for each association is selected by the Storage SCP from the proposed choices. A complete description of the configurable items and their effect on system operation are defined in Section 5.2 of this document.

The Network Storage AE internally queues the clinical and image data communicated by *Store Image* events from the ultrasound system and sends it to the remote storage SCP. Transfer may begin after an image is acquired and saved to local disk when the system is configured for "Network Autosend"; otherwise transfer will begin when the exam is finished by pressing "End Study". Each communicated object will be either an Ultrasound Image or an Ultrasound Multi-frame Image Information Object. The Network Storage AE transfers each object to the remote storage system through the Storage Service Class, and in particular the C-STORE standard service as a SCU. The Network Storage AE monitors the state of the association to the Storage SCP and uses the C-STORE response status indicator to assure each image is successfully transferred to the Storage SCP. If the Network Storage AE fails to make a network connection to the Storage SCP, or loses the connection during a transfer, it periodically attempts to reestablish the connection. Once the connection is established, transfer of images is resumed. Images are not removed from local storage until each image is successfully transferred to the Storage SCP (and committed, if the Storage Commitment service is being used).

1.2.2 Print AE

Print AE sends print studies/images to a remote DICOM Print device. It therefore performs the following tasks:

- Builds DICOM Basic Film Session, Basic Film Box, and Basic Grayscale or Color Image Box objects.

- Establishes and maintains a DICOM Association with the DICOM Print SCP.

- Performs transmit of DICOM objects to the DICOM Print SCP.

1.2.3 Verification AE

The Verification AE is a support application that assists the user in configuration and troubleshooting of network connections. Verification AE uses the C-ECHO service to verify a connection to a server, either explicitly through a user command, or implicitly to re-discover the server after a connection is lost.

In addition, if a verification Association is initiated by a remote entity, IDI will automatically respond with a success message, provided the requested AE Title matches the IDIs AE Title and that the IDI is aware of the external AE title.

1.2.4 Storage Commitment AE

The Storage Commitment AE works with the Network Storage AE. When a Storage Commitment AE is configured in the system, a Storage Commitment N-ACTION request is sent to the Storage Commitment SCP (Image Manager), following the image transfer to the Storage SCP (Image Archive). After a Storage Commitment N-EVENT-REPORT response is received from the Storage Commitment SCP, the associated images are scheduled to be cleaned from the local storage if autodelete is enabled.

1.2.5 Study Management AE

The Study Management AE allows for communicating the performed procedure steps to the Modality Performed Procedure Step (MPPS) SCP. A N-CREATE is issued after the first image in an exam is stored, setting the Performed Procedure Step Status to "In Progress". When the exam is finished, a N-SET is issued which updates the information in the MPPS to include the SOP Instance UIDs acquired in the study and change the status to "Completed". Alternatively, the exam may be canceled, changing the MPPS status to "Discontinued".

1.2.6 Worklist Management AE

The Worklist Management AE provides a mechanism of retrieving worklist information from a worklist server. A C-FIND "broad query" is performed when the system turned on, and is repeated on command by the user. Optionally, IDI may be configured to periodically re-query the MWL SCP for an updated list at a selected interval.

When a particular Scheduled Procedure Step (SPS) is selected from the worklist in preparation for beginning an exam, the demographic information from the SPS is displayed on the screen for the user to review and approve to ensure the correct patient study is selected prior to beginning acquisition.

1.3 Sequencing of Real-World Activities

1.3.1 Storage

Configuring the network must be done prior to other activities requiring network action from the ultrasound system. Appropriate association negotiation is done each time a network service is required (verifying the server or beginning transfer of images within a study). Images are sent to the configured Storage SCP either as they are acquired or at the end of acquisition.

After one or more images has been sent and acknowledged by the Storage SCP, if Storage Commitment is enabled a Storage Commitment N-ACTION request is sent to the Storage Commitment SCP.

If autodelete is enabled, images will be eligible for deletion ONLY after the images in the exam have all been successfully sent to the configured Storage and Print SCPs and Storage Commitment has succeeded if Storage Commitment is enabled.

A locally-saved exam may be "rescued"; that is, transmitted or re-transmitted to the Storage SCP upon operator command. When an exam is rescued, it becomes eligible for auto-deletion, just as in the case of live acquisition storage.

1.3.2 Print

- Specific film attributes are configured as desired, such as display format, orientation on each film, etc.

- Operator acquires print images.

- Print requests are placed on a queue, and are executed in the background.

- If the film transfer fails, Print AE attempts to re-send the film automatically.

1.3.3 Study Management

A worklist query is triggered by the *System Start* activity when the system is turned on, and the worklist may be queried periodically thereafter at a configurable poll interval or on demand by the *New Patient* activity while entering patient ID information.

IDI will create an "In Progress" MPPS when the first image of an exam is stored by the *Store Image* activity and then set the status to "Completed" and update MPPS information when the exam is completed by the *End Study* activity. The MPPS may be set "Discontinued" by either the *New Patient* or *System Start* activities.

2 Application Entity Specifications

All IDI Application Entities utilize and understand the following Application Context Name:

DICOM V3.0 Application Context	1.2.840.10008.3.1.1.1

2.1 Network Storage AE Specification

The Network Storage AE provides <u>Standard Extended</u> conformance to the following DICOM V3.0 SOP Classes as an SCU. Refer to Table 18 in Section 2.1.2.3.2.1 for a list of attributes extending the Standard SOP classes.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCU
Ultrasound Multi-frame Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.3.1	SCU
Ultrasound Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.6.1	SCU

Table 1: SOP Classes Supported by Network Storage AE

2.1.1 Association Establishment Policies

2.1.1.1 General

Maximum PDU size offered: 100,000 bytes.

2.1.1.2 Number of Associations

IDI may establish and maintain one association at a time to a given AE from the Network Storage, Storage Commitment, and Print AE's. Since only one storage destination may be specified at a time, this generally means there can be no more than one open association at a time from the Network Storage AE.

2.1.1.3 Asynchronous Nature

Multiple outstanding transactions are not supported. Replies are handled for the current transaction before another may be initiated.

2.1.1.4 Implementation Identifying Information

The Integrated Digital Interface is identified as shown in Table 2. Note that "<version>" in the Implementation Version Name is a string designating the IDI software version, which may change from time to time with software updates.

Element	Implementation Value
Implementation Class UID	1.2.840.113543.6.6.1.4
Implementation Version Name	"<version>"

Table 2: Implementation Identifying Information

2.1.2 Association Initiation By Real-World Activity

2.1.2.1 Configure Network Real-World Activity

The *Configure Network* activity does not initiate any association or services over the DICOM interface for the Network Storage AE. Configurable items may determine module attribute values, negotiated transfer syntaxes, and the selection of application entity acting as SCP for subsequent storage actions. See the Configuration Section 5.2 for more details.

2.1.2.2 New Patient Real World Activity

The *New Patient* activity does not initiate any association or services over the DICOM interface for the Network Storage AE. Rather, this activity is used to set the patient and study level information to be used in the *Store Image* and *End Study* activities by the Network Storage and other Application Entities. Patient identification information is manually entered or through the selection of entry of the Modality Worklist, a Study Instance UID is generated (if patient ID is not selected from a MWL), and other exam-level UIDs are synthesized.

2.1.2.3 Store Image Real World Activity

2.1.2.3.1 Associated Read-World Activity

The *Store Image* activity causes the storage of the image and related clinical data to local storage. Patient and study-level information entered by *the New Patient* activity and series and image-level information determined by the host imaging system, along with synthesized SOP Instance UIDs, are used in the creation of DICOM objects. This activity is repeated for each image in the study. If the system is not configured for "Network Autosend", the images will be held until triggered by the *End Study* activity. However, if the system is configured for "Network Autosend", images will begin to transfer very soon after they are stored on the local storage.

When one or more objects become eligible for transfer to the Storage SCP, an association is opened and a C-STORE event is initiated for each object to store. The Network Storage AE monitors the association status and uses the status indicator returned from the Storage SCP in determining the disposition of each image in the study. Table 3 describes the behavior of the Network Storage AE in response to various error conditions and C-STORE-RSP status indicators. All eligible objects are processed according to the behavior in Table 3.

Condition	Status Codes	Response
No Response (timeout)	none	Image object is kept in queue of objects to transfer. The open association is aborted, and after a wait period a new association is opened and storage is re-attempted.
Lost Association	none	Image object is kept in queue of objects to transfer. After a wait period, a new association is opened and storage is re-attempted
Error	Non-zero code not defined as "Refused" or "Warning"	Image object is removed from queue of objects to transfer and no retries are attempted. The failure is logged and autodelete of the exam is disallowed.
Refused	0xA7xx	Image object is removed from queue of objects to transfer. The open association is closed and the failure is logged, and after a wait period of 5 minutes a new association is opened and storage is re-attempted. If the failures persist up to the maximum of 96 retries (about 8 hours total), no further retries are attempted and autodelete of the exam is disallowed.
Warning	0xD000, 0x111, 0xB000, 0xB006, 0xB007	Ignored - actions are the same as "success" condition.
Success	0000	Image object is removed from queue of objects to transfer.

Table 3: Responses to Storage Error Conditions

2.1.2.3.2 Proposed Presentation Contexts

Each time the Network Storage AE initiates an association (as described in Section 2.1.2.3, the AE requests services summarized in Table 4. Note that the particular transfer syntaxes proposed are subject to user configuration. Transfer syntax is independently configurable for single-frame and multi-frame images.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Multi-frame Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.3.1	JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression	1.2.840.10008.1.2.4.50	SCU	None
		RLE Lossless	1.2.840.10008.1.2.5		
		Implicit VR Little Endian	1.2.840.10008.1.2		

Ultrasound Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.6.1	JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression	1.2.840.10008.1.2.4.50	SCU	None
		RLE Lossless	1.2.840.10008.1.2.5		
		Implicit VR Little Endian	1.2.840.10008.1.2		

Table 4: Proposed Presentation Contexts for the Network Storage AE

Initially, IDI attempts to open the association directly for the Ultrasound Image and/or Ultrasound Multi-frame Image SOP Class(es). If the SCP is or becomes unreachable, an association to the same SCP is periodically attempted for the Verification SOP Class until the SCP accepts the association and responds affirmatively to the C-ECHO-RQ. At that time, an association for the Image SOP Classes is re-attempted, and when accepted by the SCP the transfer resumes/begins.

Association requests include one or two Presentation Contexts for each SOP Class, depending on the configured transfer syntaxes:

- If a compressed transfer syntax is configured for a SOP Class (Ultrasound Image or Ultrasound Multi-frame Image), the association request includes two presentation contexts: one for the compressed transfer syntax and one for the Implicit VR Little Endian transfer syntax. If the SCP rejects the compressed transfer syntax, the service is marked as "Misconfigured" and objects are sent in the Implicit VR Little Endian transfer syntax; otherwise the objects are sent in the configured compressed transfer syntax.

- If only uncompressed transfer syntax is configured for a SOP Class, the association request includes only the uncompressed transfer syntax and the objects are sent to the SCP using Implicit VR Little Endian transfer syntax.

The values of certain image attributes used in the transfer of each image depends on a number of factors, including the transfer syntax accepted by the Storage SCP and the type of the image. Table 5 describes the relationships among these parameters.

Negotiated Transfer Syntax	Image Type	Resultant Attribute Values	
		Photometric Interpretation	Samples per Pixel and Bits per Sample
JPEG Baseline	All	YBR_FULL_422	3 8-bit samples / pixel
RLE	BW Image[1]	PALETTE_COLOR	1 8-bit sample / pixel

---

[1] BW Image refers to any 8-bit sample mode (for example, a "Colorization" image is an 8-bit sample image, which maps a sample to a color instead of a gray scale value).

Negotiated Transfer Syntax	Image Type	Resultant Attribute Values	
		Photometric Interpretation	Samples per Pixel and Bits per Sample
	Color Image[2]	PALETTE_COLOR	1 16-bit sample / pixel
	VCR Capture, Angio	RGB	3 8-bit samples / pixel
Implicit VR Little. Endian.	BW Image	PALETTE_COLOR Or MONOCHROME2, if Configured	1 8-bit sample / pixel
	Color Image, VCR Capture, Angio	RGB Or MONOCHROME2, if Configured	3 8-bit samples / pixel 1 8-bit sample / pixel

Table 5: Image Attributes based upon Transfer Syntax and Image Type

2.1.2.3.2.1 SOP Specific Conformance for "Ultrasound Image Storage"

The C-STORE DIMSE service conveys an instance of the Ultrasound Image Storage SOP Class. The Module content of the Ultrasound Image IOD is <u>Standard Extended</u> with the following usage of optional or conditional modules. Refer to Table 18 for a list of attributes extending the Standard SOP class.

IE	Module	Required	Usage
Patient	Patient	M	Used (mandatory)
Study	General Study	M	Used (mandatory)
	Patient Study	U	Used
Series	General Series	M	Used (mandatory)
Frame of Reference	Frame of Reference	U	Not Used
	US Frame of Reference	C	Not Used
Equipment	General Equipment	M	Used (mandatory)
Image	General Image	M	Used (mandatory)
	Image Pixel	M	Used (mandatory)
	Contrast/Bolus	C	Used if Contrast is selected during acquisition
	Palette Color lookup table	C	Used when Photometric Interpretation has a value of PALETTE COLOR (See Table 5)
	US Region Calibration	U	Used when calibration exists
	US Image	M	Used (mandatory)
	Overlay Plane	U	Not Used
	VOI LUT	U	Not Used
	SOP Common	M	Used (mandatory)
Curve	Curve Identification	M	Not used
	Curve	M	(The Curve IE is mutually exclusive with the Image IE)
	Audio	U	
	SOP Common	M	

---

[2] Color Image refers to most 16-bit sample modes (including images produced in Color Flow, Acoustic Quantification, Acoustic Densitometry, and Color Kinesis modes.

IE	Module	Required	Usage

Table 6: Usage of US Image IOD Modules

Each module has a table below indicating supported attributes and the attributes' source. Any special conditions pertaining to the listed elements will appear below the table. Note that an attribute is omitted from a Module table if it has already been discussed in a previous Module, unless it is augmented in the later Module.

Attribute Name	Tag	Type	Description & Source
Patient's Name	(0010,0010)	2	Full name entered into patient ID screen of ultrasound system or from the Modality Worklist. NULL if no name entered
Patient ID	(0010,0020)	2	Patient ID entered into patient ID screen of ultrasound system or from the Modality Worklist. NULL if no ID entered.
Patient's Birth Date	(0010,0030)	2	Value from the "DOB" field of the Patient ID screen; else NULL.
Patient's Sex	(0010,0040)	2	Value from the "Sex" field of the Patient ID screen; else NULL.
Patient Comments	(0010,4000)	3	Content of the "Misc" field on the Patient ID screen.

Table 7: Patient Module Elements

Attribute Name	Tag	Type	Description & Source
Study Instance UID	(0020,000D)	1	Uniquely generated for each study or obtained from the Modality Worklist.
Study Date	(0008,0020)	2	System date setting at time the first image of the study was acquired, if known. NULL if not known.
Study Time	(0008,0030)	2	System time setting at time the first image of the study was acquired, if known. NULL if not known.
Referring Physician's Name	(0008,0090)	2	"Physician" entered into patient ID screen of ultrasound system or from the Modality Worklist. NULL if no name is entered or available.
Study ID	(0020,0010)	2	A system-generated number for the study
Accession Number	(0008,0050)	2	"Accession" entered into Patient ID screen or from the Modality Worklist. NULL if none entered or available.
Study Description	(0008,1030)	3	If Modality Worklist is entered, one of the following (in order of priority): Requested Procedure Description SPS Description Scheduled Protocol Code Sequence "Code Meaning"

Attribute Name	Tag	Type	Description & Source
			If none available or if MWL not used, set to "Stress Echo" if exam is a Stress Exam; otherwise omitted.
Referenced Study Sequence	(0008,1110)	3	Included if present in the MWL
> Referenced SOP Class UID	(0008,1150)	1C	From the Modality Worklist
> Referenced SOP Instance UID	(0008,1155)	1C	From the Modality Worklist

Table 8: General Study Module Elements

Attribute Name	Tag	Type	Description & Source
Patient's Age	(0010,1010)	3	Included if patient date of birth was entered in patient ID screen or is included in Modality Worklist information.
Patient's Size	(0010,1020)	3	Included if entered in patient ID screen or included in Modality Worklist information.
Patient's Weight	(0010,1030)	3	Included if entered in patient ID screen or included in Modality Worklist information.

Table 9: Patient Study Module Elements

Attribute Name	Tag	Type	Description & Source
Modality	(0008,0060)	1	"US" (Ultrasound)
Series Instance UID	(0020,000E)	1	Synthesized
Series Number	(0020,0011)	2	Synthesized
Performing Physician's Name	(0008,1050)	3	Value from the "Performed By" field of the Patient ID screen; else omitted.
Operator's Name	(0008,1070)		
Protocol Name	(0018,1030)	3	Description of the conditions under which the image was acquired. In the case of an image acquired during a stress exam, the Protocol Name describes the stress protocol used.
Series Description	(0008,103E)	3	"Indication" entered into patient ID screen of ultrasound system or information from the Modality Worklist.
Referenced Study Component Sequence	(0008,1111)	3	Included
>Referenced SOP Class UID	(0008,1150)	1C	MPPS SOP Class UID 1.2.840.10008.3.1.2.3.3
>Referenced SOP Instance UID	(0008,1155)	1C	Synthesized MPPS SOP Instance UID
Request Attributes Sequence	(0040,0275)	3	Included if MWL was used as ID for this acquisition.
>Requested Procedure ID	(0040,1001)	1C	Identifier from the Modality Worklist

Attribute Name	Tag	Type	Description & Source
>Scheduled Procedure Step ID	(0040,0009)	1C	Identifier from the Modality Worklist
> Scheduled Procedure Step Description	(0040,0007)	3	Included if present in the MWL
> Scheduled Protocol Code Seq	(0040,0008)	3	Included if present in the MWL and at least one item is valid (i.e., all Type 1 attributes available from the MWL.
>>Code Value	(0008,0100)	1C	Included from the MWL if all required attributes for the item are present
>>Coding Scheme Designator	(0008,0102)	1C	Included from the MWL if all required attributes for the item are present
>>Coding Scheme Version	(0008,0103)	1C	Included from the MWL if all required attributes for the item are present
>>Code Meaning	(0008,0104)	1C	Included from the MWL if all required attributes for the item are present
Performed Procedure Step ID	(0040,0253)	3	Included if present in the MWL
Performed Procedure Step Start Date	(0040,0244)	3	Date on which the Performed Procedure Step started
Performed Procedure Step Start Time	(0040,0245)	3	Time at which the Performed Procedure Step started

Table 10: General Series Attributes

Attribute Name	Tag	Type	Description & Source
Manufacturer	(0008,0070)	2	"Philips_Medical_Systems"
Institution Name	(0008,0080)	3	"Institution Name" configured on the host imaging system.

Table 11: General Equipment Module Attributes

Attribute Name	Tag	Type	Description & Source
Instance Number	(0020,0013)	2	A number, unique within the MPPS, identifying the image.
Patient Orientation	(0020,0020)	2C	NULL
Content Date	(0008,0023)	2C	Date image was acquired, if known; NULL otherwise.
Content Time	(0008,0033)	2C	Time image was acquired, if known; NULL otherwise.
Derivation Description	(0008,2111)	3	If this is a JPEG compressed image, this attribute contains a string indicating lossy JPEG and the quality measure from the network configuration screen; "ORIGINAL" otherwise.
Image Comments	(0020,4000)	3	Includes user-entered comment requested by the ultrasound system when the image is stored. For protocol images, this will contain equipment generated or previously configured storage comments.

Table 12: General Image Storage Module Attributes

Attribute Name	Tag	Type	Description & Source
Samples Per Pixel	(0028,0002)	1	Value = 1 or 3. See Table 5
Photometric Interpretation	(0028,0004)	1	Value depends on source image and negotiated transfer syntax. See Table 5
Rows	(0028,0010)	1	Number of pixel rows
Columns	(0028,0011)	1	Number of pixel columns
Bits Allocated	(0028,0100)	1	Value = 8 or 16. See Table 5
Bits Stored	(0028,0101)	1	Value = Bits Allocated (8 or 16)
High Bit	(0028,0102)	1	Value = Bits Allocated - 1 (7 or 15)
Pixel Representation	(0028,0103)	1	0000H = unsigned integer
Pixel Data	(7FE0,0010)	1	Pixel data
Planar Configuration	(0028,0006)	1C	If Samples per Pixel is greater than 1, set to 000 = R1,G1,B1,R2,G2,B2,.... Omitted otherwise.
Pixel Aspect Ratio	(0028,0034)	1C	Ratio of vertical pixel size to horizontal pixel size (V,H). Included unless square pixels are configured on.
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Included if using PALETTE_COLOR
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Included if using PALETTE_COLOR
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Included if using PALETTE_COLOR
Red Palette Color Lookup Table Data	(0028,1201)	1C	Included if using PALETTE_COLOR
Green Palette Color Lookup Table Data	(0028,1202)	1C	Included if using PALETTE_COLOR
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Included if using PALETTE_COLOR

Table 13: Image Pixel Module Attributes

Attribute Name	Tag	Type	Description & Source
Contrast/Bolus Agent	(0018,0010)	2	Included if Contrast selected during acquisition

Table 14: Contrast/Bolus Module Attributes

Attribute Name	Tag	Type	Description & Source
Palette Color Lookup Table UID	(0028,1199)	3	Included if using PALETTE_COLOR

Table 15: Palette Color Lookup Module Attributes

Attribute Name	Tag	Type	Description & Source
Sequence of Ultrasound Regions	(0018,6011)	1	Defines a sequence of calibration regions
>Region Location Min x0	(0018,6018)	1	Upper left point of region where (x,y) = (0,0) is upper left corner of image.
>Region Location Min y0	(0018,601A)	1	
>Region Location Max x1	(0018,601C)	1	Lower right point of region where (x,y) = (0,0) is upper left corner of image.
>Region Location Max y1	(0018,601E)	1	
>Physical Units X Direction	(0018,6024)	1	Units in X direction which Physical Delta X and Ref. Pixel Physical Value X are measured in.
>Physical Units Y Direction	(0018,6026)	1	Units in Y direction which Physical Delta Y and Ref. Pixel Physical Value

Attribute Name	Tag	Type	Description & Source
			Y are measured in.
>Physical Delta X	(0018,602C)	1	Difference in physical value, in terms of above units, a move of 1 pixel in the positive X direction corresponds to.
>Physical Delta Y	(0018,602E)	1	Difference in physical value, in terms of above units, a move of 1 pixel in the positive Y direction corresponds to.
>Reference Pixel x_0	(0018,6020)	3	Used in some waveform and spectral displays where an absolute pixel value in the region should be established.
>Reference Pixel y_0	(0018,6022)		
>Ref. Pixel Physical Value X	(0018,6028)	3	Used in some waveform and spectral displays where an absolute pixel value in the region should be established.
>Ref. Pixel Physical Value Y	(0018,602A)	3	Used in some waveform and spectral displays where an absolute pixel value in the region should be established. This will be the Y value in "Physical Units Y Direction" units at the Reference Pixel.
>Region Spatial Format	(0018,6012)	1	Spatial organization of region data
>Region Data Type	(0018,6014)	1	Type of data within the region
>Region Flags	(0018,6016)	1	Transparent + Protected Except in Spectral Doppler regions, where two regions are provided: Transparent + Protected + Velocity and Transparent + Protected + Frequency

Table 16: US Region Calibration Module Attributes

Attribute Name	Tag	Type	Description & Source
Image Type	(0008,0008)	2	Value 1 = "DERIVED" if JPEG compressed image, "ORIGINAL" otherwise

Value 2 = "SECONDARY" if the image was captured from VCR; "PRIMARY" otherwise.

Values 3 and 4 = NULL |
| Lossy Image Compression | (0028,2110) | 1C | Set to 01 if the image came from a lossy source (such as VCR capture or quad-screen) or has undergone lossy (JPEG) compression.

Set to 00 otherwise. |
Number of Stages	(0008,2124)	2C	Included if this image is acquired as part of a protocol study.
Number of Views in Stage	(0008,212A)	2C	Included if this image is acquired as part of a protocol study.
Ultrasound Color Data Present	(0028,0014)	3	00 if MONOCHROME option is enabled; 01 otherwise.
Stage Name	(0008,2120)	3	Included if this image is acquired as part of a protocol study or while the protocol is paused within a protocol study.

Note: If custom names are used or if standard names are not being converted to DICOM Stage Names |

Attribute Name	Tag	Type	Description & Source
			(see Section 5.2.2), the name could be in a language other than English.
Stage Number	(0008,2122)	3	Included if this image is acquired as part of a protocol study or while the protocol is paused within a protocol study.
View Name	(0008,2127)	3	Included if this image is acquired as part of a protocol study. More than one image may contain the same Stage Name / View Name combination.
View Number	(0008,2128)	3	Included if this image is acquired as part of a protocol study. More than one image may contain the same Stage Number / View Number combination.
Number of Event Timers	(0008,2129)	3	Included if an event timer was used during image acquisition.
Event Elapsed Time(s)	(0008,2130)	3	Included if "Number of Event Timers" is not 0.
Event Timer Name(s)	(0008,2132)	3	Included if "Number of Event Timers" is not 0.
Heart Rate	(0018,1088)	3	Beats per minute, derived from ultrasound system ECG

Table 17: US Image Module Attributes

Attribute Name	Tag	Type	Description & Source
Study Status ID	(0032,000A)	3	"STARTED"
Performed Location	(0040,0243)	3	"Location" entered into patient ID screen of ultrasound system "

Table 18: Extended Attributes Not Part of the Standard SOP Class

Attribute Name	Tag	Type	Description & Source
SOP Class UID	(0008,0016)	1	US Image Storage (1.2.840.10008.5.1.4.1.1.6.1)
SOP Instance UID	(0008,0018)	1	UID generated for each instance
Specific Character Set	(0008,0005)	1C	Present with value of "ISO_IR_100" (Latin #1) if one or more characters are not in the DICOM default character set. See Section 6.
Instance Creator UID	(0008,0014)	3	UID generated for each IDI device.

Table 19: SOP Common Module Attributes

2.1.2.3.2.2 SOP Specific Conformance for Ultrasound Multi-frame Image Storage

The C-STORE DIMSE service conveys an instance of the Ultrasound Image Storage SOP Class. The Module content of the Ultrasound Image IOD is <u>Standard Extended</u> with the following usage of optional or conditional modules. Refer to Table 18 in Section 2.1.2.3.2.1 for a list of attributes extending the Standard SOP class.

IE	Module	Required	Usage
Patient	Patient	M	Used (mandatory)
Study	General Study	M	Used (mandatory)
	Patient Study	U	Used
Series	General Series	M	Used (mandatory)
Frame of Reference	Frame of Reference	U	Not Used
	US Frame of Reference	C	Not Used
Equipment	General Equipment	M	Used (mandatory)
Image	General Image	M	Used (mandatory)
	Image Pixel	M	Used (mandatory)
	Contrast/Bolus	C	Used if Contrast selected during acquisition
	Cine	M	Used (mandatory)
	Multi-frame	M	Used (mandatory)
	Palette Color lookup table	C	Used when Photometric Interpretation has a value of PALETTE COLOR (See Table 5)
	US Region Calibration	U	Used when calibration exists.
	US Image	M	Used (mandatory)
	VOI LUT	U	Not Used
	SOP Common	M	Used (mandatory)
Curve	Curve Identification	M	Not used
	Curve	M	(The Curve IE is mutually exclusive with the Image IE)
	Audio	U	
	SOP Common	M	

Table 20: Usage of US Multi-Frame Image IOD Modules

Additions and differences to module attributes from the US Image Storage SOP to the US Multi-frame Image Storage SOP are listed below. Omitted attributes and tables are expected to have the same implementation as the US Image Storage SOP.

Attribute Name	Tag	Type	Description & Source
Frame Time	(0018,1063)	1C	Time per frame (in msec) [3]
Frame Time Vector	(0018,1065)	1C	Table of frame/frame times (in msec) [3]
Recommended Display Frame Rate	(0008,2144)	3	Average frame rate over all frames in the multi-frame image.
Cine Rate	(0018,0040)	3	Average frame rate over all frames in the multi-frame image.

Table 21: Cine Module Attributes

Attribute Name	Tag	Type	Description & Source
Number of Frames	(0028,0008)	1	Number of frames in the image
Frame Increment Pointer	(0028,0009)	1	Reference to either "Frame Time" or "Frame Time Vector"

Table 22: Multi-Frame Module Attributes

Attribute Name	Tag	Type	Description & Source
SOP Class UID	(0008,0016)	1	US Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)

Table 23: SOP Common Module Attributes Modified for Multi-Frame

2.1.2.4 End Study Real World Activity

The *End Study* activity has the effect of ending the current exam and, if "Network Autosend" is not enabled, initiating the transfer of the stored study over the network to the Storage SCP. Association activity in this case is similar to that described in Section 2.1.2.3.

2.1.2.5 Rescue Study Real World Activity

The *Rescue Study* activity causes an exam to be re-sent to the Storage SCP. Attributes that originate from a Scheduled Procedure Step (SPS) are not available in rescued images if the SPS is no longer available in the current Modality Worklist.

2.1.3 Association Acceptance Policy

No associations are accepted by the Network Storage AE.

---

[3] The "Frame Time" attribute is standard for multi-frame images; "Frame Time Vector" may be configured to be used instead of Frame Time. See Section 5.2.2.

2.2 Print AE Specification

The Print AE provides <u>Standard Extended</u> Conformance to the following DICOM V3.0 SOP Classes as an SCU. Optional attributes that extend the Standard SOP Classes are indicated in Table 26 and Table 28.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCU
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	SCU
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	SCU
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4	SCU
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	SCU
Basic Color Image Box SOP Class	1.2.840.10008.5.1.1.4.1	SCU
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	SCU
Printer SOP Class	1.2.840.10008.5.1.1.16	SCU

Table 24: SOP Classes Supported by Print AE

2.2.1 Association Establishment Policies

2.2.1.1 General

Maximum PDU size offered: 100,000 bytes.

2.2.1.2 Number of Associations

IDI may establish and maintain one association at a time to a given AE from the Network Storage, Storage Commitment, and Print AE's. Since up to two printer destination may be specified at a time, this generally means there can be up to two open associations at a time from the Print AE.

2.2.1.3 Asynchronous Nature

Print AE allows a single outstanding operation on any association. Therefore, Print AE does not support asynchronous operations window negotiation, other than the default as specified by the DICOM specification.

2.2.1.4 Implementation identifying information

The Print AE has the same implementation identifying information as shown in section 2.1.1.4.

2.2.2 Association Initiation by Real-World Activity

Print AE will issue Print Management requests to an SCP supporting the DICOM V3.0 Print services, in order to produce hard copy representations of DICOM images.

2.2.2.1 Configure Network Real-World Activity

The *Configure Network* activity does not initiate any association or services over the DICOM interface for Print AE. Configurable items may determine module attribute values and the selection of application entity acting as SCP for subsequent storage actions. Refer to the Tables in the Section and the Configuration Section 5.2 for more details.

Up to two DICOM Printers may be used concurrently: one for printing grayscale data (designated "BW") and one for printing color or grayscale data (designated "Color"). Each printer may be individually configured as to the attributes values used in printing. The host imaging system may automatically decide which printer to use for each type of image it generates, or the user can manually designate the printer destination for each image stored. Note that the "BW" and "Color" printers may not be configured to be the same physical DICOM printer (i.e., may not have the same AE Title).

2.2.2.2 Print Image Real-World Activity

2.2.2.2.1 Associated Read-World Activity

An image is designated to print when it is stored by the *Store Image* activity with DICOM Print selected on the host imaging system control panel. This is the *Print Image* Real-World Activity.

As with Network Storage, if the system is not configured for "Network Autosend" the images will be held until triggered by the *End Study* activity before sending to the SCPs. However, if the system <u>is</u> configured for "Network Autosend", an association will be opened and images will begin to transfer soon after enough images have been designated to print to fill a page on the destination printer (based on the setting of the Image Display Format attribute (2010,0010)).

2.2.2.2.2 Proposed Presentation Contexts - Print

Print AE proposes and supports the following Presentation Contexts for Print.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Printer SOP Class	1.2.840.10008.5.1.1.18	Implicit VR Little Endian	1.2.840.10008.1.1.16	SCU	None

Table 25: Proposed Presentation Contexts for the Print AE

Initially, IDI attempts to open the association directly for appropriate Print SOP Class(es). If the SCP is or becomes unreachable, an association to the same SCP

is periodically attempted for the Verification SOP Class until the SCP accepts the association and responds affirmatively to the C-ECHO-RQ. At that time, an association for the Print SOP Class is re-attempted and the transfer of print data continues.

In addition to the SOP Classes listed above, IDI proposes but does not support any DIMSE services for the following SOP Classes:
- Referenced Grayscale Print Management Meta-SOP Class
- Referenced Color Print Management Meta-SOP Class
- Basic Annotation Box SOP Class
- Print Job SOP Class
- Presentation LUT SOP Class

2.2.2.2.2.1 SOP Specific Conformance for Basic Film Session SOP Class

Print AE issues the N-CREATE command for the Basic Film Session SOP Class. Optional (Usage "U") attributes that are not used by the Print AE are omitted from the attribute tables.

Attribute Name	Tag	Usage	Attribute Description	
			Options	**Default**
Number of Copies	(2000,0010)	U	[1 to 99]	1
Print Priority	(2000,0020)	U	HIGH MED LOW	MED
Medium Type	(2000,0030)	U	PAPER CLEAR FILM BLUE FILM	PAPER
Film Destination	(2000,0040)	U	MAGAZINE PROCESSOR BIN_i	PROCESSOR
Film Session Label	(2000,0050)	U	NULL	
Printer Name	(2110,0030)	Extended	From Printer N-GET	<empty>
Manufacturer	(0008,0070)	Extended	From Printer N-GET	<empty>
Manufacturer Model Name	(0008,1090)	Extended	From Printer N-GET	<empty>

Table 26: Basic Film Session Attributes

2.2.2.2.2.2 SOP Specific Conformance for Basic Film Box SOP Class

Print AE issues the following DIMSE-N commands for the Basic Film Box SOP Class. Optional (Usage "U") attributes that are not used by the Print AE are omitted from the attribute tables.

N-CREATE

Attribute Name	Tag	Usage	Attribute Description	
			Options	**Default**
Image Display Format	(2010,0010)	M	Only STANDARD*cols,rows* is supported	STANDARD\2,3
Referenced Film Session Sequence	(2010,0500)	M	Always set	
> Referenced SOP Class UID	(0008,1150)	M	Always set	
> Referenced SOP Instance UID	(0008,1155)	M	Always set	
Film Orientation	(2010,0040)	U	PORTRAIT LANDSCAPE	PORTRAIT
Film Size ID	(2010,0050)	U	8INX10IN, 8_5INX11IN, 10INX12IN, 10INX14IN, 11INX14IN, 11INX17IN, 14INX14IN, 14INX17IN, 24CMX24CM, 24CMX30CM, A3, A4, … (defined terms)	8INX10IN
Magnification Type	(2010,0060)	U	REPLICATE, BILINEAR, CUBIC, NONE, … (defined terms)	CUBIC
Max Density	(2010,0130)	U	0-399	[empty]
Configuration Information	(2010,0150)	U	[Text string] Vendor specific information	Not apply if this field is empty or missing
Smoothing Type	(2010,0080)	U	This parameter is valid and applied only if Magnification Type is CUBIC	NORMAL
Border Density	(2010,0100)	U[4]	BLACK, WHITE or a density number: 0-399	BLACK
Empty Image Density	(2010,0110)	U[4]	BLACK, WHITE or a density number: 0-399	BLACK
Min Density	(2010,0120)	U[4]	0-399	[empty]
Trim	(2010,0140)	U	YES, NO	YES

Table 27: Basic Film Box Attributes

N-ACTION

Print AE supports only STANDARD formats (i.e., "STANDARD\cols,rows") with details dependent upon the resolution and capabilities of printer. Other DICOM Image Display Formats are not supported.

---

[4] Note that if the N-CREATE-RSP returns an error status 105h or 106h, the N-CREATE is retried with the attributes Border Density, Empty Image Density, and Min Density removed from the N-CREATE-RQ.

2.2.2.2.2.3 SOP Specific Conformance for Basic Grayscale Image Box SOP Class

Print AE issues the N-SET command for the Basic Grayscale Image Box SOP Class. Optional (Usage "U") attributes that are not used by the Print AE are omitted from the attribute tables.

Attribute Name	Tag	Usage	Attribute Description	
			Options	**Default**
Image Position	(2020,0010)	M	Always set	
Basic Grayscale Image Sequence	(2020,0110)	M	Always set	
>Samples Per Pixel	(0028,0002)	M	Always set (1)	
>Photometric Interpretation	(0028,0004)	M	Always set (MONOCHROME2)	
>Rows	(0028,0010)	M	Always set	
>Columns	(0028,0011)	M	Always set	
>Pixel Aspect Ratio	(0028,0034)	MC	Always set	
>Bits Allocated	(0028,0100)	M	Always set (8)	
>Bits Stored	(0028,0101)	M	Always set (8)	
>High Bit	(0028,0102)	M	Always set (7)	
>Pixel Representation	(0028,0103)	M	Always set (0)	
> Window Center	(0028,1050)	Extended	[string value] Apply only when photometric interpretation is either MONOCHROME1 or MONOCHROME2	[empty] Not apply if either window center or window width is empty or missing
> Window Width	(0028,1051)	Extended	[string value] Apply only when photometric interpretation is either MONOCHROME1 or MONOCHROME2	[empty] Not apply if either window center or window width is empty or missing
>Pixel Data	(7FE0,0010)	M	Always set	
Polarity	(2020,0020)	U	NORMAL REVERSE	NORMAL
Magnification Type	(2010,0060)	U	REPLICATE, BILINEAR, CUBIC, NONE, … (defined terms)	CUBIC
Smoothing Type	(2010,0080)	U	This parameter is valid and applied only if Magnification Type is CUBIC	NORMAL

Table 28: Basic Grayscale Image Box Attributes

2.2.2.2.2.4   SOP Specific Conformance for Basic Color Image Box SOP Class

Print AE issues the N-SET command for the Basic Color Image Box SOP Class. Optional (Usage "U") attributes that are not used by the Print AE are omitted from the attribute tables.

Attribute Name	Tag	Usage	Attribute Description	
			Options	**Default**
Image Position	(2020,0010)	M	Always set	
Basic Color Image Sequence	(2020,0111)	M	Always set	
>Samples Per Pixel	(0028,0002)	M	Always set (3)	
>Photometric Interpretation	(0028,0004)	M	Always set (RGB)	
>Planar Configuration	(0028,0006)	M	Always set (0)	
>Rows	(0028,0010)	M	Always set	
>Columns	(0028,0011)	M	Always set	
>Pixel Aspect Ratio	(0028,0034)	MC	Always set	
>Bits Allocated	(0028,0100)	M	Always set (8)	
>Bits Stored	(0028,0101)	M	Always set (8)	
>High Bit	(0028,0102)	M	Always set (7)	
>Pixel Representation	(0028,0103)	M	Always set (0)	
>Pixel Data	(7FE0,0010)	M	Always set	
Polarity	(2020,0020)	U	NORMAL REVERSE	NORMAL
Magnification Type	(2010,0060)	U	REPLICATE, BILINEAR, CUBIC, NONE, … (defined terms)	CUBIC
Smoothing Type	(2010,0080)	U	This parameter is valid and applied only if Magnification Type is CUBIC	NORMAL

Table 29: Basic Color Image Box Attributes

2.2.2.2.2.5 SOP Specific Conformance for Printer SOP Class

Print AE issues the N-GET command to retrieve the following Printer SOP Class information:

Attribute Name	Tag	Usage SCU
Printer Status	(2110,0010)	U
Printer Status Info	(2110,0020)	U
Printer Name	(2110,0030)	U
Manufacturer	(0008,0070)	U
Manufacturer's Model Name	(0008,1090)	U

Table 30: Printer Attributes

2.2.2.2.2.6 SOP Specific Conformance for Basic Grayscale Print Management Meta SOP Class

The Meta SOP class is supported at negotiation, but is not implemented as the individual SOP classes defined by the DICOM specification.

2.2.2.2.2.7 SOP Specific Conformance for Basic Color Print Management Meta SOP Class

The Meta SOP class is supported at negotiation, but is not implemented as the individual SOP classes defined by the DICOM specification.

2.2.2.3 End Study Real World Activity

The *End Study* activity ends the current exam. If "Network Autosend" is not enabled, *End Study* initiates the transfer of the images designated to print over the network to the appropriate Print SCPs. Any partially-full pages are sent to the printer at this time. Association activity in this case is similar to that described in Section 2.2.2.2.

2.2.2.4 Rescue Study Real World Activity

The *Rescue Study* activity causes each image that was designated to print when it was originally stored by the *Store Image* activity (by DICOM Print selected on the host imaging system control panel) to be reprinted. See Section 2.2.2.2 for details.

2.2.3 Association Acceptance Policy

No associations are accepted by the Print AE.

2.3 Verification AE Specification

The Verification AE provides standard conformance to the DICOM SOP Class shown in Table 31. Note that the entity provides conformance for this service in the roles of both SCU and SCP.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCU or SCP

Table 31: SOP Class Supported by Verification AE

2.3.1 Association Establishment Policies

2.3.1.1 General

Maximum PDU size offered: 100,000 bytes.

2.3.1.2 Number of Associations

There can be no more than one open association at a time from the Verification AE.

Each incoming verification request to the Verification SCP opens one association. The maximum number of simultaneous associations accepted by IDI is set at 32. This applies across all AEs specified.

2.3.1.3 Asynchronous Nature

Multiple outstanding transactions on a single association are not supported. Replies are handled for the current transaction before another may be initiated.

2.3.1.4 Implementation Identifying Information

The Verification AE has the same implementation identifying information as shown in section 2.1.1.4.

2.3.2 Association Initiation By Real-World Activity

2.3.2.1 Configure Network Real-World Activity

2.3.2.1.1 Associated Read-World Activity

Using the "VEIRFYSERVER" command in the Network Utilities will cause the IDI to attempt to verify the named server. This will cause an association for the Verification SOP Class to be opened. A C-ECHO event is initiated to the chosen server, and the user is notified if a successful C-ECHO-RSP is received.

2.3.2.1.2 Proposed Presentation Contexts

Only one association is established for each verification attempt. When the association is opened, the presentation contexts noted in Table 32 are proposed.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 32: Proposed Presentation Context for Verification SCU

2.3.2.1.2.1 SOP Specific Conformance for Verification SOP Class

The C-ECHO request primitive is sent to the Verification SCP. The C-ECHO response primitive is returned by the Verification SCP with a status indicator of success. The absence of a C-ECHO response within a specific timeout period is an indication that the server cannot be located through the Verification service.

2.3.3 Association Acceptance Policy

2.3.3.1 External Verify Real-World Activity

2.3.3.1.1 Associated Real World Activity

IDI will respond to E*xternal Verification* requests to provide an external Verification SCU with an indication that IDI's DICOM functionality is present on the network.

2.3.3.1.2 Presentation Context Table – Verification SCP

IDI will accept associations for the Verification SOP as stated in Table 33.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

Table 33: Accepted Presentation Contexts for Verification SCP

2.3.3.1.2.1 SOP Specific Conformance for Verification SOP Class

The Verification AE provides standard conformance to the DICOM Verification Service Class. IDI returns the following status code.

Condition	Status Codes	Description
Success	0000	Operation performed properly.

Table 34: Verification status codes

2.3.3.1.3 Presentation Context Acceptance Criterion

Associations are <u>only</u> accepted from Verification SCUs that are defined in the list of configured servers (see Section 5.2.1); otherwise the association will be rejected.

2.3.3.1.4 Transfer Syntax Selection Policies

Only the Implicit VR Little Endian transfer syntax is accepted for Verification associations.

2.4 Storage Commitment AE Specification

The Storage Commitment AE provides Standard Conformance to the following DICOM V3.0 SOP Classes as an SCU.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCU
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	SCU

Table 35: SOP Class Supported by Storage Commitment AE

When the Storage Commitment service is enabled, Storage Commitment N-ACTION requests are sent to the configured Storage Commitment SCP for all objects of the Ultrasound Image (1.2.840.10008.5.1.4.1.1.6.1) and Ultrasound Multi-frame Image (1.2.840.10008.5.1.4.1.1.3.1) SOP Classes that are successfully stored by the Network Storage AE.

If Storage Commitment is enabled, no objects in an exam (i.e., in the Performed Procedure Step) may be auto-deleted until all objects in the exam have been confirmed committed by the Storage Commitment SCP. If all objects in an exam have been successfully stored and N-EVENT-REPORT responses are received indicating all objects have been successfully committed, the exam becomes eligible for auto-deletion. If a N-EVENT-REPORT is received indicating one or more images in an exam have failed commitment, autodelete is inhibited for the exam but no further action is taken by IDI.

2.4.1 Association Establishment Policies

2.4.1.1 General

Maximum PDU size offered is 100,000 bytes.

2.4.1.2 Number of Associations

IDI may establish and maintain one association at a time to a given AE from the Network Storage, Storage Commitment, and Print AE's. This generally means there can be no more than one open association at a time from the Storage Commitment AE.

Incoming associations are used in the Storage Commitment AE for N-EVENT-REPORT responses from previously-issued N-ACTION requests. The maximum number of simultaneous associations accepted by IDI is set at 32. This applies across all AEs specified.

2.4.1.3 Asynchronous Nature

Multiple outstanding transactions are not supported. Replies are handled for the current transaction before another may be initiated.

2.4.1.4 Implementation Identifying Information

The Storage Commitment AE has the same implementation identifying information as shown in section 2.1.1.4.

2.4.2 Association Initiation By Real-World Activity

2.4.2.1 Store Image Real-World Activity

2.4.2.1.1 Associated Real World Activity

If the Storage Commitment service is enabled, each image that is successfully stored by the Network Storage AE will also be included in a N-ACTION request to the Storage Commitment SCP. . The number of SOP Instances included in each N-ACTION request varies, depending on several factors. If "Network Autosend" is enabled, generally each image stored will be included in its own N-ACTION request. If "Network Autosend" is not enabled, then one or more N-ACTION requests will be used for the images in the exam, depending on how many images are ready to transfer at the time the exam ends and the Storage SCP is available.

2.4.2.1.2 Proposed Presentation Contexts for the Storage Commitment SCU

The Storage Commitment AE requests the presentation contexts listed in Table 36 below:

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 36: Storage Commitment - Presentation Contexts

Initially, IDI attempts to open an association directly for the Storage Commitment Push Model SOP Class. If the SCP is or becomes unreachable, an association to the same SCP is periodically attempted for the Verification SOP Class until the SCP accepts the association and responds affirmatively to the C-ECHO-RQ. At that time, an association for Storage Commitment is opened and the N-ACTION re-attempted.

2.4.2.1.2.1 SOP Specific Conformance for the Storage Commitment SOP Class

The Storage Commitment AE supports the following elements for this SOP class as an SCU. The Transaction UID Attribute (0008,1195) value generated by IDI uniquely identifies each Storage Commitment Request.

Action Type Name	Action Type ID	Attribute Name	Tag
Request Storage Commitment	1	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		> Referenced SOP Class UID	(0008,1150)
		> Referenced SOP Instance UID	(0008,1155)

Table 37: Storage Commitment Request – Attributes

The Referenced Study Component Sequence attribute (0008,1111) is <u>not</u> supported, as it is very rare in IDI for all images in a MPPS to be committed in a single N-ACTION request.

If the N-ACTION-RSP response status is "Success", the Storage Commitment AE knows the request was received by the SCP and can expect a N-EVENT-REPORT from the SCP. If the N-ACTION-RSP response status is other than "Success", the exam status is marked as "not completed". After the "retry time interval" (currently 12 hours), the N-ACTION-RQ is re-attempted.

For each N-ACTION that has been sent, the Storage Commitment AE expects an N-EVENT-REPORT response from the Storage Commitment SCP. If that response has not been received within the "retry time interval", the Transaction UID expires and another N-ACTION request with a new Transaction UID is made for the included SOP Instances.

2.4.2.2 Rescue Study Real-World Activity

If Storage Commitment is enabled when an exam is "rescued" by *the Rescue Study* activity, Storage Commitment is performed as described in this Section. Upon successful commitment of all the images in the exam, the exam becomes eligible for auto-deletion.

2.4.3 Association Acceptance Policy

2.4.3.1 Commit Images Real-World Activity

2.4.3.1.1 Associated Real World Activity

After a Storage Commitment SCP has accepted a N-ACTION from the Storage Commitment AE, the SCP will open an association with IDI in order to notify the Storage Commitment AE of commitment success or failure for each SOP Instance UID referenced in the N-ACTION.

2.4.3.1.2 Presentation Context Table

The Storage Commitment AE accepts associations for the presentation context described in Table 38. SCP/SCU role selection negotiation is supported, allowing the association requestor to act as SCP for the N-EVENT-REPORT DIMSE service.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 38: Accepted Presentation Context for Storage Commitment SCU

2.4.3.1.2.1 SOP Specific Conformance for the Storage Commitment SOP Class

The Storage Commitment AE expects to receive one N-EVENT-REPORT for each N-ACTION that had been accepted by the Storage Commitment AE. Each N-EVENT-REPORT includes information on the successful or failed commitment of the SOP Instances of the original N-ACTION. The attributes of the N-EVENT-REPORT supported by the Storage Commitment AE are shown in Table 39:

Action Type Name	Event Type ID	Attribute Name	Tag
Storage Commitment Request Successful	1	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		> Referenced SOP Class UID	(0008,1150)
		> Referenced SOP Instance UID	(0008,1155)
Storage Commitment Request Complete – Failures Exist	2	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		> Referenced SOP Class UID	(0008,1150)
		> Referenced SOP Instance UID	(0008,1155)

Action Type Name	Event Type ID	Attribute Name	Tag
		Failed SOP Sequence	(0008,1198)
		> Referenced SOP Class UID	(0008,1150)
		> Referenced SOP Instance UID	(0008,1155)
		> Failure Reason	(0008,1197)

Table 39: Storage Commitment N-EVENT-REPORT Response

If the Event Type ID is 1, all images in the N-ACTION are committed. However, if the Event Type ID is not 1 (i.e., is 2), then at least one SOP Instance, as noted by the items in the Failed SOP Sequence, have not committed. If this is the case, then the exam is marked with a "-" character in the STUDYSTATUS display indicating a failure has occurred in processing this exam, and Storage Commitment is marked with a "-" character in the detailed status display indicating the a Storage Commitment failure is the cause of the exam failure.

The user may choose "Rescue Study" to reattempt a transfer of the exam that failed commitment. When this is done, all images of the exam are re-transmitted to the Storage SCP by the Network Storage AE, and new requests for Storage Commitment are made as well. If the images are all successfully committed this time, the STUDYSTATUS display for the rescued exam is marked with a "+" indicating successful storage and commitment, and the exam is now eligible for auto-deletion.

2.4.3.1.3 Presentation Context Acceptance Criterion

Associations are <u>only</u> accepted from Storage Commitment SCPs that are defined in the list of configured servers (see Section 5.2.1); otherwise the association will be rejected.

2.4.3.1.4 Transfer Syntax Selection Policies

Only the Implicit VR Little Endian transfer syntax is accepted for Storage Commitment associations.

2.5 Study Management AE Specification

The Study Management AE provides Standard Conformance to the following DICOM V3.0 SOP Classes as an SCU:

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCU
Modality Performed Procedure Step SOP Class	1.2.840.10008.3.1.2.3.3	SCU

Table 40: SOP Class Supported by Study Management AE

2.5.1 Association Establishment Policies

2.5.1.1 General

Maximum PDU size offered: 100,000 bytes.

2.5.1.2 Number of Associations

IDI may establish and maintain one association at a time for the Study Management AE.

2.5.1.3 Asynchronous Nature

Multiple outstanding transactions are not supported. Replies are handled for the current transaction before another may be initiated.

2.5.1.4 Implementation identifying information

The Study Management AE has the same implementation identifying information as shown in section 2.1.1.4.

2.5.2 Association Initiation By Real-World Activity

2.5.2.1 Configure Network Real-World Activity

The *Configure Network* activity does not initiate any association or services over the DICOM interface for the Study Management AE. Configurable items may determine module attributes and the selection of application entity acting as SCP for subsequent storage actions. See the Configuration Section 5.2 for more details.

2.5.2.2 New Patient Real World Activity

The *New Patient* activity does not initiate any association or services over the DICOM interface for the Study Management AE. Rather, this activity is used to set the patient and study level information to be used in the *Store Image* and *End Study* activities by the Study Management AE. Patient identification information is manually entered or through the selection of entry of the Modality

Worklist, a Study Instance UID is generated (if patient ID is not selected from a MWL), and other exam-level UIDs are synthesized for use in this Application Entity.

2.5.2.3 Store Image Real-World Activity

2.5.2.3.1 Associated Real World Activity

The first image stored marks the beginning of a new Modality Performed Procedure Step (MPPS). At this time, a MPPS is created on the MPPS SCP through the use of the N-CREATE service. If the MPPS SCP is unavailable at the time the first image is stored, the request is queued and will be sent when the MPPS SCP is available.

2.5.2.3.2 Proposed Presentation Contexts

The Study Management AE requests the presentation contexts listed in the following table:

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 41: Study Management – Proposed Presentation Context

Initially, IDI attempts to open the association directly for the Modality Performed Procedure Step SOP Class. If the MPPS SCP is or becomes unreachable, an association to the same SCP is periodically attempted for the Verification SOP Class until the SCP accepts the association and responds affirmatively to the C-ECHO-RQ. At that time, an association for the MPPS SOP Class is opened and the N-CREATE re-attempted.

2.5.2.3.2.1 SOP Specific Conformance for MPPS SOP Class

At the storage of the first image of the study, an N-CREATE is used to create the Modality Performed Procedure Step on the MPPS SCP with the status "In Progress". Attributes available from the Scheduled Procedure Step used from the Modality Worklist, if any, from information entered in the host imaging system "Patient ID" screen, and information generated by the host imaging system and/or IDI are used to set attribute values for the N-CREATE. The variables set in the N-CREATE and their origins are listed in Table 42.

2.5.2.4 End Study Real-World Activity

2.5.2.4.1 Associated Real World Activity

When the user ends the exam by pressing the "End Study" button on the host imaging system, the MPPS is "Completed". Alternatively, if "Network Autosend" is disabled, the user may choose to cancel acquisition, the exam is saved in local storage and the MPPS status becomes "Discontinued. At this time, the Study Management AE attempts to modify the MPPS on the MPPS SCP through the use through the use of the N-SET service. If the MPPS SCP is unavailable, the request is queued and will be sent when the MPPS SCP is available.

2.5.2.4.2 Proposed Presentation Contexts

The Study Management AE requests the presentation contexts listed in Table 41.

2.5.2.4.2.1 SOP Specific Conformance for MPPS SOP Class

At the end of the exam, there is additional information that is now available that needs to be added or updated in the MPPS that had been created when the first image was stored. This is done through an N-SET to the MPPS SCP. The updated attributes are shown in the "N-SET Usage" column of Table 42.

Attribute Name	Tag	N-CREATE Usage	N-SET Usage
Specific Character Set	(0008,0005)	Present with value of "ISO_IR_100" (Latin #1) if one or more characters are not in the DICOM default character set. See Section .	Present with value of "ISO_IR_100" (Latin #1) if one or more characters are not in the DICOM default character set. See Section .
Performed Procedure Step Relationship			
Scheduled Step Attribute Sequence	(0040,0270)	Present	Not allowed
> Study Instance UID	(0020,000D)	If available from the MWL; else synthesized by the host imaging system	Not allowed
> Referenced Study Sequence	(0008,1110)	Present if exam acquired using a MWL entry; else NULL	Not allowed
>> Referenced SOP Class UID	(0008,1150)	From the MWL	Not allowed
>> Referenced SOP Instance UID	(0008,1155)	From the MWL	Not allowed

Attribute Name	Tag	N-CREATE Usage	N-SET Usage
> Accession Number	(0008,0050)	If available from the MWL; else from the "Accession" field of the Patient ID screen, if entered; else NULL	Not allowed
> Requested Procedure ID	(0040,1001)	If available from the MWL; else NULL	Not allowed
> Requested Procedure Description	(0032,1060)	If available from the MWL; else NULL	Not allowed
> Scheduled Procedure Step ID	(0040,0009)	If available from the MWL; else NULL	Not allowed
> Scheduled Procedure Step Description	(0040,0007)	If available from the MWL; else NULL	Not allowed
> Scheduled Protocol Code Sequence	(0040,0008)	If available from the MWL; else NULL	Not allowed
>> Code Value	(0008,0100)	From the MWL	Not allowed
>> Coding Scheme Designator	(0008,0102)	From the MWL	Not allowed
>> Coding Scheme Version	(0008,0104)	From the MWL	Not allowed
>> Code Meaning	(0008,0104)	From the MWL	Not allowed
Patient Name	(0010,0010)	If available from the MWL; else from the "Name" fields of the Patient ID screen; else NULL	Not allowed
Patient ID	(0010,0020)	If available from the MWL; else from the "ID" field of the Patient ID screen; else NULL	Not allowed
Patient Birth Date	(0010,0032)	If available from the MWL; else from the "DOB" field of the Patient ID screen; else NULL	Not allowed
Patient Sex	(0010,0040)	If available from the MWL; else from the "Sex" field of the Patient ID screen; else NULL	Not allowed
Referenced Patient Sequence	(0008,1120)	If available from the MWL; else NULL	Not allowed
> Referenced SOP Class UID	(0008,1150)	From the MWL	Not allowed
> Referenced SOP Instance UID	(0008,1155)	From the MWL	Not allowed
Performed Procedure Step Information			
Performed Procedure Step ID	(0040,0253)	Synthesized by IDI	Not allowed
Performed Station AE Title	(0040,0241)	AE Title of IDI	Not allowed

Attribute Name	Tag	N-CREATE Usage	N-SET Usage
Performed Station Name	(0040,0242)	NULL	Not allowed
Performed Location	(0040,0243)	NULL	Not allowed
Performed Procedure Step Start Date	(0040,0244)	Date of the acquisition of the first image in the MPPS	Not allowed
Performed Procedure Step Start Time	(0040,0245)	Time of the acquisition of the first image in the MPPS	Not allowed
Performed Procedure Step Status	(0040,0252)	"IN PROGRESS"	"COMPLETED" or "DISCONTINUED" (see Section 2.5.2.4.1)
Performed Procedure Step Description	(0040,0254)	NULL	Not used
Performed Procedure Type Description	(0040,0255)	NULL	Not used
Procedure Code Sequence	(0008,1032)	If "Requested Procedure Code Sequence" available from the MWL; else NULL	If "Requested Procedure Code Sequence" available from the MWL; else NULL
> Code Value	(0008,0100)	From the MWL	From the MWL
> Coding Scheme Designator	(0008,0102)	From the MWL	From the MWL
> Coding Scheme Version	(0008,0104)	If available from the MWL; else omitted	If available from the MWL; else omitted
> Code Meaning	(0008,0104)	If available from the MWL; else omitted	If available from the MWL; else omitted
Performed Procedure Step End Date	(0040,0250)	NULL	Date "End Study" is pressed.
Performed Procedure Step End Time	(0040,0251)	NULL	Time "End Study" is pressed.
Image Acquisition Results			
Modality	(0008,0060)	"US"	Not allowed
Study ID	(0020,0010)	If MWL is used, set to "Requested Procedure ID" if available from the MWL; else synthesized by IDI. If MWL is not used, set to NULL. May differ from the value of Study ID in DICOM images.	Not allowed
Performed Protocol Code Sequence	(0040,0260)	If "Scheduled Protocol Code Sequence" available from the MWL; else NULL	If "Scheduled Protocol Code Sequence" available from the MWL; else NULL
> Code Value	(0008,0100)	From the MWL	From the MWL

Attribute Name	Tag	N-CREATE Usage	N-SET Usage
> Coding Scheme Designator	(0008,0102)	From the MWL	From the MWL
> Coding Scheme Version	(0008,0104)	If available from the MWL; else omitted	If available from the MWL; else omitted
> Code Meaning	(0008,0104)	If available from the MWL; else omitted	If available from the MWL; else omitted
Performed Series Sequence	(0040,0340)	One item representing the series used for this MPPS	One item representing the series used for this MPPS
> Performing Physician's Name	(0008,1050)	From "Scheduled Performing Physician's Name" in the MWL, if available; else the "Performed By" field of the Patient ID screen; else NULL	From "Scheduled Performing Physician's Name" in the MWL, if available; else the "Performed By" field of the Patient ID screen; else NULL
> Protocol Name	(0018,1030)	Either the name of the Stress Protocol selected on the host imaging system, or "CLR Standard" for non-stress exams	Either the name of the Stress Protocol selected on the host imaging system, or "CLR Standard" for non-stress exams
> Operator's Name	(0008,1070)	From the "Performed By" field of the Patient ID screen; else NULL	From the "Performed By" field of the Patient ID screen; else NULL
> Series Instance UID	(0020,000E)	Synthesized by IDI	Synthesized by IDI
> Series Description	(0008,103E)	NULL	NULL
> Retrieve AE Title	(0008,0054)	NULL	NULL
> Referenced Image Sequence	(0008,1140)	NULL	One item for each image in the MPPS.
>> Referenced SOP Class UID	(0008,1150)	No items in this SQ	SOP Class UID of the image
>> Referenced Instance UID	(0008,1155)		SOP Instance UID of the image
> Referenced Non-image Composite SOP Instance Sequence	(0040,0220)	NULL	NULL
>> Referenced SOP Class UID	(0008,1150)	No items in this SQ	No items in this SQ
>> Referenced Instance UID	(0008,1155)		

Table 42: Modality Performed Procedure Step N-CREATE and N-SET Attributes

2.5.2.5 Rescue Study Real-World Activity

No action is taken by the Study Management AE as a result of *the Rescue Study* activity.

2.5.3 Association Acceptance Policy

No associations are accepted by the Study Management AE.

2.6 Worklist Management AE Specification

The Worklist Management AE provides <u>Standard Extended</u> Conformance to the following DICOM V3.0 SOP Classes as an SCU. It is extended by its use of the Study Status ID as a Matching Key, as shown in Table 45.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCU
Modality Worklist SOP Class	1.2.840.10008.5.1.4.31	SCU

Table 43: SOP Class Supported by Worklist Management AE

The Worklist Management AE retrieves a list of Scheduled Procedure Steps (SPS's) from the Modality Worklist (MWL) SCP based on pre-configured "Broad Query" query attributes. The user of the host imaging system may select one of these Scheduled Procedure Steps as the source of patient identity, patient demographics, and study management identifiers for all images acquired during the exam. In turn, these attributes are used in creating DICOM image objects and Modality Performed Procedure Step output objects.

2.6.1 Association Establishment Policies

2.6.1.1 General

Maximum PDU size offered: 100,000 bytes.

2.6.1.2 Number of Associations

IDI may establish and maintain one association at a time to a given AE from the Worklist Management AE.

2.6.1.3 Asynchronous Nature

Multiple outstanding transactions are not supported. Replies are handled for the current transaction before another may be initiated.

2.6.1.4 Implementation identifying information

The Worklist Management AE has the same implementation identifying information as shown in section 2.1.1.4.

2.6.2 Association Initiation By Real-World Activity

2.6.2.1 Configure Network

The *Configure Network* activity does not initiate any association or services over the DICOM interface for the Worklist Management AE. Configurable items include the selection of application entity acting as SCP for Modality

Worklist C-FIND requests, the constraints used in the query (i.e., key values), and whether and how often the list is updated on a periodic basis (MWL Polling). See the Configuration Section 5.2 for more details.

2.6.2.2 System Start Real-World Activity

2.6.2.2.1 Associated Read-World Activity

If the Modality Worklist service is enabled, an attempt is made to retrieve an updated worklist every time the system starts, and at intervals thereafter if MWL Polling is enabled. These periodic updates occur at a configured interval, with a default of Polling <u>on</u> with an interval of 15 minutes.

The MWL C-FIND request and result processing is identical whether the query was initiated by the *System Start* activity or by an explicit request in *the New Patient* activity.

2.6.2.2.2 Proposed Presentation Contexts – Worklist Management AE

The Worklist Management AE requests the presentation contexts listed in Table 44 below:

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Modality Worklist SOP Class	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 44: Worklist Management - Presentation Contexts

Initially, IDI attempts to open an association directly for the Modality Worklist SOP Class. If the SCP is or becomes unreachable, an association to the same SCP is periodically attempted for the Verification SOP Class until the SCP accepts the association and responds affirmatively to the C-ECHO-RQ. At that time, an association for the Modality Worklist SOP Class is opened and the operation re-attempted.

2.6.2.2.2.1 SOP Specific Conformance for the Modality Worklist SOP Class

Table 45 describes the use of attributes as both Matching Key values in the C-FIND request message, and as Return Keys in the set of C-FIND-RSP messages. The Matching Key Usage follows the DICOM Standard for attribute matching, including Single Value matching and Range matching. For those Matching Keys that are used by IDI, the Attribute Type as defined by DICOM is indicated: Required or Optional. These values indicate the degree to which the MWL SCP must support the attribute as a Matching Key.

Similarly, the Attribute Type of values used as Return Keys is given as defined by DICOM: Type 1 (required), Type 1C (conditionally required), Type 2 (required but may be NULL), Type 2C (conditionally required but may be NULL), or Type 3 (optional).

An empty value in the Matching Key column means that this value is not used as a matching key. An empty value in the Return Key column means that this value is ignored by IDI. If an attribute that is non-mandatory to the SCU is not used by IDI as a matching key and its value as a return key is ignored, the attribute is omitted from the list of attributes.

Attribute Name	Tag	Matching Key Usage	Return Key Usage
SOP Common			
Specific Character Set	(0008,0005)	Not used.	C-FIND-RSP rejected if present and not set to "ISO_IR_100" (Latin 1)
Scheduled Procedure Step			
Scheduled Procedure Step Sequence	(0040,0100)	Required	Type 1
> Scheduled Station AE Title	(0040,0001)	Required Single Value matching to the value specified in MWLQUERY AETITLE (See Section 5.2)	Not used
> Scheduled Procedure Step Start Date	(0040,0002)	Required Range matching to the value specified in MWLQUERY START_DATE (See Section 5.2)	Not used

Attribute Name	Tag	Matching Key Usage	Return Key Usage
> Scheduled Procedure Step Start Time	(0040,0003)	Required Range matching to the value specified in MWLQUERY START_DATE (See Section 5.2)	Not used
> Modality	(0008,0060)	Required Single Value matching to the value specified in MWLQUERY MODALITY (See Section 5.2)	Not used
> Scheduled Performing Physician's Name	(0040,0006)		Type 2 Sets "Performed by" in the Patient ID screen, and "Performing Physician's Name" in the MPPS.
> Scheduled Procedure Step Description	(0040,0007)		Type 1C Set in MPPS and images. May be used to set "Description" field on the Patient Selection screen, and "Study Description" in images: 2nd choice, configurable
> Scheduled Procedure Step Location	(0040,0011)		Type 2 Sets "Location" field on the Patient Selection screen.
> Scheduled Protocol Code Sequence	(0040,0008)		Type 1C Set as "Scheduled Protocol Code Sequence" and "Performed Protocol Code Sequence" in MPPS, and as "Scheduled Protocol Code Sequence" in images.
>> Code Value	(0008,0100)		Type 1 Set in MPPS and images.
>> Coding Scheme Designator	(0008,0102)		Type 1 Set in MPPS and images.
>> Coding Scheme Version	(0008,0103)		Type 3 If present, set in MPPS and images.

Attribute Name	Tag	Matching Key Usage	Return Key Usage
>> Code Meaning	(0008,0104)		Type 3 If present, set in MPPS and images. May also be used to set "Description" field on the Patient Selection screen, and "Study Description" in images: 3rd choice, configurable
> Scheduled Procedure Step ID	(0040,0009)		Type 1 Set in MPPS and images.
> Scheduled Procedure Step Status	(0040,0020)	Single Value matching to the value specified in MWLQUERY PROCEDURE_ STATUS constraint (See Section 5.2.6)	Not used
Requested Procedure			
Requested Procedure ID	(0040,1001)		Type 1 Set in MPPS and images.
Requested Procedure Description	(0032,1060)		Type 1C Set in MPPS. May also be used to set "Description" field on the Patient Selection screen, and "Study Description" in images: 1st choice, configurable
Requested Procedure Code Sequence	(0032,1064)		Type 1C If present, set as "Procedure Code Sequence" in MPPS.
> Code Value	(0008,0100)		Type 1C Set in MPPS.
> Coding Scheme Designator	(0008,0102)		Type 1C Set in MPPS.
> Coding Scheme Version	(0008,0103)		Type 3 If present, set in MPPS.
> Code Meaning	(0008,0104)		Type 3 If present, set in MPPS.
Study Instance UID	(0020,000D)		Type 1 Set in MPPS and images.
Referenced Study Sequence	(0008,1110)		Type 2 Set in MPPS and images.
> Referenced SOP Class UID	(0008,1150)		Type 1C Ignored.
> Referenced SOP Instance UID	(0008,1155)		Type 1C Set in MPPS and images.

Attribute Name	Tag	Matching Key Usage	Return Key Usage
Reason for the Requested Procedure	(0040,1002)		Type 3 May be used to set "Indication" field on the Patient Selection screen: 1st choice, configurable
Imaging Service Request			
Accession Number	(0008,0050)		Type 2 Displayed on Patient ID screen. Set in MPPS and images.
Referring Physician's Name	(0008,0090)		Type 2 Sets "Physician" in the Patient ID screen.
Reason for Imaging Service Request	(0040,2001)		Type 3 May be used to set "Indication" field on the Patient Selection screen: 2nd choice, configurable
Visit Relationship			
Referenced Patient Sequence	(0008,1120)		Type 2 Set in MPPS.
> Referenced SOP Class UID	(0008,1150)		Type 2 Ignored.
> Referenced SOP Instance UID	(0008,1155)		Type 2 Set in MPPS.
Patient Identification			
Patient Name	(0010,0010)		Type 1 Displayed on Patient ID screen. Set in MPPS and images.
Patient ID	(0010,0020)		Type 1 Displayed on Patient ID screen. Set in MPPS and images.
Patient Demographic			
Patient Birth Date	(0010,0030)		Type 2 Sets the "DOB" field on the Patient ID screen.
Patient Sex	(0010,0040)		Type 2 Sets the "Sex" field on the Patient ID screen.
Patient's Weight	(0010,1030)		Type 2 Sets the "Weight" field on the Patient ID screen.

Attribute Name	Tag	Matching Key Usage	Return Key Usage
Patient's Size	(0010,1020)		Type 3 Sets the "Height" field on the Patient ID screen.
Extended Attributes			
Study Status ID (extended value)	(0032,000A)	Extended (supported by many SCPs) Single Value matching to the value specified in MWLQUERY STATUS constraint. (See Section 5.2.6)	Not used

Table 45: Modality Worklist Usage in the Worklist Management AE

2.6.3 Association Acceptance Policy

No associations are accepted by the Worklist Management AE.

3 Communications Profiles

The Integrated Digital Interface conforms to the DICOM Application Context 1.2.840.10008.3.1.1.1.

3.1 Supported Communication Stacks

IDI provides DICOM V3.0 TCP/IP Network Communication Support.

3.2 TCP/IP Stack

TCP/IP networking protocol is used, with either static IP addressing or DHCP. Name resolution, if desired, may be accomplished through a variety of mechanisms including DNS, WINS, NetBIOS name resolution, and LMHOSTS file lookup, or may be avoided entirely through the direct entry of the remote host's IP address.

The Verification AE and Storage Commitment AE wait on Port 104 for any incoming association requests.

3.2.1 Physical Media Support

10BaseT and 100BaseT are supported.

3.2.2 Communication Timeouts and Wait Periods

Network timeouts are pre-selected to be appropriate to a large range of network configurations.

There are two connection timeouts:

1. "Connect": This is the time to wait for a network connect to be accepted. It is 120 seconds.

2. "Read": This is the time to wait for a network read operation to be accepted. It is set to 120 seconds. It can be configured see section 5.2.1.

In addition, the Network Storage AE supports an independently-configured C-STORE-RSP timeout, which allows for the variable amount of processing that may be performed by a Store SCP after receiving an object via C-STORE-RQ and before returning a C-STORE-RSP to the SCU. This timeout has a default value of 60 minutes.

4 Extensions/Specializations/Privatizations

4.1 Standard Extended / Specialized / Private SOPs

This implementation extends the following classes:
1. Ultrasound Image Storage and Ultrasound Multi-frame Image Storage SOP Classes. See Table 18.

2. Basic Film Session (see Table 26) and Basic Grayscale Image Box (see Table 28) SOP Classes, and therefore the Basic Grayscale Print Management and Basic Color Print Management Meta SOP Classes that depend on the Basic Film Session SOP Class.

3. Worklist Management SOP Class (see Table 45).

4.2 Private Transfer Syntaxes

No private transfer syntaxes have been implemented.

5 Configuration

5.1 AE Title / Presentation Address Mapping

Mapping from AE Title to Presentation Address is achieved through the Network Utilities configuration (see section **Error! Reference source not found.**). Each remote AE is defined by specifying the server name or IP address, the TCP port number, and the Application Entity Title. If a server name is provided, an appropriate mapping mechanism of name to IP address must be provided using available Windows/NT network configuration capabilities.

5.2 Configurable Parameters

5.2.1 General networking

- IDI network configuration parameters, including IP address, subnet mask, default gateways, name servers (DNS, WINS), and DHCP.

- IDI's AE Title

- Specification (adding, listing, deleting) of DICOM server (SCP) addresses:
  - Server Name or IP address
  - TCP/IP Port Number
  - SCP's AE Title
  - Connection timeout in seconds (default = 120 seconds). This becomes the Read timeout mentioned in Section 3.2.2)

- Verification of a server in the server list (C-ECHO)

- Log level configuration

5.2.2 Network Storage Configurable Parameters

- Server selection for the Network Storage AE

- Compression of transferred images. Compression for single frame and multi-frame images is configured separately. Choices include:
  - Lossy JPEG compressed (with JPEG "quality factor")
  - Lossless RLE compression
  - No compression (Implicit VR Little Endian transfer syntax)

- Monochrome switch: if set, causes color images to be sent as MONOCHROME2.

- Square Pixels switch: if set, native rectangular pixel images are converted to square pixels before storage.

- Image attribute choices
  - Source of the "Study Description" attribute value:
    - MWL attribute to be used, if MWL is present
    - Value to use for stress exams, if no MWL value is present
    - Value to use for non-stress exams, if no MWL value is present
  - Whether to mark multiple images in a given stage-view with view name and number
  - Whether to mark Mode B and Mode C stress images with view name and number
  - Whether to convert basic Stage Names to DICOM defined terms, if possible.
  - Whether to use Frame Time Vector instead of Frame Time in Ultrasound Multi-frame Images

- C-STORE-RSP timeout value, in minutes (default 60, max 120)

5.2.3 Print Configurable Parameters

- Server selection for the up to two printers (one BW, one Color)

- For each printer, print attributes listed in the "Options" column of the following tables are configurable:
  - Table 26: Basic Film Session Attributes
  - Table 27: Basic Film Box Attributes
  - Table 28: Basic Grayscale Image Box Attributes
  - Table 29: Basic Color Image Box Attributes

5.2.4 Storage Commitment Configurable Parameters

- Server selection for the Storage Commitment AE

5.2.5 Study Management Configurable Parameters

- Server selection for the Study Management AE

5.2.6 Worklist Management Configurable Parameters

- Server selection for the Worklist Management AE

- C-FIND query constraints:
  - Start Date (today, yesterday, last n days, next n days, within m hours)
  - Modality
  - Status (scheduled only, unconstrained), configurable to use one of two MWL C-FIND-RQ attributes.
    - Scheduled Procedure Step Status (0040,0020)
    - Study Status ID (0032,000A)
  - Scheduled Station AE Title (may be different from IDI AE Title)

- Modality Worklist Polling poll period (from 1-60 minutes
- Modality Worklist attribute to be used for the Patient Selection screen "Description" field

6 Support of Extended Characters

IDI supports the following character sets:
- ISO-IR 6 (default) Basic G0 Set
- ISO-IR 100 Latin Alphabet No. 1