S517-E092
Rev:First

SDR-150C

DICOM Conformance Statement

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NO TEXT

Conformance Statement Overview

The application software of SDR-150C is called "CXDI Controller RF" and the name is used in this document. This product CXDI Controller RF (hereinafter referred to as “CXDI RF”) implements the necessary DICOM services to download work lists from an information system, save acquired DX images X-Ray Radio Fluoroscopic Images and associated Presentation States to a network storage device or local drive, print to a networked hardcopy device and inform the information system about the work actually done.

The table below provides an overview of the network services supported by CXDI RF.

Network Services

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
X-Ray Radio Fluoroscopic Image Storage	Yes	No
Digital X-Ray Image Storage – For Presentation	Yes	No
Computed Radiography Image Storage	Yes	No
Grayscale Softcopy Presentation State	Yes	No
Verification	Yes	Yes
Workflow Management		
Modality Worklist	Yes	No
Storage Commitment Push Model	Yes	No
Modality Performed Procedure Step	Yes	No
Verification	Yes	No
Print Management		
Basic Grayscale Print Management	Yes	No
Presentation LUT	Yes	No
Verification	Yes	No

NOTE

Although there are the descriptions about the following features in this document, SDR-150C doesn't support the features now.

- Storage Commitment
- Modality Performed Procedure Step
- IHE profile

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1. Introduction

1.1 Revision History

Document Version	Date of Issue	Software Version	Description
First	Oct. 17, 2011	1.00	First issue

1.2 Audience

This document is written for the people that need to understand how CXDI RF will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. This document contains some basic DICOM definitions so that any reader may understand how this product implements DICOM features. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the product's functionality, and how that functionality integrates with other devices that support compatible DICOM features.

1.3 Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between CXDI RF and other DICOM products. The Conformance Statement should be read and understood in conjunction with the DICOM Standard. DICOM by itself does not guarantee interoperability. The Conformance Statement does, however, facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:

— The comparison of different Conformance Statements is just the first step towards assessing interconnectivity and interoperability between the product and other DICOM conformant equipment.

— Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility.

CXDI RF has participated in an industry-wide testing program sponsored by Integrating the Healthcare Enterprise (IHE). The IHE Integration Statement for CXDI RF, together with the IHE Technical Framework, may facilitate the process of validation testing.

1.4 Terms and Definitions

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class.
Examples : Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

Application Entity (AE) – an end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title – the externally known name of an Application Entity, used to identify a DICOM application to other DICOM applications on the network.

Application Context – the specification of the type of communication used between Application Entities.
Example: DICOM network protocol.

Association – a network communication channel set up between Application Entities.

Attribute – a unit of information in an object definition; a data element identified by a tag. The information may be a complex data structure (Sequence), itself composed of lower level data elements.
Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD) – the specified set of Attributes that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The Attributes may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C).
Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Module – a set of Attributes within an Information Object Definition that are logically related to each other.
Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation – first phase of Association establishment that allows Application Entities to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context – the set of DICOM network services used over an Association, as negotiated between Application Entities; includes Abstract Syntaxes and Transfer Syntaxes.

Protocol Data Unit (PDU) – a packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

Service Class Provider (SCP) – role of an Application Entity that provides a DICOM network service; typically, a server that performs operations requested by another Application Entity (Service Class User).
Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

Service Class User (SCU) – role of an Application Entity that uses a DICOM network service; typically, a client.
Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class – the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification.
Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance – an information object; a specific occurrence of information exchanged in a SOP Class.
Examples: a specific x-ray image.

Tag – a 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the “group” and the “element”. If the “group” number is odd, the tag is for a private (manufacturer-specific) data element.
Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

Transfer Syntax – the encoding used for exchange of DICOM information objects and messages. Examples: JPEG compressed (images), little endian explicit value representation.

Unique Identifier (UID) – a globally unique “dotted decimal” string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier.
Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR) – the format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

1.5 Basics of DICOM Communication

This section describes terminology used in this Conformance Statement for the non-specialist. The key terms used in the Conformance Statement are highlighted in *italics* below. This section is not a substitute for training about DICOM, and it makes many simplifications about the meanings of DICOM terms.

Two **Application Entities** (devices) that want to communicate with each other over a network using DICOM protocol must first agree on several things during an initial network "handshake". One of the two devices must initiate an **Association** (a connection to the other device), and ask if specific services, information, and encoding can be supported by the other device (**Negotiation**).

DICOM specifies a number of network services and types of information objects, each of which is called an **Abstract Syntax** for the Negotiation. DICOM also specifies a variety of methods for encoding data, denoted **Transfer Syntaxes**. The Negotiation allows the initiating Application Entity to propose combinations of Abstract Syntax and Transfer Syntax to be used on the Association; these combinations are called **Presentation Contexts**. The receiving Application Entity accepts the Presentation Contexts it supports.

For each Presentation Context, the Association Negotiation also allows the devices to agree on **Roles** – which one is the **Service Class User** (SCU - client) and which is the **Service Class Provider** (SCP - server). Normally the device initiating the connection is the SCU, i.e., the client system calls the server, but not always.

The Association Negotiation finally enables exchange of maximum network packet (**PDU**) size, security information, and network service options (called **Extended Negotiation** information).

The Application Entities, having negotiated the Association parameters, may now commence exchanging data. Common data exchanges include queries for worklists and lists of stored images, transfer of image objects and analyses (structured reports), and sending images to film printers. Each exchangeable unit of data is formatted by the sender in accordance with the appropriate **Information Object Definition**, and sent using the negotiated Transfer Syntax. There is a Default Transfer Syntax that all systems must accept, but it may not be the most efficient for some use cases. Each transfer is explicitly acknowledged by the receiver with a **Response Status** indicating success, failure, or that query or retrieve operations are still in process.

1.6 Abbreviations

AE	Application Entity
AET	Application Entity Title
CR	Computed Radiography
CT	Computed Tomography
DHCP	Dynamic Host Configuration Protocol
DICOM	Digital Imaging and Communications in Medicine
DNS	Domain Name System
DX	Digital X-ray
GSDF	Grayscale Standard Display Function
GSPS	Grayscale Softcopy Presentation State
HIS	Hospital Information System
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
IPv4	Internet Protocol version 4
ISO	International Organization for Standardization
LDAP	Lightweight Directory Access Protocol
LUT	Look-up Table
MPPS	Modality Performed Procedure Step
MSPS	Modality Scheduled Procedure Step
MWL	Modality Worklist
NTP	Network Time Protocol
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
RF	Radiofluoroscopy
RIS	Radiology Information System
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
SPS	Scheduled Procedure Step
TCP/IP	Transmission Control Protocol/Internet Protocol
UL	Upper Layer
VM	Value Multiplicity
VR	Value Representation

1.7 References

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at http://medical.nema.org/

2. Networking

2.1 Implementation Model

2.1.1 Application Data Flow

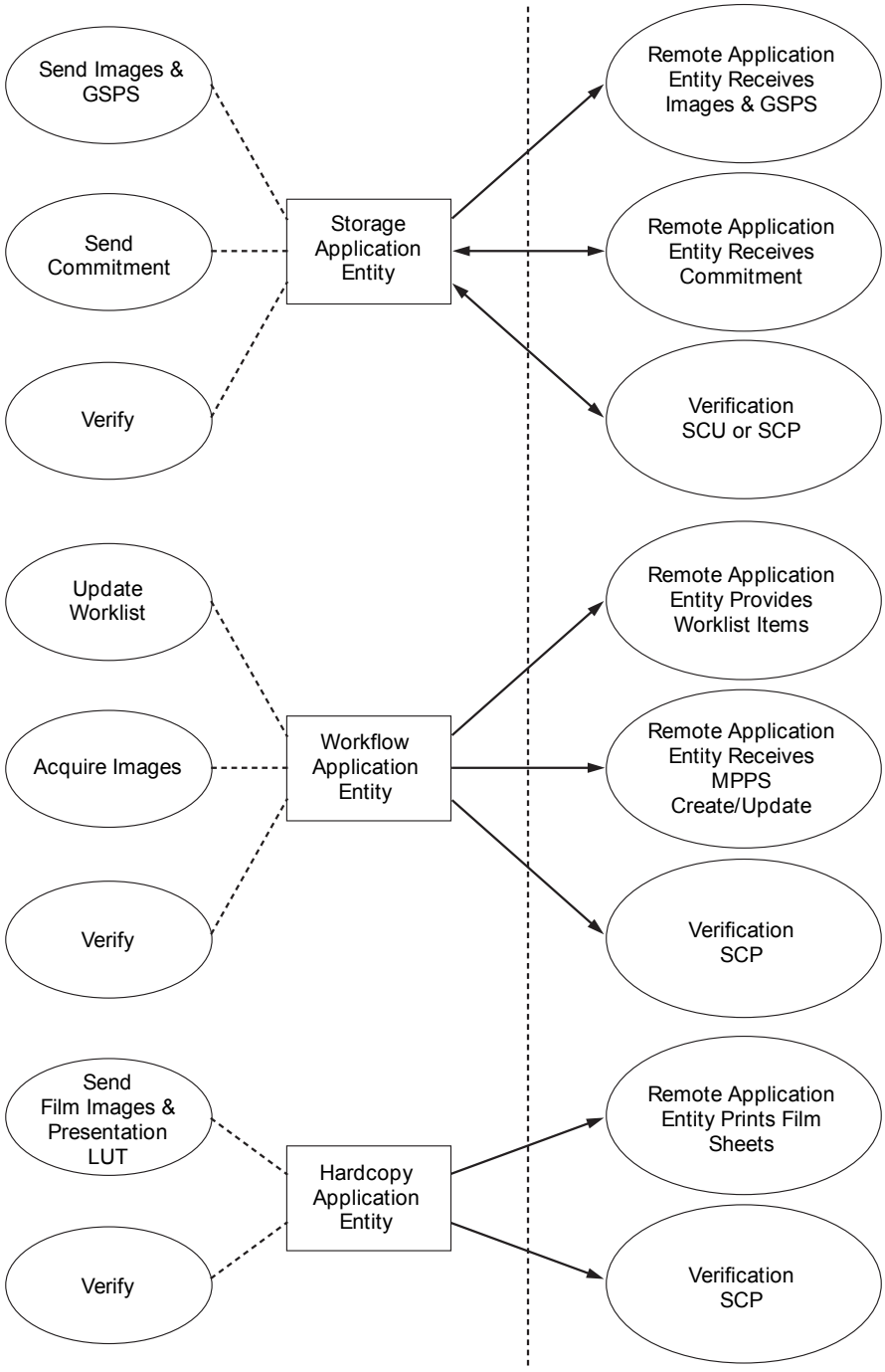

Figure 2.1-1
Application Data Flow Diagram

— The Storage Application Entity sends images and Presentation States to a remote AE. It is associated with the local real-world activity “Send Images & GSPS”. “Send Images & GSPS” is performed upon user request for each study completed or for specific images selected. When activated by user’s settings (auto-send), each marked set of images and associated Presentation States can be immediately stored to a preferred destination whenever a Study is closed by the user. If the remote AE is configured as an archive device the Storage AE will request Storage Commitment and if a commitment is successfully obtained will record this information in the local database.

— The Workflow Application Entity receives Worklist information from and sends MPPS information to a remote AE. It is associated with the local real-world activities “Update Worklist” and “Acquire Images”. When the “Update Worklist” local real-world activity is performed the Workflow Application Entity queries a remote AE for worklist items and provides the set of worklist items matching the query request. ”Update Worklist” is performed as a result of an operator request. When the “Acquire Images” local real-world activity is performed the Workflow Application Entity creates and updates Modality Performed Procedure Step instances managed by a remote AE. Acquisition of images will result in automated creation of an MPPS Instance. Completion of the MPPS is performed as the result of an operator action.

— The Hardcopy Application Entity prints images on a remote AE (Printer). It is associated with the local real-world activity “Film Images”. “Film Images” creates a print-job within the print queue containing one virtual film sheets composed from images.

2.1.2 Functional Definition of AEs

2.1.2.1 Functional Definition of Storage Application Entity

The existence of a send-job queue entry with associated network destination will activate the Storage AE. An association request is sent to the destination AE and upon successful negotiation of a Presentation Context the image transfer is started. If the association cannot be opened, the related send-job is set to an error state and can be restarted by the user via job control interface. By default, the Storage AE will not try to initiate another association for this send-job automatically.

2.1.2.2 Functional Definition of Workflow Application Entity

Worklist Update attempts to download a Worklist from a remote node. If the Workflow AE establishes an Association to a remote AE, it will transfer all worklist items via the open Association. During receiving the worklist response items are counted and the query processing is canceled if the configurable limit of items is reached. The results will be displayed in a list, which will be cleared with the next Worklist Update.

The Workflow AE performs the creation of an MPPS Instance automatically whenever acquisition is started. Further updates on the MPPS data can be performed interactively from the related MPPS user interface. The MPPS “Completed” or “Discontinued” states can only be set from the user interface.

2.1.2.3 Functional Definition of Hardcopy Application Entity

The existence of a print-job in the print queue will activate the Hardcopy AE. An association is established with the printer and the printer’s status determined. If the printer is operating normally, the film sheets described within the print-job will be printed. If the printer is not operating normally, the print-job will set to an error state and can be restarted by the user via the job control interface.

2.1.3 Sequencing of Real-World Activities

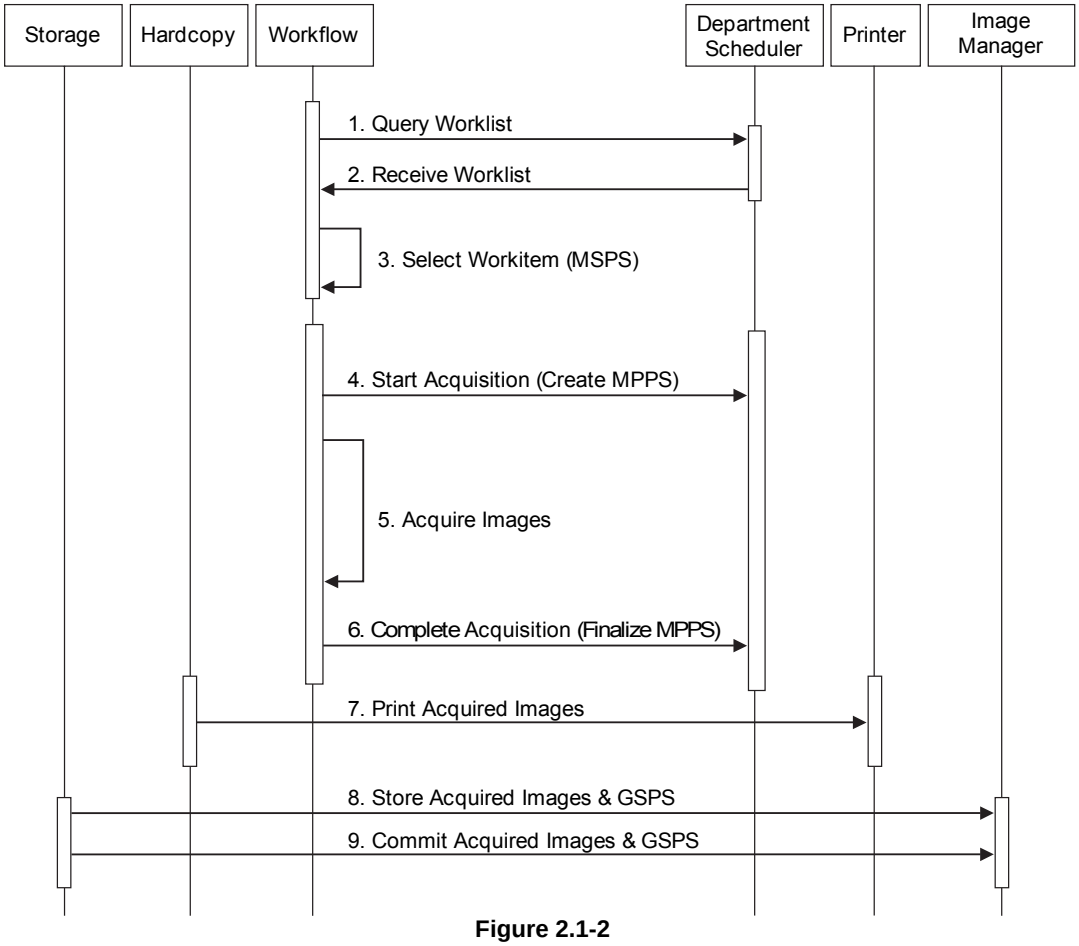

Figure 2.1-2
Sequencing Constraints

Under normal scheduled workflow conditions the sequencing constraints illustrated in Figure 2.1-2 apply:

1. Query Worklist
2. Receive Worklist of Modality Scheduled Procedure Steps (MSPS)
3. Select Workitem (MSPS) from Worklist
4. Start acquisition and create MPPS
5. Acquire Images
6. Complete acquisition and finalize MPPS
7. Print acquired images
8. Store acquired images and any associated Grayscale Softcopy Presentation State (GSPS) instances.
9. If the Image Manager is configured as an archive device the Storage AE will request Storage Commitment for the images and associated GSPS instances.

Other workflow situations (e.g. unscheduled procedure steps) will have other sequencing constraints. Printing could equally take place after the acquired images have been stored. Printing could be omitted completely if no printer is connected or hardcopies are not required.

2.2 AE Specifications

2.2.1 Storage Application Entity Specification

2.2.1.1 SOP Classes

CXDI RF provides Standard Conformance to the following SOP Classes:

Table 2.2-1
SOP Classes for AE Storage

SOP Class Name	SOP Class UID	SCU	SCP
X-Ray Radio Fluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Yes	No
Digital X-Ray Image Storage-For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes	No
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes	No
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Yes	No
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	No
Verification	1.2.840.10008.1.1	Yes	Yes

2.2.1.2 Association Policies

2.2.1.2.1 General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Table 2.2-2
DICOM Application Context for AE Storage

Application Context Name	1.2.840.10008.3.1.1.1

2.2.1.2.2 Number of Associations

CXDI RF initiates one Association at a time for each destination to which a transfer request is being processed in the active job queue list. Only one job will be active at a time, the other remains pending until the active job is completed or failed.

Table 2.2-3
Number of Associations Initiated for AE Storage

Maximum number of simultaneous Associations	1

CXDI RF accepts Associations to receive N-EVENT-REPORT notifications for the Storage Commitment Push Model SOP Class.

Table 2.2-4
Number of Associations Accepted for AE Storage

Maximum number of simultaneous Associations	2

2.2.1.2.3 Asynchronous Nature

CXDI RF supports asynchronous communication (multiple outstanding transactions over a single Association).

Table 2.2-5
Asynchronous Nature as a SCU for AE Storage

Maximum number of outstanding asynchronous transactions	2

2.2.1.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Table 2.2-6
DICOM Implementation Class and Version for AE Storage

Implementation Class UID	1.2.392.200046.100.13.xxxxx[*1]
Implementation Version Name	CXDI RF xxxxx[*1]

[*1] xxxxx: Actually replaced by the version number

2.2.1.3 Association Initiation Policy

2.2.1.3.1 Activity – Verify

2.2.1.3.1.1 Description and Sequencing of Activities

The request for a verification is initiated by user interaction and the result is displayed on user interface.

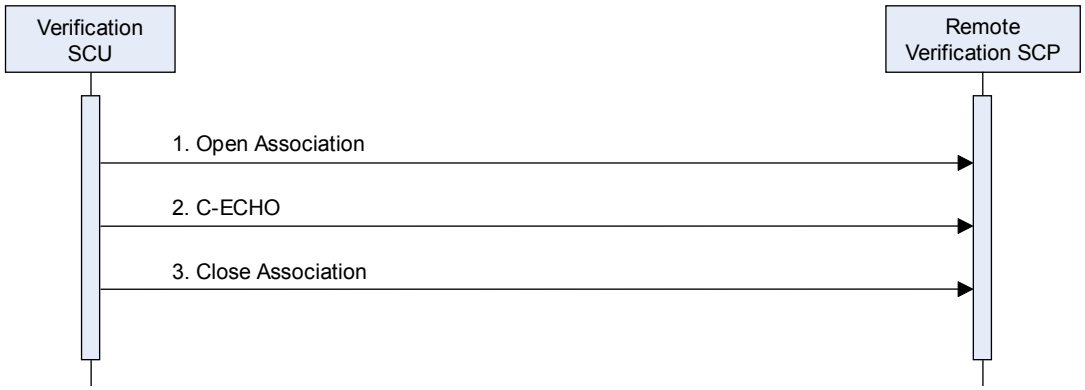

Figure 2.2-1
Sequencing of Activity – verify

1. The Verification SCU opens an association with the Remote Verification SCP.
2. Verification is transmitted to the Remote Verification SCP using a C-ECHO request and the Remote Verification SCP replies with a C-ECHO response (status success).
3. The Verification SCU closes the association with the Remote Verification SCP.

2.2.1.3.1.2 Proposed Presentation Contexts

The CXDI RF is capable of proposing the Presentation Contexts as shown in the following table:

Table 2.2-7
Proposed Presentation Context for Connectivity Verification

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

2.2.1.3.1.3 SOP Specific Conformance Verification SOP Class

The CXDI RF provides standard conformance to the DICOM Verification Service Class as an SCU. The status code for the C-ECHO is as follows:

Table 2.2-8
C-ECHO Response Status Handling Behavior

Code	Status	Meaning
0000	Success	The C-ECHO request is accepted.
Any other status code.	*	The Association is released using A-RELEASE and the failure is reported to the user.

2.2.1.3.2 Activity – Send Images & Pres States

2.2.1.3.2.1 Description and Sequencing of Activities

A user can select images and presentation states and request them to be sent to multiple destinations (up to 2). Each request is forwarded to the job queue and processed individually. When the “Output Setting” option is active, each instance stored in database will be forwarded to the network job queue for a pre-configured auto-send target destination. It can be configured which instances will be automatically marked and the destination where the instances are automatically sent to. The “Output Setting” is triggered by the End Exam. The transfer of presentation states is optional.

The Storage AE is invoked by the job control interface that is responsible for processing network archival tasks. The job consists of data describing the instances marked for storage and the destination. An internal daemon process triggered by a job for a specific network destination initiates a C-STORE request to store images. The output of the Image is only P-Value. If the process successfully establishes an Association to a remote Application Entity, it will transfer each instance via the open Association. Status of the transfer is reported through the job control interface. Only one job will be active at a time. If the C-STORE Response from the remote Application contains a status other than Success or Warning, the Association is aborted and the related Job is switched to a failed state. It can be restarted any time by user interaction.

The Storage AE attempts to initiate a new Association in order to issue a C-STORE request.

If the Remote AE is configured as an archive device the Storage AE will, after all images and presentation states have been sent, transmit Storage Commitment request (N-ACTION) over a separate association. Upon receiving the N-ACTION response the Storage AE will delay releasing the Association for a configurable amount of time. If no N-EVENT-REPORT is received within this time period the Association will be immediately released (i.e. notification of Storage Commitment success or failure will be received over a separate association). However, the Storage AE is capable of receiving an N-EVENT-REPORT request at any time during an association provided a Presentation Context for the Storage Commitment Push Model has been successfully negotiated (i.e. the N-ACTION is sent at the end of one association and the N-EVENT-REPORT is received during an association initiated for a subsequent send job or during an association initiated by the Remote AE for the specific purpose of sending the N-EVENT-REPORT).

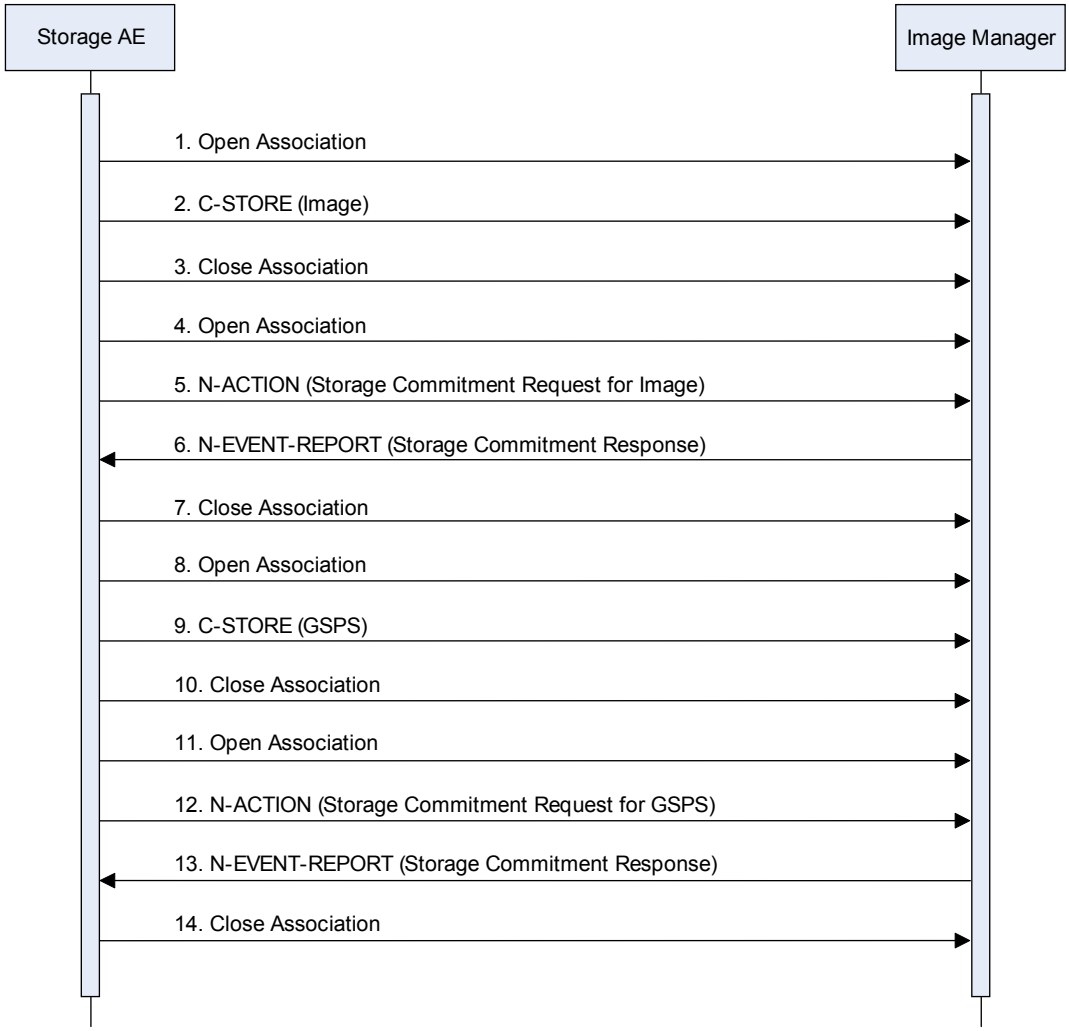

Figure 2.2-2
Sequencing of Activity – Send Images & Pres States

A possible sequence of interactions between the Storage AE and an Image Manager (e.g. a storage or archive device supporting the Storage and Storage Commitment SOP Classes as an SCP) is illustrated in Figure 2.2-2:

1. The Storage AE opens an association with the Image Manager.

2. An acquired image is transmitted to the Image Manager using a C-STORE request and the Image Manager replies with a C-STORE response (status success).

3. The Storage AE closes the association with the Image Manager.

4. The Storage AE opens an association with the Image Manager.

5. An N-ACTION request is transmitted to the Image Manager to obtain storage commitment of previously transmitted image. The Image Manager replies with an N-ACTION response indicating the request has been received and is being processed.

6. The Image Manager immediately transmits an N-EVENT-REPORT request notifying the Storage AE of the status of the Storage Commitment Request (sent in step 5 using the N-ACTION message). The Storage AE replies with an N-EVENT-REPORT response confirming receipt. The Image Manager could send this message at any time or omit it entirely in favor of transmitting the N-EVENT-REPORT over a separate dedicated association (see note).

7. The Storage AE closes the association with the Image Manager.

8. The Storage AE opens an association with the Image Manager.

9. An acquired GSPS is transmitted to the Image Manager using a C-STORE request and the Image Manager replies with a C-STORE response (status success).

10. The Storage AE closes the association with the Image Manager.

11. The Storage AE opens an association with the Image Manager.

12. An N-ACTION request is transmitted to the Image Manager to obtain storage commitment of previously transmitted GSPS. The Image Manager replies with an N-ACTION response indicating the request has been received and is being processed.

13. The Image Manager immediately transmits an N-EVENT-REPORT request notifying the Storage AE of the status of the Storage Commitment Request (sent in step 12 using the N-ACTION message). The Storage AE replies with an N-EVENT-REPORT response confirming receipt. The Image Manager could send this message at any time or omit it entirely in favor of transmitting the N-EVENT-REPORT over a separate dedicated association (see note).

14. The Storage AE closes the association with the Image Manager.

NOTE: Many other message sequences are possible depending on the number of images and GSPS instances to be stored, support for Storage Commitment and when the SCP sends the N-EVENT-REPORT. The N-EVENT-REPORT can also be sent over a separate association initiated by the Image Manager (see Section 2.2.1.4.2 on Activity – Receive Storage Commitment Response).

2.2.1.3.2.2 Proposed Presentation Contexts

CXDI RF is capable of proposing the Presentation Contexts shown in the following table:

Table 2.2-9
Proposed Presentation Contexts for Activity Send Images

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
X-Ray Radio Fluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Digital X-Ray Image Storage-For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

A Presentation Context for the Storage Commitment Push Model will only be proposed if the Remote AE is configured as an archive device.

2.2.1.3.2.3 SOP Specific Conformance Image & Pres State Storage SOP Classes

All Image & Presentation State Storage SOP Classes supported by the Storage AE exhibit the same behavior, except where stated, and are described together in this section.

The status meaning is logged and the job warning is reported to the user via the job control application when receiving Event Type Image/GSPS failure. If images relating to GSPS in a send job have status failure then the GPSP is not send.

The behavior of Storage AE when encountering status codes in a C-STORE response is summarized in the Table below:

Table 2.2-10
Storage C-STORE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has successfully stored the SOP Instance. If all SOP Instances in a send job have status success then the job is marked as complete.
Refused	Out of Resources	A700-A7FF	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application. This is a transient failure.
Error	Data Set does not match SOP Class	A900-A9FF	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.
Error	Cannot Understand	C000-CFFF	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.
Warning	Coercion of Data Elements	B000	Image transmission is considered successful. The status meaning is logged and the job warning is reported to the user via the job control application.
Warning	Elements Discarded	B006	Image transmission is considered successful. The status meaning is logged and the job warning is reported to the user via the job control application.
Warning	Data Set does not match SOP Class	B007	Image transmission is considered successful. The status meaning is logged and the job warning is reported to the user via the job control application.
*	*	Any other status code.	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.

Error Comment(0000,0902) and Error ID(0000,0903) are reported to the user via additional information on error dialog.

The behavior of Storage AE during communication failure is summarized in the Table below:

Table 2.2-11
Storage Communication Failure Behavior

Exception	Behavior
Timeout	The send job is marked as failed. The reason is logged and the job failure is reported to the user via the job control application.
Association aborted by the SCP or network layers	The send job is marked as failed. The reason is logged and the job failure is reported to the user via the job control application.

A failed send job can be restarted by user interaction.

The contents of X-Ray Image Storage SOP Instances created by CXDI RF conform to the DICOM X-Ray Image IOD definition and are described in section 6.1.

The contents of Grayscale Softcopy Presentation State Storage SOP Instances created by CXDI RF conform to the DICOM Grayscale Softcopy Presentation State IOD and are described in section 6.1.

Grayscale Softcopy Presentation State Storage SOP Instances are created upon user request (e.g. explicitly via “End Exam”) in order to save the most recent visual appearance of an image. Even If images from multiple studies are being displayed a separate Presentation State will be created for each image.

When displaying an existing image the most recently saved Grayscale Softcopy Presentation State containing references to the image will be automatically applied.

Grayscale Softcopy Presentation State Storage SOP Instances created by CXDI RF will only reference instances of X-Ray Image Storage SOP Instances.

2.2.1.3.2.4 SOP Specific Conformance for Storage Commitment SOP Class

2.2.1.3.2.4.1 Storage Commitment Operations (N-ACTION)

The Storage AE will request storage commitment for instances of the X-Ray Image Storage SOP Class and Grayscale Softcopy Presentation State Storage SOP Class if the Remote AE is configured as an archive device and a presentation context for the Storage Commitment Push Model has been accepted.

The Storage AE will consider Storage Commitment failed if no N-EVENT-REPORT is received for a Transaction UID within a configurable time period after receiving a successful N-ACTION response (duration of applicability for a Transaction UID).

The behavior of Storage AE when encountering status codes in an N-ACTION response is summarized in the Table below:

Table 2.2-12
Storage Commitment N-ACTION Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The request for storage commitment is considered successfully sent. A timer is started which will expire if no N-EVENT-REPORT for the Transaction UID is received within a configurable timeout period.
*	*	Any other status code.	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.

The behavior of Storage AE during communication failure is summarized in the Table below:

Table 2.2-13
Storage Commitment Communication Failure Behavior

Exception	Behavior
Timeout	The send job is marked as failed. The reason is logged and the job failure is reported to the user.
Association aborted by the SCP or network layers	The send job is marked as failed. The reason is logged and the job failure is reported to the user.

2.2.1.3.2.4.2 Storage Commitment Notifications (N-EVENT-REPORT)

The Storage AE is capable of receiving an N-EVENT-REPORT notification if it has successfully negotiated a Presentation Context for the Storage Commitment Push Model (i.e. only associations established with archive devices).
Upon receipt of an N-EVENT-REPORT the timer associated with the Transaction UID will be canceled.
The behavior of Storage AE when receiving Event Types within the N-EVENT-REPORT is summarized in the Table below.

Table 2.2-14
Storage Commitment N-EVENT-REPORT Behavior

Event Type Name	Event Type ID	Behavior
Storage Commitment Request Successful	1	The Referenced SOP Instance under Referenced SOP Sequence (0008,1199) are marked within the database as “Stored & Committed (SC)”. Successfully committed SOP Instances are candidates for automatic deletion from the local database if local resources become scarce. The conditions under which automatic deletion is initiated and the amount of space freed are site configurable. The oldest SOP Instances are deleted first.
Storage Commitment Request Complete – Failures Exist	2	The Referenced SOP Instances under Referenced SOP Sequence (0008,1199) are treated in the same way as in the success case (Event Type 1). The Referenced SOP Instances under Failed SOP Sequence (0008,1198) are marked within the database as “Store & Commit Failed (SF)”. The Failure Reasons are logged and the job failure is reported to the user via the job control application. A send job that failed storage commitment will not be automatically restarted but can be restarted by user interaction.

The reasons for returning specific status codes in an N-EVENT-REPORT response are summarized in the Table below.

Table 2.2-15
Storage Commitment N-EVENT-REPORT Response Status Reasons

Service Status	Further Meaning	Error Code	Reasons
Success	Success	0000	The storage commitment result has been successfully received.
Failure	Invalid object instance	0117	The Transaction UID in the N-EVENT-REPORT request is not recognized.

2.2.1.4 Association Acceptance Policy

2.2.1.4.1 Activity – Verify

2.2.1.4.1.1 Description and Sequencing of Activities

The Verification SCP will accept associations in order to receive C-ECHO request.

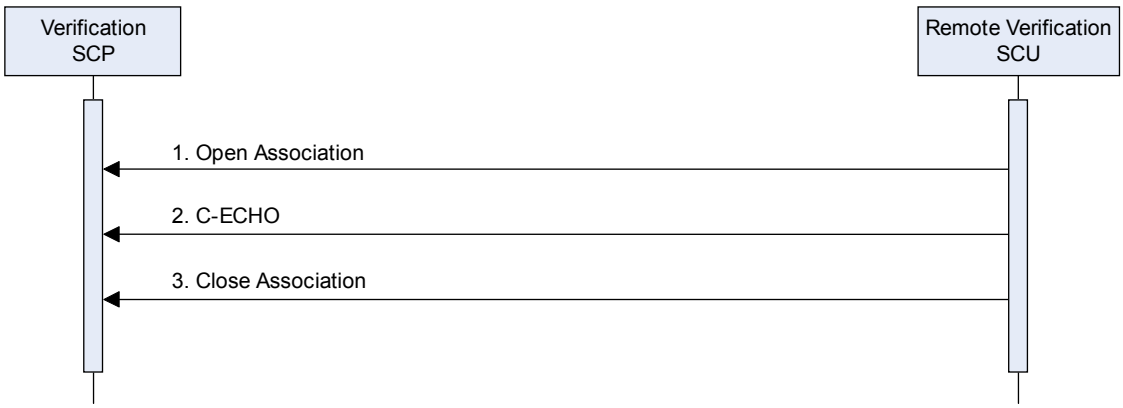

Figure 2.2-3
Sequencing of Activity – Verify

1. The Image Manager opens an association with the Storage AE.
2. Verification is transmitted to the Storage AE using a C-ECHO request and the Storage AE replies with a C-ECHO response (status success).
3. The Image Manager closes the association with the Storage AE.

The result of C-ECHO is reported to the user via the message field.

2.2.1.4.1.2 Accepted Presentation Contexts

The CXDI RF will accept Presentation Contexts as shown in the Table below.

Table 2.2-16
Acceptable Presentation Contexts for Connectivity Verification

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

2.2.1.4.1.3 SOP Specific Conformance for Verification SOP Class

The Storage AE provides standard conformance to the Verification SOP Class as an SCP. If the C-ECHO request was successfully received, a 0000 (Success) status code will be returned in the C-ECHO response. Otherwise, Association will be aborted.

2.2.1.4.2 Activity – Receive Storage Commitment Response

2.2.1.4.2.1 Description and Sequencing of Activities

The Storage AE will accept associations in order to receive responses to a Storage Commitment Request.

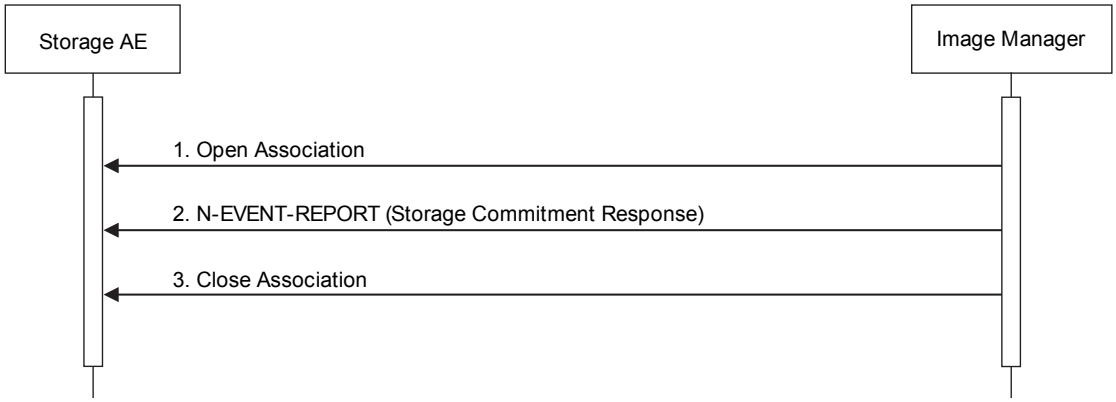

Figure 2.2-4
Sequencing of Activity – Receive Storage Commitment Response

A possible sequence of interactions between the Storage AE and an Image Manager (e.g. a storage or archive device supporting Storage Commitment SOP Classes as an SCP) is illustrated in the Figure above:

1. The Image Manager opens a new association with the Storage AE.

2. The Image Manager sends an N-EVENT-REPORT request notifying the Storage AE of the status of a previous Storage Commitment Request. The Storage AE replies with an N-EVENT-REPORT response confirming receipt.

3. The Image Manager closes the association with the Storage AE.

The Storage AE may reject association attempts as shown in the Table below. The Result, Source and Reason/Diag columns represent the values returned in the appropriate fields of an ASSOCIATE-RJ PDU (see PS 3.8, Section 9.3.4). The contents of the Source column is abbreviated to save space and the meaning of the abbreviations are:

a) 1 – DICOM UL service-user

b) 2 – DICOM UL service-provider (ASCE related function)

c) 3 – DICOM UL service-provider (Presentation related function)

Table 2.2-17
Association Rejection Reasons

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

2.2.1.4.2.2 Accepted Presentation Contexts

The Storage AE will accept Presentation Contexts as shown in the Table below.

Table 2.2-18
Acceptable Presentation Contexts for
Activity Receive Storage Commitment Response

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
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
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

2.2.1.4.2.3 SOP Specific Conformance for Storage Commitment SOP Class

2.2.1.4.2.3.1 Storage Commitment Notifications (N-EVENT-REPORT)

Upon receipt of an N-EVENT-REPORT the timer associated with the Transaction UID will be canceled.
The behavior of Storage AE when receiving Event Types within the N-EVENT-REPORT is summarized in Table 2.2-14.
The reasons for returning specific status codes in an N-EVENT-REPORT response are summarized in Table 2.2-15.

2.2.2 Workflow Application Entity Specification

2.2.2.1 SOP Classes

CXDI RF provides Standard Conformance to the following SOP Classes:

Table 2.2-19
SOP Classes for AE Workflow

SOP Class Name	SOP Class UID	SCU	SCP
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	No
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Yes	No

2.2.2.2 Association Policies

2.2.2.2.1 General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Table 2.2-20
DICOM Application Context for AE Workflow

Application Context Name	1.2.840.10008.3.1.1.1

2.2.2.2.2 Number of Associations

CXDI RF initiates one Association at a time for a Worklist request.

Table 2.2-21
Number of Associations Initiated for AE Workflow

Maximum number of simultaneous Associations	1

2.2.2.2.3 Asynchronous Nature

CXDI RF does not support asynchronous communication (multiple outstanding transactions over a single Association).

Table 2.2-22
Asynchronous Nature as a SCU for AE Workflow

Maximum number of outstanding asynchronous transactions	N/A

2.2.2.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Table 2.2-23
DICOM Implementation Class and Version for AE Workflow

Implementation Class UID	1.2.392.200046.100.13.xxxxx[*1]
Implementation Version Name	CXDI RF xxxxx[*1]

[*1] xxxxx: Actually replaced by the version number

2.2.2.3 Association Initiation Policy

2.2.2.3.1 Activity – Verify

See 2.2.1.3.1.

2.2.2.3.2 Activity – Worklist Update

2.2.2.3.2.1 Description and Sequencing of Activities

The request for a Worklist Update is initiated by user interaction, i.e. pressing the buttons “Refresh”/“Refresh Option”. With “Refresh Option” a dialog to enter search criteria is opened and an interactive query can be performed.

The interactive Patient Worklist Query will display a dialog for entering data as search criteria. When the Query is started on user request, only the data from the dialog will be inserted as matching keys into the query.

Upon initiation of the request, the CXDI RF will build an Identifier for the C-FIND request, will initiate an Association to send the request and will wait for Worklist responses. After retrieval of all responses, CXDI RF will access the local database to add or update patient demographic data. To protect the system from overflow, the CXDI RF will limit the number of processed worklist responses to a configurable maximum. During receiving the worklist response items are counted and the query processing is canceled by issuing a C-FIND-CANCEL if the configurable limit of items is reached. The results will be displayed in a list, which will be cleared with the next worklist update.

CXDI RF will initiate an Association in order to issue a C-FIND request according to the Modality Worklist Information Model.

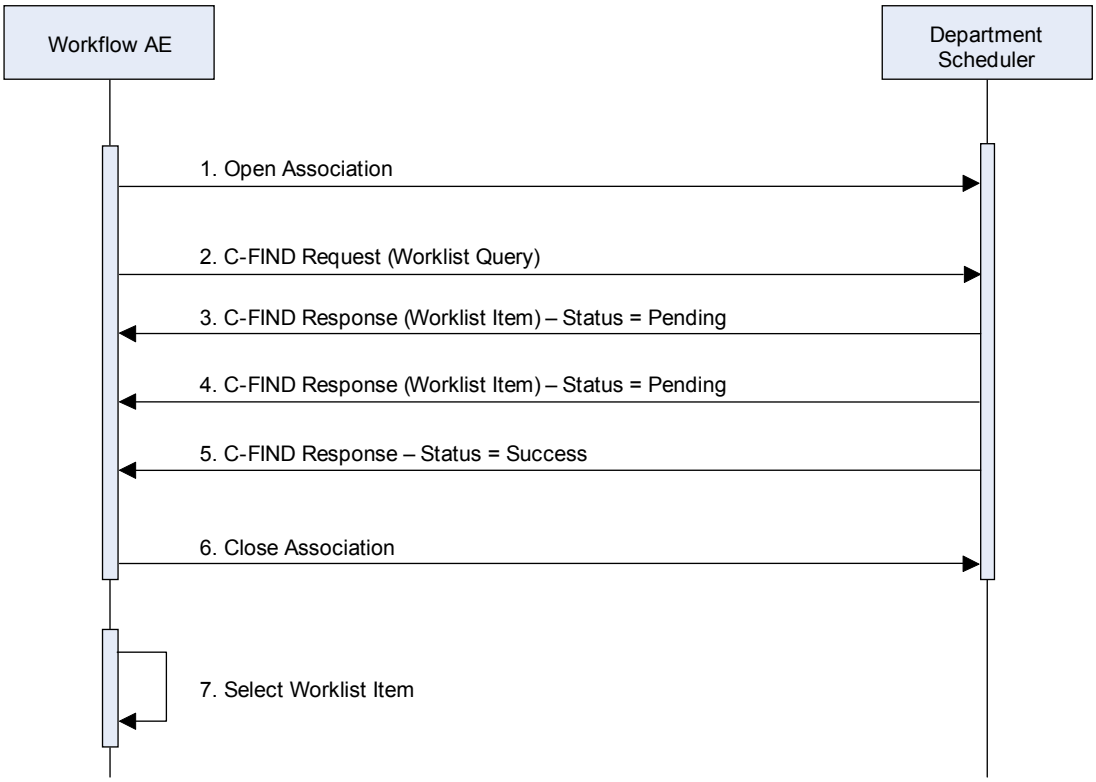

Figure 2.2-5
Sequencing of Activity – Worklist Update

A possible sequence of interactions between the Workflow AE and a Departmental Scheduler (e.g. a device such as a RIS or HIS which supports the Modality Worklist SOP Class as an SCP) is illustrated in the Figure above:

1. The Worklist AE opens an association with the Departmental Scheduler.

2. The Worklist AE sends a C-FIND request to the Departmental Scheduler containing the Worklist Query attributes.

3. The Departmental Scheduler returns a C-FIND response containing the requested attributes of the first matching Worklist Item.

4. The Departmental Scheduler returns another C-FIND response containing the requested attributes of the second matching Worklist Item.

5. The Departmental Scheduler returns another C-FIND response with status “Success” indicating that no further matching Worklist Items exist. This example assumes that only 2 Worklist items match the Worklist Query.

6. The Worklist AE closes the association with the Departmental Scheduler.

7. The user selects a Worklist Item from the Worklist and prepares to acquire new images.

2.2.2.3.2.2 Proposed Presentation Contexts

CXDI RF will propose Presentation Contexts as shown in the following table:

Table 2.2-24
Proposed Presentation Contexts for Activity Worklist Update

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

2.2.2.3.2.3 SOP Specific Conformance for Modality Worklist

The behavior of CXDI RF when encountering status codes in a Modality Worklist C-FIND response is summarized in the Table below. If CXDI RF receives any other SCP response status than “Success” or “Pending”, an error message will appear on the user interface.

Table 2.2-25
Modality Worklist C-FIND Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete	0000	The SCP has completed the matches. Worklist items are available for display or further processing.
Refused	Out of Resources	A700	The Association is released using A-RELEASE. The status meaning is logged and reported to the user.
Failed	Identifier does not match SOP Class	A900	The Association is released using A-RELEASE. The status meaning is logged and reported to the user.
Failed	Unable to Process	C000 – CFFF	The Association is released using A-RELEASE. The status meaning is logged and reported to the user.
Cancel	Matching terminated due to Cancel request	FE00	If the query was cancelled due to too many worklist items then the SCP has completed the matches. Worklist items are available for display or further processing. Otherwise, the Association is released using A-RELEASE. The status meaning is logged and reported to the user.
Pending	Matches are continuing	FF00	The worklist item contained in the Identifier is collected for later display or further processing.
Pending	Matches are continuing – Warning that one or more Optional Keys were not supported	FF01	The worklist item contained in the Identifier is collected for later display or further processing.
*	*	Any other status code.	The Association is released using A-RELEASE. The status meaning is logged and reported to the user.

The behavior of CXDI RF during communication failure is summarized in the Table below.

Table 2.2-26
Modality Worklist Communication Failure Behavior

Exception	Behavior
Timeout	The worklist query is marked as failed. The reason is logged and reported to the user if an interactive query.
Association aborted by the SCP or network layers	The worklist query is marked as failed. The reason is logged and reported to the user if an interactive query.

Acquired images will always use the Study Instance UID specified for the Scheduled Procedure Step (if available). If an acquisition is unscheduled, a Study Instance UID will be generated locally.

The Table below provides a description of the CXDI RF Worklist Request Identifier and specifies the attributes that are copied into the images. Unexpected attributes returned in a C-FIND response are ignored.

Requested return attributes not supported by the SCP are set to have no value. Non-matching responses returned by the SCP due to unsupported optional matching keys are ignored.

Table 2.2-27
Worklist Request Identifier

Module Name Attribute Name	Tag	VR	M	R	Q	D	IOD
SOP Common							
Specific Character Set	(0008,0005)	CS		x			
Scheduled Procedure Step							
Scheduled Procedure Step Sequence	(0040,0100)	SQ		x			
> Modality	(0008,0060)	CS	S	x	x	x	
> Requested Contrast Agent	(0032,1070)	LO		x			
> Scheduled Station AE Title	(0040,0001)	AE	S	x	x		
> Scheduled Procedure Step Start Date	(0040,0002)	DA	R	x	x	x	
> Scheduled Procedure Step Start Time	(0040,0003)	TM	R	x	x	x	
> Scheduled Performing Physician’s Name	(0040,0006)	PN	S*	x	x		
> Scheduled Procedure Step Description	(0040,0007)	LO		x		x	x
> Scheduled Protocol Code Sequence	(0040,0008)	SQ		x			x
> Code Value	(0008,0100)	CS		x			x
> Coding Scheme Designator	(0008,0102)	SH		x			x
> Coding Scheme Version	(0008,0103)	SH		x			x
> Code Meaning	(0008,0104)	LO		x		x	x
> Scheduled Procedure Step ID	(0040,0009)	SH		x			x
> Scheduled Station Name	(0040,0010)	SH	S	x	x		
> Scheduled Procedure Step Location	(0040,0011)	SH	S	x	x		
> Pre-Medication	(0040,0012)	LO		x			
> Comments on the Scheduled Procedure Step	(0040,0400)	LT					
Requested Procedure							

Module Name Attribute Name	Tag	VR	M	R	Q	D	IOD
Referenced Study Sequence	(0008,1110)	SQ		x			x
> Referenced SOP Class UID	(0008,1150)	UI		x			x
> Referenced SOP Instance UID	(0008,1155)	UI		x			x
Study Instance UID	(0020,000D)	UI		x			x
Requested Procedure Description	(0032,1060)	LO		x		x	x
Requested Procedure Code Sequence	(0032,1064)	SQ		x			x
> Code Value	(0008,0100)	CS		x			x
> Coding Scheme Designator	(0008,0102)	SH		x			x
> Coding Scheme Version	(0008,0103)	SH		x			x
> Code Meaning	(0008,0104)	LO		x			x
Requested Procedure ID	(0040,1001)	SH	S	x	x	x	x
Reason for the Requested Procedure	(0040,1002)	LO					
Requested Procedure Priority	(0040,1003)	SH					
Patient Transport Arrangements	(0040,1004)	LO					
Requested Procedure Location	(0040,1005)	LO					
Requested Procedure Comments	(0040,1400)	LT					
Imaging Service Request							
Accession Number	(0008,0050)	SH	S	x	x	x	x
Referring Physician's Name	(0008,0090)	PN		x		x	x
Requesting Physician	(0032,1032)	PN					
Requesting Service	(0032,1033)	LO					
Order Entered By	(0040,2008)	PN					
Order Enterer’s Location	(0040,2009)	SH					
Order Callback Phone Number	(0040,2010)	SH					
Placer Order Number / Imaging Service Request	(0040,2016)	LO					
Filler Order Number / Imaging Service Request	(0040,2017)	LO					
Imaging Service Request Comments	(0040,2400)	LT					
Visit Identification							
Institution Name	(0008,0080)	LO					
Institution Address	(0008,0081)	LO					
Admission ID	(0038,0010)	LO					
Issuer of Admission ID	(0038,0011)	LO					
Visit Status							
Visit Status ID	(0038,0008)	CS					
Current Patient Location	(0038,0300)	LO					
Patient’s Institution Residence	(0038,0400)	LO					
Visit Comments	(0038,4000)	LT					

Visit Admission							
Referring Physician's Address	(0008,0092)	ST					

Module Name Attribute Name	Tag	VR	M	R	Q	D	IOD
Referring Physician's Telephone Numbers	(0008,0094)	SH					
Admitting Diagnosis Description	(0008,1080)	LO					
Route of Admissions	(0038,0016)	LO					
Patient Identification							
Patient Name	(0010,0010)	PN	S*	x	x	x	x
Patient ID	(0010,0020)	LO	S	x	x	x	x
Issuer of Patient ID	(0010,0021)	LO					
Other Patient IDs	(0010,1000)	LO					
Patient's Birth Name	(0010,1005)	PN					
Patient's Mother's Birth Name	(0010,1060)	PN					
Medical Record Locator	(0010,1090)	LO					
Patient Demographic							
Patient's Birth Date	(0010,0030)	DA		x		x	x
Patient's Sex	(0010,0040)	CS		x		x	x
Patient's Age	(0010,1010)	AS		x		x	
Patient's Size	(0010,1020)	DS					
Patient's Weight	(0010,1030)	DS					
Military Rank	(0010,1080)	LO		x		x	
Branch of Service	(0010,1081)	LO					
Country of Residence	(0010,2150)	LO					
Region of Residence	(0010,2152)	LO					
Patient's Telephone Numbers	(0010,2154)	SH					
Ethnic Group	(0010,2160)	SH					
Patient's Religious Preference	(0010,21F0)	LO					
Patient Comments	(0010,4000)	LT					
Confidentiality constraint on patient data	(0040,3001)	LO					
Patient Medical							
Medical Alerts	(0010,2000)	LO					
Allergies	(0010,2110)	LO					
Smoking Status	(0010,21A0)	CS					
Additional Patient History	(0010,21B0)	LT					
Pregnancy Status	(0010,21C0)	US		x		x	
Special Needs	(0038,0050)	LO					
Patient State	(0038,0500)	LO					

The above table should be read as follows:

Module Name:
The name of the associated module for supported worklist attributes.

Attribute Name:
Attributes supported to build an CXDI RF Worklist Request Identifier.

Tag: DICOM tag for this attribute.

VR: DICOM VR for this attribute.

M: Matching keys for Worklist Update. An “S” will indicate that CXDI RF will supply an attribute value for Single Value Matching, an “R” will indicate Range Matching and a “*” will denote wildcard matching.

R: Return keys. An “x” will indicate that CXDI RF will supply this attribute as Return Key with zero length for Universal Matching.

Q: Interactive Query Key. An “x” will indicate that CXDI RF will supply this attribute as matching key, if entered in the Query Patient Worklist dialog. For example, the Patient Name can be entered thereby restricting Worklist responses to Procedure Steps scheduled for the patient.

D: Displayed keys. An “x” indicates that this worklist attribute is displayed to the user during a patient registration dialog. For example, Patient Name will be displayed when registering the patient prior to an examination.

IOD: An “x” indicates that this Worklist attribute is included into all Object Instances created during performance of the related Procedure Step.

2.2.2.3.3 Activity – Acquire Images

2.2.2.3.3.1 Description and Sequencing of Activities

After Patient registration, the CXDI RF is awaiting the 1st application of X-Ray Dose to the patient. The trigger to create an MPPS SOP Instance is derived from this event. An Association to the configured MPPS SCP system is established immediately and the related MPPS SOP Instance will be created. An MPPS Instance that has been sent with a state of “COMPLETED” or “DISCONTINUED” can no longer be updated.

The CXDI RF will support creation of “unscheduled cases” by allowing MPPS Instances to be communicated for locally registered Patients.

CXDI RF will initiate an Association to issue an:

— N-CREATE request according to the CREATE Modality Performed Procedure Step SOP Instance.

— N-SET request to update the contents and state of the MPPS according to the SET Modality Performed Procedure Step Information operation.

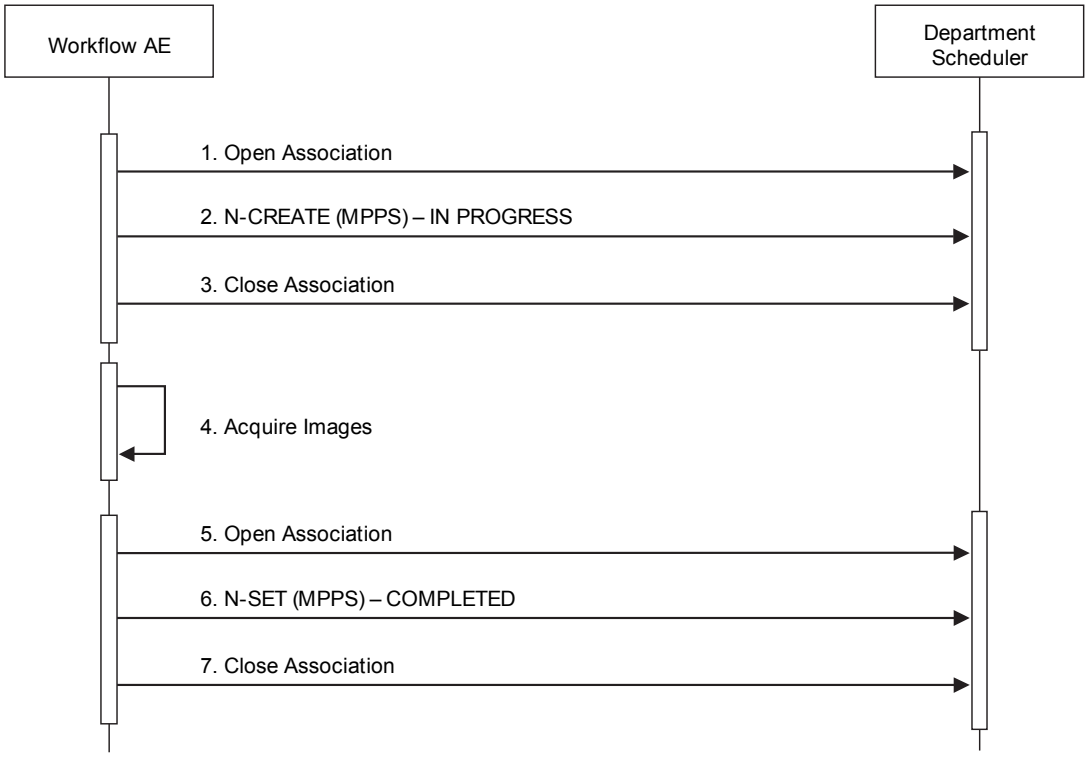

Figure 2.2-6
Sequencing of Activity – Acquire Images

A possible sequence of interactions between the Workflow AE and a Departmental Scheduler (e.g. a device such as a RIS or HIS which supports the MPPS SOP Class as an SCP) is illustrated in Figure 2.2-6:

1. The Worklist AE opens an association with the Departmental Scheduler.

2. The Worklist AE sends an N-CREATE request to the Departmental Scheduler to create an MPPS instance with status of “IN PROGRESS” and create all necessary attributes. The Departmental Scheduler acknowledges the MPPS creation with an N-CREATE response (status success).

3. The Worklist AE closes the association with the Departmental Scheduler.

4. All images are acquired and stored in the local database.

5. The Worklist AE opens an association with the Departmental Scheduler.

6. The Worklist AE sends an N-SET request to the Departmental Scheduler to update the MPPS instance with status of “COMPLETED” and set all necessary attributes. The Departmental Scheduler acknowledges the MPPS update with an N-SET response (status success).

7. The Worklist AE closes the association with the Departmental Scheduler.

2.2.2.3.3.2 Proposed Presentation Contexts

CXDI RF will propose Presentation Contexts as shown in the following table:

Table 2.2-28
Proposed Presentation Contexts for Real-World Activity Acquire Images

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

2.2.2.3.3.3 SOP Specific Conformance for MPPS

The behavior of CXDI RF when encountering status codes in an MPPS N-CREATE or N–SET response is summarized in Table 2.2-29. If any other SCP response status than “Success” or “Warning” is received by CXDI RF, an error message will appear on the user interface.

Table 2.2-29
MPPS N-CREATE / N-SET Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has completed the operation successfully.
Failure	Processing Failure – Performed Procedure Step Object may no longer be updated	0110	The Association is released using A-RELEASE and the MPPS is marked as failed. The status meaning is logged and reported to the user.
Warning	Attribute Value Out of Range	0116	The MPPS operation is considered successful. The status meaning is logged and the job warning is reported to the user via the job control application.
*	*	Any other status code.	The Association is released using A-RELEASE and the MPPS is marked as failed. The status meaning is logged and reported to the user.

The behavior of CXDI RF during communication failure is summarized in the Table below:

Table 2.2-30
MPPS Communication Failure Behavior

Exception	Behavior
Timeout	The send job is marked as failed. The reason is logged and the job failure is reported to the user via the job control application.
Association aborted by the SCP or network layers	The MPPS is marked as failed. The reason is logged and reported to the user.

Table 2.2-31 provides a description of the MPPS N-CREATE and N-SET request identifiers sent by CXDI RF. Empty cells in the N-CREATE and N-SET columns indicate that the attribute is not sent. A “Zero length” attribute will be sent with zero length.

Table 2.2-31
MPPS N-CREATE / N-SET Request Identifier

Attribute Name	Tag	VR	N-CREATE	N-SET
Specific Character Set	(0008,0005)	CS	“ISO_IR 100”, “ISO_IR 101”, “ISO_IR 110”, “ISO_IR 126”, “ISO_IR 144”, “ISO_IR 148”, “ISO 2022 IR 13”, “ISO 2022 IR 87”, “GB18030”, “ISO_IR 192”	
Modality	(0008,0060)	CS	“DX”, “CR”, “RF”	
Procedure Code Sequence	(0008,1032)	SQ	From Modality Worklist	From Modality Worklist
> Code Value	(0008,0100)	SH	From Modality Worklist	From Modality Worklist
> Coding Scheme Designator	(0008,0102)	SH	From Modality Worklist	From Modality Worklist
> Coding Scheme Version	(0008,0103)	SH	From Modality Worklist	From Modality Worklist
> Code Meaning	(0008,0104)	LO	From Modality Worklist	From Modality Worklist
Referenced Patient Sequence	(0008,1120)	SQ	Zero length	
Patient’s Name	(0010,0010)	PN	From Modality Worklist or user input (3 component groups with 5 components)	
Patient ID	(0010,0020)	LO	From Modality Worklist or user input	
Patient’s Birth Date	(0010,0030)	DA	From Modality Worklist or user input. Dates before the year 1753 cannot be input.	
Patient’s Sex	(0010,0040)	CS	From Modality Worklist or user input	
Image and Fluoroscopy Area Dose Product	(0018,115E)	DS		Total DAP
Study ID	(0020,0010)	SH	From Modality Worklist ("Requested Procedure ID" is used.)	
Performed Station AE Title	(0040,0241)	AE	From configuration	
Performed Station Name	(0040,0242)	SH	Zero length	

Attribute Name	Tag	VR	N-CREATE	N-SET
Performed Location	(0040,0243)	SH	Zero length	
Performed Procedure Step Start Date	(0040,0244)	DA	Actual start date	
Performed Procedure Step Start Time	(0040,0245)	TM	Actual start time	
Performed Procedure Step End Date	(0040,0250)	DA	Zero length	Actual end date
Performed Procedure Step End Time	(0040,0251)	TM	Zero length	Actual end time
Performed Procedure Step Status	(0040,0252)	CS	“IN PROGRESS”	“DISCONTINUED”, “COMPLETED”
Performed Procedure Step ID	(0040,0253)	SH	Automatically created	
Performed Procedure Step Description	(0040,0254)	LO	User input	User input
Performed Procedure Type Description	(0040,0255)	LO	Zero length	
Performed Protocol Code Sequence	(0040,0260)	SQ	Zero length	Zero or more items
> Code Value	(0008,0100)	SH		From Modality Worklist or user input
> Coding Scheme Designator	(0008,0102)	SH		From Modality Worklist or “Canon Unique”
> Coding Scheme Version	(0008,0103)	SH		From Modality Worklist or not send
> Code Meaning	(0008,0104)	LO		From Modality Worklist or user input
Scheduled Step Attributes Sequence	(0040,0270)	SQ	If 1st dose applied results in an Instance	
> Accession Number	(0008,0050)	SH	From Modality Worklist or user input	
> Referenced Study Sequence	(0008,1110)	SQ	From Modality Worklist	
>> Referenced SOP Class UID	(0008,1150)	UI	From Modality Worklist	
>> Referenced SOP Instance UID	(0008,1155)	UI	From Modality Worklist	
> Study Instance UID	(0020,000D)	UI	From Modality Worklist or generated by device	
> Requested Procedure Description	(0032,1060)	LO	From Modality Worklist	
> Scheduled Procedure Step Description	(0040,0007)	LO	From Modality Worklist	
> Scheduled Protocol Code Sequence	(0040,0008)	SQ	From Modality Worklist	
>> Code Value	(0008,0100)	SH	From Modality Worklist	
>> Coding Scheme Designator	(0008,0102)	SH	From Modality Worklist	

Attribute Name	Tag	VR	N-CREATE	N-SET
>> Coding Scheme Version	(0008,0103)	SH	From Modality Worklist	
>> Code Meaning	(0008,0104)	LO	From Modality Worklist	
> Scheduled Procedure Step ID	(0040,0009)	SH	From Modality Worklist	
> Requested Procedure ID	(0040,1001)	SH	From Modality Worklist	
Total Time of Fluoroscopy	(0040,0300)	US		Total time
Total Number of Exposures	(0040,0301)	US		Number of exposures
Exposure Dose Sequence	(0040,030E)	SQ		Zero or more items
> KVP	(0018,0060)	DS		Generated by device
> Exposure Time	(0018,1150)	IS		Generated by device
> Radiation Mode	(0018,115A)	CS		“PULSED”
> X-Ray Tube Current	(0018,8151)	DS		Generated by device
Performed Series Sequence	(0040,0340)	SQ	Zero length	One or more items
> Retrieve AE Title	(0008,0054)	AE		Zero length
> Series Description	(0008,103E)	LO		User input
> Performing Physician’s Name	(0008,1050)	PN		User input
> Operator’s Name	(0008,1070)	PN		User input
> Referenced Image Sequence	(0008,1140)	SQ		Zero or more items
>> Referenced SOP Class UID	(0008,1150)	UI		“1.2.840.10008.5.1.4.1.1.1.1”, “1.2.840.10008.5.1.4.1.1.1”, “1.2.840.10008.5.1.4.1.1.12.2”
>> Referenced SOP Instance UID	(0008,1155)	UI		Automatically created
> Protocol Name	(0018,1030)	LO		User input
> Series Instance UID	(0020,000E)	UI		Automatically created
> Referenced Non-Image Composite SOP Instance Sequence	(0040,0220)	SQ		Zero or more items
>> Referenced SOP Class UID	(0008,1150)	UI		“1.2.840.10008.5.1.4.1.1.11.1”
>> Referenced SOP Instance UID	(0008,1155)	UI		Automatically created
Entrance Dose in mGy	(0040,8302)	DS		Generated by device

2.2.2.4 Association Acceptance Policy

The Workflow Application Entity does not accept Associations.

2.2.3 Hardcopy Application Entity Specification

2.2.3.1 SOP Classes

CXDI RF provides Standard Conformance to the following SOP Classes:

Table 2.2-32
SOP Classes for AE Hardcopy

SOP Class Name	SOP Class UID	SCU	SCP
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	Yes	No
Presentation LUT	1.2.840.10008.5.1.1.23	Yes	No

2.2.3.2 Association Policies

2.2.3.2.1 General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Table 2.2-33
DICOM Application Context for AE Hardcopy

Application Context Name	1.2.840.10008.3.1.1.1

2.2.3.2.2 Number of Associations

CXDI RF initiates one Association at a time for each configured hardcopy device. Multiple hardcopy devices can be configured.

Table 2.2-34
Number of Associations Initiated for AE Hardcopy

Maximum number of simultaneous Associations	1

2.2.3.2.3 Asynchronous Nature

CXDI RF does not support asynchronous communication (multiple outstanding transactions over a single Association).

Table 2.2-35
Asynchronous Nature as a SCU for AE Hardcopy

Maximum number of outstanding asynchronous transactions	N/A

2.2.3.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Table 2.2-36
DICOM Implementation Class and Version for AE Hardcopy

Implementation Class UID	1.2.392.200046.100.13.xxxxx [*1]
Implementation Version Name	CXDI RF xxxxx [*1]

[*1] xxxxx: Actually replaced by the version number

2.2.3.3 Association Initiation Policy

2.2.3.3.1 Activity – Verify

See 2.2.1.4.1.

2.2.3.3.2 Activity – Film Images

2.2.3.3.2.1 Description and Sequencing of Activities

A user composes images onto film sheets and requests them to be sent to a specific hardcopy device. The user can select the desired film format. Each print-job is forwarded to the job queue and processed individually.
The Hardcopy AE is invoked by the job control interface that is responsible for processing network tasks. The job consists of data describing the images and graphics to be printed as well as the requested layout and other parameters. The film sheet is internally processed, converted to a STANDARD/1,1 page and then the page image is sent. If no association to the printer can be established, the print-job is switched to a failed state and the user informed.

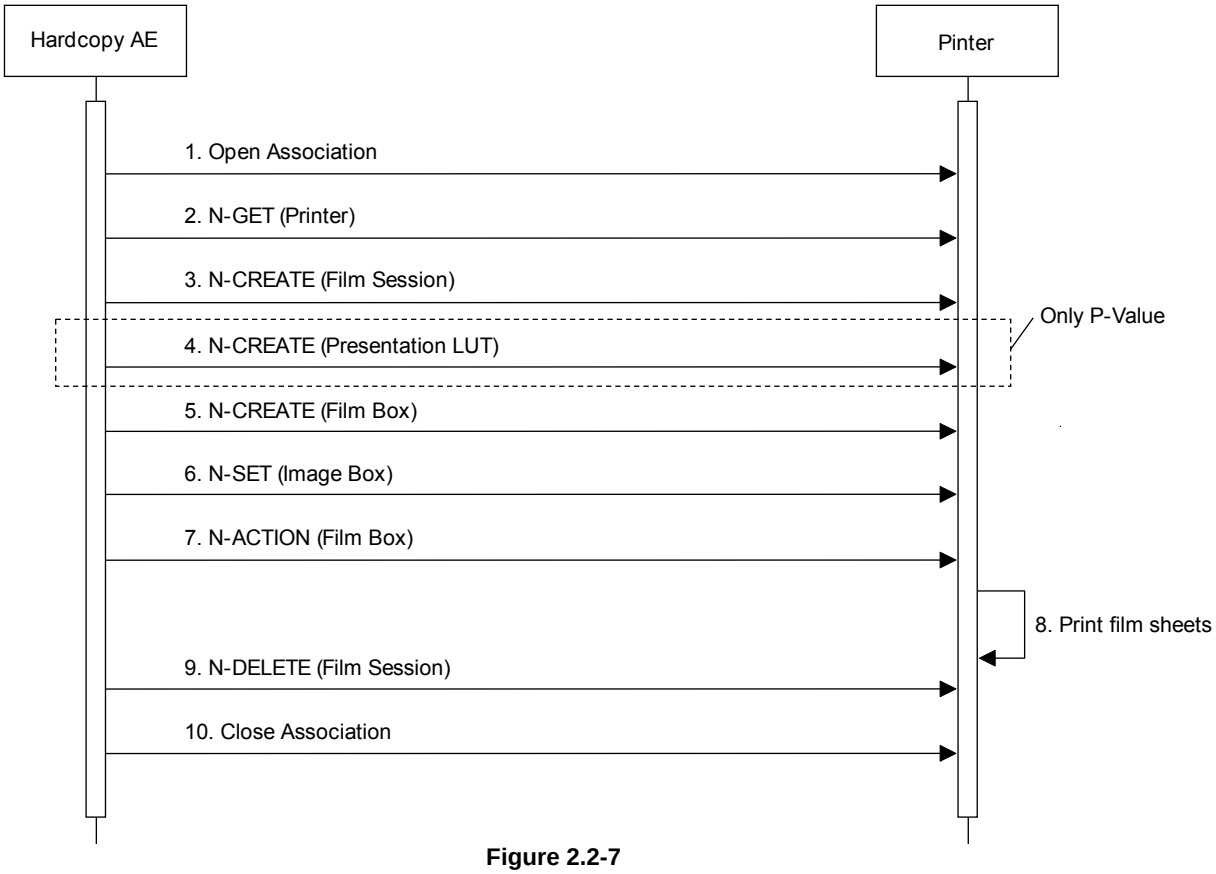

Figure 2.2-7
Sequencing of Activity – Film Images

A typical sequence of DIMSE messages sent over an association between Hardcopy AE and a Printer is illustrated in Figure 2.2-7:

1. Hardcopy AE opens an association with the Printer.

2. N-GET on the Printer SOP Class is used to obtain current printer status information. If the Printer reports a status of FAILURE, the print-job is switched to a failed state and the user informed.

3. N-CREATE on the Film Session SOP Class creates a Film Session.

4. N-CREATE on the Presentation LUT SOP Class creates a Presentation LUT（if supported by the printer）.

5. N-CREATE on the Film Box SOP Class creates a Film Box linked to the Film Session. A single Image Box will be created as the result of this operation. (Hardcopy AE only uses the format STANDARD\1,1)

6. N-SET on the Image Box SOP Class transfers the contents of the film sheet to the printer.

7. N-ACTION on the Film Box SOP Class instructs the printer to print the Film Box.

8. The printer prints the requested number of film sheets.

9. N-DELETE on the Film Session SOP Class deletes the complete Film Session SOP Instance hierarchy.

10. Hardcopy AE closes the association with the Printer.

Status of the print-job is reported through the job control interface. Only one job will be active at a time. If any Response from the remote Application contains a status other than Success or Warning, the Association is released and the related Job is switched to a failed state. It can be restarted any time by user interaction.

2.2.3.3.2.2 Proposed Presentation Contexts

CXDI RF is capable of proposing the Presentation Contexts shown in the Table below:

Table 2.2-37
Proposed Presentation Contexts for Activity Film Images

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Presentation LUT	1.2.840.10008.5.1.1.23	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

2.2.3.3.2.3 Common SOP Specific Conformance for all Print SOP Classes

The general behavior of Hardcopy AE during communication failure is summarized in the Table below. This behavior is common for all SOP Classes supported by Hardcopy AE.

Table 2.2-38
Hardcopy Communication Failure Behavior

Exception	Behavior
Timeout	The print-job is marked as failed. The reason is logged and the job failure is reported to the user via the job control application.
Association aborted by the SCP or network layers	The print-job is marked as failed. The reason is logged and the job failure is reported to the user via the job control application.

2.2.3.3.2.4 SOP Specific Conformance for the Printer SOP Class

Hardcopy AE supports the following DIMSE operations and notifications for the Printer SOP Class:

— N-GET

Details of the supported attributes and status handling behavior are described in the following subsections.

2.2.3.3.2.4.1 Printer SOP Class Operations (N-GET)

Hardcopy AE uses the Printer SOP Class N-GET operation to obtain information about the current printer status. The attributes obtained via N-GET are listed in the Table below:

Table 2.2-39
Printer SOP Class N-GET Response Attributes

Attribute Name	Tag	VR	Value	Presence of Value	Source
Printer Status	(2110,0010)	CS	Provided by Printer	ALWAYS	Printer
Printer Status Info	(2110,0020)	CS	Provided by Printer	ALWAYS	Printer

The Printer Status information is evaluated as follows:

1. If Printer status (2110,0010) is NORMAL, the print-job continues to be printed.
2. If Printer status (2110,0010) is FAILURE, the print-job is marked as failed.
3. If Printer status (2110,0010) is WARNING, the print-job continues to be printed.

Printer Status(2110,0010) and Printer Status Info(2110,0020) are reported to the user via additional information on error dialog if Print Status is FAILURE or WARNING.

The behavior of Hardcopy AE when encountering status codes in an N-GET response is summarized in the Table below:

Table 2.2-40
Printer SOP Class N-GET Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The request to get printer status information was success.
*	*	Any other status code.	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.

Error Comment(0000,0902) and Error ID(0000,0903) are reported to the user via additional information on error dialog.

2.2.3.3.2.5 SOP Specific Conformance for the Film Session SOP Class

Hardcopy AE supports the following DIMSE operations for the Film Session SOP Class:

— N-CREATE

— N-DELETE

Details of the supported attributes and status handling behavior are described in the following subsections.

2.2.3.3.2.5.1 Film Session SOP Class Operations (N-CREATE)

The attributes supplied in an N-CREATE Request are listed in the Table below:

Table 2.2-41
Film Session SOP Class N-CREATE Request Attributes

Attribute Name	Tag	VR	Value	Presence of Value	Source
Number of Copies	(2000,0010)	IS		ANAP	CONFIG
Print Priority	(2000,0020)	CS	“HIGH”, “MED”, “LOW”	ANAP	CONFIG
Medium Type	(2000,0030)	CS	“PAPER”, “CLEAR FILM”, “BLUE FILM”	ANAP	CONFIG
Film Destination	(2000,0040)	CS	“MAGAZINE” or “PROCESSOR”	ANAP	CONFIG

* ANAP:Attribute Not Always Present

The behavior of Hardcopy AE when encountering status codes in an N-CREATE response is summarized in the Table below:

Table 2.2-42
Film Session SOP Class N-CREATE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has completed the operation successfully.
Failure	Invalid Attribute Value	0106	The Association is released using A-RELEASE. The status meaning is logged and reported to the user.
Failure	Resource limitation	0213	The Association is released using A-RELEASE. The status meaning is logged and reported to the user.
Warning	Memory allocation not supported	B600	The N-CREATE operation is considered successful but the status meaning is logged.
*	*	Any other status code.	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.

Error Comment(0000,0902) and Error ID(0000,0903) are reported to the user via additional information on error dialog.

2.2.3.3.2.5.2 Film Session SOP Class Operations (N-DELETE)

The behavior of Hardcopy AE when encountering status codes in an N-DELETE response is summarized in the Table below:

Table 2.2-43
Printer SOP Class N-DELETE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has completed the operation successfully.
*	*	Any other status code.	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.

2.2.3.3.2.6 SOP Specific Conformance for the Presentation LUT SOP Class

Hardcopy AE supports the following DIMSE operations for the Presentation LUT SOP Class:

— N-CREATE

Details of the supported attributes and status handling behavior are described in the following subsections.

2.2.3.3.2.6.1 Presentation LUT SOP Class Operations (N-CREATE)

The attributes supplied in an N-CREATE Request are listed in the Table below:

Table 2.2-44
Presentation LUT SOP Class N-CREATE Request Attributes

Attribute Name	Tag	VR	Value	Presence of Value	Source
Presentation LUT Shape	(2050,0020)	CS	“IDENTITY”	ALWAYS	AUTO

The behavior of Hardcopy AE when encountering status codes in an N-CREATE response is summarized in the Table below:

Table 2.2-45
Presentation LUT SOP Class N-CREATE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has completed the operation successfully.
Warning	Requested Min Density or Max Density outside of printer’s operating range.	B605	The N-CREATE operation is considered successful but the status meaning is logged.
*	*	Any other status code.	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.

Error Comment(0000,0902) and Error ID(0000,0903) are reported to the user via additional information on error dialog.

2.2.3.3.2.7 SOP Specific Conformance for the Film Box SOP Class

Hardcopy AE supports the following DIMSE operations for the Film Box SOP Class:

— N-CREATE

— N-ACTION

Details of the supported attributes and status handling behavior are described in the following subsections.

2.2.3.3.2.7.1 Film Box SOP Class Operations (N-CREATE)

The attributes supplied in an N-CREATE Request are listed in the Table below:

Table 2.2-46
Film Box SOP Class N-CREATE Request Attributes

Attribute Name	Tag	VR	Value	Presence of Value	Source
Image Display Format	(2010,0010)	CS	“STANDARD\1,1”	ALWAYS	AUTO
Film Orientation	(2010,0040)	CS	“PORTRAIT”, “LANDSCAPE”	ALWAYS	CONFIG
Film Size ID	(2010,0050)	CS		ALWAYS	CONFIG
Magnification Type	(2010,0060)	CS	“REPLICATE”, “BILINEAR”, “CUBIC”, “NONE”	ANAP	CONFIG
Smoothing Type	(2010,0080)	CS		ANAP	CONFIG
Border Density	(2010,0100)	CS	“BLACK”, “WHITE”	ALWAYS	CONFIG
Min Density	(2010,0120)	US		ANAP	CONFIG
Max Density	(2010,0130)	US		ANAP	CONFIG
Trim	(2010,0140)	CS	“YES”, “NO”	ANAP	CONFIG
Configuration Information	(2010,0150)	ST		ANAP	CONFIG
Illumination	(2010,015E)	US		ANAP	CONFIG
Reflective Ambient Light	(2010,0160)	US		ANAP	CONFIG
Referenced Film Session Sequence	(2010,0500)	SQ		ALWAYS	AUTO
> Referenced SOP Class UID	(0008,1150)	UI	“1.2.840.10008.5.1.1.1”	ALWAYS	AUTO
> Referenced SOP Instance UID	(0008,1155)	UI	From created Film Session SOP Instance	ALWAYS	AUTO
Referenced Presentation LUT Sequence	(2050,0500)	SQ		ALWAYS	AUTO
> Referenced SOP Class UID	(0008,1150)	UI	“1.2.840.10008.5.1.1.23”	ALWAYS	AUTO
> Referenced SOP Instance UID	(0008,1155)	UI	From Created Presentation LUT SOP Instance	ALWAYS	AUTO

* ANAP:Attribute Not Always Present

The behavior of Hardcopy AE when encountering status codes in an N-CREATE response is summarized in the Table below:

Table 2.2-47
Film Box SOP Class N-CREATE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has completed the operation successfully.
Warning	Requested Min Density or Max Density outside of printer's operating range.	B605	The N-CREATE operation is considered successful but the status meaning is logged.
Failure	There is an existing Film Box that has not been printed and N-ACTION at the Film Session level is not supported.	C616	The Association is released using A-RELEASE. The status meaning is logged and reported to the user.
*	*	Any other status code.	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.

Error Comment(0000,0902) and Error ID(0000,0903) are reported to the user via additional information on error dialog.

2.2.3.3.2.7.2 Film Box SOP Class Operations (N-ACTION)

An N-ACTION Request is issued to instruct the Print SCP to print the contents of the Film Box. The Action Reply argument in an N-ACTION response is not evaluated.
The behavior of Hardcopy AE when encountering status codes in an N-ACTION response is summarized in the Table below:

Table 2.2-48
Film Box SOP Class N-ACTION Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has completed the operation successfully. The film has been accepted for printing.
Warning	Film Box SOP Instance hierarchy does not contain Image Box SOP Instances (empty page)	B603	The N-ACTION operation is considered successful but the status meaning is logged.
Warning	Image size is larger than Image Box size. The Image has been demagnified.	B604	The N-ACTION operation is considered successful but the status meaning is logged.
Warning	Image size is larger than the Image Box size. The Image has been cropped to fit.	B609	The N-ACTION operation is considered successful but the status meaning is logged.
Warning	Image size or Combined Print Image Size is larger than the Image Box size. The Image or Combined Print Image has been decimated to fit.	B60A	The N-ACTION operation is considered successful but the status meaning is logged.
Failure	Unable to create Print Job SOP Instance; print queue is full.	C602	The Association is released using A-RELEASE and the print-job is marked as failed. The status meaning is logged and reported to the user.

Service Status	Further Meaning	Error Code	Behavior
Failure	Image size is larger than Image Box size.	C603	The Association is released using A-RELEASE and the print-job is marked as failed. The status meaning is logged and reported to the user.
Failure	Combined Print Image Size is larger than the Image Box size.	C613	The Association is released using A-RELEASE and the print-job is marked as failed. The status meaning is logged and reported to the user.
*	*	Any other status code.	The Association is released using A-RELEASE and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via the job control application.

Error Comment(0000,0902) and Error ID(0000,0903) are reported to the user via additional information on error dialog.

2.2.3.3.2.8 SOP Specific Conformance for the Image Box SOP Class

Hardcopy AE supports the following DIMSE operations for the Image Box SOP Class:

— N-SET

Details of the supported attributes and status handling behavior are described in the following subsections.

2.2.3.3.2.8.1 Image Box SOP Class Operations (N-SET)

The attributes supplied in an N-SET Request are listed in the Table below:

Table 2.2-49
Image Box SOP Class N-SET Request Attributes

Attribute Name	Tag	VR	Value	Presence of Value	Source
Image Box Position	(2020,0010)	US	“1”	ALWAYS	AUTO
Requested Image Size	(2020,0030)	DS		ALWAYS	AUTO
Requested Decimate/Crop Behavior	(2020,0040)	CS	“DECIMATE”, “CROP”, “FAIL”	ALWAYS	CONFIG
Basic Grayscale Image Sequence	(2020,0110)	SQ		ALWAYS	AUTO
> Samples Per Pixel	(0028,0002)	US	“1”	ALWAYS	AUTO
> Photometric Interpretation	(0028,0004)	CS	“MONOCHROME1” , “MONOCHROME2”	ALWAYS	CONFIG
> Rows	(0028,0010)	US		ALWAYS	AUTO
> Columns	(0028,0011)	US		ALWAYS	AUTO
> Bits Allocated	(0028,0100)	US	“16”	ALWAYS	AUTO
> Bits Stored	(0028,0101)	US	“12”	ALWAYS	AUTO
> High Bit	(0028,0102)	US	“11”	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
> Pixel Representation	(0028,0103)	US	“0”	ALWAYS	AUTO
> Pixel Data	(7FE0,0010)	OW	Pixels of rendered film sheet	ALWAYS	AUTO

The behavior of Hardcopy AE when encountering status codes in an N-SET response is summarized in the Table below:

Table 2.2-50
Image Box SOP Class N-SET Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has completed the operation successfully. Image successfully stored in Image Box.
Warning	Image size is larger than Image Box size. The image has been demagnified.	B604	The N-SET operation is considered successful but the status meaning is logged.
Warning	Requested Min Density or Max Density outside of printer’s operating range.	B605	The N-SET operation is considered successful but the status meaning is logged.
Warning	Image size is larger than Image Box size. The image has been cropped to fit.	B609	The N-SET operation is considered successful but the status meaning is logged.
Warning	Image size or Combined Print Image Size is larger than Image Box size. The image or combined Print Image has been decimated to fit.	B60A	The N-SET operation is considered successful but the status meaning is logged.
Failure	Image size is larger than Image Box size.	C603	The Association is released using A-RELEASE and the print-job is marked as failed. The status meaning is logged and reported to the user.
Failure	Insufficient memory in printer to store the image.	C605	The Association is released using A-RELEASE and the print-job is marked as failed. The status meaning is logged and reported to the user.
Failure	Combined Print Image Size is larger than Image Box size.	C613	The Association is released using A-RELEASE and the print-job is marked as failed. The status meaning is logged and reported to the user.
*	*	Any other status code.	The Association is released using A-RELEASE and the print-job is marked as failed. The status meaning is logged and reported to the user.

Error Comment(0000,0902) and Error ID(0000,0903) are reported to the user via additional information on error dialog.

2.2.3.4 Association Acceptance Policy

The Hardcopy Application Entity does not accept Associations.

2.3 Network Interfaces

2.3.1 Physical Network Interface

CXDI RF supports a single network interface. One of the following physical network interfaces will be available depending on installed hardware options:

Table 2.3-1
Supported Physical Network Interfaces

Ethernet 1000baseT
Ethernet 100base-TX
Ethernet 10baseT

2.3.2IPv4 and IPv6 Support

This product only supports IPv4 connections.

2.4 Configuration

2.4.1 AE Title/Presentation Address Mapping

2.4.1.1 Local AE Titles

All local applications use the AE Titles and TCP/IP Ports configured via the Service Tool. The Field Service Engineer can configure the TCP Port via the Service Tool. The default AE Title is “CANON_CXDI” for all local AEs. The local AE Title used by each individual application can be configured independently of the AE Title used by other local applications. If so configured, all local AEs are capable of using the same AE Title.

Table 2.4-1
AE Title Configuration Table

Application Entity	Default AE Title	Default TCP/IP Port
Storage	CANON_CXDI	Not Applicable
Workflow	CANON_CXDI	Not Applicable
Hardcopy	CANON_CXDI	Not Applicable

2.4.1.2 Remote AE Title/Presentation Address Mapping

The AE Title, host names and port numbers of remote applications are configured using the CXDI user interface.

2.4.1.2.1 Storage

The CXDI RF Settings user interface must be used to set the AE Titles, port-numbers, host-names and capabilities for the remote Storage SCPs. Associations will only be accepted from known AE Titles and associations from unknown AE Titles will be rejected (an AE Title is known if it can be selected within the Settings user interface). Multiple remote Storage SCPs can be defined. Any Storage SCP can be configured to be an “Archive” device causing storage commitment to be requested for images or presentation states transmitted to the device.

2.4.1.2.2 Workflow

The CXDI RF Settings user interface must be used to set the AE Title, port-number, host-name and capabilities of the remote Modality Worklist SCP. Only a single remote Modality Worklist SCP can be defined.

2.4.1.2.3 Hardcopy

The CXDI RF Settings user interface must be used to set the AE Titles, port-numbers, host-names, IP-addresses and capabilities for the remote Print SCPs.
Multiple remote Print SCPs can be defined.

2.4.2 Parameters

A large number of parameters related to acquisition and general operation can be configured using the Service Tool. The Table below only shows those configuration parameters relevant to DICOM communication. See the CXDI RF Service Manual for details on general configuration capabilities.

Table 2.4-2
Configuration Parameters Table

Parameter	Configurable (Yes/No)	Default Value
Storage Parameters		
Supported Transfer Syntaxes (separately configurable for each remote AE)	Yes	Implicit VR Little Endian
Max PDU Length	Yes	16384 Bytes
ARTIM time-out	Yes	30 s
Send time-out	Yes	60 s
Receive time-out	Yes	60 s
Storage Commitment Parameters		
Supported Transfer Syntaxes (separately configurable for each remote AE)	Yes	Implicit VR Little Endian
Max PDU Length	Yes	16384 Bytes
Timeout waiting for a Storage Commitment Notification(maximum duration of applicability for a Storage Commitment Transaction UID).	No	∞
ARTIM time-out	Yes	30 s
Send time-out	Yes	60 s
Receive time-out	Yes	60 s
Modality Worklist Parameters		
Supported Transfer Syntaxes (separately configurable for each remote AE)	Yes	Implicit VR Little Endian
Max PDU Length	Yes	16384 Bytes
ARTIM time-out	Yes	30 s
Send time-out	Yes	60 s
Receive time-out	Yes	60 s
MPPS Parameters		
Supported Transfer Syntaxes (separately configurable for each remote AE)	Yes	Implicit VR Little Endian
Max PDU Length	Yes	16384 Bytes
ARTIM time-out	Yes	30 s
Send time-out	Yes	60 s
Receive time-out	Yes	60 s
Print Parameters		

Parameter	Configurable (Yes/No)	Default Value
Supported Transfer Syntaxes (separately configurable for each remote AE)	Yes	Implicit VR Little Endian
Max PDU Length	Yes	16384 Bytes
ARTIM time-out	Yes	30 s
Send time-out	Yes	60 s
Receive time-out	Yes	60 s

4. Support of Character Sets

All CXDI RF DICOM applications support the following character sets in addition to the default:

ISO 2022 IR 6 (ISO 646)

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

ISO_IR 101 (ISO 8859-2: Latin Alphabet No.2 supplementary set)

ISO_IR 110 (ISO 8859-4: Latin Alphabet No.4 supplementary set)

ISO_IR 126 (ISO 8859-7: Greek)

ISO_IR 144 (ISO 8859-5: Cyrillic)

ISO_IR 148 (ISO 8859-9: Latin Alphabet No.5 supplementary set)

ISO 2022 IR 13 (JIS X 0201: Romaji, Katakana)

ISO 2022 IR 87 (JIS X 0208: Kanji)

GB18030

ISO_IR 192 (Unicode in UTF-8)

5. Security

CXDI RF does not support any specific security measures.

It is assumed that CXDI RF is used within a secured environment. It is assumed that a secured environment includes at a minimum:

a) Firewall or router protections to ensure that only approved external hosts have network access to CXDI RF.

b) Firewall or router protections to ensure that CXDI RF only has network access to approved external hosts and services.

c) Any communication with external hosts and services outside the locally secured environment use appropriate secure network channels (e.g. such as a Virtual Private Network (VPN))

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

6. Annexes

6.1 IOD Contents

6.1.1 Created SOP Instances

Table 6.1-1, Table 6.1-2, and Table 6.1-3 specifies the attributes of an X-Ray Image transmitted by the CXDI RF storage application.

Table 6.1-4 specifies the attributes of a Grayscale Softcopy Presentation State transmitted by the CXDI RF storage application.

The following tables use a number of abbreviations. The abbreviations used in the “Presence of …” column are:

VNAP	Value Not Always Present (attribute sent zero length if no value is present)
ANAP	Attribute Not Always Present
ALWAYS	Always Present
EMPTY	Attribute is sent without a value

The abbreviations used in the “Source” column:

MWL	the attribute value source Modality Worklist
USER	the attribute value source is from User input
AUTO	the attribute value is generated automatically
MPPS	the attribute value is the same as that use for Modality Performed Procedure Step
CONFIG	the attribute value source is a configurable parameter

NOTE: All dates and times are encoded in the local configured calendar and time. Date, Time and Time zone are configured using the Windows Date and Time.

6.1.1.1 X-Ray Image IOD

Table 6.1-1
IOD of Created DX SOP Instances

IE	Module	Reference	Presence of Module
Patient	Patient	Table 6.1-5	ALWAYS
Study	General Study	Table 6.1-6	ALWAYS
	Patient Study	Table 6.1-7	ALWAYS
Series	General Series	Table 6.1-8	ALWAYS
	DX Series	Table 6.1-14	ALWAYS
Equipment	General Equipment	Table 6.1-16	ALWAYS
Image	General Image	Table 6.1-17	ALWAYS
	Image Pixel	Table 6.1-18	ALWAYS
	DX Anatomy Imaged	Table 6.1-24	ALWAYS
	DX Image	Table 6.1-25	ALWAYS
	DX Detector	Table 6.1-27	ALWAYS
	DX Positioning	Table 6.1-29	ALWAYS
	Acquisition Context	Table 6.1-30	ALWAYS
	SOP Common	Table 6.1-32	ALWAYS
	X-Ray Acquisition Dose	Table 6.1-33	ALWAYS
	X-Ray Grid	Table 6.1-34	ALWAYS

Table 6.1-2
IOD of Created CR SOP Instances

IE	Module	Reference	Presence of Module
Patient	Patient	Table 6.1-5	ALWAYS
Study	General Study	Table 6.1-6	ALWAYS
	Patient Study	Table 6.1-7	ALWAYS
Series	General Series	Table 6.1-8	ALWAYS
	CR Series	Table 6.1-15	ALWAYS
Equipment	General Equipment	Table 6.1-16	ALWAYS
Image	General Image	Table 6.1-17	ALWAYS
	Image Pixel	Table 6.1-18	ALWAYS
	CR Image	Table 6.1-26	ALWAYS
	Modality LUT	Table 6.1-28	ALWAYS
	VOI LUT	Table 6.1-31	ALWAYS
	SOP Common	Table 6.1-32	ALWAYS
	Other	Table 6.1-35	ALWAYS

6.1.1.2 X-Ray Radiofluoroscopic Image IOD

Table 6.1-3
IOD of Created RF SOP Instances

IE	Module	Reference	Presence of Module
Patient	Patient	Table 6.1-5	ALWAYS
Study	General Study	Table 6.1-6	ALWAYS
	Patient Study	Table 6.1-7	ALWAYS
Series	General Series	Table 6.1-8	ALWAYS
Equipment	General Equipment	Table 6.1-16	ALWAYS
Image	General Image	Table 6.1-17	ALWAYS
	Image Pixel	Table 6.1-18	ALWAYS
	Cine	Table 6.1-19	Only if Multi-frame
	Multi-Frame	Table 6.1-20	Only if Multi-frame
	X-Ray Image	Table 6.1-21	ALWAYS
	X-Ray Acquisition	Table 6.1-22	ALWAYS
	XRF Positioner	Table 6.1-23	ALWAYS
	Modality LUT	Table 6.1-28	ALWAYS
	VOI LUT	Table 6.1-31	ALWAYS
	SOP Common	Table 6.1-32	ALWAYS
	Other	Table 6.1-35	ALWAYS

6.1.1.3 Grayscale Softcopy Presentation State IOD

Table 6.1-4
IOD of Created Grayscale Softcopy Presentation State SOP Instances

IE	Module	Reference	Presence of Module
Patient	Patient	Table 6.1-5	ALWAYS
Study	General Study	Table 6.1-6	ALWAYS
	Patient Study	Table 6.1-7	ALWAYS
Series	General Series	Table 6.1-8	ALWAYS
	Presentation Series	Table 6.1-9	ALWAYS
Equipment	General Equipment	Table 6.1-16	ALWAYS
Presentation State	Presentation State Identification	Table 6.1-10	ALWAYS
	Presentation State Relationship	Table 6.1-11	ALWAYS
	Displayed Area	Table 6.1-12	ALWAYS
	Softcopy Presentation LUT	Table 6.1-13	ALWAYS
	SOP Common	Table 6.1-32	ALWAYS

6.1.1.4 Modules

Table 6.1-5
Patient

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Name	(0010,0010)	PN	From Modality Worklist or user input. Values supplied via Modality Worklist will be entered as received. Values supplied via user input will contain 3 component groups with 5 components (some possibly empty).	VNAP	MWL/ USER
Patient ID	(0010,0020)	LO	From Modality Worklist or user input or generated by device	ALWAYS	MWL/ USER/ AUTO
Patient's Birth Date	(0010,0030)	DA	From Modality Worklist or user input. Dates before the year 1753 cannot be input.	VNAP	MWL/ USER
Patient's Sex	(0010,0040)	CS	From Modality Worklist or user input	VNAP	MWL/ USER
Other Patient IDs	(0010,1000)	LO	From user input or generated by device.	ANAP	USER/ AUTO
Patient Comments	(0010,4000)	LT	From user input or generated by device.	ANAP	USER/ AUTO

Table 6.1-6
General Study

Attribute Name	Tag	VR	Value	Presence of Value	Source
Study Date	(0008,0020)	DA	<yyyymmdd>	ALWAYS	AUTO
Study Time	(0008,0030)	TM	<hhmmss.fff>	ALWAYS	AUTO
Accession Number	(0008,0050)	SH	From Modality Worklist or user input	VNAP	MWL/ USER
Referring Physician's Name	(0008,0090)	PN	From Modality Worklist or user input	VNAP	MWL/ USER
Study Description	(0008,1030)	LO	Comment text box in study list.	ANAP	USER
Procedure Code Sequence	(0008,1032)	SQ	From Modality Worklist	ANAP	MWL
> Code Value	(0008,0100)	SH	From Modality Worklist	ANAP	MWL
> Coding Scheme Designator	(0008,0102)	SH	From Modality Worklist	ANAP	MWL
> Coding Scheme Version	(0008,0103)	SH	From Modality Worklist	ANAP	MWL
> Code Meaning	(0008,0104)	LO	From Modality Worklist	ANAP	MWL
Name of Physician(s) Reading Study	(0008,1060)	PN	From Modality Worklist or user input	ANAP	MWL/ USER
Referenced Study Sequence	(0008,1110)	SQ	From Modality Worklist	ANAP	MWL
> Referenced SOP Class UID	(0008,1150)	UI	From Modality Worklist	ANAP	MWL

Attribute Name	Tag	VR	Value	Presence of Value	Source
> Referenced SOP Instance UID	(0008,1155)	UI	From Modality Worklist	ANAP	MWL
Study Instance UID	(0020,000D)	UI	From Modality Worklist or generated by device	ALWAYS	MWL/ AUTO
Study ID	(0020,0010)	SH	From Modality Worklist or generated by device	ALWAYS	MWL/ AUTO

Table 6.1-7
Patient Study

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Age	(0010,1010)	AS	From Modality Worklist or user input or calculated from DoB input on base of actual Date	ANAP	MWL/ USER/ AUTO
Patient's Size	(0010,1020)	DS	From Modality Worklist	ANAP	MWL
Patient's Weight	(0010,1030)	DS	From Modality Worklist	ANAP	MWL

Table 6.1-8
General Series

Attribute Name	Tag	VR	Value	Presence of Value	Source
Series Date	(0008,0021)	DA	<yyyymmdd>	ALWAYS	AUTO
Series Time	(0008,0031)	TM	<hhmmss.fff>	ALWAYS	AUTO
Modality	(0008,0060)	CS	"RF", "CR" , "DX"	ALWAYS	AUTO
Series Description	(0008,103E)	LO	Organ from Study list. Maximum 512 characters.	ANAP	USER
Operator's Name	(0008,1070)	PN	Operator field in Study list. Maximum 64 characters.	ANAP	USER
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related. The Sequence shall have one Item. (If this module is created by DX image, this attribute includes DX series module.)	ANAP	AUTO
> Referenced SOP Class UID	(0008,1150)	UI	"1.2.840.10008.3.1.2.3.3"	ANAP	AUTO
> Referenced SOP Instance UID	(0008,1155)	UI	MPPS SOP Instance UID	ANAP	AUTO
Body Part Examined	(0018,0015)	CS	Defined Terms are in PS3.16 Annex L.	ALWAYS	AUTO
Protocol Name	(0018,1030)	LO	Organ program, "Unknown"	ALWAYS	AUTO
Series Instance UID	(0020,000E)	UI	Generated by device	ALWAYS	AUTO
Series Number	(0020,0011)	IS	Generated by device	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Laterality	(0020,0060)	CS	“L”, “R”, empty (If this module is created by DX image, this attribute includes DX Anatomy Imaged module.)	ANAP	AUTO
Performed Procedure Step Start Date	(0040,0244)	DA	<yyyymmdd>	ALWAYS	AUTO
Performed Procedure Step Start Time	(0040,0245)	TM	<hhmmss.fff>	ALWAYS	AUTO
Performed Procedure Step ID	(0040,0253)	SH	Generated by device	ALWAYS	AUTO
Performed Procedure Step Description	(0040,0254)	LO	User input	ANAP	AUTO
Performed Protocol Code Sequence	(0040,0260)	SQ	From Modality Worklist	ANAP	MWL
> Code Value	(0008,0100)	SH	From Modality Worklist or user input	ANAP	MWL
> Coding Scheme Designator	(0008,0102)	SH	From Modality Worklist or “Canon Unique”	ANAP	MWL
> Coding Scheme Version	(0008,0103)	SH	From Modality Worklist or not send	ANAP	MWL
> Code Meaning	(0008,0104)	LO	From Modality Worklist or user input	ANAP	MWL
Request Attributes Sequence	(0040,0275)	SQ	From Modality Worklist	ANAP	MWL
> Requested Procedure Description	(0032,1060)	LO	From Modality Worklist	ANAP	MWL
> Scheduled Procedure Step Description	(0040,0007)	LO	From Modality Worklist	ANAP	MWL
> Scheduled Protocol Code Sequence	(0040,0008)	SQ	From Modality Worklist	ANAP	MWL
>> Code Value	(0008,0100)	SH	From Modality Worklist	ANAP	MWL
>> Coding Scheme Designator	(0008,0102)	SH	From Modality Worklist	ANAP	MWL
>> Coding Scheme Version	(0008,0103)	SH	From Modality Worklist	ANAP	MWL
>> Code Meaning	(0008,0104)	LO	From Modality Worklist	ANAP	MWL
> Scheduled Procedure Step ID	(0040,0009)	SH	From Modality Worklist	ANAP	MWL
> Requested Procedure ID	(0040,1001)	SH	From Modality Worklist	ANAP	MWL

Table 6.1-9
Presentation Series

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	“PR”	ALWAYS	AUTO

Table 6.1-10
Presentation State Identification

Attribute Name	Tag	VR	Value	Presence of Value	Source
Instance Number	(0020,0013)	IS	Generated by device	ALWAYS	AUTO
Content Label	(0070,0080)	CS	"CONTENTLABEL"	ALWAYS	AUTO
Content Description	(0070,0081)	LO	"Content description"	ALWAYS	AUTO
Presentation Creation Date	(0070,0082)	DA	Generated by device	ALWAYS	AUTO
Presentation Creation Time	(0070,0083)	TM	Generated by device	ALWAYS	AUTO
Content Creator’s Name	(0070,0084)	PN	Generated by device	VNAP	AUTO

Table 6.1-11
Presentation State Relationship

Attribute Name	Tag	VR	Value	Presence of Value	Source
Referenced Series Sequence	(0008,1115)	SQ	One or more items	ALWAYS	AUTO
> Referenced Image Sequence	(0008,1140)	SQ	From referenced image	ALWAYS	AUTO
>> Referenced SOP Class UID	(0008,1150)	UI	From referenced image	ALWAYS	AUTO
>> Referenced SOP Instance UID	(0008,1155)	UI	From referenced image	ALWAYS	AUTO
>> Referenced Frame Number	(0008,1160)	IS	If referenced image is a multi-frame image	ANAP	AUTO
> Series Instance UID	(0020,000E)	UI	From referenced image	ALWAYS	AUTO

Table 6.1-12
Displayed Area

Attribute Name	Tag	VR	Value	Presence of Value	Source
Displayed Area Selection Sequence	(0070,005A)	SQ	One or more items	ALWAYS	AUTO
> Referenced Image Sequence	(0008,1140)	SQ	One or more items	ALWAYS	AUTO
>> Referenced SOP Class UID	(0008,1150)	UI	From referenced image	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
>> Referenced SOP Instance UID	(0008,1155)	UI	From referenced image	ALWAYS	AUTO
>> Referenced Frame Number	(0008,1160)	IS	If referenced image is a multi-frame image	ANAP	AUTO
> Displayed Area Top Left Hand Corner	(0070,0052)	SL	“1\1”	ALWAYS	AUTO
> Displayed Area Bottom Right Hand Corner	(0070,0053)	SL	From current display setting	ALWAYS	AUTO
> Presentation Size Mode	(0070,0100)	CS	“SCALE TO FIT”	ALWAYS	AUTO
> Presentation Pixel Spacing	(0070,0101)	DS	“0.16\0.16”, “0.32\0.32” , “0.125\0.125”	ANAP	AUTO

Table 6.1-13
Softcopy Presentation LUT

Attribute Name	Tag	VR	Value	Presence of Value	Source
Presentation LUT Shape	(2050,0020)	CS	“IDENTITY”	ALWAYS	AUTO

Table 6.1-14
DX Series

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	“DX”	ALWAYS	AUTO
Presentation Intent Type	(0008,0068)	CS	Identifies the intent of the images that are contained within this Series. FOR PRESENTATION	ALWAYS	AUTO
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related. The Sequence shall have one Item.	ANAP	AUTO
> Referenced SOP Class UID	(0008,1150)	UI	“1.2.840.10008.3.1.2.3.3”	ANAP	AUTO
> Referenced SOP Instance UID	(0008,1155)	UI	MPPS SOP Instance UID	ANAP	AUTO

Table 6.1-15
CR Series

Attribute Name	Tag	VR	Value	Presence of Value	Source
Body Part Examined	(0018,0015)	CS	Defined Terms are in PS3.16 Annex L.	ALWAYS	AUTO
View Position	(0018,5101)	CS	"AP","PA","LL","RL","RLD","LLD", "RLO","LLO",empty	VNAP	AUTO
Collimator/Grid Name	(0018,1180)	SH	Generated by device	ANAP	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Focal Spot	(0018,1190)	DS	Generated by device	ANAP	AUTO

Table 6.1-16
General Equipment

Attribute Name	Tag	VR	Value	Presence of Value	Source
Manufacturer	(0008,0070)	LO	“Canon Inc.”	ALWAYS	AUTO
Institution Name	(0008,0080)	LO	From Configuration	ANAP	CONFIG
Station Name	(0008,1010)	SH	From Configuration	ALWAYS	CONFIG
Manufacturer’s Model Name	(0008,1090)	LO	“CXDI Controller RF”	ALWAYS	AUTO
Device Serial Number	(0018,1000)	LO	From Configuration (Sensor S/N)	ALWAYS	CONFIG
Software Version	(0018,1020)	LO	From Configuration (CXDI-50RF version)	ALWAYS	CONFIG
Spatial Resolution	(0018,1050)	DS	The inherent limiting resolution in mm of the acquisition equipment for high contrast objects for the data gathering and reconstruction technique chosen. If variable across the images of the series, the value at the image center.	ALWAYS	AUTO
Date of Last Calibration	(0018,1200)	DA	Last calibration date (If this module is created by GSPS, this attribute doesn’t appear.)	ANAP	AUTO
Time of Last Calibration	(0018,1201)	TM	Last calibration Time (If this module is created by GSPS, this attribute doesn’t appear.)	ANAP	AUTO

Table 6.1-17
General Image

Attribute Name	Tag	VR	Value	Presence of Value	Source
Acquisition Date	(0008,0022)	DA	Generated by device	ALWAYS	AUTO
Acquisition Time	(0008,0032)	TM	Generated by device	ALWAYS	AUTO
Instance Number	(0020,0013)	IS	Generated by device	ALWAYS	AUTO
Patient Orientation	(0020,0020)	CS	Generated by device (If this module is created by DX image, this attribute includes DX Image module.)	ANAP	AUTO
Presentation LUT Shape	(2050,0020)	CS	“IDENTITY” (If this module is created by DX image, this attribute includes DX Image module.)	ANAP	AUTO

Table 6.1-18
Image Pixel

Attribute Name	Tag	VR	Value	Presence of Value	Source
Samples per Pixel	(0028,0002)	US	“1” (If this module is created by DX/RF image, this attribute includes DX Image/X-Ray Image module.)	ANAP	AUTO
Rows	(0028,0010)	US	Vertical pixel number	ALWAYS	AUTO
Columns	(0028,0011)	US	Horizontal pixel number	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	“16” (If this module is created by DX/RF image, this attribute includes DX Image/X-Ray Image module.)	ANAP	AUTO
Bits Stored	(0028,0101)	US	“12” (If this module is created by DX/RF image, this attribute includes DX Image/X-Ray Image module.)	ANAP	AUTO
High Bit	(0028,0102)	US	“11” (If this module is created by DX/RF image, this attribute includes DX Image/X-Ray Image module.)	ANAP	AUTO
Pixel Representation	(0028,0103)	US	“0” (If this module is created by DX/RF image, this attribute includes DX Image/X-Ray Image module.)	ANAP	AUTO
Pixel Data	(7FE0,0010)	OW	Pixel Data	ALWAYS	AUTO

Table 6.1-19
Cine

Attribute Name	Tag	VR	Value	Presence of Value	Source
Cine Rate	(0018,0040)	IS	Only if multi-frame	ANAP	AUTO
Frame Time vector	(0018,1065)	DS	Only if multi-frame	ANAP	AUTO

Table 6.1-20
Multi-Frame

Attribute Name	Tag	VR	Value	Presence of Value	Source
Number of Frames	(0028,0008)	IS	Only if multi-frame	ANAP	AUTO
Frame Increment Pointer	(0028,0009)	AT	“0x00181065”	ANAP	AUTO

Table 6.1-21
X-ray Image

Attribute Name	Tag	VR	Value	Presence of Value	Source
Image Type	(0008,0008)	CS	“DERIVED\PRIMARY\SINGLE PLANE”	ALWAYS	AUTO
Samples per Pixel	(0028,0002)	US	“1”	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Photometric Interpretation	(0028,0004)	CS	“MONOCHROME2”	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	“16”	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	“12”	ALWAYS	AUTO
High Bit	(0028,0102)	US	“11”	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	“0”	ALWAYS	AUTO
Pixel Intensity Relationship	(0028,1040)	CS	“LOG”	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	CS	“00”	ALWAYS	AUTO

Table 6.1-22
X-ray Acquisition

Attribute Name	Tag	VR	Value	Presence of Value	Source
KVP	(0018,0060)	DS	Generated by device	VNAP	AUTO
Field of View Shape	(0018,1147)	CS	“RECTANGLE”	ALWAYS	AUTO
Field of View Dimension(s)	(0018,1149)	IS	Generated by device	ALWAYS	AUTO
Exposure Time	(0018,1150)	IS	Generated by device	ANAP	AUTO
X-Ray Tube Current	(0018,1151)	IS	Generated by device	ANAP	AUTO
Exposure	(0018,1152)	IS	Generated by device	ANAP	AUTO
Radiation Setting	(0018,1155)	CS	“SC”, “GR”	ALWAYS	AUTO
Radiation Mode	(0018,115A)	CS	“PULSED”	ALWAYS	AUTO
Image and Fluoroscopy Area Dose Product	(0018,115E)	DS	Generated by device	VNAP	AUTO
Imager Pixel Spacing	(0018,1164)	DS	Generated by device	ALWAYS	AUTO
Grid	(0018,1166)	CS	Generated by device	ANAP	AUTO
Focal Spot(s)	(0018,1190)	DS	Generated by device	ANAP	AUTO
Pixel Spacing	(0028,0030)	DS	Generated by device “DX”/”CR”: The value on detector. “RF”: The value on Patient. (10cm above the table) in default configuration	ANAP	AUTO

Table 6.1-23
XRF Positioner

Attribute Name	Tag	VR	Value	Presence of Value	Source
Distance Source to Detector	(0018,1110)	DS	Generated by device or user input	ANAP	AUTO/ USER
Distance Source to Patient	(0018,1111)	DS	Generated by device or user input	ANAP	AUTO/ USER

Table 6.1-24
DX Anatomy Imaged

Attribute Name	Tag	VR	Value	Presence of Value	Source
Anatomic Region Sequence	(0008,2218)	SQ	Zero Length	ALWAYS	AUTO
Image Laterality	(0020,0062)	CS	Laterality of (possibly paired) body part (as described in Anatomic Region Sequence (0008,2218)) examined. Enumerated Values: “R” = right “L” = left “U” = unpaired “B” = both left and right	ALWAYS	AUTO

Table 6.1-25
DX Image

Attribute Name	Tag	VR	Value	Presence of Value	Source
Image Type	(0008,0008)	CS	“DERIVED\PRIMARY\” “DERIVED\SECONDARY\”	ALWAYS	AUTO
Acquisition Device Processing Code	(0018,1401)	LO	Generated by device	ALWAYS	AUTO
Patient Orientation	(0020,0020)	CS	“A”(Anterior), “P”(Posterior), “R”(Right), “L”(Left), “H”(Head), “F”(Foot)	ALWAYS	AUTO
Samples per Pixel	(0028,0002)	US	“1”	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	“MONOCHROME2”	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	“16”	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	“12”	ALWAYS	AUTO
High Bit	(0028,0102)	US	“11”	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	“0”	ALWAYS	AUTO
Burned In Annotation	(0028,0301)	CS	“NO”	ALWAYS	AUTO
Pixel Intensity Relationship	(0028,1040)	CS	“LOG”	ALWAYS	AUTO
Pixel Intensity Relationship Sign	(0028,1041)	SS	“1”	ALWAYS	AUTO
Window Center	(0028,1050)	DS	“2048”	ALWAYS	AUTO
Window Width	(0028,1051)	DS	“4096”	ALWAYS	AUTO
Rescale Intercept	(0028,1052)	DS	“0”	ALWAYS	AUTO
Rescale Slope	(0028,1053)	DS	“1”	ALWAYS	AUTO
Rescale Type	(0028,1054)	LO	“US”	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	CS	“00” = NOT lossy compression	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Presentation LUT Shape	(2050,0020)	CS	“IDENTITY”	ALWAYS	AUTO

Table 6.1-26
CR Image

Attribute Name	Tag	VR	Value	Presence of Value	Source
Photometric Interpretation	(0028,0004)	CS	“MONOCHROME2”	ALWAYS	AUTO
KVP	(0018,0060)	DS	Generated by device	ANAP	AUTO
Distance Source to Detector	(0018,1110)	DS	Generated by device or user input	ANAP	AUTO/ USER
Distance Source to Patient	(0018,1111)	DS	Generated by device or user input	ANAP	AUTO/ USER
Exposure	(0018,1152)	IS	Generated by device	ANAP	AUTO
Imager Pixel Spacing	(0018,1164)	DS	Generated by device	ALWAYS	AUTO
Acquisition Device Processing Code	(0018,1401)	LO	Generated by device	ALWAYS	AUTO
Relative X-Ray Exposure	(0018,1405)	IS	Generated by device	ANAP	AUTO
Pixel Spacing	(0028,0030)	DS	Generated by device "CR": The value on detector.	ANAP	AUTO

Table 6.1-27
DX Detector

Attribute Name	Tag	VR	Value	Presence of Value	Source
Imager Pixel Spacing	(0018,1164)	DS	Generated by device	ALWAYS	AUTO
Detector Type	(0018,7004)	CS	“SCINTILLATOR”	ALWAYS	AUTO
Detector Configuration	(0018,7005)	CS	“AREA”	ALWAYS	AUTO
Detector ID	(0018,700A)	SH	Generated by device	ALWAYS	AUTO
Date of Last Detector Calibration	(0018,700C)	DA	Last calibration date	ALWAYS	AUTO
Time of Last Detector Calibration	(0018,700E)	TM	Last calibration Time	ALWAYS	AUTO
Detector Binning	(0018,701A)	DS	“1\1”	ALWAYS	AUTO
Pixel Spacing	(0028,0030)	DS	Generated by device "DX": The value on detector.	ANAP	AUTO

Table 6.1-28
Modality LUT

Attribute Name	Tag	VR	Value	Presence of Value	Source
Rescale Intercept	(0028,1052)	DS	“0”	ALWAYS	AUTO
Rescale Slope	(0028,1053)	DS	“1”	ALWAYS	AUTO
Rescale Type	(0028,1054)	LO	“US”	ALWAYS	AUTO

Table 6.1-29
DX Positioning

Attribute Name	Tag	VR	Value	Presence of Value	Source
Distance Source to Detector	(0018,1110)	DS	Generated by device or user input	ANAP	AUTO/ USER
Distance Source to Patient	(0018,1111)	DS	Generated by device or user input	ANAP	AUTO/ USER
Positioner Type	(0018,1508)	CS	“”	EMPTY	AUTO
View Position	(0018,5101)	CS	"AP","PA","LL","RL","RLD","LLD", "RLO","LLO"	ANAP	AUTO

Table 6.1-30
Acquisition Context

Attribute Name	Tag	VR	Value	Presence of Value	Source
Acquisition Context Sequence	(0040,0555)	SQ	Zero length	ALWAYS	AUTO

Table 6.1-31
VOI LUT

Attribute Name	Tag	VR	Value	Presence of Value	Source
Window Center	(0028,1050)	DS	“2048”	ALWAYS	AUTO
Window Width	(0028,1051)	DS	“4096”	ALWAYS	AUTO

Table 6.1-32
SOP Common

Attribute Name	Tag	VR	Value	Presence of Value	Source
Specific Character Set	(0008,0005)	CS	“ISO_IR 100”, “ISO_IR 101”, “ISO_IR 110”, “ISO_IR 126”, “ISO_IR 144”, “ISO_IR 148”, “ISO 2022 IR 13”, “ISO 2022 IR 87”, “GB18030”, “ISO_IR 192”	ANAP	CONFIG

Attribute Name	Tag	VR	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	UI	“1.2.840.10008.5.1.4.1.1.1.1”(DX) “1.2.840.10008.5.1.4.1.1.1 “(CR) “1.2.840.10008.5.1.4.1.1.12.2 “(RF) "1.2.840.10008.5.1.4.1.1.11.1"(GSPS)	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	UI	Generated by device	ALWAYS	AUTO

Table 6.1-33
X-ray Acquisition Dose

Attribute Name	Tag	VR	Value	Presence of Value	Source
KVP	(0018,0060)	DS	Generated by device	ANAP	AUTO
Exposure	(0018,1152)	IS	Generated by device	ANAP	AUTO
Image and Fluoroscopy Area Dose Product	(0018,115E)	DS	Generated by device	ANAP	AUTO
Relative X-ray Exposure	(0018,1405)	IS	Generated by device	ANAP	AUTO
Entrance Dose in mGy	(0040,8302)	DS	Generated by device	ANAP	AUTO

Table 6.1-34
X-ray Grid

Attribute Name	Tag	VR	Value	Presence of Value	Source
Grid ID	(0018,1006)	LO	Generated by device	ANAP	AUTO

Table 6.1-35
Other

Attribute Name	Tag	VR	Value	Presence of Value	Source
Acquisition Device Processing Code	(0018,1401)	LO	Generated by device (If this module is created by DX/CR image, this attribute includes DX Image/CR Image module.)	ANAP	AUTO
Relative X-Ray Exposure	(0018,1405)	IS	EI / REX / NONE (If this module is created by DX/CR image, this attribute includes X-RAY ACQUISITION DOSE/CR IMAGE module.)	ANAP	AUTO
Entrance Dose in mGy	(0040,8302)	DS	Generated by device	ANAP	AUTO

6.1.2 Used Fields in Received IOD by Application

The CXDI RF storage application does not receive SOP Instances. The usage of attributes received via Modality Worklist is described in section 2.2.2.3.2.3.

6.1.3 Attribute mapping

The relationships between attributes received via Modality Worklist, stored in acquired images and communicated via MPPS are summarized in Table 6.1-36.

Table 6.1-36
Attribute Mapping Between Modality Worklist, Image and MPPS

Modality Worklist	Image IOD	MPPS IOD
Patient Name	Patient Name	Patient Name
Patient ID	Patient ID	Patient ID
Patient's Birth Date	Patient's Birth Date	Patient's Birth Date
Patient's Sex	Patient's Sex	Patient's Sex
Patient's Size	Patient's Size	
Patient's Weight	Patient's Weight	
Referring Physician's Name	Referring Physician's Name	
----	----	Scheduled Step Attributes Sequence
Study Instance UID	Study Instance UID	> Study Instance UID
Referenced Study Sequence	Referenced Study Sequence	> Referenced Study Sequence
Accession Number	Accession Number	> Accession Number
----	Request Attributes Sequence	----
Requested Procedure ID	> Requested Procedure ID	> Requested Procedure ID
Requested Procedure Description	> Requested Procedure Description	> Requested Procedure Description
Scheduled Procedure Step ID	> Scheduled Procedure Step ID	> Scheduled Procedure Step ID
Scheduled Procedure Step Description	> Scheduled Procedure Step Description	> Scheduled Procedure Step Description
Scheduled Protocol Code Sequence	> Scheduled Protocol Code Sequence	> Scheduled Protocol Code Sequence
----	Performed Protocol Code Sequence	Performed Protocol Code Sequence
Requested Procedure ID	Study ID	Study ID
----	Study Date	Performed Procedure Step Start Date
----	Study Time	Performed Procedure Step Start Time
----	Study Description	Performed Procedure Step Description
----	Performed Procedure Step ID	Performed Procedure Step ID
----	Performed Procedure Step Start Date	Performed Procedure Step Start Date

Modality Worklist	Image IOD	MPPS IOD
----	Performed Procedure Step Start Time	Performed Procedure Step Start Time
----	Performed Procedure Step Description	Performed Procedure Step Description
Requested Procedure Code Sequence	Procedure Code Sequence	Procedure Code Sequence
----	Referenced Performed Procedure Step Sequence	----
----	> Referenced SOP Class UID	SOP Class UID
----	> Referenced SOP Instance UID	SOP Instance UID
----	----	Performed Series Sequence
----	Protocol Name	> Protocol Name
----	Series Description	> Series Description
----	Series Instance UID	> Series Instance UID
----	Operators' Name	> Operators' Name
----	----	> Referenced Image Sequence
----	SOP Class UID (Image)	>> Referenced SOP Class UID
----	SOP Instance UID (Image)	>> Referenced SOP Instance UID
----	----	> Referenced Non-Image Composite SOP Instance Sequence
----	SOP Class UID (GSPS)	>> Referenced SOP Class UID
----	SOP Instance UID (GSPS)	>> Referenced SOP Instance UID

6.1.4 Coerced/Modified Fields

The Modality Worklist AE will reject attribute values received in the response to a Modality Worklist Query if the value length is longer than the maximum length permitted by the attribute's VR.

6.2 Data Dictionary of Private Attributes

CXDI RF does not support private attribute.

6.3 Coded Terminology and Templates

The Workflow AE is capable of supporting arbitrary coding schemes for Protocol Codes. The contents of Scheduled Protocol Code Sequence (0040,0008) supplied in Worklist Items will be mapped to Image IOD and MPPS attributes as described in Table 6.1-36. A user will establish a mapping between the site-specific codes and the Protocol Names used internally to identify acquisition protocols.

6.4 Grayscale Image Consistency

The high resolution display monitor attached to the CXDI RF can be calibrated according to the Grayscale Standard Display Function (GSDF). And the Image Consistency is achieved through the support of the Presentation LUT.

6.5 Standard Extended/Specialized/Private SOP Classes

CXDI RF does not claim conformance to any Extended, Specialized or Private SOP Classes.

6.6 Private Transfer Syntaxes

CXDI RF does not support private transfer syntaxes.