
DICOM

Conformance Statement

CX50 4.0.X

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0.1 REVISION HISTORY

Document Version	Date of Issue	Author	Description
A	May 8, 2016	EC, JL, ML	Initial Release; Updated for CX50 4.0.X Release

1 CONFORMANCE STATEMENT OVERVIEW

The Philips CX50 4.0.X Ultrasound systems implement the necessary DICOM® services to download worklists from an information system, save acquired US Images, Cardiac 3D Presentation State (Subpage) objects and Structured Reports to a network storage device, CD/DVD or USB, print to a networked hardcopy device and inform the information system about the work actually done.

Table 1 provides an overview of the supported network services.

**Table 1
NETWORK SERVICES**

Networking SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Ultrasound Image Storage	Yes*	No
Ultrasound Multiframe Image Storage	Yes*	No
Storage Commitment Push Model	Yes*	No
Comprehensive SR	Yes*	No
Cardiac 3D Presentation State (Subpage) object Storage ⁽¹⁾	Yes*	No
Workflow Management		
Modality Worklist	Yes*	No
Modality Performed Procedure Step	Yes*	No
Print Management		
Basic Grayscale Print Management	Yes*	No
Basic Color Print Management	Yes*	No

* Purchasable option.

⁽¹⁾ Cardiac 3D Presentation State (Subpage) objects are associated with a Cardiac 3D image. These objects cannot be independently stored but they can be stored along with the associated images.

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Table 2 below specifies the Media Storage Application Profiles supported.

**Table 2
MEDIA SERVICES**

Media Storage Application Profile	Write Files (FSC or FSU)	Read Files (FSR)
Compact Disk - Recordable		
STD-US-SC-MF ⁽¹⁾ -CD-R for Ultrasound images, compressed and uncompressed and associated Cardiac 3D Presentation State (Subpage) objects	Yes / Yes ⁽²⁾	Yes ⁽³⁾
STD-GEN-CD for Structured Reports	Yes / Yes ⁽²⁾	No
DVD		
STD-US-SC-MF ⁽¹⁾ -DVD for Ultrasound images, compressed and uncompressed and associated Cardiac 3D Presentation State (Subpage) objects	Yes / Yes ⁽²⁾	Yes ⁽³⁾
STD-GEN-DVD for Structured Reports	Yes / Yes ⁽²⁾	No
USB Devices		
STD-GEN-USB-JPEG for Ultrasound images, compressed and uncompressed, associated Cardiac 3D Presentation State (Subpage) objects and Structured Reports	Yes / Yes	Yes ^(3,4)

(1) Note that the "MF" designator includes both Single Frame (SF) and Multi-frame (MF) ultrasound images.

(2) Only acts as a FSU for media that may be written to multiple times.

(3) Only reads and imports data from other Philips CX50 systems.

(4) Yes, but not for importing Structured Reports.

**Table 3
SUPPORTED STRUCTURED REPORT TEMPLATES**

Concept Name
OB-GYN Ultrasound Procedure Report (Template ID 5000)
Vascular Ultrasound Procedure Report (Template ID 5100)
Adult Echocardiography Procedure Report (Template ID 5200)
Pediatric Echocardiography Procedure Reports (Template ID 5220)

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3 INTRODUCTION

3.1 AUDIENCE

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

3.2 REMARKS

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

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

The scope of this Conformance Statement is to facilitate communication between the Philips Healthcare CX50 4.0.X ultrasound systems and other vendors' Medical equipment. The Conformance Statement should be read and understood in conjunction with the DICOM Standard [DICOM]. However, by itself it is not guaranteed to ensure the desired interoperability and successful interconnectivity.

The user should be aware of the following important issues:

- The comparison of different conformance statements is the first step towards assessing interconnectivity between Philips Healthcare and non - Philips Healthcare equipment.
- Test procedures should be defined to validate the desired level of connectivity.
- The DICOM standard will evolve to meet the users' future requirements. Philips Healthcare is actively involved in developing the standard further and therefore reserves the right to make changes to its products or to discontinue its delivery.

3.3 IMPORTANT NOTE TO THE READER

Interoperability

Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into an IT environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by this Conformance Statement does not guarantee interoperability of Philips equipment with non-Philips equipment. It is the user's responsibility to analyze thoroughly the application requirements and to specify a solution that integrates Philips equipment with non-Philips equipment.

Validation

Philips equipment has been carefully tested to assure that the actual implementation of the DICOM interface corresponds with this Conformance Statement. Where Philips equipment is linked to non-Philips equipment, the first step is to compare the relevant Conformance Statements. If the Conformance Statements indicate that successful information exchange should be possible, additional validation tests will be necessary to ensure the functionality, performance, accuracy and stability of image and image related data. It is the responsibility of the user (or user's agent) to specify the appropriate test suite and to carry out the additional validation tests.

New versions of the DICOM Standard

The DICOM Standard will evolve in future to meet the user's growing requirements and to incorporate new features and technologies. Philips is actively involved in this evolution and plans to adapt its equipment to future versions of the DICOM Standard. In order to do so, Philips reserves the right to make changes to its

products or to discontinue its delivery. The user should ensure that any non-Philips provider linking to Philips equipment also adapts to future versions of the DICOM Standard. If not, the incorporation of DICOM enhancements into Philips equipment may lead to loss of connectivity (in case of networking) and incompatibility (in case of media).

3.4 DEFINITIONS, TERMS AND ABBREVIATIONS

Definitions, terms and abbreviations used in this document are defined within the different parts of the DICOM standard.

Abbreviations and terms are as follows:

AE	DICOM Application Entity
AET	Application Entity Title
CD-R	Compact Disk Recordable
DICOM	Digital Imaging and Communications in Medicine
FSC	File-Set Creator
FSU	File-Set Updater
FSR	File-Set Reader
GSDF	Grayscale Standard Display Function
IOD	(DICOM) Information Object Definition
ISO	International Standard Organization
LOINC	Logical Observation Identifiers Names and Codes
MPPS	Modality Performed Procedure Step
MWL	Modality Worklist
R	Required Key Attribute for Modality Worklist Query Matching
O	Optional Key Attribute for Modality Worklist Query Matching
PDU	DICOM Protocol Data Unit
PDE	Patient Data Entry
SCP	DICOM Service Class Provider (DICOM server)
SCU	DICOM Service Class User (DICOM client)
SOP	DICOM Service-Object Pair
SNOMED	Systematized Nomenclature of Medicine (SRT)
U	Unique Key Attribute for Modality Worklist Query Matching, or Optional Attribute
US	Ultrasound

3.5 REFERENCES

[DICOM] Digital Imaging and Communications in Medicine (DICOM), NEMA PS 3.1-3.20, 2015

Integrating the Healthcare Enterprise (IHE) Radiology Technical Framework, Vol. 1, Integration Profiles, Revision 8.0 Final Text, August 30, 2007

Integrating the Healthcare Enterprise (IHE) Radiology Technical Framework, Vol. 2, Transactions, Revision 8.0 Final Text, August 30, 2007

Integrating the Healthcare Enterprise (IHE) Radiology Technical Framework, Vol. 3, Transactions (Continued), Revision 8.0 Final Text August 30, 2007

Integrating the Healthcare Enterprise (IHE) Cardiology Technical Framework, Year 2: 2005-2006, Volume 1, Integration Profiles, Revision 2.1, June 9, 2006

4 NETWORKING

4.1 IMPLEMENTATION MODEL

4.1.1 Application Data Flow

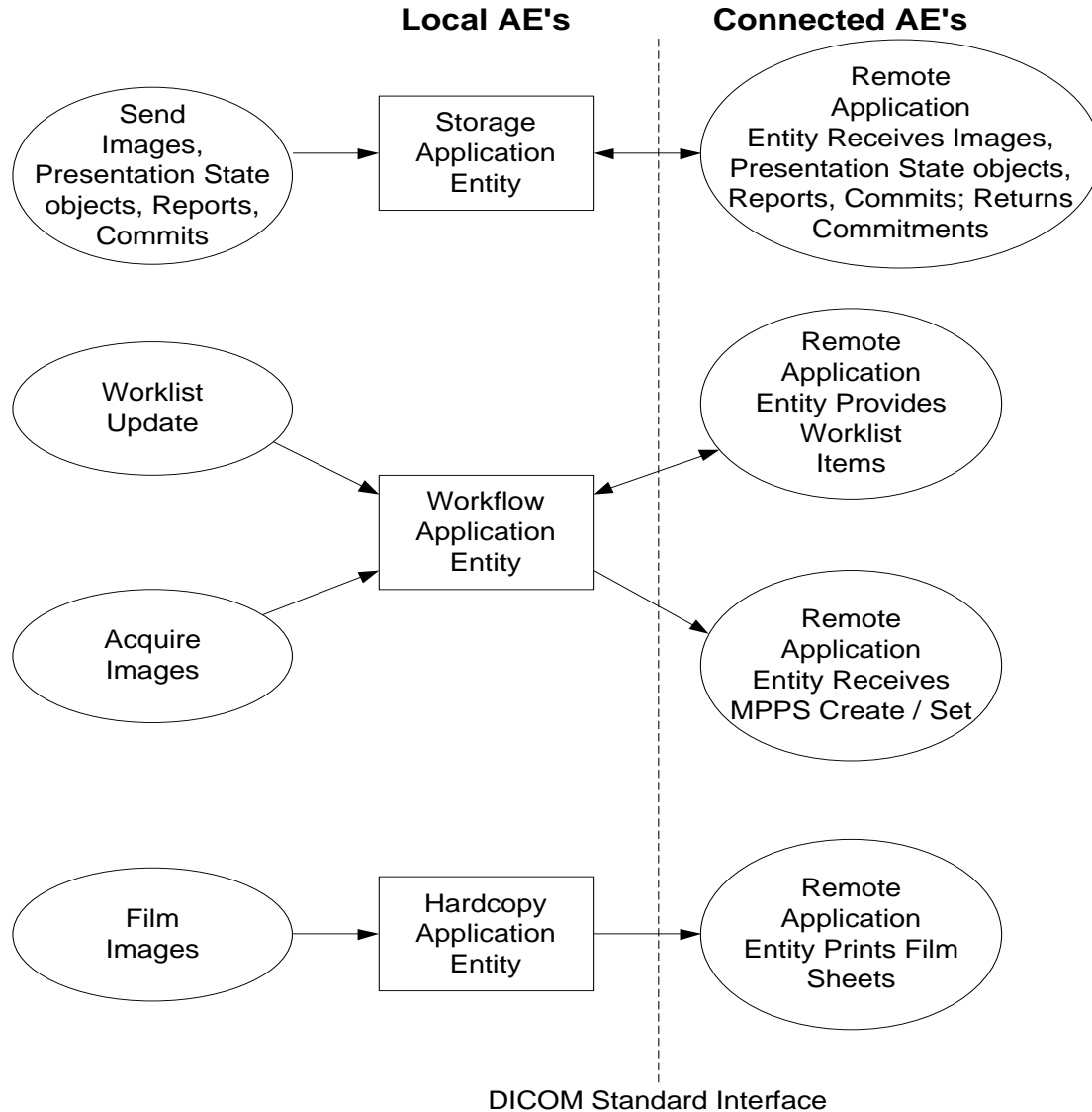


Figure 1
APPLICATION DATA FLOW DIAGRAM

- The **Storage Application Entity** sends **Images** and associated **Cardiac 3D Presentation State** objects to one or two remote AEs and **Structured Reports** to a single remote AE. Acquisition of images is associated with the local real-world activity "Freeze" then "Acquire" for single frame and "Acquire" for loops or clips. Sending or exporting of images depends on user configuration, either "Send as you go" as and when the image is acquired (or) "Batch" when End Exam is pressed, (or) Manual. An exam may be exported by user selecting from "Review". A storage commitment server is configured for one of the two image storage servers. Storage Commitment for Structured Reports requires a separate commit server configuration entry. If the remote AE is configured for **Storage**

Commitment, the Storage AE will request Storage Commitment after successful storage of the image(s) and Structured Reports, if sent. If a commitment response is successfully obtained, there will be no job remaining in the queue (viewed using CNTL-J).

- The **Workflow Application Entity** receives Modality Worklist (MWL) information from and sends Modality Performed Procedure Step (MPPS) information to remote AEs. It is associated with the local real-world activities “Update Worklist”, “Search” or automatic MWL polling and “Acquire Images”.
When either the “Update Worklist”, “Search” local real-world activity is performed or automatic polling is executed, the Workflow Application Entity queries a remote AE for worklist items and provides the set of worklist items matching the query request. “Update Worklist” or “Search” are operator initiated. Polling is performed automatically at specific time intervals.

Modality Performed Procedure Step (MPPS) messages are sent from the system under the following circumstances:

- MPPS N-Create, Status = IN PROGRESS:
 - Closing the Patient Data Entry screen will result in automated creation of an MPPS Instance managed by a remote AE.
 - MPPS N-Set, Status = COMPLETE
 - Completion of the MPPS is performed as the result of an operator action of ending the exam.
 - MPPS N-Set, Status = DISCONTINUED
 - “Cancel” causes the “Discontinued” status to be sent.
- An Ended Exam may be ‘appended’ with images and SRs within 24 hours of the beginning of the exam. There are two fundamental methods to perform append:
 - *Note: The system will notify the user that it is “Restarting” the study. If beyond 24 hours, the system will not allow new images to be acquired.*
 - Append from Patient Data Entry
 - Press the “Patient” hardkey. If Modality Worklist is configured, press the “Manual Entry” button and/or select the “Restart” button to get a list of exams that are less than 24 hours old. Select an exam and ‘OK’ to close Patient Data Entry to return to scanning.
 - Append from Image Review
 - Press the “Review” hardkey then select the “Search for Study” icon to see the list of performed studies. Select the exam and hit “Open Study” to return to live scanning to acquire images and measurements.
- The **Hardcopy Application Entity** sends DICOM print pages to a remote AE (Printer or print server). It is associated with the local real-world activity Acquire when a DICOM Printer is configured for Batch Mode in the current preset, or “DICOM print” is selected with Right Button on the Exam in the system Patient Directory.
 - Additionally, individual images can be selected in Review and sent with the selection of “Print selected still images to DICOM Printer” icon.
 - Either action creates a print queue containing one or more virtual film sheets composed from images acquired by the user. It creates and sends fully rendered pages already containing the user’s selected formatting choices. Only a single image object per sheet is sent to the printer. This print object is rather large compared to sending individual Image Box objects to the printer. If the user has both a BW and Color DICOM printer configured and selected, and is using “Send as you go”, the images containing no Color Flow or Chroma data will be sent to the BW printer, all others will be sent to the Color printer.
 - Exam data is sent to all selected Store, Print and Workflow destinations simultaneously in accordance with system configuration of “Send as you go” or “Batch” at end of exam or “Manual”.

4.1.2 Functional Definition of AEs

4.1.2.1 Functional Definition of Storage Application Entity

A Network Store queue 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 queue's Status is set to RETRY as displayed in the Job Manager (CNTL-J). The user may select "Retry Job" to attempt re-send. After the automatic retries have failed, the job is set to ERROR. The user may "Delete Job" and re-send manually. Deleting a job does not remove the data, as it is still present on the system. Only the request to transfer the data is removed. Once any communication issues have been resolved, "Retry Job" may be selected or if the jobs were deleted, they may be queued again from the Review directory.

Storage Commitment messages are structured and sent depending on the user configuration for sending data. If the system is set for "Send as you go", then commit requests are sent when the images are exported. Several images may be contained in a single request. When the system is set to "Batch mode" all images are exported at the end of the exam, a Storage Commitment queue is established and remains in the Job Manager window until the N-Event-Report-Request message is received.

Studies sent manually from "Review" will also send Storage Commitment requests.

4.1.2.2 Functional Definition of Workflow Application Entity

"Update Worklist" performs a Broad Worklist Query to download a Modality Worklist from a Modality Worklist server with studies matching the search criteria by sending a C-Find Request containing user-definable Query parameters. Query parameters are stored in the "Advanced" tab adjacent to the MWL SCP selection in the "Servers and Roles" setup page. 10 Customizable Queries may be used, 5 are factory defaults.

Settings that may be customized are:

- Query Name (not sent in the DICOM data)
- Start Date (All Dates, Today or Date Range)
- AE Title (This system, Any or Another specific)
- Modality (Ultrasound or All Modalities)

"Search" opens a dialog to enter the parameters for a Patient-based Query that allows a more specific query. The parameters are:

- Patient Name (may use wild card "**")
- Patient ID (may use wild card "**")
- Accession Number
- Requested Procedure ID
- Modality (default – US for Ultrasound)

Additionally, date range criteria may also be set:

- Exam Date (MM/dd/yyyy) Specific date
- Today This includes a +, - and +- and box for # of days
- All Dates

When the Workflow AE establishes an association to a remote AE, a MWL C-Find-Rq message is sent to the MWL server. The server will transfer all matching worklist items via the open association. The results of a successful Worklist Update will overwrite the data in the Worklist display.

There is no queue management for Worklist.

The Workflow AE creates a MPPS Instance when the PDE (Patient Data Entry screen) is closed. An MPPS N-Create-Rq message is sent to the MPPS server with the status of "IN PROGRESS". At the end of the exam, when

“Completed” or “Cancel” are selected, an MPPS N-Set-Rq message is sent with “COMPLETED” or “DISCONTINUED” respectively. MPPS message queues are listed in the Job Manager (CNTL-J) window.

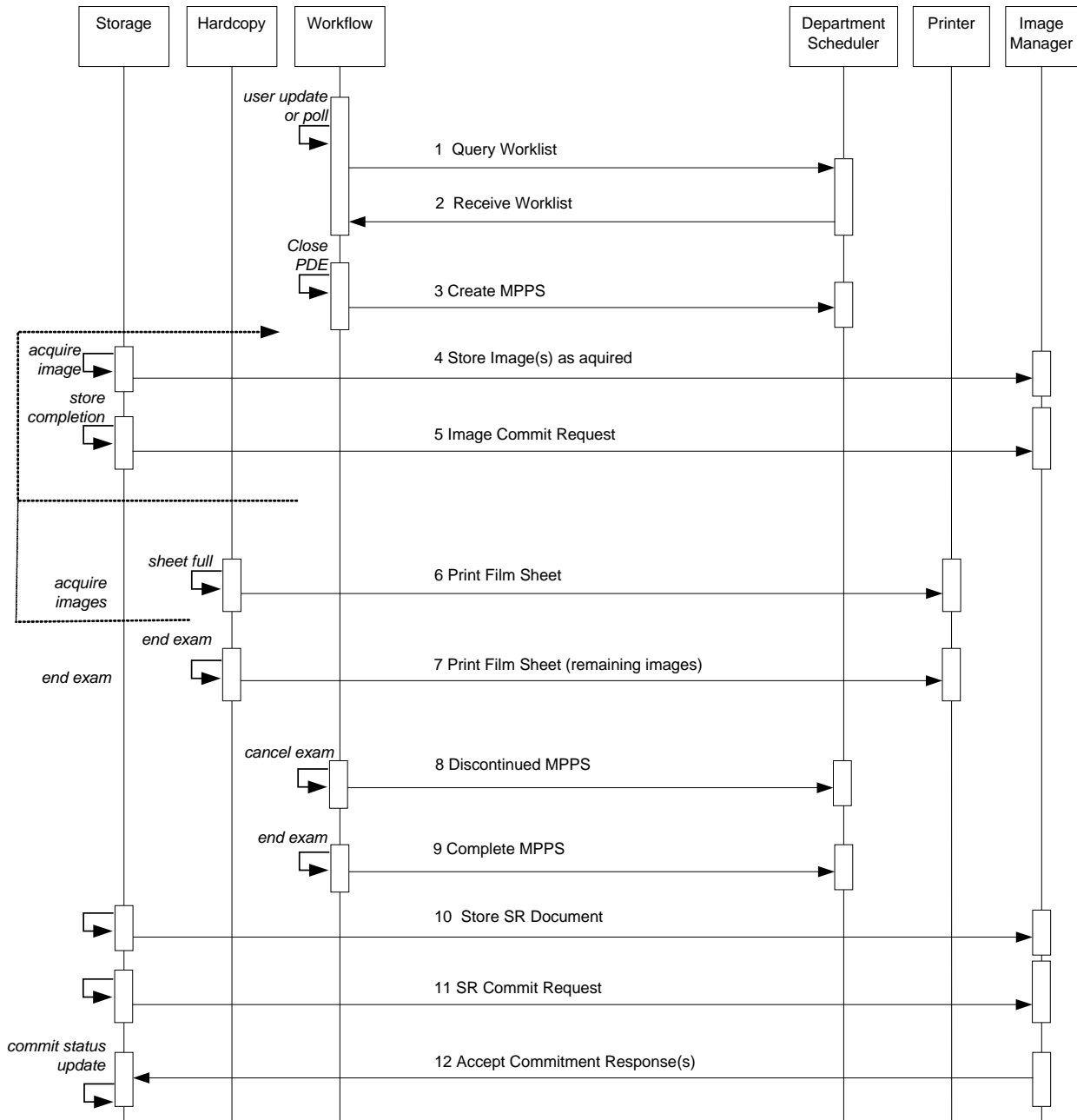
4.1.2.3 Functional Definition of Hardcopy Application Entity

A print queue will activate the Hardcopy AE. An association is established with the printer(s) and the printer’s status is determined. If the printer is operating normally, the film sheet print requests will be sent. If the printer is not operating normally, the print queue status is set to “Failed” and can be restarted by the user via the queue management interface.

When both a BW and a Color DICOM printer are configured, the images that contain color data, i.e., Color Flow Doppler or “Chroma” will be sent to the Color printer only, and all other images will be sent to the BW printer. Otherwise, all images will be sent to the selected printer.

There is an embedded retry mechanism that retries based on the individual server’s settings as configured by the user. Default values are: 20 Retries with 120 seconds (2 minutes) Interval.

Sequencing of Real-World Activities



Note: Step 8 may occur prior to acquisition of the first image if the exam is cancelled prior to first image.

FIGURE 2A:
SEQUENCING CONSTRAINTS – SEND AS YOU GO CONFIGURATION

Figures 2a and 2b illustrate normal scheduled workflow conditions.

Notes:

- Printing to DICOM printers may occur independent of any other DICOM activity.

- All selected store, print and workflow devices are sent data during the exam when configured for “Send as you go”, at the end of exam “Batch” or from Review when set for Manual.
- Selecting a study from Review for export will send to selected devices.

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

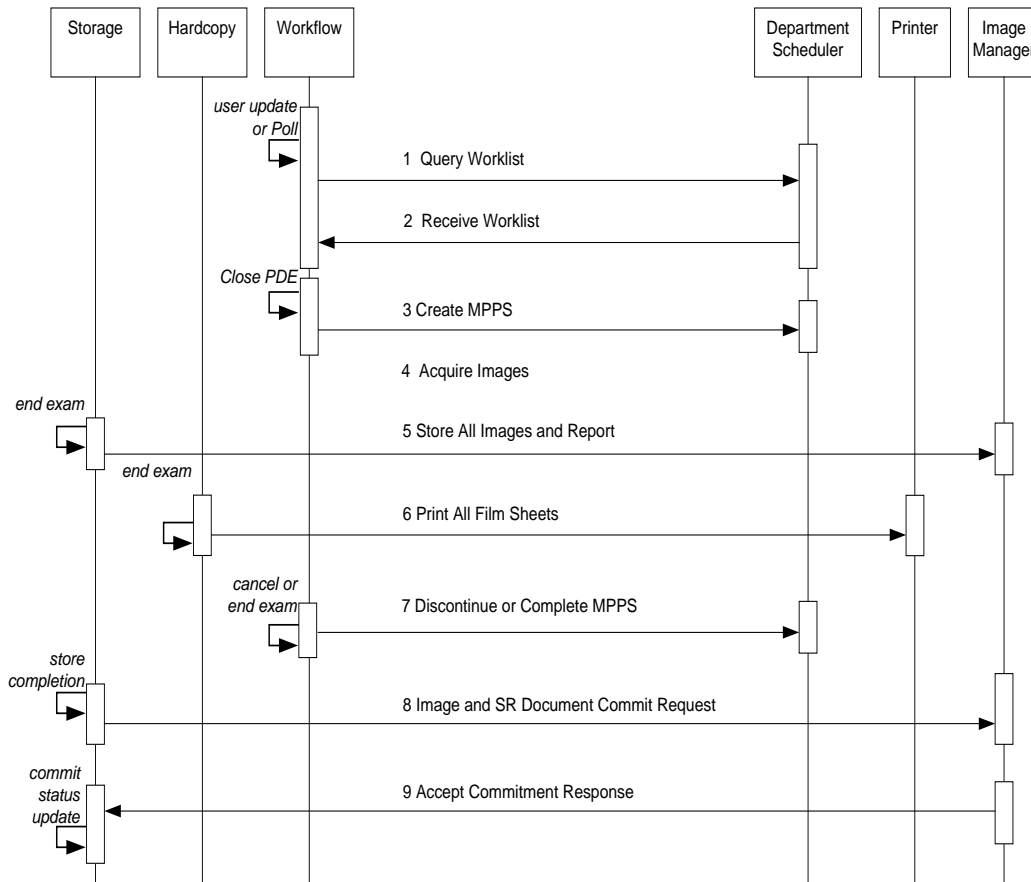


FIGURE 2B:
SEQUENCING CONSTRAINTS – END EXAM CONFIGURATION

4.2 AE SPECIFICATIONS

4.2.1 Storage Application Entity Specification

4.2.1.1 SOP Classes

CX50 4.0.X provides Standard Extended¹ Conformance to the following SOP Classes:

Table 3
SOP CLASSES FOR AE STORAGE

SOP Class Name	SOP Class UID	SCU	SCP
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	No
US Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
Comprehensive Structured Report Storage	1.2.840.10008.5.1.4.1.1.88.33	Yes	No
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	No
Cardiac 3D Presentation State (Subpage) object Storage	1.3.46.670589.2.5.1.1	Yes	No

4.2.1.2 Association Establishment Policy

4.2.1.2.1 General

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

Table 4
DICOM APPLICATION CONTEXT FOR AE STORAGE

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

The PDU size is configurable with a minimum size of 100 and a maximum size of 16,000. The default PDU size is 16,000.

4.2.1.2.2 Number of Associations

CX50 4.0.X initiates one Association at a time for each destination to which a transfer request is being processed in the active job queue list. Two Storage SCPs may be selected, but only one job will be active at a time, the other(s) remain pending until the active job is completed or failed.

Table 5
NUMBER OF ASSOCIATIONS INITIATED FOR AE STORAGE

Maximum number of simultaneous Associations	5, 1 for each configured storage device
---	---

One Primary Storage Server, one Secondary Storage Server, one Storage Commitment Server, one SR Storage Server and one SR Storage Commitment Server.

CX50 4.0.X accepts Associations for N-EVENT-REPORT notifications for the Storage Commitment Push Model SOP Class on a separate association.

Table 6

¹ See section 8.7 for information on the Standard Extended SOP Class

NUMBER OF ASSOCIATIONS ACCEPTED FOR AE STORAGE

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

4.2.1.2.3 Asynchronous Nature

CX50 4.0.X does not support asynchronous communication (multiple outstanding transactions over a single Association).

Table 7
ASYNCHRONOUS NATURE AS A SCU FOR AE STORAGE

Maximum number of outstanding asynchronous transactions	1
---	---

4.2.1.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Table 8
DICOM IMPLEMENTATION CLASS AND VERSION FOR AE STORAGE

Implementation Class UID	1.3.46.670589.14.1000.400
Implementation Version Name	CX50_4.0

4.2.1.3 Association Initiation Policy

4.2.1.3.1 Activity – Store Images, Loops and Structured Reports

4.2.1.3.1.2 Description and Sequencing of Activities

Images and Reports may be sent from the selected studies from the Review directory. When the “Send as you go” option is active, the queue is serviced continuously during the exam. Each image is sent in its own association that is opened and closed. Additional images acquired during the exam will be sent using subsequent associations.

Note: Images include corresponding Presentation State objects in case of Cardiac 3D images.

If the C-STORE response from the remote application contains a status other than Success or Warning, the association is retried until switched to a failed state.

When a system configured with network destinations is used without the network connected, it is considered to be in “Portable” mode. When returning from portable, reconnecting the network cable will initiate transfer.

The Storage Commitment service is implemented to handle image commitment separately from Structured Reports. For Images, only the Primary Store SCP may be associated with a commitment server. For Structured Reports, the SR Store SCP may be configured with its own commit server. In each case, the Storage AE will transmit a Storage Commitment request (N-ACTION) over a separate Association from the storage of image or report objects. Outstanding Commit Requests (those that have not received an N-Event-Report) will remain in the Job Manager (CNTL-J) until the report is received.

The Storage AE can only receive an N-EVENT-REPORT request in a separate subsequent association initiated by the SCP employing PDU 54H SCP/SCU Role Negotiation in the SCP’s Association Request. It cannot receive N-Event-Report-Rq messages on the same association as the N-Action-Rq.

Structured Reports will contain only supported measurements and calculations created by CX50 4.0.X. This may exclude some entries displayed in the on-system report. Measurements or calculations that are not supported for export are listed in Appendix A.

- The OB and Gyn Study types create OB-GYN Ultrasound Procedure Reports.

- The Vascular Study type creates Vascular Ultrasound Procedure Reports.
- The Cardiac (Adult Echo) Study type creates Adult Echocardiography Reports.
- The Cardiac (Ped Echo) Study type creates Pediatric Echocardiography Reports.

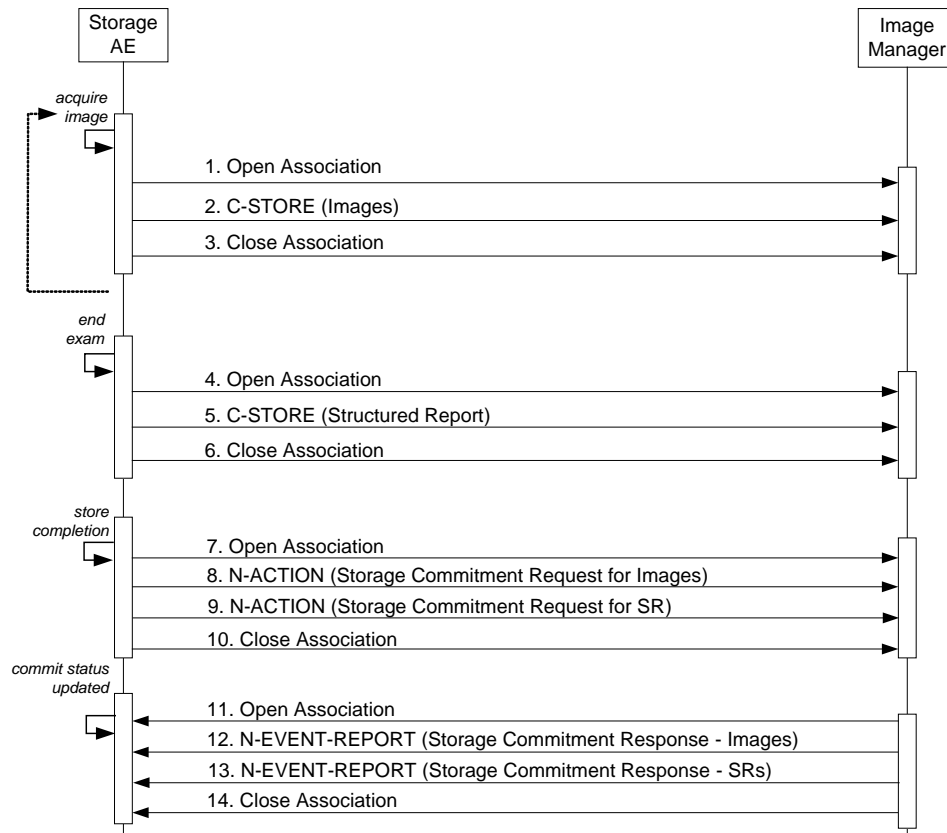


Figure 3
SEQUENCING OF ACTIVITY – SEND IMAGES AND STRUCTURED REPORT

The sequence of interactions between the Storage AE and an Image Manager is illustrated in Figure 3 for the “Store” configuration option “Send as you go.” The alternative option, “Batch mode” differs only in the removal of the loop symbol on the ‘acquire images’ activity

NOTES: The N-EVENT-REPORT must be sent over a separate association initiated by the Image Manager (see Section 4.2.1.4.1 on Activity – Receive Storage Commitment Response).

4.2.1.3.1.2 Proposed Presentation Contexts

CX50 4.0.X is capable of proposing the Presentation Contexts shown in the following table:

**Table 9
PROPOSED PRESENTATION CONTEXTS FOR ACTIVITY SEND IMAGES**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Implicit VR Little Endian* Explicit VR Little Endian JPEG Lossy Baseline RLE Lossless	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.5	SCU	None
US Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian Explicit VR Little Endian JPEG Lossy Baseline RLE Lossless	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.5	SCU	None
Comprehensive Structured Report Storage	1.2.840.10008.5.1.4.1.1.88.33	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None
Cardiac 3D Presentation State (Subpage) object Storage	1.3.46.670589.2.5.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

*The following applies to both US Image and US Multiframe Images

JPEG used if image Photometric Interpretation is

YBR_FULL_422

RLE Lossless is used if image formats are any of

Palette Color, RLE Compressed

RGB, RLE Compressed

MONOCHROME2, RLE Compressed

Implicit Little Endian (ILE) transfer Syntax is used when:

Palette Color, Uncompressed ILE

RGB, Uncompressed ILE

MONOCHROME2, Uncompressed ILE

Explicit Little Endian (ELE) transfer syntax is used when:

Palette Color, Uncompressed ELE

RGB, Uncompressed ELE

MONOCHROME2, Uncompressed ELE

Storage Commitment N-Action Requests are only sent to the image storage device that is configured as the Storage Commitment server and associated with the Primary SCP. SRs are sent to their own configured SCP and Storage Commitment for SRs are handled separately from images.

4.2.1.3.1.3 SOP Specific Conformance for Image and Comprehensive Structured Report Storage SOP Classes

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

Table 10 describes C-Store response behavior.

The following Default Settings and Ranges may be used where applicable in Table 10:

Setting	Default	Range
Connect Timeout	30 sec	10 – 999 sec
Read Timeout	300 sec	30 – 999 sec
Maximum Retries	20	0 – 999

**Table 10
STORAGE C-STORE RESPONSE STATUS HANDLING BEHAVIOR**

Establishing the Association with Default settings

Condition (After C-Store)	Status Codes (C-Store-RSP)	Response
Could not establish the association within 30-second time window (Connect Timeout) due to NO RESPONSE from the Storage Server	Not Applicable	The association attempt is aborted, and after 5-minutes a new association is attempted. CX50 4.0.X will make three attempts to open an association with the configured Storage SCP before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the 'Retry Interval' input control on the DICOM Setup screen and the number of retries is mapped to 'Maximum Retries' on the DICOM Setup screen.
Refused	A7xxH	If the Storage SCP server refuses the association, then the association attempt is aborted. CX50 4.0.X will wait 5-minutes and then reattempt the association. CX50 4.0.X will make three attempts to establish the association before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. As an example, the association would be refused if the storage server employs a high security mechanism whereby it only accepts association requests from DICOM Servers that it knows about and the CX50 4.0.X's AE Title was not in the PACS database. See the timeout and retry settings above.

During Image or SR Transfer

Service Status	Error Code	Behavior
After association has been accepted, there is no response to a request within 5-minute time window (Read Timeout).	Not Applicable	If the association is lost during active image transfer to the Storage SCP server, CX50 4.0.X will initiate a new association after 5 minutes, and attempt to store all the images. If during transfer, the association is again lost, CX50 4.0.X will wait another 5 minutes and try again. CX50 4.0.X will make three attempts to send all the images before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. See the timeout and retry settings above.
Error	A9xxH, CxxxH, 0122H, Other	CX50 4.0.X will treat all errors as failure of Storage request (also called as Job). A failed job is automatically retried after 5 minutes. If the job fails even after three attempts, CX50 4.0.X will abort this request and place the job in an Error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error.
Warning	D000H, B000H, B006H, B007H	If the Storage SCP issues a warning on a particular image (perhaps it had to use coercion), CX50 4.0.X logs the warning to the DICOM log file as an informational event and continues on as if the image was successfully stored to the PACS (see row below).
Success	0000H	When an image is successfully stored to the Storage SCP (PACS), CX50 4.0.X will keep a record of the successful storage. If all the images in the job are successfully stored, CX50 4.0.X will notify the user (through an icon on the list of studies), and the job will be removed from the job manager.
*	Any other status code.	The Association is aborted using A-ABORT and the transfer fails. The status is logged.

The behavior of Storage AE during communication failure is summarized in Table 11.

Table 11
STORAGE COMMUNICATION FAILURE BEHAVIOR

Exception	Behavior
Timeout	Same as Service Status timeouts in Table 10 above.
Association aborted by the SCP or network layers	Same as Service Status in Table 10 above.

The contents of US Image, US Multiframe Storage, C3D Presentation State and Comprehensive Structured Report Storage SOP Instances conform to the DICOM IOD definitions described in Section 8.1.

4.2.1.3.1.4 SOP Specific Conformance for Storage Commitment Push Model SOP Class

4.2.1.3.1.4.1 Storage Commitment Operations (N-ACTION)

The Storage AE will request storage commitment for the configured device.

Table 12 summarizes the behavior of Storage AE when receiving response status codes.

Table 12
STORAGE COMMITMENT N-ACTION RESPONSE STATUS HANDLING BEHAVIOR

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000H	The system waits for the N-Event-Report.
*	*	Any other status code.	The commit status remains incomplete for all objects.

Table 13 summarizes the behavior of Storage AE during communication failure.

Table 13
STORAGE COMMITMENT COMMUNICATION FAILURE BEHAVIOR

Exception	Behavior
Timeout	Same as non-success status in Table 12.
Association aborted by the SCP or network layers	Same as non-success status in Table 12.

4.2.1.3.1.4.2 Storage Commitment Tags (N-ACTION)

The Storage AE will request storage commitment using the following tags

NOTE: Storage Commitment may only be automatically requested by the system at the end of a study.

Table 13a
STORAGE COMMITMENT N-ACTION-REQUEST MESSAGE CONTENTS

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

Subsequently, CX50 4.0.X expects N-EVENT-REPORT messages from the storage commit server although CX50 4.0.X does not assume that the event will arrive at any particular time. CX50 4.0.X does not wait but will process the event whenever it arrives.

CX50 4.0.X might be either powered down or disconnected from the network and used in portable mode, it is possible for the N-EVENT-REPORT to arrive from the Storage Commitment SCP while CX50 4.0.X cannot receive it. If an outstanding N-EVENT-REPORT does not arrive within 96 hours, then CX50 4.0.X will reissue the same Storage Commitment request. When the event arrives, CX50 4.0.X returns an N-EVENT-REPORT response primitive with one of the following status codes.

4.2.1.3.1.4.3 Storage Commitment Notifications (N-EVENT-REPORT)

The Storage AE can receive an N-EVENT-REPORT notification received from the SCP via Reverse-role negotiation.

Table 14 summarizes the behavior of Storage AE when receiving Event Types within the N-EVENT-REPORT.

Table 14
STORAGE COMMITMENT N-EVENT-REPORT BEHAVIOUR

Event Type Name	Event Type ID	Behavior
Storage Commitment Request Successful	1	The commit status is set to complete for each object.
Storage Commitment Request Complete – Failures Exist	2	The commit status remains incomplete. The commit comment for each object is logged.

The reasons for returning specific status codes in an N-EVENT-REPORT response are summarized in Table 15.

Table 15
STORAGE COMMITMENT N-EVENT-REPORT RESPONSE STATUS REASONS

Service Status	Further Meaning	Error Code	Reasons
Success	Success	0000H	The storage commitment result has been successfully received.

4.2.1.3.1.4.4 Storage Commitment Tags (N-EVENT-REPORT)

Tags supported for receiving an N-Event-Report message.

Table 16 lists the tags that may be received within the N-EVENT-REPORT.

Table 16
STORAGE COMMITMENT N-EVENT-REPORT MESSAGE CONTENTS

Event Type Name	Event Type ID	Attribute	Tag	Requirement Type SCP
Storage Commitment Request Successful	1	Transaction UID	(0008,1195)	1
		<i>Retrieve AE Title</i>	(0008,0054)	3
		<i>Storage Media File-Set ID</i>	(0088,0130)	3
		<i>Storage Media File-Set UID</i>	(0088,0140)	3
		Referenced SOP Sequence	(0008,1199)	1
		>Referenced SOP Class UID	(0008,1150)	1
		>Referenced SOP Instance UID	(0008,1155)	1
		> <i>Retrieve AE Title</i>	(0008,0054)	3
		> <i>Storage Media File-Set ID</i>	(0088,0130)	3
		> <i>Storage Media File-Set UID</i>	(0088,0140)	3
Storage Commitment Request	2	Transaction UID	(0008,1195)	1
		<i>Retrieve AE Title</i>	(0008,0054)	3

Event Type Name	Event Type ID	Attribute	Tag	Requirement Type SCP
Complete – Failures Exist		<i>Storage Media File-Set ID</i>	(0088,0130)	3
		<i>Storage Media File-Set UID</i>	(0088,0140)	3
		Referenced SOP Sequence	(0008,1199)	1
		>Referenced SOP Class UID	(0008,1150)	1
		>Referenced SOP Instance UID	(0008,1155)	1
		> <i>Retrieve AE Title</i>	(0008,0054)	3
		> <i>Storage Media File-Set ID</i>	(0088,0130)	3
		> <i>Storage Media File-Set UID</i>	(0088,0140)	3
		Failed SOP Sequence	(0008,1198)	1
		>Referenced SOP Class UID	(0008,1150)	1
		>Referenced SOP Instance UID	(0008,1155)	1
		>Failure Reason	(0008,1197)	1

In Table 16 above, the attributes in *italics* may be sent from the server, handled and ignored by CX50 4.0.X.

4.2.1.4 Association Acceptance Policy

4.2.1.4.1 Activity – Receive Storage Commitment Response

4.2.1.4.1.1 Description and Sequencing of Activities

The Storage AE accepts associations for pending responses to a Storage Commitment Request only using SCP/SCU Role Negotiation; explicitly stating that the association is initiated by the SCP to the SCU. Any other will be rejected.

4.2.1.4.1.2 Accepted Presentation Contexts

Table 17 summarizes Presentation Contexts that the Storage AE accepts.

**Table 17
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 Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

4.2.1.4.1.3 SOP Specific Conformance for Storage Commitment Push Model SOP Class

4.2.1.4.1.3.1 Storage Commitment Notifications (N-EVENT-REPORT)

Upon receipt of an N-EVENT-REPORT the timer associated with the Transaction UID will be canceled.

Table 17b summarizes the behavior of Storage AE when receiving Event Types within the N-EVENT-REPORT.

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. 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 17b summarizes the reasons for returning specific status codes in an N-EVENT-REPORT response.

**Table 17b
ASSOCIATION REJECTION REASONS**

Result	Source	Reason/Diag	Explanation
2 – Rejected Transient	c	2 – Local Limit Exceeded	The (configurable) maximum number of simultaneous associations has been reached. An association request with the same parameters may succeed at a later time.
2 – Rejected Transient	c	1 – Temporary Congestion	No associations can be accepted at this time. An association request with the same parameters may succeed at a later time.
1 – Rejected Permanent	a	2 – Application Context Name Not Supported	The association request contained an unsupported Application Context Name. An association request with the same parameters will not succeed at a later time.
1 – Rejected Permanent	a	7 – Called AE Title Not Recognized	The association request contained an unrecognized Called AE Title. A successful association request will require configuration changes. This rejection reason normally occurs when the association initiator is incorrectly configured and attempts to address the association acceptor using the wrong AE Title. Make sure the Commit Server has the correct AE Title and IP Address for the ultrasound system.
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. Ensure there is no variation in Case in this system's AE Title on the Commit Server.
1 – Rejected Permanent	b	1 – No Reason Given	The association request could not be parsed. An association request with the same format will not succeed at a later time.

4.2.2 Workflow Application Entity Specification

4.2.2.1 SOP Classes

CX50 4.0.X provides Standard Conformance to the following SOP Classes:

Table 18
SOP CLASSES FOR AE WORKFLOW

SOP Class Name	SOP Class UID	SCU	SCP
MWL 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

4.2.2.2 Association Establishment Policy

4.2.2.2.1 General

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

Table 19
DICOM APPLICATION CONTEXT FOR AE WORKFLOW

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

4.2.2.2.2 Number of Associations

CX50 4.0.X initiates one Association at a time for a Worklist request and a separate association for Modality Performed Procedure Step messages.

Table 20
NUMBER OF ASSOCIATIONS INITIATED FOR AE WORKFLOW

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

4.2.2.2.3 Asynchronous Nature

CX50 4.0.X does not support asynchronous communication.

Table 21
ASYNCHRONOUS NATURE AS A SCU FOR AE WORKFLOW

Maximum number of outstanding asynchronous transactions	1
---	---

4.2.2.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Table 22
DICOM IMPLEMENTATION CLASS AND VERSION FOR AE WORKFLOW

Implementation Class UID	1.3.46.670589.14.1000.400
Implementation Version Name	CX50_4.0

4.2.2.3 Association Initiation Policy

4.2.2.3.1 Activity – Worklist Update

4.2.2.3.1.2 Description and Sequencing of Activities

Worklist queries for Modality (US) or All Modalities may be initiated by the user or will occur at a preset interval set as one of the following:

Broad Worklist Query

- The user may press “Update Worklist” to send a query: using search keys: Start Date, Modality and AE Title selections made in the Set Modality Worklist Queries configuration page.
- The user may configure the system to search for studies scheduled for its AE Title, or it may be set to search for a different AE Title’s studies, or all.
- The system may be set* to periodically poll the worklist server. Default is 30 minutes, adjustable in one minute increments from 1** to 32,767 minutes.
 - * Follow Setups > System > DICOM > DICOM Preset > Change Settings for current preset > Modify in Roles > MWL SCP – Advanced > MWL Polling Frequency.
 - ** Note: Setting to 0 (zero) minutes effectively disables polling for locations that prefer that polling is not used.

Patient-Based Worklist Query

- The system also supports searching for a specific patient’s scheduled procedure by entering any combination of the following:
 - The patient’s name, a wildcard “*”, or the first few letters of the last name and a wildcard.
 - The patient’s ID, or the first few characters of the ID and a wildcard.
 - The Accession Number of the procedure.
 - The Requested Procedure ID
 - The Modality, only Ultrasound
 - The Date or Date Range.

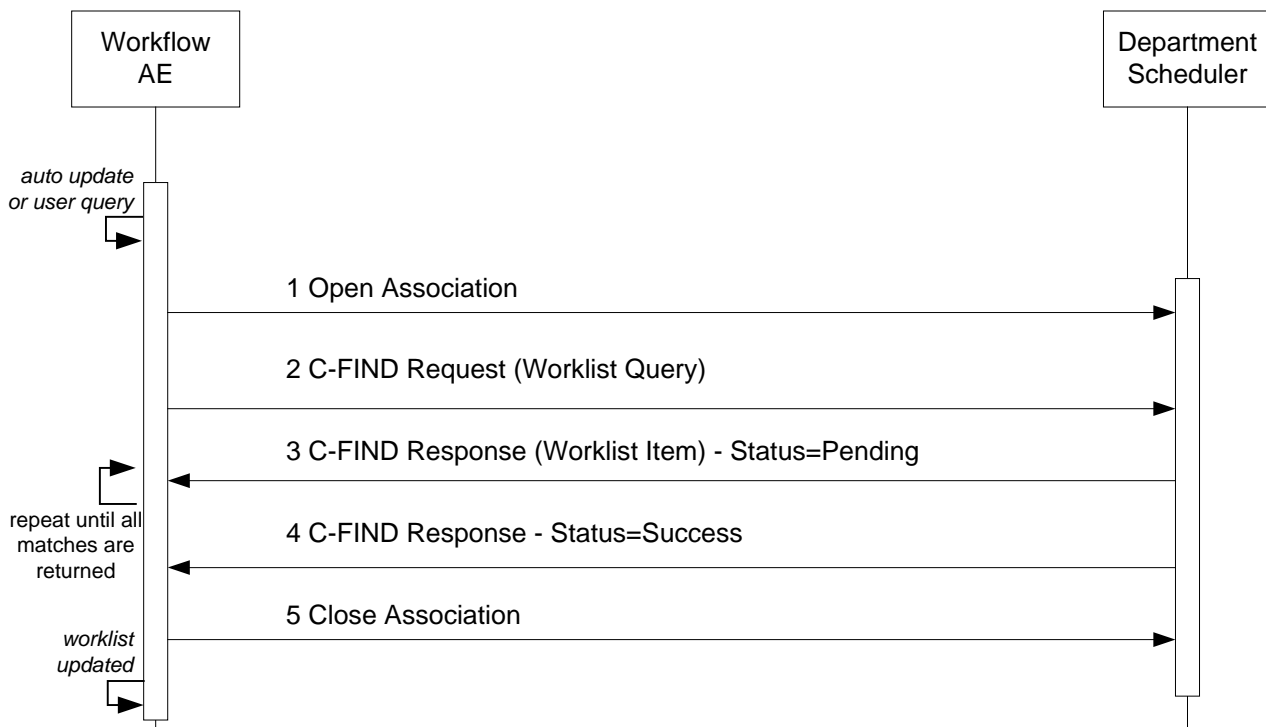


Figure 5
SEQUENCING OF ACTIVITY – WORKLIST UPDATE

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 MWL SOP Class as an SCP) is illustrated in Figure 5:

4.2.2.3.1.2 Proposed Presentation Contexts

CX50 4.0.X will propose Presentation Contexts as shown in the following table:

Table 23
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	Explicit VR Little Endian* Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

*Note: If the worklist server accepts Explicit VR Little Endian and Implicit VR Little Endian then CX50 4.0.X will use Explicit VR Little Endian Transfer Syntax.

4.2.2.3.1.3 SOP Specific Conformance for Modality Worklist

Table 24 summarizes the behavior of CX50 4.0.X when encountering status codes in a MWL C-FIND response.

A message “query failed” will appear on the user interface if CX50 4.0.X receives any other SCP response status than “Success” or “Pending.”

Table 24
MODALITY WORKLIST C-FIND RESPONSE STATUS HANDLING BEHAVIOR

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete	0000H	The system replaced the worklist from the response.
Refused	Out of Resources	A700H	The Association is aborted using A-ABORT. The worklist is not replaced.
Failed	Identifier does not match SOP Class	A900H	Same as "Refused" above.
Failed	Unable to Process	C000H – CFFFH	Same as "Refused" above.
Cancel	Matching terminated due to Cancel request	FE00H	The retrieved items are ignored.
Pending	Matches are continuing	FF00H	Continue.
Pending	Matches are continuing – Warning that one or more Optional Keys were not supported	FF01H	Continue.
*	*	Any other status code.	Same as "Refused" above.

Table 25 summarizes the behavior of CX50 4.0.X during communication failure.

Table 25
MODALITY WORKLIST COMMUNICATION FAILURE BEHAVIOR

Exception	Behavior
Timeout	Same as Service Status "Refused" in the table above.
Association aborted by the SCP or network layers	Same as Service Status "Refused" in the table above.

Table 26 describes the CX50 4.0.X Worklist Matching Keys and requested attributes. Unexpected attributes returned in a C-FIND response are ignored.

Non-matching responses returned by the SCP due to unsupported optional matching keys are ignored.

**Table 26
WORKLIST MATCHING KEYS**

Module Name Attribute Name	Tag	VR	M	R	D	IOD
Scheduled Procedure Step						
Scheduled Procedure Step Sequence	(0040,0100)	SQ		x		
> Scheduled Station AE Title	(0040,0001)	AE	S, *	x		
> Scheduled Procedure Step Start Date	(0040,0002)	DA	S, R	x	x	x
> Scheduled Procedure Step Start Time	(0040,0003)	TM		x	x	x
> Scheduled Procedure Step End Date	(0040,0004)	DA		x		
> Scheduled Procedure Step End Time	(0040,0005)	TM		x		
> Modality	(0008,0060)	CS	S, *	x		x
> Scheduled Performing Physician's Name ¹	(0040,0006)	PN		x	x	x
> Scheduled Procedure Step Description ²	(0040,0007)	LO		x	x	x
> Scheduled Protocol Code Sequence ³	(0040,0008)	SQ		x		x
> Scheduled Station Name	(0040,0010)	SH		x		
> Scheduled Procedure Step Location ⁴	(0040,0011)	SH		x	x	x
> Pre-Medication	(0040,0012)	LO		x		
> Scheduled Procedure Step ID	(0040,0009)	SH		x		x
> Requested Contrast Agent	(0032,1070)	LO		x		
> Scheduled Procedure Step Status	(0040,0020)	CS		x		x
> Comments on the Scheduled Procedure Step	(0040,0400)	LT		x		
Requested Procedure						
Requested Procedure ID ⁵	(0040,1001)	SH	S	x	x	x
Reason for the Requested Procedure ⁶	(0040,1002)	LO		x		
Requested Procedure Description	(0032,1060)	LO		x		x
Study Instance UID	(0020,000D)	UI		x		x
Referenced Study Sequence	(0008,1110)	SQ		x		x
Requested Procedure Code Sequence	(0032,1064)	SQ		x		
Names of Intended Recipients of Results	(0040,1010)	PN		x		
Requested Procedure Comments	(0040,1400)	LT		x		
Imaging Service Request						
Accession Number ⁷	(0008,0050)	SH	S	x	x	x
Requesting Physician	(0032,1032)	PN		x		
Requesting Service	(0032,1033)	LO		x		
Referring Physician's Name ⁸	(0008,0090)	PN		x	x	x
Reason for the Imaging Service Request ⁹	(0040,2001)	LO		x	x	
Imaging Service Request Comments	(0040,2400)	LT		x		
Visit Admission						
Current Patient Location	(0038,0300)	LO		x		
Patient Identification						
Patient's Name	(0010,0010)	PN	S *	x	x	x
Patient ID	(0010,0020)	LO	S *	x	x	x
Other Patient IDs ¹⁰	(0010,1000)	LO		x	x	x

Module Name Attribute Name	Tag	VR	M	R	D	IOD
Patient Demographic						
Patient's Birth Date ¹¹	(0010,0030)	DA		x	x	x
Patient's Birth Time ¹¹	(0010,0032)	TM		x	x	
Patient's Sex ¹²	(0010,0040)	CS		x	x	x
Patient's Age ¹³	(0010,1010)	AS		x		
Patient Size ¹⁴	(0010,1020)	DS		x	x	x
Ethnic Group	(0010,2160)	SH		x		
Patient's Weight ¹⁵	(0010,1030)	DS		x	x	x
Patient Comments	(0010,4000)	LT		x	x	
Referenced Patient Sequence	(0008,1120)	SQ		x		x
Patient Medical						
Medical Alerts	(0010,2000)	LO		x		
Additional Patient's History	(0010,21B0)	LT		x		
Pregnancy Status	(0010,21C0)	US		x		

* = Wildcard matching

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 a CX50 4.0.X Worklist Request Identifier.

Tag: DICOM tag for this attribute.

VR: DICOM VR for this attribute.

M: Matching keys for Worklist Update. An "S" indicates that CX50 4.0.X supplies an attribute value for Single Value Matching, "R" indicates a Range Value and "*" is for Wildcard matching. See section 4.2.2.3.1.2 for setup location.

R: Return keys. An "x" indicates that CX50 4.0.X supplies this attribute as a Return Key with zero length for Universal Matching.

D: Displayed keys. An "x" indicates that this worklist attribute is displayed to the user in the Patient Data Entry screen or Worklist Directory.

IOD: An "x" indicates that this Worklist attribute's data is included into applicable Image, SR or MPPS Object Instances created during performance of the related Procedure Step.

Notes:

- 1 Scheduled Performing Physician's Name is set in MPPS, sets the "Performed by" field in the Patient ID screen.
- 2 Scheduled Procedure Step Description is set in MPPS and images. May be used to set "Description" field in the Patient Selection screen and is mapped to "Study Description" in images. 2nd Configuration choice for "Study Description" in images.
- 3 Returned Scheduled Protocol Code Sequence contents are mapped to Scheduled Action Item Code Sequence and Performed Action Item Code Sequence in MPPS. If Code Meaning is present it is the 3rd Configuration option for Study description in images.
- 4 Scheduled Procedure Step Location sets the "Location" field in the Patient Selection Screen.
- 5 Requested Procedure Description value is set in the "Description" field of the Patient Selection screen and "Study Description" of the Patient ID screen. Manual entry to Study Description field is also sent in Image and MPPS messages.
- 6 May be used to set "Indication" field on Patient Selection screen. 1st choice, configurable. Not exported in DICOM.
- 7 Displayed on Patient ID screen and sent in MPPS and Images.
- 8 Sets the "Referring Physician" in Patient ID and Patient Selection screens.

- 9 May be used to set "Indication" field on Patient Selection screen. 2nd choice, configurable.
- 10 Displayed in "Alternate ID Number" field of Patient ID screen. Sent only in Images.
- 11 Birth Date and Birth Time can populate the 'DOB' field of Patient ID screen. Birth Date only is sent in MPPS messages.
- 12 Populates the "Gender" field in the Patient Selection screen.
- 13 Populates the "Age" field in the Patient Selection screen.
- 14 Populates "Height" fields in "Patient ID" and "Patient Selection" screens.
- 15 Populates "Weight" fields in "Patient ID" and "Patient Selection" screens.

4.2.2.3.2 Activity –Acquire Images

4.2.2.3.2.1 Description and Sequencing of Activities

An association to the configured MPPS SCP system is established immediately after the closing the Patient Data Entry screen, sending the MPPS N-Create message with status of "IN PROGRESS".

The "End Exam" button causes a "COMPLETED" status in the N-Set message. An exam for which an MPPS Instance is sent with a state of "COMPLETED" can no longer be updated; however, it may be appended. See section 4.1.1, Application Data Flow for details on append.

Pressing the "Cancel" button causes a "DISCONTINUED" message. An exam for which an MPPS Instance is sent with a state of "DISCONTINUED" can also no longer be updated; however, it may be appended. See section 4.1.1, Application Data Flow for details on append.

The system supports creation of "unscheduled cases" by allowing MPPS instances to be communicated for locally registered Patients.

The system performs a single Performed Procedure Step at a time per Scheduled Procedure Step.

CX50 4.0.X will initiate an Association to issue an:

- N-CREATE request according to the CREATE Modality Performed Procedure Step SOP Instance operation or a
- N-SET request to finalize the contents and state of the MPPS according to the SET Modality Performed Procedure Step Information operation.

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

When the user ends the scheduled procedure by closing the study and saving any changes, the MPPS status is "Completed". Alternatively, the user may choose to cancel acquisition, the study is saved in local storage and the MPPS status becomes "Discontinued". At this time, the Study Management AE attempts to modify the MPPS on the MPPS SCP through the use of the N-SET service. If the MPPS SCP is unavailable, the request is queued and will be sent when the MPPS SCP is available.

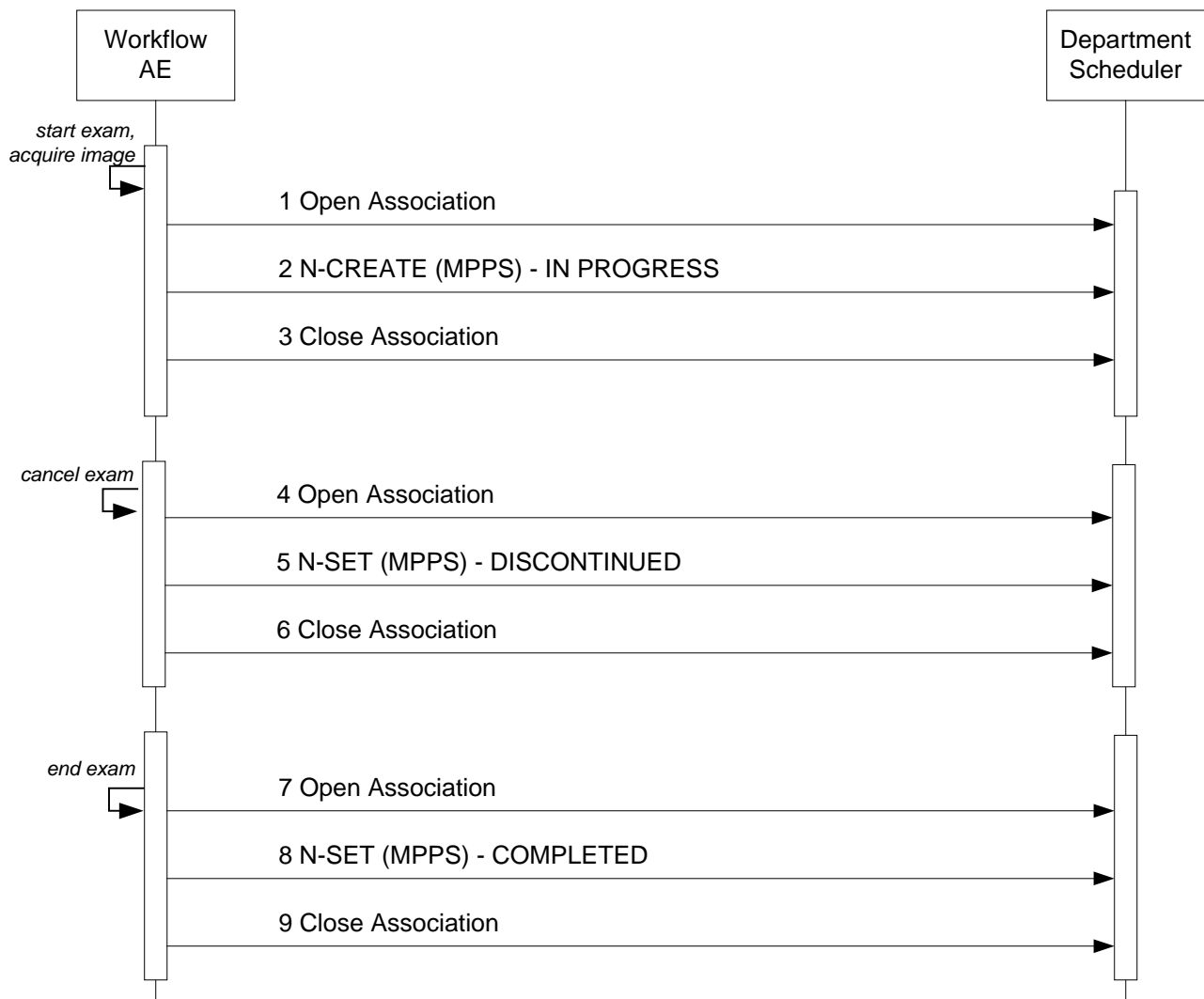


Figure 6
SEQUENCING OF ACTIVITY – ACQUIRE IMAGES

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 6.

Note: The Cancel and End Exam commands are mutually exclusive. They are both represented here for illustration purposes only. Actual workflow uses one or the other for a given exam.

4.2.2.3.2.2 Proposed Presentation Contexts

CX50 4.0.X will propose Presentation Contexts as shown in the following table:

Table 27
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	Explicit VR Little Endian*	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		

*Note: If the worklist server accepts Explicit VR Little Endian and Implicit VR Little Endian then CX50 4.0.X will use Explicit VR Little Endian Transfer Syntax.

4.2.2.3.2.3 SOP Specific Conformance for MPPS

Table 28 summarizes the behavior of CX50 4.0.X when encountering status codes in an MPPS N-CREATE or N-SET response.

The updated attributes are shown in Table 30 below. The “N-CREATE Usage” column shows the attributes transmitted when the status of the study changes to “IN-PROGRESS”. The “N-SET Usage” column shows the attributes transmitted when the status of the study changes to “COMPLETED” or “DISCONTINUED”.

Note: The following fields are copied from the selected MWL entry to the Patient ID screen:

- Accession Number
- Patient’s Name
- Patient’s ID
- Patient’s Birth Date
- Patient’s Sex
- Referring Physician’s Name
- Study description

Usually, the performing physician will accept the information in the Patient ID Screen, as is, however the physician has the option of editing the information before starting the study. If the physician edits this information then the MPPS N-CREATE command that is sent to the MPPS server on study start will use the edited information and not the original MWL information.

Table 28
MPPS N-CREATE / N-SET RESPONSE STATUS HANDLING BEHAVIOR

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000H	The SCP has completed the operation successfully.
Failure	Processing Failure – Performed Procedure Step Object may no longer be updated	0110H	The Association is aborted.
Warning	Attribute Value Out of Range	0116H	The error message is displayed.
*	*	Any other status code.	Same as “Failure” above.

Table 29 summarizes the behavior of CX50 4.0.X during communication failure.

**Table 29
MPPS COMMUNICATION FAILURE BEHAVIOR**

Exception	Behavior
Timeout	Same as "Failure" above.
Association aborted by the SCP or network layers	Same as "Failure" above.

Table 30 provides a description of the MPPS N-CREATE and N-SET request identifiers. Empty cells in the N-CREATE and N-SET columns indicate that the attribute is not sent.

**Table 30
MPPS N-CREATE / N-SET REQUEST IDENTIFIER**

Attribute Name	Tag	VR	N-CREATE	N-SET
Specific Character Set	(0008,0005)	CS	See Section 6 for details.	
Modality	(0008,0060)	CS	US	
Referenced Patient Sequence	(0008,1120)	SQ	If available from MWL, else NULL	
> Referenced SOP Class UID	(0008,1150)	UI	1.2.840.10008.3.1.2.1.1 No value sent for unscheduled study.	
>Referenced SOP Instance UID	(0008,1155)	UI	No value sent for unscheduled study.	
Patient's Name	(0010,0010)	PN	As received from MWL or entered in PDE.	
Patient ID	(0010,0020)	LO	From Modality Worklist or user input to the "MRN" field. MWL value may be edited.	
Patient's Birth Date	(0010,0030)	DA	Same as above, except "Patient's Birth Date" field.	
Patient's Sex	(0010,0040)	CS	Same as above, except "Gender" field.	
Study ID	(0020,0010)	SH	System Generated, starting with 1 and incrementing for each study,	
Performed Station AE Title	(0040,0241)	AE	AE Title from configuration (requires power cycle to use updated setting)	
Performed Station Name	(0040,0242)	SH	Same as "Performed Station AE Title" tag above.	
Performed Location	(0040,0243)	SH	If available from MWL, else NULL	

Attribute Name	Tag	VR	N-CREATE	N-SET
Performed Procedure Step Start Date	(0040,0244)	DA	Actual start date (on close of PDE screen)	
Performed Procedure Step Start Time	(0040,0245)	TM	Actual start time (on close of PDE screen)	
Procedure Code Sequence	(0008,1032)	SQ	Mapped from Requested Procedure Code Sequence (0032,1064) from MWL No value sent for unscheduled study.	As received from MWL No value sent for unscheduled study.
>Code Value	(0008,0100)	SH	As received from MWL No value sent for unscheduled study.	As received from MWL No value sent for unscheduled study.
>Coding Scheme Designator	(0008,0102)	SH	As received from MWL No value sent for unscheduled study.	As received from MWL No value sent for unscheduled study.
>Coding Scheme Version	(0008,0103)	SH	As received from MWL No value sent for unscheduled study.	As received from MWL No value sent for unscheduled study.
>Code Meaning	(0008,0104)	LO	As received from MWL No value sent for unscheduled study.	As received from MWL No value sent for unscheduled study.
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	COMPLETED or DISCONTINUED
Performed Procedure Step ID	(0040,0253)	SH	Auto generated in the format, <YYYYMMDD.HHMMSS>	
Performed Procedure Step Description	(0040,0254)	LO	Set from "Study Description" field in PDE, else mapped from Requested Procedure Description in MWL.	
Performed Procedure Type Description	(0040,0255)	LO	If present in MWL, else "Indication" field in PDE.	
Performed Protocol Code Sequence	(0040,0260)	SQ	Zero length, or mapped from MWL Scheduled Protocol Code Sq (0040,0008)	Same
Scheduled Step Attributes Sequence	(0040,0270)	SQ		
> Accession Number	(0008,0050)	SH	From MWL or user PDE input. MWL value may be edited.	
> Referenced Study Sequence	(0008,1110)	SQ	One item per item in the MWL Reference Study Sequence. Absent if unscheduled.	

Attribute Name	Tag	VR	N-CREATE	N-SET
>> Referenced SOP Class UID	(0008,1150)	UI	Same value as in of the Reference Study Sequence in the MWL	
>> Referenced SOP Instance UID	(0008,1155)	UI	Same value as in of the Reference Study Sequence in the MWL	
> Study Instance UID	(0020,000D)	UI	Same value as in MWL attribute or auto generated	
> Requested Procedure Description	(0032,1060)	LO	Same value as in MWL attribute, 1 st Choice, from "Study Description" in PDE, else NULL	
> Scheduled Procedure Step Description	(0040,0007)	LO	Same value as in MWL attribute, else NULL	
> Scheduled Protocol Code Sequence	(0040,0008)	SQ	Same value as in MWL attribute, else NULL	
> Scheduled Procedure Step ID	(0040,0009)	SH	Same value as in MWL attribute, else NULL	
> Requested Procedure ID	(0040,1001)	SH	Same value as in MWL attribute, else NULL	
Performed Series Sequence	(0040,0340)	SQ		One item per acquired series
> Retrieve AE Title	(0008,0054)	AE	Zero Length	Same
> Series Description	(0008,103E)	LO	Zero Length	Same
> Performing Physician's Name	(0008,1050)	PN	From the "Performed by" field in PDE	From the "Performed by" field in PDE
> Operator's Name	(0008,1070)	PN	From the "Performed by" field in PDE	Same
> Referenced Image Sequence	(0008,1140)	SQ	Zero Length	Zero Length
>> Referenced SOP Class UID	(0008,1150)	UI		
>> Referenced SOP Instance UID	(0008,1155)	UI		
> Protocol Name	(0018,1030)	LO	"Free Form"	"Free Form"
> Series Instance UID	(0020,000E)	UI	Auto Generated	Same
> Referenced Non-Image Composite SOP Instance Sequence	(0040,0220)	SQ	Zero Length	Zero Length

4.2.2.4 Association Acceptance Policy

The Workflow Application Entity does not accept Associations.

4.2.3 Hardcopy Application Entity Specification

4.2.3.1 SOP Classes

CX50 4.0.X provides Standard Conformance to the following SOP Classes:

Table 31
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
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	Yes	No

The Print Meta SOP Classes are defined by the following set of supported SOP Classes:

- Basic Film Session SOP Class
- Basic Film Box SOP Class
- Basic Grayscale (or Color) Image Box SOP Class
- Printer SOP Class

Important note about printing by CX50 4.0.X:

- The number of Film Boxes per session is one
- The number of images per Film Box is one
- Most image formatting and layout is performed by CX50 4.0.X resulting in a single rather large dataset sent to the printer
- CX50 4.0.X will release the association after the print command (N-Action-Rq) is sent. It will not hold the associations open to receive the printer's N-Event-Report message.

4.2.3.2 Association Establishment Policy

4.2.3.2.1 General

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

Table 32
DICOM APPLICATION CONTEXT FOR AE HARDCOPY

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

4.2.3.2.2 Number of Associations

CX50 4.0.X initiates one Association at a time for each configured hardcopy device. Multiple hardcopy devices can be configured.

Table 33
NUMBER OF ASSOCIATIONS INITIATED FOR AE HARDCOPY

Maximum number of simultaneous Associations	2
---	---

Note: One Black and White only Printer/Server and one Color Printer/Server.

4.2.3.2.3 Asynchronous Nature

CX50 4.0.X does not support asynchronous communication (multiple outstanding transactions over a single Association).

Table 34
ASYNCHRONOUS NATURE AS A SCU FOR AE HARDCOPY

Maximum number of outstanding asynchronous transactions	1
---	---

4.2.3.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Table 35
DICOM IMPLEMENTATION CLASS AND VERSION FOR AE HARDCOPY

Implementation Class UID	1.3.46.670589.14.1000.400
Implementation Version Name	CX50_4.0

4.2.3.3 Association Initiation Policy

4.2.3.3.1 Activity – Film Images

4.2.3.3.1.2 Description and Sequencing of Activities

The system composes images onto film sheets and sends print requests to job queue.

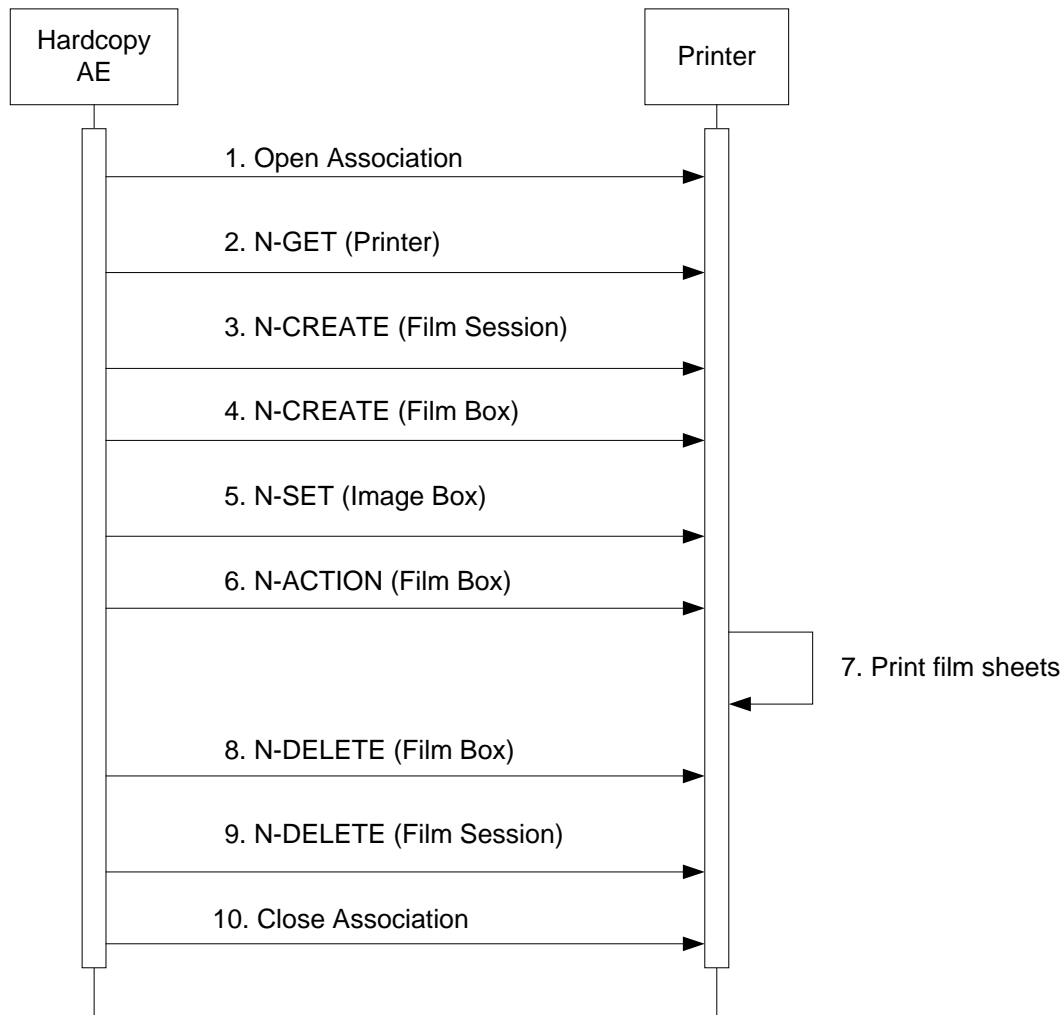


Figure 7
SEQUENCING OF ACTIVITY – PRINT IMAGES

Figure 7 illustrates a typical sequence of DIMSE messages sent over an association between Hardcopy AE and a Printer. Two DICOM Printers may be simultaneously configured, one for BW and one for Color prints.

If both BW and Color printers are configured and selected, the images that contain color data, i.e., Color Flow Doppler or “Chroma” will be sent to the Color printer, and all other images will be sent to the BW printer.

In “Send as you go”, images will be sent to the printer when the number needed to fill the configured format is met, until “End Exam” is pressed when page(s) that have not been exported will be sent. In “Batch mode” or “Manual”, each formatted page is sent as soon as it is composed by the system. If fewer images than a full page are sent, the remaining blank spaces will be sent black.

Status of the print-job is reported through the Job Manager (CNTL-J). Only one job will be active at a time for each separate hardcopy device. If any 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.

4.2.3.3.1.2 Proposed Presentation Contexts

Table 36 shows the Presentation Contexts CX50 4.0.X is capable of proposing.

**Table 36
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	Explicit VR Little Endian*	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	Explicit VR Little Endian*	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		

* Note: If the worklist server accepts Explicit VR Little Endian and Implicit VR Little Endian then CX50 4.0.X will use Explicit VR Little Endian Transfer Syntax.

4.2.3.3.1.3 Common SOP Specific Conformance for all Print SOP Classes

Table 37 summarizes the general behavior of Hardcopy AE during communication failure. This behavior is common for all SOP Classes supported by Hardcopy AE.

**Table 37
HARDCOPY COMMUNICATION FAILURE BEHAVIOR**

Exception	Behavior
Timeout	The Association is aborted and reported as "Failed."
Association aborted by the SCP or network layers	"Network Communication Failure" is reported.

4.2.3.3.1.4 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.

4.2.3.3.1.4.1 Printer SOP Class Operations (N-GET)

Hardcopy AE uses the Printer SOP Class N-GET operation to obtain information about the current printer status. Table 38 lists the attributes obtained via N-GET.

**Table 38
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 retried as configured then is marked as failed.
3. If Printer status (2110,0010) is WARNING, the print-job continues to be printed.

Table 39 summarizes the behavior of Hardcopy AE when encountering status codes in an N-GET response.

**Table 39
PRINTER SOP CLASS N-GET RESPONSE STATUS HANDLING BEHAVIOR**

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000H	The request to get printer status information was success.
*	*	Any other status code.	Same as Timeout above.

4.2.3.3.1.4.2 Printer SOP Class Notifications (N-EVENT-REPORT)

Hardcopy AE is capable of receiving an N-EVENT-REPORT request at any time during an association.

Table 40 summarizes the behavior of Hardcopy AE when receiving Event Types within the N-EVENT-REPORT.

**Table 40
PRINTER SOP CLASS N-EVENT-REPORT BEHAVIOUR**

Event Type Name	Event Type ID	Behavior
Normal	1	The print-job continues to be printed.
Warning	2	The print-job. For user-recoverable warnings, the job retries as configured. Then marked as failed.
Failure	3	The job retries as configured print then is marked as failed.
*	*	Status code of 0113H

Table 41 summarizes the reasons for returning specific status codes in an N-EVENT-REPORT response.

**Table 41
PRINTER SOP CLASS N-EVENT-REPORT RESPONSE STATUS REASONS**

Service Status	Further Meaning	Error Code	Reasons
Success	Success	0000H	The notification event has been successfully received.
Failure	No Such Event Type	0113H	An invalid Event Type ID was supplied in the N-EVENT-REPORT request.
Failure	Processing Failure	0110H	An internal error occurred during processing of the N-EVENT-REPORT. A short description of the error will be returned in Error Comment (0000,0902).

4.2.3.3.1.5 SOP Specific Conformance for the Film Session SOP Class

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

— N-CREATE

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

4.2.3.3.1.5.1 Film Session SOP Class Operations (N-CREATE)

Table 42 lists the attributes supplied in an N-CREATE Request.

**Table 42
FILM SESSION SOP CLASS N-CREATE REQUEST ATTRIBUTES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Number of Copies	(2000,0010)	IS	Default 1. Range is 1 – 99.	ALWAYS	USER
Print Priority	(2000,0020)	CS	HIGH	ALWAYS	AUTO
Medium Type	(2000,0030)	CS	BLUE FILM, CLEAR FILM or PAPER and 'Printer Specific' options*	VNAP	USER
Film Destination	(2000,0040)	CS	MAGAZINE or PROCESSOR and 'Printer Specific' options *	ANAP	USER
Film Session Label	(2000,0050)	LO	Philips Medical Systems	ALWAYS	AUTO

*Dependent on the specific printer selected

Table 43 summarizes the behavior of Hardcopy AE when encountering status codes in an N-CREATE response.

**Table 43
FILM SESSION SOP CLASS N-CREATE RESPONSE STATUS HANDLING BEHAVIOR**

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000H	The SCP has completed the operation successfully.
Warning	Attribute Value Out of Range	0116H	System continues operations.
Warning	Attribute List Error	0107H	Same as above.
*	*	Any other status	The Association is aborted and the print-job fails.

Service Status	Further Meaning	Error Code	Behavior
		code.	

4.2.3.3.1.5.2 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 44
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 aborted using A-ABORT and the print-job is marked as failed. The status meaning is logged and reported to the user.

4.2.3.3.1.6 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.

4.2.3.3.1.6.1 Film Box SOP Class Operations (N-CREATE)

Table 47 lists the attributes supplied in an N-CREATE Request.

**Table 47
FILM BOX SOP CLASS N-CREATE REQUEST ATTRIBUTES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Image Display Format	(2010,0010)	ST	STANDARD\1,1	ALWAYS	AUTO
Referenced Film Session Sequence	(2010,0500)	SQ		ALWAYS	AUTO
>Referenced SOP Class UID	(0008,1150)	UI	1.2.840.10008.5.1.1.1	ALWAYS	AUTO
>Referenced SOP Instance UID	(0008,1155)	UI	From created Film Session SOP Instance	ALWAYS	AUTO
Film Orientation	(2010,0040)	CS	Default = PORTRAIT, or LANDSCAPE	ALWAYS	AUTO/USER

Attribute Name	Tag	VR	Value	Presence of Value	Source
Film Size ID	(2010,0050)	CS	Default – 8INX10IN and DICOM Defined Terms: 8INX10IN, 8_5INX11IN, 10INX12IN, 10INX14IN, 11INX14IN, 11INX17IN, 14INX14IN, 14INX17IN, 24CMX24CM, 24CMX30CM, A4, A3 and 'Printer Specific' options.	ALWAYS	AUTO/USER
Magnification Type	(2010,0060)	CS	NONE, CUBIC, BILINEAR, REPLICATE, 'Printer Specific' options	ANAP	USER
Min Density	(2010,0120)	US	User editable 0-999	ANAP	USER
Max Density	(2010,0130)	US	User editable 0-999	ANAP	USER
Trim	(2010,0140)	CS	NO	ALWAYS	AUTO
Configuration Information	(2010,0150)	ST	DICOM supports a "config ID#" or a "config string". Check "Printer Catalog" for appropriate data.	ANAP	USER

Table 48 summarizes the behavior of Hardcopy AE when encountering status codes in an N-CREATE response.

**Table 48
FILM BOX SOP CLASS N-CREATE RESPONSE STATUS HANDLING BEHAVIOR**

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000H	The SCP has completed the operation successfully.
Warning	Requested Max Density outside of printer's operating range	B605H	The N-CREATE operation is considered successful but the status meaning is logged.
*	*	Any other status code.	The Association is aborted and the job failed.

4.2.3.3.1.6.2 Film Box SOP Class Operations (N-ACTION)

The Hardcopy AE issues an N-ACTION Request to instruct the Print SCP to print the contents of the Film Box.

Table 49 summarizes the behavior of Hardcopy AE when encountering status codes in an N-ACTION response.

**Table 49
FILM BOX SOP CLASS N-ACTION RESPONSE STATUS HANDLING BEHAVIOR**

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000H	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)	B603H	The Association is aborted and the job is failed.
Failure	Unable to create Print Job SOP Instance;	C602H	Same as B603H above.

Service Status	Further Meaning	Error Code	Behavior
	print queue is full.		
*	*	Any other status code.	Same as B603H above.

4.2.3.3.1.7 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.

4.2.3.3.1.7.1 Image Box SOP Class Operations (N-SET)

Table 50 lists the attributes supplied in an N-SET Request.

**Table 50
IMAGE BOX SOP CLASS N-SET REQUEST ATTRIBUTES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Image Position	(2020,0010)	US	1	ALWAYS	AUTO
Polarity	(2020,0020)	CS	NORMAL	ALWAYS	AUTO
Basic Grayscale Image Sequence	(2020,0110)	SQ	Used for BW (Monochrome2) print	ALWAYS*	AUTO
Basic Color Image Sequence	(2020,0111)	SQ	Used for Color (RGB) print	ALWAYS*	AUTO
>Samples Per Pixel	(0028,0002)	US	1 for Monochrome2 3 for RGB	ALWAYS	AUTO
>Photometric Interpretation	(0028,0004)	CS	MONOCHROME2 RGB	ALWAYS	AUTO
>Planar Configuration	(0028,0006)	US	"01" for Color-by-plane "00" for Color-by-pixel, Used only for RGB print.	ANAP	USER
>Rows	(0028,0010)	US	Depends on film size	ALWAYS	See Printer Catalog
>Columns	(0028,0011)	US	Depends on film size	ALWAYS	See Printer Catalog
>Bits Allocated	(0028,0100)	US	8	ALWAYS	AUTO
>Bits Stored	(0028,0101)	US	8	ALWAYS	AUTO
>High Bit	(0028,0102)	US	7	ALWAYS	AUTO
>Pixel Representation	(0028,0103)	US	0	ALWAYS	AUTO

>Pixel Data	(7FE0,0010)	OW	Pixels of rendered film sheet.	ALWAYS	AUTO
-------------	-------------	----	--------------------------------	--------	------

* Mutually exclusive attributes

Table 51 summarizes the behavior of Hardcopy AE when encountering status codes in an N-SET response.

**Table 51
IMAGE BOX SOP CLASS N-SET RESPONSE STATUS HANDLING BEHAVIOR**

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000H	The SCP has completed the operation successfully.
Failure	Insufficient memory in printer to store the image.	C605H	The Association is aborted and the job is failed.
*	*	Any other status code.	Same as C605H above.

4.2.3.4 Association Acceptance Policy

The Hardcopy Application Entity does not accept Associations.

4.2.4 Verification Application Entity specification

4.2.4.1 SOP Class

CX50 4.0.X provides Standard Conformance to the following SOP Class:

**Table 51.1
SOP CLASSES FOR AE VERIFICATION**

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	Yes	Yes

4.2.4.2 Association Establishment Policy

4.2.4.2.1 General

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

**Table 51.2
DICOM APPLICATION CONTEXT FOR AE VERIFICATION**

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

4.2.4.2.2 Number of Associations

CX50 4.0.X initiates one Association at a time for a Verification request.

**Table 51.3
NUMBER OF ASSOCIATIONS INITIATED FOR AE VERIFICATION**

Maximum number of simultaneous Associations	Up to 10, one for each configured remote device
---	---

**Table 51.4
NUMBER OF ASSOCIATIONS ACCEPTED FOR AE VERIFICATION**

Maximum number of simultaneous Associations	Unlimited - calling AE must be already configured in CX50 4.0.X.
---	--

4.2.4.2.3 Asynchronous Nature

CX50 4.0.X does not support asynchronous communication (multiple outstanding transactions over a single Association).

**Table 51.5
ASYNCHRONOUS NATURE AS A SCU FOR AE VERIFICATION**

Maximum number of outstanding asynchronous transactions	1
---	---

4.2.4.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

**Table 51.6
DICOM IMPLEMENTATION CLASS AND VERSION FOR AE VERIFICATION**

Implementation Class UID	1.3.46.670589.14.1000.400
Implementation Version Name	CX50_4.0

4.2.4.3 Association Initiation Policy

4.2.4.3.1 Activity – Verify as SCU and SCP

4.2.4.3.2 Description and Sequencing of Activities

SCU: The user can verify the existence of a DICOM server on the hospitals network, through a button, “Ping”, in the ‘DICOM Setup’ screen. When the user presses this button, CX50 4.0.X will initiate the association.

Only one association is established for each verification attempt. However, the proposed presentation contexts not only includes the ‘Verification SOP class’ but also includes all the SOP classes that CX50 4.0.X could possibly be connected to as Servers. This is done in order to retrieve the capabilities of the remote Server.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU /SCP	None
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Implicit VR Little Endian* Explicit VR Little Endian JPEG Lossy Baseline RLE Lossless	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.5	SCU	None
US Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian Explicit VR Little Endian JPEG Lossy Baseline RLE Lossless	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.5	SCU	None

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Comprehensive Structured Report Storage	1.2.840.10008.5.1.4.1.1.88.33	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None
Cardiac 3D Presentation State Storage	1.3.46.670589.2.5.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Explicit VR Little Endian* Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Explicit VR Little Endian* Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	Explicit VR Little Endian* Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	Explicit VR Little Endian* Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

CX50 4.0.X initiates an Association in order to issue:

- C-ECHO request according to the Verification SOP Class.

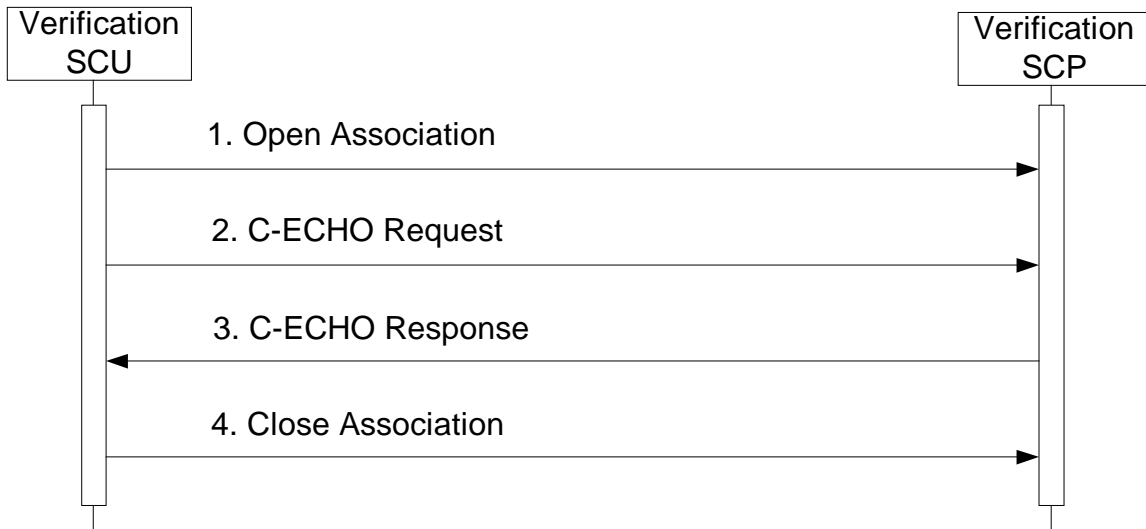


Figure 8a
SEQUENCING OF ACTIVITY – ISSUE VERIFY

SCP: The system listens on the port configured on the “This System” Configuration screen for Verification requests initiated by other remote devices. The calling device AE must already be configured as a remote device in CX50 4.0.X or the association is rejected.

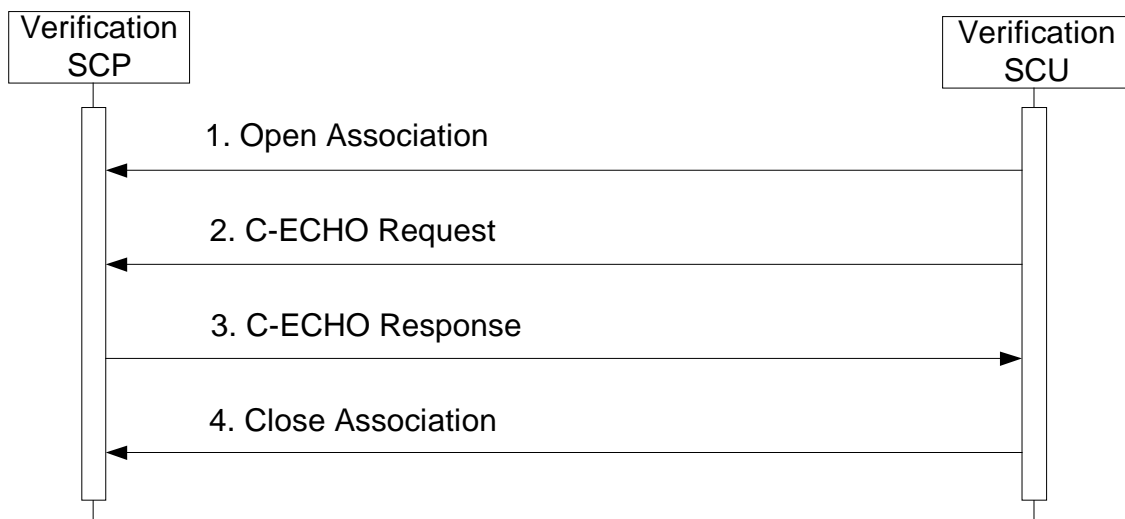


Figure 8b
SEQUENCING OF ACTIVITY – RECEIVE VERIFY

4.2.4.3.3 Proposed Presentation Contexts

CX50 4.0.X will propose Presentation Contexts as shown in the following table:

**Table 51.7
PROPOSED PRESENTATION CONTEXTS FOR ACTIVITY VERIFICATION**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU /SCP	None

4.2.4.3.4 SOP Specific Conformance for Verification

Table 51.8 summarizes the behavior of CX50 4.0.X when receiving status codes in a C-ECHO response.

A message will appear on the user interface if CX50 4.0.X receives any other SCP response status than “Success.”

**Table 51.8
VERIFICATION C-ECHO RESPONSE STATUS HANDLING BEHAVIOR**

Service Status	Further Meaning	Error Code	Behavior
Success		0000H	Device Status is set to: Verified
Refused	Out of Resources	A700H	Device Status is set to: Not Verified
Failed	Unable to Process	C000H – CFFFH	Same as “Refused” above.
*	*	Any other status code.	Same as “Refused” above.

4.2.4.3.4.1 Verification SOP Class Operations (C-ECHO)

4.2.4.3.5 Association Acceptance Policy

4.2.4.3.5.1 Verification SOP Class Notifications

Association Negotiation Request message contents for each DICOM device:

Device Type	SOP Classes Requested	Additional Notes
Primary or Secondary Storage SCP	US Image Storage US Multiframe Storage Verification	
Storage Commit SCP	Storage Commitment Verification	
SR Storage SCP	Comprehensive Structured Report Storage Verification	
SR Storage Commit SCP	Storage Commitment Verification	

Device Type	SOP Classes Requested	Additional Notes
B&W Printer SCP	Basic Grayscale META Print Verification	Color images may be sent to a bw printer if it supports converting to BW.
Color Printer SCP	Basic Color META Print Verification	May be the same printer if color is also supported.
MWL SCP	Modality Worklist Verification	MWL query settings are located in Setups > System > DICOM > DICOM Preset > Change Settings for current preset > Modify in Roles > MWL SCP – Advanced > Set Modality Worklist Query page.
PPS SCP	Modality Performed Procedure Step Verification	

4.3 PHYSICAL NETWORK INTERFACES

4.3.1 Supported Communication Stacks

4.3.1.2 TCP/IP Stack

CX50 4.0.X provides DICOM TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

4.3.2 Physical Network Interface

The CX50 4.0.X system supports one network interface at a time. The following physical network interfaces are available:

**Table 52
SUPPORTED PHYSICAL NETWORK INTERFACE**

1) Ethernet 10/100/1000BaseT, RJ-45, UTP, STP; AutoDetect Speed, Full or Half Duplex
2) 802.11 a/b/g/n Wireless

4.4 CONFIGURATION

4.4.1 AE Title/Presentation Address Mapping

The DICOM setup screen allows the user to configure a significant number of options including (but not limited to):

- For the CX50 4.0.X system, it's AE Title, IP Address and Port number, Wired or Wireless connection.
- For DICOM servers, their AE Title, Port number, IP address.
- For Storage SCP's and for media storage; the image format.

Advanced settings (including Photometric Interpretation settings: MONOCHROME2, RGB, Palette color and YBR_FULL_422 and Transfer Syntaxes: Implicit Little Endian, Explicit Little Endian, RLE and JPEG for images), loop timing, pixel spacing, and display compensation.

- For SR Storage SCP's, which SR template(s) to export.
- For DICOM Printers, many DICOM configuration settings
- For a MWL server, the query parameters: scheduled procedure start range, modality, AE Title.
- For locations that include Emergency Department reporting solutions, e.g., Telexy QPath, the advanced options allow completing configuration.

The Devices Configuration section allows the following device types to be configured:

Device Type	Supported SOPs
Primary or Secondary Storage SCP	Ultrasound Store Ultrasound Multiframe Store Cardiac 3D Presentation State Store
Storage Commit SCP	Storage Commitment Push Model
SR Storage SCP	Comprehensive Structured Report Store
SR Storage Commit SCP	Storage Commitment Push Model
B&W Printer SCP	Basic Grayscale Print Meta
Color Printer SCP	Basic Color Print Meta
MWL SCP	Modality Worklist
PPS SCP	Modality Performed Procedure Step

To configure a single server that supports image store, commitment and PPS, a “Server” entry must be configured under “Setups>DICOM...>Change Settings for DICOM Preset>Servers and Roles>Servers”. Enter a Name (an ‘alias’ used in the system UI only), the appropriate AE Title, IP Address, Port number and timeout values. “Ping” sends an ICMP ping message to the address and a DICOM Verification Association message is sent to the Port and AE Title. A success message is displayed if all is configured correctly at this level. If not, an error message dialog is displayed indicating possible reasons and suggested corrective actions. Hit “Done” to continue to Role definition.

Once the server data is defined, then its role and options are configured. For each role, as in Primary Storage SCP, MPPS SCP, etc, select the server’s alias name from the list. If “Advanced” options are available, select the “Advanced” button to access them.

When Role configuration is completed and “Done” is selected under “Roles”, then another set of Verification messages are sent to each server confirming network connectivity and DICOM role support. A dialog box updates as the tasks are in progress. No error messages indicates successful configuration.

4.4.1.1 Secure DICOM Configuration Option

DICOM Setup supports the ability to make secure connections between the ultrasound system and DICOM servers. The “DICOM Setup” page includes the “This System” tab that includes a “Secure DICOM” button. Select that button to open the “Secure DICOM Configuration” dialog and select the “Modify” button. Select the “Use Transport Layer Security (Use TLS) checkbox and optionally the “Use TLS Encryption” box.

With a USB device connected to the system containing the certificates, select “Manage Certificates” to enter certificates. Detailed instructions are available in Help on the system.

After entering the certificates into the system, make the selection for “* This System’s Certificate:”

Similarly, with the certificates imported into the system, when configuring remote servers to connect with under the “Systems and Roles” tab, the correct certificate may be selected in the “Servers” side’s “Secure DICOM” button.

Note: If the system is set for Secure DICOM, it will only communicate with secure devices, and the system’s default listening port will change from 104 to 2762.

4.4.1.2 Local AE Title

All local AEs use the same AE Title and TCP/IP Port configured via the Setups>DICOM...>Change Settings for DICOM Setup>This System screen. The system listens on the configured Port only for Verification requests and Storage Commitment N-Event -Reports. The system supports Static Addressing or DHCP to receive its IP Address, Subnet Mask and Default Gateway address.

4.4.1.3 Remote AE Title/Presentation Address Mapping

The AE Titles, IP Addresses and Port numbers of remote applications are manually configured using the Setups>DICOM...>Change Settings for DICOM Preset>Servers and Roles. The remote system’s IP Address may be entered manually if known or the Host Name of the remote device may be entered and resolved by the DNS if the network includes this service.

4.4.2 Workflow

Setup is used to set the AE Title, Port number and IP Address the remote MWL SCP. Multiple MWL SCPs may be defined, but only a single remote MWL SCP can be selected at a time.

The default MWL query uses Modality = “US”. This may be changed in the “Set Modality Worklist Query Customizable Queries” definition page. Alternately, “All Modalities” may be selected.

“AE Title” may be selected as the system’s or a custom query value may be defined for a different AE Title or for “ANY”.

The Start Date defaults to "Today" but may be modified to be "All Dates", or a Date Range that may be 0 - 99 days (or hours) Prior plus the next 0 -99 days.

The automated polling interval range for sending MWL queries is between 1 and 32,767 minutes, defaulting to 30 minutes.

Setup is used to set the AE Title, Port number and IP Address of the remote MPPS SCP. Multiple MPPS SCPs may be defined, but only a single remote MPPS SCP can be selected at a time.

4.4.3 Hardcopy

Setup is used to set the AE Titles, Port numbers and IP Addresses for the remote Print SCPs.

Multiple remote Print SCPs can be defined, but up to one Grayscale and one Color Print SCP may be selected at a time.

Automatic sending of color images to the color printer and BW images to the BW printer is selectable in the Setups>DICOM...>Change Settings for DICOM Preset>Servers and Roles>BW or Color Printer SCP Advanced settings.

5 MEDIA STORAGE

5.1 IMPLEMENTATION MODEL

5.1.1 Application Data Flow

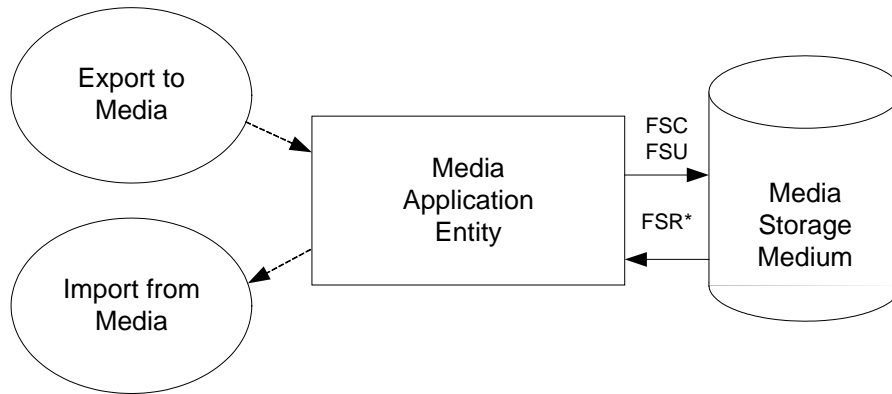


Figure 9
APPLICATION DATA FLOW DIAGRAM FOR MEDIA STORAGE

- The Media Application Entity exports Images and Structured Reports to a removable storage medium. It is associated with the local real-world activity “Export” using the configured export selection parameters for selected patients’ data (images and / or Structured Reports). For “Import”, the system will not read in Structured Reports.
- Throughout this section, the term “Media” refers to any of the media listed below which is in use.

CX50 4.0.X will support the use of most writable media including CD-R, CD-RW, DVD-R, DVD+R, DVD-RW, DVD+RW, and USB devices. The DICOM structure will be the same regardless of media used.

5.1.2 Functional Definition of AEs

5.1.2.1 Functional Definition of Media Application Entity

Using “Export” will pass the currently selected patients’ exams or individually selected images to the Media Application Entity. The contents of each export job will be written to the selected media destination. The size of the selected media is used to determine and display the number of media required for the export. When a device is filled to capacity, the system will prompt the user for addition media and continue.

5.1.3 Sequencing of Real-World Activities

At least one image must exist and be selected before the Media Application Entity can be invoked. The operator can insert new media at any time. The Media Application Entity will wait indefinitely for media to be inserted before starting to write to the device.

5.1.4 File Meta Information Options

The implementation information written to the File Meta Header in each file is:

Table 65
DICOM IMPLEMENTATION CLASS AND VERSION FOR MEDIA STORAGE

Implementation Class UID	1.3.46.670589.14.1000.400
Implementation Version Name	CX50_4.0

5.2 AE SPECIFICATIONS

5.2.1 Media Application Entity Specification

The Media Application Entity provides standard conformance to the DICOM Interchange Option of the Media Storage Service Class. The Application Profiles and roles are listed in

Table 66
APPLICATION PROFILES, ACTIVITIES AND ROLES FOR OFFLINE-MEDIA

Application Profiles Supported	Real World Activity	Role	SC Option
STD-US-SC-MF-CDR STD-GEN-CD*	Send to...Media	FSC	Interchange
STD-US-SC-MF-DVD STD-GEN-DVD STD-GEN-USB-JPEG		FSC, U**	
STD-US-SC-MF-CDR STD-US-SC-MF-DVD STD-GEN-USB-JPEG		R***	

* Note that Ultrasound-specific Application Profiles do not include Structured Report SOP Class, necessitating addition of the STD-GEN CDR and DVD Application Profiles.

** Update functionality requires DVD+RW, or USB

*** File Set Reader functionality may be limited only to media created by other CX50 4.0.X systems.

For previously imported studies, CX50 4.0.X will export the IODs using the transfer syntax and tags that were used when CX50 4.0.X originally imported the study.

Transfer Syntax and Photometric Interpretation options for removable media

Transfer Syntax	Photometric Interpretation
Uncompressed (DICOM Explicit VR Little Endian)	Palette Color
Uncompressed (DICOM Explicit VR Little Endian)	RGB
Uncompressed (DICOM Explicit VR Little Endian)	MONOCHROME2
RLE (Lossless) Compression	Palette Color
RLE (Lossless) Compression	RGB
RLE (Lossless) Compression	MONOCHROME2
JPEG (Lossy) Compression	YBR_FULL_422

Reading a DICOM study from removable media

When requested to read the media directory, the CX50 4.0.X Application Entity acts as FSR using the Interchange Option.

Choosing the Import operation from a menu initiates importing images. See the system user manuals for a description of the specific user interface capabilities. CX50 4.0.X doesn't support FSR role for DICOM SR.

5.2.1.1 File Meta Information for the Application Entity

The File-Set Identifier included in the File Meta Header is "".

5.2.1.2 Real-World Activities

5.2.1.2.1 Activity – Send to Media – “Export”

The Media Application Entity acts as an FSC using the interchange option when requested to export SOP Instances from the local database to media.

The contents of the export job will be written together with a corresponding DICOMDIR to media. The user can cancel an export job in the job queue.

5.2.1.2.2 Activity – Import from Media – “Import”

The Media Application Entity acts as an FSR using the interchange option when requested to import SOP Instances from media to the local database.

The Import Studies icon presents the directory of the system or the offline media. Selected exams are transferred from the media to the system for review. Objects transferred to the system retain their original SOP Instance UIDs.

Note: Structured Reports may not be read back into CX50 4.0.X.

5.2.1.2.3 Activity – Update to Media – Export”

The Media Application Entity acts as an FSU using the interchange option when requested to export SOP Instances from the local database to media upon which DICOM data already resides.

The system user selects exams from the system’s directory for transfer to media that already contains data. The DICOMDIR is updated allowing access to original and new data.

5.2.1.2.3.1 Media Storage Application Profiles

See Table 66 for supported Application Profiles.

5.2.1.2.3.2 Options

The Media Application Entity supports the SOP Classes and Transfer Syntaxes listed in Table 67.

Table 67
IODS, SOP CLASSES AND TRANSFER SYNTAXES FOR OFFLINE MEDIA

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Media Storage Directory Storage	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian JPEG Lossy Baseline RLE	1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.5
US Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian JPEG Lossy Baseline RLE	1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.5
Comprehensive Structured Report Storage*	1.2.840.10008.5.1.4.1.1.88.33	Explicit VR Little Endian	1.2.840.10008.1.2.1
Cardiac 3D Presentation State Storage*	1.3.46.670589.2.5.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1

* Export only.

Directory Information Module

All data elements are used as described in DICOM 3.0 Part 3 for Basic Directory Object Definitions. As stated in the Ultrasound Application Profile, “The (DICOMDIR) Directory shall include Directory Records of PATIENT, STUDY, SERIES, IMAGE and SR DOCUMENT corresponding to the information object files in the File-set”. These are present when writing media. Given this requirement, CX50 4.0.X uses these directory records to identify the study to import with the exception of SR DOCUMENT. If there are DICOM image files on the import media that do not appear in the DICOMDIR Directory Information Module (either because references to these files were omitted or because the Directory Information Module, optional in DICOM but required in the Ultrasound Application Profile, does not exist), these files are not recognized by the system.

CX50 4.0.X ignores directory Record Types other than those above.

CX50 4.0.X also ignores the “File-set consistency Flag” (0004,1212).

Patient Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008,0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details.
Patient Name	(0010,0010)	2	Displayed to help the user identify the patient folder in which to place the studies for this patient.
Patient ID	(0010,0020)	1	Displayed to help the user identify the patient folder in which to place the studies for this patient.

Study Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008,0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details.
Study Date	(0008,0020)	1	Used in displaying list of studies to user
Study Time	(0008,0030)	1	Used in displaying list of studies to user
Accession Number	(0008,0050)	2	Stored in the system database
Study Description	(0008,1030)	2	Generated
Study Instance UID	(0020,000D)	1C	Stored in the system database
Study ID	(0020,0010)	1	Stored in the system database

Series Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008,0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details.
Modality	(0008,0060)	1	Only US is supported. Other modalities are ignored.
Series Instance UID	(0020,000E)	1	Stored
Series Description	(0008,103E)	3	Stored
Series Number	(0020,0011)	1	Stored

Image Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008,0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details.
Instance Number	(0020,0013)	1	Used
Referenced File ID	(0004,1500)	1C	Used
Referenced SOP Class UID in File	(0004,1510)	1C	Used
Referenced SOP UID in File	(0004,1511)	1C	Used
Referenced Transfer Syntax UID in File	(0004,1512)	1C	Used
Content Date	(0008,0023)	3	Used for ordering the thumbnail display. On Export, comes from the image.
Content Time	(0008,0033)	3	Used for ordering the thumbnail display. On Export, comes from the image.

SR Document Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008,0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details.
Instance Number	(0020,0013)	1	Used
Referenced File ID	(0004,1500)	1C	Used
Referenced SOP Class UID in File	(0004,1510)	1C	Used
Referenced SOP UID in File	(0004,1511)	1C	Used
Referenced Transfer Syntax UID in File	(0004,1512)	1C	Used
Content Date	(0008,0023)	3	Used for ordering the thumbnail display. On Export, comes from the image.
Content Time	(0008,0033)	3	Used for ordering the thumbnail display. On Export, comes from the image.
Concept Name Code Sequence	(0040,A043)	1	Code describing the concept represented by the root Content Item (Document Title).
>Code Value	(0008,0100)		Used to identify SR Template value
>Coding Scheme Designator	(0008,0102)		DCM
>Code Meaning	(0008,0104)		Name of the SR template
Completion Flag	(0040,A491)		"PARTIAL"
Verificaiton Flag	(0040,A493)		"UNVERIFIED"

Presentation State Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008,0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details.
Instance Number	(0020,0013)	1	Used
Referenced File ID	(0004,1500)	1C	Used
Referenced SOP Class UID in File	(0004,1510)	1C	Used
Referenced SOP Instance UID in File	(0004,1511)	1C	Used
Referenced Transfer Syntax UID in File	(0004,1512)	1C	Used
SOP Class UID	(0008,0016)	1	Used
SOP Instance UID	(0008,0018)	1	Used
Content Date	(0008,0023)	3	Used
Content Time	(0008,0033)	3	Used

6 SUPPORT OF CHARACTER SETS

All CX50 4.0.X DICOM applications support the

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

CX50 4.0.X will offer support for Chinese and Russian. This includes translating system text into these languages and allowing the user to input Chinese and Cyrillic characters into the system. One important aspect of this is that the user will be able to enter these special characters into the Patient ID screen.

The present DICOM standard allows Code Extension Techniques for multi-byte characters. Therefore, as well as the default character set (ISO-IR 6), CX50 4.0.X supports the following extended character sets:

ISO-IR 100	Latin Alphabet No. 1
ISO-IR 144	Russian Cyrillic

Important Note:

When an Application Entity which, does not support Code Extension Techniques, receives a Data Set, which includes multi-byte characters from a CX50 4.0.X system, misrepresentation of characters may occur.

The DICOM standard states that it is the responsibility of the Application Entity, which receives the Data Sets to take whatever action is considered necessary to minimize the effect of misrepresented characters. It is not the responsibility of the CX50 4.0.X system to take such action.

6.1 SUPPORT FOR RUSSIAN MARKETS

CX50 4.0.X uses "Code-extension techniques" to encode Russian Cyrillic characters in DICOM tags with value representations of SH, LO, ST, LT, UT, and PN.

The technique requires two things in a DICOM file that contains these characters:

1. Add the Optional Specific Character Set tag (0008,0005) and set the value to the list of identifiers for all the non-standard character sets that will appear in any string in the file separated by backslashes. For example:

For Russian systems:

(0008,0005) = "ISO 2022 IR 144\ISO 2022 IR 100"

For English systems:

(0008,0005) = "ISO 2022 IR 100"

2. Embed escape sequences in the strings that contain Cyrillic characters to cause the DICOM interpreting code to switch from one character set to another.

The escape sequences to be used are defined as:

"<ESC>(B" ISO - IR 6 ASCII - DICOM default character set

"<ESC>(J" ISO - IR 144 Russian Cyrillic

6.2 SUPPORT FOR CHINESE MARKETS

CX50 4.0.X does not support Chinese character sets. CX50 4.0.X however provides support for Chinese customers so that they can enter text using Chinese characters.

If the system is set up for Chinese, then the user can enter one version of the patient name. This would make Chinese systems work in the same way as Russian, English, French, Italian, and Spanish systems. The Chinese user will be able to enter the patient name using a combination of Chinese and Roman characters – all of the characters will appear wherever the system displays the patient name (image, report, Search for Study window, etc.).

All Chinese characters entered into the Patient ID screen will be lost if a user exports or backs up a study to media. This will be noticed when the study is imported back into the system; upon import, each Chinese character will be replaced with a question mark (“?”) character. The question marks will make it obvious to the user that the characters were lost.

If the user enters a patient name that consists entirely of Chinese characters, then the name will display as “??????”. In this case, the user will have to identify the study in the “Import Study” and “Search for Study” windows by the MRN. If the user enters a patient name that consists of a combination of Roman and Chinese characters, then Roman characters will be preserved, and the name will come back as something like “Lee ????????”. This will give users who like to back up their studies the flexibility of entering a patient name with a combination of Roman and Chinese characters, and have at least part of the name come back during import.

Note that the original Chinese name will be “burned into” study images that are exported to media. These Chinese characters will remain on the images when the studies are imported back into the system.

7 SECURITY

7.1 GENERAL SECURITY

CX50 4.0.X incorporates an internal firewall that only accepts incoming traffic on the designated listening port, as configured in the “This System” tab of the DICOM setups screen. Changes to this port value require a power cycle to become effective.

7.2 SUPPORTED DICOM SECURITY PROFILES

7.2.1 TLS Secure Transport Connection Profiles

Basic TLS Secure Transport Connection Profile and the AES TLS Secure Transport Connection Profile are supported using Transport Layer Security Version 1.2 protocol with the following features:

Supported TLS Feature	Mechanism
Entity Authentication	RSA based certificates
Exchange of Master Secrets	RSA
Data Integrity	SHA
Privacy (Cyphersuite Options)	TLS_RSA_WITH_AES_128_CBC_SHA (preferred) TLS_RSA_WITH_3DES_EDE_CBC_SHA

TLS authentication may be used with or without TLS encryption – default is with TLS encryption.

For outgoing TLS requests where CX50 4.0.X acts as a TLS Client, the received server RSA certificate is validated by verifying its digital signature against a certificate in the local Trusted Certificate Authorities store whose Subject matches the Issuer of the received certificate. If requested by the TLS Server, CX50 4.0.X will then send the certificate configured for “This System” from the local Personal store.

For incoming TLS connection requests where CX50 4.0.X acts as a TLS Server, the certificate configured for “This System” is sent from the Personal store to the client as specified in the TLS protocol. CX50 4.0.X always requests a client certificate from the TLS Client.

Certificates are locally managed. The site administrator may import certificates from media to the Trusted Certificate Authority store for verifying incoming certificates; these may be either CA certificates or self-signed end-entity certificates. The site administrator may also import certificates from media to the Personal store along with the certificates private key for certificates representing ‘This System’. A wide variety of certificate file formats are supported, including:

- Base 64 Text: PEM format (.pem, .crt), usually unencrypted but may be encrypted. If encrypted, the encryption password must be provided when importing.
- ASN.1 Binary: BER, DER, CER formats (.der, .cer, .crt)
- PKCS#12: Encrypted Container for certificates with private keys (.pfx, .p12). This format is used primarily for the “This System” certificate with corresponding private key. The encryption password must be provided when importing.
- PKCS#7: Container for multiple certificates. If there is only one certificate in the container, then the certificate is saved to the user-specified store name. If there are multiple certificates in the container, then

the Issuer and Subject names of each certificate are compared; if the names are the same, the certificate is stored in the Trusted Certificate Authority store, else in the Intermediate Certificate Authority store.

The site administrator may also remove previously-imported certificates.

The incoming TCP port defaults to port 2762 when TLS security is enabled; this port may be changed by the user if desired.

8 ANNEXES

8.1 CREATED IOD INSTANCES

Table 69 specifies the attributes of an Ultrasound Image transmitted by the CX50 4.0.X storage application.

Table 70 specifies the attributes of a Comprehensive Structured Reports transmitted by the CX50 4.0.X storage application. Please note that there are differences between which Structured Report Templates are used in each product.

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 Unless otherwise noted, values returned from worklist may be overridden by User input.
USER	the attribute value source is from User input
AUTO	the attribute value is generated automatically
MPPS	the attribute value is the same as the Modality Performed Procedure Step service
CONFIG	the attribute value source is a configurable parameter

8.1.1 US or US Multiframe Image IOD

Table 69
IOD OF CREATED US OR US MULTIFRAME SOP INSTANCES

IE	Module	Reference	Presence of Module
Patient	Patient	Table 72	ALWAYS
Study	General Study	Table 73	ALWAYS
	Patient Study	Table 74	ALWAYS
Series	General Series	Table 75	ALWAYS
Equipment	General Equipment	Table 76	ALWAYS
Image	General Image	Table 77	ALWAYS
	Image Pixel	Table 78	ALWAYS
	Palette Color Lookup Table	Table 78-a	ANAP
	Cine	Table 79	Only if Multi-frame

IE	Module	Reference	Presence of Module
	Multi-frame	Table 80	Only if Multi-frame
	US Region Calibration	Table 81	ANAP
	US Image	Table 82	ALWAYS
	VOI LUT	Table 83	ANAP
	SOP Common	Table 84	ALWAYS

8.1.2 Comprehensive Structured Report IOD

Table 70
IOD OF CREATED COMPREHENSIVE STRUCTURED REPORT SOP INSTANCES

IE	Module	Reference	Presence of Module
Patient	Patient	Table 72	ALWAYS
Study	General Study	Table 73	ALWAYS
	Patient Study	Table 74	ALWAYS
Series	SR Document Series	Table 85	ALWAYS
Equipment	General Equipment	Table 76	ALWAYS
Document	SR Document General	Table 86	ALWAYS
	SR Document Content	Table 87	ALWAYS
	SOP Common	Table 88	ALWAYS

8.1.3 Cardiac 3D Presentation State Object IOD

Table 71
IOD OF CARDIAC 3D PRESENTATION STATE OBJECT SOP INSTANCES

IE	Module	Reference	Presence of Module
Patient	Patient	Table 72	ALWAYS
Study	General Study	Table 73	ALWAYS
	Patient Study	Table 74	ALWAYS
Series	Presentation State Series	Table 89	ALWAYS
Equipment	General Equipment	Table 76	ALWAYS

Presentation State	Presentation State Relationship	Table 90	ALWAYS
	SOP Common	Table 91	ALWAYS

8.1.4 Common Modules

**Table 72
PATIENT MODULE OF CREATED SOP INSTANCES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Name	(0010,0010)	PN	Same attribute of MWL or PDE input	ALWAYS	MWL/ USER/ AUTO
Patient ID	(0010,0020)	LO	From MWL, user input or system generated.	ALWAYS	MWL/ USER/ AUTO
Patient's Birth Date	(0010,0030)	DA	Same attribute of MWL or PDE input	VNAP	MWL/ USER
Patient's Sex	(0010,0040)	CS	Same attribute of MWL or PDE input User Input may be: M = male F = female O = other If "Unknown", an empty string is sent.	VNAP	MWL/ USER
Other Patient IDs	(0010,1000)	LO	Same attribute of MWL or PDE input to Alternate ID number.	ANAP	MWL/ USER

**Table 73
GENERAL STUDY MODULE OF CREATED SOP INSTANCES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Study Instance UID	(0020,000D)	UI	Same value as in MWL or auto generated If non-Worklist, format is: 1.3.46.670589.14.<model>.400.4.<serno>.<datetime>.<n> <model> is 1000 for CX50 4.0.X. <serno> is system serial number <datetime> is date time when the uid was requested in yyyyymmddhhmmss format <n> is the nth image generated at the <datetime>th second	ALWAYS	MWL/ AUTO
Study Date	(0008,0020)	DA	Study's Start Date (0040,0244).	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Study Time	(0008,0030)	TM	Study's Start Time (0040,0245).	ALWAYS	AUTO
Referring Physician's Name	(0008,0090)	PN	User Input from Patient ID screen. From MWL, only Last, First and Middle names sent as "Last, First, Middle" in the Last name field.	VNAP	MWL/USER
Study ID	(0020,0010)	SH	Auto-generated starting at 1	ALWAYS	AUTO
Accession Number	(0008,0050)	SH	Same attribute of MWL or user PDE input.	VNAP	MWL/USER
Study Description	(0008,1030)	LO	'Study Description' in PDE or, Configurable by the user through setup. Can either be a fixed list or (for users with a MWL server), can be obtained from the MWL Server. The string used will be the first non-empty string from the following list: Requested Procedure description tag (0032,1060), Scheduled Procedure Step description tag (0040,0007) Scheduled Procedure Step, "Code Meaning" tag (0008,0104) Reason for the requested procedure tag (0040,1002) Reason for imaging service request tag (0040,2001)	ANAP	MWL/USER

**Table 74
PATIENT STUDY MODULE OF CREATED SOP INSTANCES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient Size	(0010,1020)	DS	Same value as MWL attribute or PDE input.	ANAP	MWL/USER
Patient's Weight	(0010,1030)	DS	Same value as MWL attribute or PDE input.	ANAP	MWL/USER
Additional Patient's History	(0010,21B0)	LT	Only from User Input	ANAP	USER

**Table 75
GENERAL SERIES MODULE OF CREATED IMAGE SOP INSTANCES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	"US"	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Series Instance UID	(0020,000E)	UI	A system generated Unique Identifier of the form: 1.3.46.670589.14.<model>.400.3.<serno>.<datetime>.<n> <model> is 1000 for CX50 4.0.X. <serno> is system serial number <datetime> is date time when the uid was requested in yyyymmddhhmmss format <n> is the nth image generated at the <datetime>th second Note: If a study is reopened, a new SeriesInstUID would be generated and all newly acquired images would be part of the new series. Also the MPPS messages (if applicable) that would be sent when the study is restarted would contain the newly generated SeriesInstUID.	ALWAYS	AUTO
Series Number	(0020,0011)	IS	Always 1 for images	ALWAYS	AUTO
Performing Physician's Name	(0008,1050)	PN	PDE input, 'Performed by'.	ANAP	USER
Protocol Name	(0018,1030)	LO	"Free Form" "Exercise 2 Stage" "Exercise 3 Stage" "Pharmacological 4 Stage" user defined	ANAP	AUTO
Series Description	(0008,103E)	LO	User entry in the 'Study Description' field of the Patient ID screen. If the user does not enter a value, this tag is not sent.	ANAP	MWL/ USER
Operator's Name	(0008,1070)	PN	User entry in the 'Performed by' field of the Patient ID screen. If the user does not enter a value, this tag is not sent.	ANAP	MWL/ USER
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ	Identifies the MPPS SOP Instance this image is related to * Will be present when an MPPS Server is configured.	ANAP*	AUTO
>Referenced SOP Class UID	(0008,1150)	UI	PPS SOP Class = "1.2.840.10008.3.1.2.3.3" * Will be present when an MPPS Server is configured.	ANAP*	AUTO
>Referenced SOP Instance UID	(0008,1155)	UI	PPS Instance UID of the PPS generating this image * Will be present when an MPPS Server is configured.	ANAP*	AUTO
Request Attributes Sequence	(0040,0275)	SQ	This sequence will be present only for scheduled study. In case of unscheduled study, this sequence will not be present. This sequence will not be present if attributes 'Requested Procedure ID' and/or 'Scheduled Procedure Step ID' is/are missing.	ANAP	AUTO / MWL

Attribute Name	Tag	VR	Value	Presence of Value	Source
>Requested Procedure ID	(0040,1001)	SH	Auto-generated=Study ID or value from MWL. One item.	ANAP	AUTO / MWL
>Requested Procedure Description	0032,1060	LO	Set with the value entered or selected in "Study Description" field of Patient ID screen. If the study is started from MWL, the "Study Description" field of Patient ID screen is populated from 'Requested Procedure Description' attribute of MWL. (1st choice, configurable)	ANAP	USER/ MWL
>Scheduled Procedure Step ID	(0040,0009)	SH	Auto-generated=Study ID or value from MWL. One item.	ANAP	AUTO / MWL
>Scheduled Procedure Step Description	(0040,0007)	LO	Same value as MWL attribute.	ANAP	MWL
>Scheduled Protocol Code Sequence	(0040,0008)	SQ	Same value as MWL attribute.	ANAP	MWL
Performed Procedure Step ID	(0040,0253)	SH	Set as current date and time in the format yyyyymmdd.hhmmss.	ANAP	AUTO
Performed Procedure Step Start Date	(0040,0244)	DA	Date on which the Performed Procedure Step started on close of Patient Data Entry Screen	ANAP	AUTO
Performed Procedure Step Start Time	(0040,0245)	TM	Time on which the Performed Procedure Step started on close of Patient Data Entry Screen	ANAP	AUTO
Performed Procedure Step Description	(0040,0254)	LO	Set with the value entered or selected in 'Study Description' field of Patient ID screen. If the study is started from MWL, the "Study Description" field of Patient ID screen is populated from 'Requested Procedure Description' attribute of MWL. (1st choice, configurable).	ANAP	USER / MWL
Performed Protocol Code Sequence	(0040,0260)	SQ	Zero length, or mapped from MWL Scheduled Protocol Code Sq (0040,0008)	ANAP	MWL

**Table 76
GENERAL EQUIPMENT MODULE OF CREATED SOP INSTANCES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Manufacturer	(0008,0070)	LO	Philips Medical Systems	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Institution Name	(0008,0080)	LO	Entered by the user from the 'System' tab in the 'Setup' screen ('Top Border' button).Note: If the user imports an EnVisor or CX50 4.0.X study that was generated at another institution and opens the study the institution name displayed along the top border of the system screen is the institution viewing the images not the institution where the image was acquired. The institution name where the image was acquired can however be burned into the image. Also, if the user exports the study to removable media or to a networked PACS and changes the format of the image data in some way either by exporting it in a different image format from the internal format (Palette Color, RLE) or by applying a display compensation curve, then the institution name is changed to the current institution. 'Philips Healthcare' default.	VNAP	CONFIG
Station Name	(0008,1010)	SH	The AE Title of CX50 4.0.X system on which the image is acquired. The user can configure the AE Title of the system through 'Setup'.	VNAP	CONFIG
Software Version(s)	(0018,1020)	LO	This is a multi-valued tag which contains the following components: Model Name CX50_4.0 Then the part number and version of PRINTERS Ultrasound Application DRIVERS Operating System Service pack and patch version information if applicable	ALWAYS	AUTO
Manufacturer's Model Name	(0008,1090)	LO	CX50	ALWAYS	AUTO

8.1.5 US or Multiframe Image Modules

Table 77
GENERAL IMAGE MODULE OF CREATED US SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Instance Number	(0020,0013)	IS	Generated by device, increments from “1” in each series. Gaps in values may exist if images are deleted on the system prior to export.	ALWAYS	AUTO
Patient Orientation	(0020,0020)	CS	The system sends the tag empty	VNAP	AUTO
Content Date	(0008,0023)	DA	<yyyymmdd>	ALWAYS	AUTO
Content Time	(0008,0033)	TM	<hhmmss>	ALWAYS	AUTO
Image Type	(0008,0008)	CS	<p>The system computes this value as the four component multi-value attribute: “<Pixel Data Characteristics> / <Patient Examination Characteristics> / <Modality Specific Characteristics> / <Implementation Specific Identifiers>”</p> <p><Pixel Data Characteristics> Palette Color & RGB: “ORIGINAL” denotes original source-data YBR: “DERIVED” denotes pixels that have been derived from the original – in this case by lossy compression. MONOCHROME2: “DERIVED” denotes pixels that have been derived from the original – in this case by grayscale transformations. <Patient Examination Characteristics> Always “PRIMARY” <Modality Specific Characteristics> This is based on the user-selected entry in the drop down list ‘Additional Data Type’ on the Patient Id screen. It is mapped to the most appropriate value from the DICOM standard (Ex: “ABDOMINAL”). <Implementation Specific Identifiers>” Always blank.</p>	ALWAYS	CONFIG
Acquisition Date	(0008,0022)	DT	The system uses the same value as the Content Date, tag (0008,0023).	ALWAYS	AUTO
Acquisition Time	(0008,0032)	TM	The system uses the same value as the Content time, tag (0008,0033).	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Acquisition Datetime	(0008,002A)	DT	The system generates this as a combination of Acquisition Date and Acquisition Time. The format is yyyyymmddhhmmss.ffffff	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	CS	"01" if image is lossy compressed, "00" if not.	ALWAYS	AUTO
Image Comments	(0020,4000)	LT	Not used with images. For reports, contains: "Report Version x Page x of x"	ANAP	AUTO
Presentation LUT Shape	(2050,0020)	CS	"IDENTITY". Only if "Image Export Format" is GSDF.	ANAP	AUTO

**Table 78
IMAGE PIXEL MODULE OF CREATED US OR US MULTIFRAME SOP INSTANCES**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Samples per Pixel	(0028,0002)	US	1 for MONOCHROME2 1 for PALETTE COLOR 3 for RGB 3 for YBR_FULL_422	ALWAYS	CONFIG
Photometric Interpretation	(0028,0004)	CS	MONOCHROME2 PALETTE COLOR RGB YBR_FULL_422	ALWAYS	CONFIG
Rows	(0028,0010)	US	2D B/W & Color stills/loops, acquired with top & right border: 600 2D B/W & Color quad-sized loops from stress: 300 Reports: 600	ALWAYS	CONFIG
Columns	(0028,0011)	US	2D B/W & Color stills/loops, acquired with top & right border: 800 2D B/W & Color quad-sized loops from stress: 336 Reports: 800	ALWAYS	CONFIG
Bits Allocated	(0028,0100)	US	Based on the 'Image Format' that is set by the user in DICOM Setup. Palette Color Mode: 2D B&W: 8 bits 2D Color & Reports: 16 bits RGB Mode: 2D B&W,: 8 bits 2D Color & Reports : 8 bits YBR_FULL_422 Mode:	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
			2D B&W: 8 bits 2D Color & Reports: 8 bits MONOCHROME2 Mode: 8 bits		
Bits Stored	(0028,0101)	US	Always the same numbers as Bits Allocated.	ALWAYS	AUTO
High Bit	(0028,0102)	US	The High Bit is always (Bits Allocated -1).	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	"0" pixels are Unsigned integers	ALWAYS	AUTO
Pixel Data	(7FE0,0010)	OW / OB		ALWAYS	AUTO
Planar Configuration	(0028,0006)	US	Palette Color Images: Not present RGB Images: Zero (color-by-pixel) YBR: Images: Always zero (color-by-pixel) MONOCHROME2 Images: Not present	ANAP	AUTO
Red Palette Color Lookup Table Descriptor	(0028,1101)	IC	See Table 78-a.	ANAP	CONFIG
Green Palette Color Lookup Table Descriptor	(0028,1102)	IC	See Table 78-a.	ANAP	CONFIG
Blue Palette Color Lookup Table Descriptor	(0028,1103)	IC	See Table 78-a.	ANAP	CONFIG
Red Palette Color Lookup Table Data	(0028,1201)	IC	See Table 78-a.	ANAP	CONFIG
Green Palette Color Lookup Table Data	(0028,1202)	IC	See Table 78-a.	ANAP	CONFIG
Blue Palette Color Lookup Table Data	(0028,1203)	IC	See Table 78-a.	ANAP	CONFIG

**Table 78-a
PALETTE COLOR LOOKUP TABLE MODULE**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Red Palette Color Lookup Table Descriptor	(0028,1101)	US	Used only for 2D and REPORT acquired as image. B&W stills & loops: 256, 0, 16 Color stills & loops: 0, 0, 16 REPORT (acquired as image): xx, 0, 16 where 'xx' is a variable value.	VNAP	CONFIG

Attribute Name	Tag	VR	Value	Presence of Value	Source
Green Palette Color Lookup Table Descriptor	(0028,1102)	US	Used only for 2D and REPORT acquired as image. B&W stills & loops: 256, 0, 16 Color stills & loops: 0, 0, 16 REPORT (acquired as image): xx, 0, 16 where 'xx' is a variable value.	VNAP	CONFIG
Blue Palette Color Lookup Table Descriptor	(0028,1103)	US	Used only for 2D and REPORT acquired as image. B&W stills & loops: 256, 0, 16 Color stills & loops: 0, 0, 16 REPORT (acquired as image): xx, 0, 16 where 'xx' is a variable value.	VNAP	CONFIG
Red Palette Color Lookup Table Data	(0028,1201)	OW	Used only for 2D and REPORT acquired as image.	ANAP	CONFIG
Green Palette Color Lookup Table Data	(0028,1202)	OW	Used only for 2D and REPORT acquired as image.	ANAP	CONFIG
Blue Palette Color Lookup Table Data	(0028,1203)	OW	Used only for 2D and REPORT acquired as image.	ANAP	CONFIG

**Table 79
CINE MODULE OF CREATED US MULTIFRAME SOP**

Attribute Name	Tag	VR	Value	Presence of Value	Source
Recommended Display Frame Rate	(0008,2144)	IS	Used for Multiframe	ANAP	AUTO
Cine Rate	(0018,0040)	IS	Used for Multiframe	ANAP	AUTO
Effective Series Duration	(0018,0072)	DS	Used for Multiframe	ANAP	AUTO
Frame Time	(0018,1063)	DS	Nominal time (in msec) per individual frame. Present if Frame Increment Pointer (0028,0009) points to Frame Time. Note: If you export a study to removable media using Average Frame Time, on import back into the system only the images up to but not including the loop will be imported. However the study on media is fine and can be imported onto a PACS without any problems.	ANAP	CONFIG
Frame Time Vector	(0018,1065)	DS	An array that contains the real time increments (in msec) between frames for a Multi-frame image. Present if Frame Increment Pointer (0028,0009) points to Frame Time Vector.	ANAP	CONFIG

Table 80
MULTI-FRAME MODULE OF CREATED US MULTIFRAME SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Number of Frames	(0028,0008)	IS	# of frames in object	ANAP	AUTO
Frame Increment Pointer	(0028,0009)	AT	Configurable by the user in DICOM Setup. If the user selects a loop timing preference where each frame in a loop has the same duration then Frame Increment Pointer takes the value 0018,1063 (Frame Time). If the user selects a loop timing preference where each frame in a loop has the different duration then Frame Increment Pointer takes the value 0018,1065 (Frame Time Vector).	ANAP	CONFIG

Table 81
US REGION CALIBRATION MODULE OF CREATED US IMAGE OR US MULTIFRAME IMAGE SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Sequence of Ultrasound Regions	(0018,6011)	SQ	A sequence is present for each region on the system display	ANAP	AUTO
>Region Location Min x ₀	(0018,6018)	UL	Top Left position of region.	ALWAYS	AUTO
>Region Location Min y ₀	(0018,601A)	UL	Top Left position of region	ALWAYS	AUTO
>Region Location Max x ₁	(0018,601C)	UL	Bottom Right position of region	ALWAYS	AUTO
>Region Location Max y ₁	(0018,601E)	UL	Bottom Right position of region	ALWAYS	AUTO
>Physical Units X Direction	(0018,6024)	US	Enumerated Value. 2D Image = 0003H = CM MMode / Doppler = 0004H = SEC	ALWAYS	AUTO
>Physical Units Y Direction	(0018,6026)	US	Enumerated Value. ECG Region = 0000H = None 2D Image = 0003H = CM MMode = 0003H = CM Doppler = 0007H = CM / SEC	ALWAYS	AUTO
>Physical Delta X	(0018,602C)	FD	The physical value per pixel increment	ALWAYS	AUTO
>Physical Delta Y	(0018,602E)	FD	The physical value per pixel increment	ALWAYS	AUTO
>Reference Pixel X ₀	(0018,6020)	SL	The X pixel value of baseline	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
>Reference Pixel Y0	(0018,6022)	SL	The Y pixel value of baseline	ALWAYS	AUTO
>Reference Pixel Physical Value X	(0018,6028)	FD	For each region, the X coordinate of the reference point for measurements within that region.	ALWAYS	AUTO
>Reference Pixel Physical Value Y	(0018,602A)	FD	For each region, the Y coordinate of the reference point for measurements within that region.	ALWAYS	AUTO
>Region Spatial Format	(0018,6012)	US	Enumerated Value. 2D (tissue or flow) = 0001H MMode (tissue or flow) = 0002H Spectral (CW or PW Doppler) = 0003H ECG (waveform) = 0004H	ALWAYS	AUTO
>Region Data Type	(0018,6014)	US	Enumerated Value. Tissue = 0001H PW Spectral Doppler = 0003H CW Spectral Doppler = 0004H ECG (waveform) = 000AH	ALWAYS	AUTO
>Region Flags	(0018,6016)	UL	Always set to 3.	ALWAYS	AUTO

Table 82
US IMAGE MODULE OF CREATED US IMAGE OR US MULTIFRAME IMAGE SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Samples Per Pixel	(0028,0002)	US	See 'Image Pixel Module'	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	See 'Image Pixel Module'	ALWAYS	CONFIG
Bits Allocated	(0028,0100)	US	See 'Image Pixel Module'	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	See 'Image Pixel Module'	ALWAYS	AUTO
High Bit	(0028,0102)	US	See 'Image Pixel Module'	ALWAYS	AUTO
Planar Configuration	(0028,0006)	US	See 'Image Pixel Module'	ANAP	AUTO
Pixel Representation	(0028,0103)	US	"0" Pixels are Unsigned integers	ALWAYS	AUTO
Frame Increment Pointer	(0028,0009)	AT	(0018,1063) "Frame Time" or (0018,1065) "Frame Time Vector"	ANAP	CONFIG
Image Type	(0008,0008)	CS	See 'General Image Module'	ALWAYS	CONFIG
Lossy Image Compression	(0028,2110)	CS	"01" if image is lossy compressed, "00" if not.	ALWAYS	AUTO
Ultrasound Color	(0028,0014)	US	0 or 1	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Data Present					
Acquisition Datetime	(0008,002A)	DT	The date and time that the acquisition of data that resulted in this image started.	ALWAYS	AUTO
Transducer Data	(0018,5010)	LO	Transducer name. VM = 3, the last two fields are written as "UNUSED".	ALWAYS	AUTO
Transducer Type	(0018,6031)	LO	SECTOR_PHASED, LINEAR, CURVED LINEAR Only used for 2D images; not used for Doppler-only images (i.e. pencil probes)	ANAP	AUTO
Processing Function	(0018,5020)	LO	The factory-defined exam/preset that was active when the image was acquired even if a user-defined preset.	ALWAYS	AUTO

Table 83
VOI LUT MODULE OF CREATED US SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Window Center	(0028,1050)	DS	2^{n-1} where n is the number of bits per pixel n = 8 Center = 128 n = 16 Center = 32768 Value only meaningful with MONOCHROME2.	ANAP	AUTO
Window Width	(0028,1051)	DS	2^n where n is the number of bits per pixel n = 8 Width = 256 n = 16 Width = 65336 Value only meaningful with MONOCHROME2.	ANAP	AUTO

Table 84
SOP COMMON MODULE OF CREATED US IMAGE OR US MULTIFRAME IMAGE SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	UI	1.2.840.10008.5.1.4.1.1.6.1 for US Image 1.2.840.10008.5.1.4.1.1.3.1 for US Multiframe Image	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	UI	Generated by device in the format: 1.3.46.670589.14.1000.400.2.xxxxxx.yyyymmddhhmmss.v where 2 indicates a SOP Instance UID, x indicates the system serial number, then date and time and v is a counter of the instances.	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
Specific Character Set	(0008,0005)	CS	<p>The attribute contains all the character sets used (this is a multi-value attribute). See Section 6 for more information on the character sets that this system uses.</p> <p>ISO_IR 100 and possibly more.</p> <p>The most likely scenario that would require a non Basic Character set would be when the system has been set to a locale that uses non Basic characters (e.g. Russia) AND the user has entered one of these characters into the Patient Identification screen,</p>	ALWAYS	AUTO

8.1.6 Comprehensive Structured Report Modules

Table 85
SR DOCUMENT SERIES MODULE OF CREATED COMPREHENSIVE SR SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	"SR"	ALWAYS	AUTO
Series Instance UID	(0020,000E)	UI	Auto-generated	ALWAYS	AUTO
Series Number	(0020,0011)	IS	A number unique within the Study starting with 2.	ALWAYS	AUTO
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ	Identifies the MPPS SOP Instance to which this image is related	ANAP	MPPS
>Referenced SOP Class UID	(0008,1150)	UI	PPS SOP Class = "1.2.840.10008.3.1.2.3.3"	ANAP	MPPS
> Referenced SOP Instance UID	(0008,1155)	UI	PPS Instance UID of the PPS generating this document	ANAP	MPPS

Table 86
SR DOCUMENT GENERAL MODULE OF CREATED COMPREHENSIVE SR SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Instance Number	(0020,0013)	IS	Unique number starting with "0" zero.	ALWAYS	AUTO
Completion Flag	(0040,A491)	CS	PARTIAL	ALWAYS	AUTO
Verification Flag	(0040,A493)	CS	UNVERIFIED	ALWAYS	AUTO
Content Date	(0008,0023)	DA	Date content created.	ALWAYS	AUTO
Content Time	(0008,0033)	TM	Time content created.	ALWAYS	AUTO
Referenced Request Sequence	(0040,A370)	SQ	Identifies Requested Procedures being fulfilled (completely or partially) by creation of this Document. Null string if unscheduled.	VNAP	AUTO
>Study Instance UID	(0020,000D)	UI	Same value as in MWL or auto generated	ALWAYS	MWL/ AUTO
>Referenced Study Sequence	(0008,1110)	SQ	1 item per item in MWL, absent if unscheduled	ANAP	MWL
>>Referenced SOP Class UID	(0008,1150)	UI	Identifies the Referenced SOP Class	ANAP	MWL
>>Referenced SOP Instance UID	(0008,1155)	UI	Instance UID	ANAP	MWL
>Accession Number	(0008,0050)	SH	Same attribute of MWL or user PDE input.	VNAP	MWL/ USER

Attribute Name	Tag	VR	Value	Presence of Value	Source
>Placer Order Number/Imaging Service Request	(0040,2016)	LO	Order Number of Imaging Service Request assigned by placer	VNAP	MWL
>Filler Order Number/Imaging Service Request	(0040,2017)	LO	Order Number of Imaging Service Request assigned by filler	VNAP	MWL
>Requested Procedure ID	(0040,1001)	SH	1 item per item in MWL, absent if unscheduled	ANAP	MWL
>Requested Procedure Description	(0032,1060)	LO	1 item per item in MWL, absent if unscheduled	ANAP	MWL
>Requested Procedure Code Sequence	(0032,1064)	SQ	1 item per item in MWL, absent if unscheduled	ANAP	MWL

Table 87

SR DOCUMENT CONTENT MODULE OF CREATED COMPREHENSIVE SR SOP INSTANCES

This table describes the template-specific data summarized from the following tables in the DICOM Standard: Document Content Macro, Document Relationship Macro, Numeric Measurement Macro and Code Macro

Attribute Name	Tag	VR	Value	Presence of Value	Source
Content Template Sequence	(0040,A504)	SQ		ALWAYS	AUTO
>Template Identifier	(0040,DB00)	CS	The Root Content Item identifies TID 5000 (OB-GYN) 5100 (Vascular) 5200 (Adult Echo) 5220 (Ped Echo)	ALWAYS	AUTO
>Mapping Resource	(0008,0105)	CS	DCMR	ALWAYS	AUTO
Content Sequence	(0040,A730)	SQ		ALWAYS	AUTO
>Relationship Type	(0040,A010)	CS	<i>See Appendix A.2 DICOM Structured Report Export Specifications</i>	ALWAYS	AUTO
<i>Document Relationship Macro Table</i>			<i>See Appendix A.2 DICOM Structured Report Export Specifications</i>	ANAP	AUTO
<i>Document Content Macro</i>			<i>See Appendix A.2 DICOM Structured Report Export Specifications</i>	ALWAYS	AUTO
Value Type	(0040,A040)	CS	CONTAINER, always first tag of SR	ALWAYS	AUTO
Concept Name Code Sequence	(0040,A043)	SQ		ALWAYS	AUTO
>Code Value	(0008,0100)		125000 for OB-GYN 125100 for Vascular 125200 for Adult Echo 125195 for Ped Echo	ALWAYS	AUTO

Attribute Name	Tag	VR	Value	Presence of Value	Source
>Coding Scheme Designator	(0008,0102)		DCM	ALWAYS	AUTO
>Code Meaning	(0008,0104)		“OB-GYN Procedure Report” “Vascular Ultrasound Procedure Report” “Adult Echocardiography Procedure Report” “Pediatric Cardiac Ultrasound Report”	ALWAYS	AUTO
Continuity of Content	(0040,A050)	CS	SEPARATE	ALWAYS	AUTO
<i>Numeric Measurement Macro</i>			<i>See Appendix A.2 DICOM Structured Report Export Specifications</i>	ALWAYS	AUTO
<i>Code Macro</i>			<i>See Appendix A.2 DICOM Structured Report Export Specifications</i>	ALWAYS	AUTO

Table 88
SOP COMMON MODULE OF CREATED COMPOSITE SR SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	UI	1.2.840.10008.5.1.4.1.1.88.33	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	UI	Generated by device	ALWAYS	AUTO
Specific Character Set	(0008,0005)	CS	ISO_IR 100. See Section 6 for details.	ALWAYS	CONFIG

Table 89
PRESENTATION STATE SERIES MODULE OF CREATED PRESENTATION STATE SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	“PR”	ALWAYS	AUTO
Series Instance UID	(0020,000E)	UI	Auto-generated	ALWAYS	AUTO
Series Number	(0020,0011)	IS	Always set to 1.	ALWAYS	AUTO

Table 90
PRESENTATION STATE RELATIONSHIP MODULE OF CREATED PRESENTATION STATE SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
>Referenced Series Sequence	(0008,1115)	SQ	Sequence of Items where each Item includes the Attributes of one Series to which the Presentation applies. One or more Items shall be included in this sequence.	ALWAYS	AUTO
>Referenced Image Sequence	(0008,1140)	SQ	The set of images and frames to which the Presentation State object applies. These shall be of the Study defined by Study Instance UID (0020,000D) and the Series defined by Series Instance UID (0020,000E). One or more Items shall be included in this sequence. The referenced SOP Class shall be the same for all Images in any Item of this Referenced Series Sequence (0008,1115).	ALWAYS	AUTO
>Referenced SOP Class UID	(0008,1150)	UI	Uniquely identifies the referenced SOP Class. SOP Class for US Image: 1.2.840.10008.5.1.4.1.1.6.1 SOP Class for Multiframe Image: 1.2.840.10008.5.1.4.1.1.3.1	ALWAYS	AUTO
> Referenced SOP Instance UID	(0008,1155)	UI	Uniquely identifies the referenced SOP Instance. Generated by device in the format: 1.3.46.670589.14.1000.400.2.xxxxxx.yyyymmddh hmmsss.v where 2 indicates a SOP Instance UID, x indicates the system serial number, then date and time and v is a counter of the instances.	ALWAYS	AUTO

Table 91
SOP COMMON MODULE OF CREATED PRESENTATION STATE SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	UI	1.3.46.670589.2.5.1.1	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	UI	Generated by device	ALWAYS	AUTO
Specific Character Set	(0008,0005)	CS	ISO_IR 100. See Section 6 for details.	ALWAYS	CONFIG

8.2 USED FIELDS IN RECEIVED IOD BY APPLICATION

The CX50 4.0.X storage applications do not receive SOP Instances. The usage of attributes received via MWL is described in section 4.2.2.3.1.3 SOP Specific Conformance for Modality Worklist.

8.3 ATTRIBUTE MAPPING

Table 92 summarizes the relationships between attributes received via MWL, stored in acquired images and communicated via MPPS. The format and conventions used in Table 92 are the same as the corresponding table in DICOM Part 4, Annex M.6

**Table 92
ATTRIBUTE MAPPING BETWEEN MODALITY WORKLIST, IMAGE AND MPPS**

Modality Worklist	Image IOD	MPPS IOD
Patient's Name	Patient's Name	Patient's 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 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 > Study Description > Series Description > Performed 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
----	Study ID – Requested Procedure ID from MWL, else generated	Study ID – Requested Procedure ID from MWL, else generated
----	Performed Procedure Step ID	Performed Procedure Step ID
----	Performed Procedure Step Start Date	Performed Procedure Step Start Date
----	Performed Procedure Step Start Time	Performed Procedure Step Start Time
----	Performed Procedure Step Description	Performed Procedure Step Description

Modality Worklist	Image IOD	MPPS IOD
Requested Procedure Code Sequence	Procedure Code Sequence	Procedure Code Sequence
----	Referenced Performed Procedure Step Sequence	Performed Series Sequence
----	>Referenced SOP Class UID	SOP Class UID
----	>Referenced SOP Instance UID	SOP Instance UID
----	Protocol Name	Protocol Name

8.4 COERCED/MODIFIED FIELDS

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

8.5 CONTROLLED TERMINOLOGY

The Workflow AE is capable of supporting arbitrary coding schemes for Procedure and Protocol Codes. The contents of Requested Procedure Code Sequence (0032,1064) and Scheduled Protocol Code Sequence (0040,0008) supplied in Worklist Items will be mapped to Image IOD and MPPS attributes as described in Table 92.

Structured Reporting uses codes supplied by DCMR (DICOM Code Mapping Resource, PS 3-16), LOINC (Logical Observation Names and Codes), SRT (SNOMED – Systematized Nomenclature of Medicine) and 99PMSBLUS (Philips Private Codes for Ultrasound).

8.6 GRAYSCALE IMAGE CONSISTENCY

The high-resolution display monitor is calibrated according to the Grayscale Standard Display Function (GSDF).

8.7 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

8.7.1 Standard Extended / Specialized / Private SOPs

The US or US Multiframe Image Storage SOP Classes are extended to create a Standard Extended SOP Class by addition of standard and private attributes to the created SOP Instances as documented in section 8.1.

Tag Number	Tag Name	Added to:
(0028,0030)	Pixel Spacing	Images with a single 2D region or dual 2D with same depth See details in Section 8.7.3
(2050,0020)	Presentation LUT Shape	Images when 'GSDF' output format is selected

8.7.2 2D

The Pixel Spacing tag is added to the exported DICOM file when the user has configured this tag to be included and the image contains only one 2D calibration region and no Doppler or M-Mode calibration regions.

Contain the Pixel Spacing tag: 2D still, 2D loop, 2D color still, 2D color loop, MMode Preview Still, PW Preview Still, CW Preview still, Dual with same calibration on both images.

Do NOT contain the Pixel Spacing tag: MMode live trace, MMode frozen trace, PW live trace, PW Frozen trace, CW live trace, CW frozen trace, Reports and dual images with different calibration on each image.

This attribute is system generated, if used.

Attribute Name	Tag	Type	VR	Description	Value
Pixel Spacing	0028,0030	3	DS	Physical distance in the patient between the center of each pixel, specified by a numeric pair adjacent row spacing (delimiter) adjacent column spacing (in mm).	Adjacent row spacing \ Adjacent column spacing (in mm)

8.7.4 PRIVATE TRANSFER SYNTAXES

There are no Private Transfer Syntaxes.

APPENDIX A – Structured Reports

A.1 STRUCTURED REPORTS

Note that all the concepts defined privately by Philips have the CSD value as '99PMSBLUS'.

A.1.1 INTRODUCTION

The Philips CX50 implements DICOM Structured Report Templates TID 5000 (OB-GYN Ultrasound Procedure Report), TID 5100 (Vascular Ultrasound Report), TID 5200 (Echocardiography Procedure Report) and TID 5220 (Pediatric) See section A.2 for the DICOM Structured Report export capabilities.

DICOM PS 3.17 of the DICOM Standard includes tree diagrams showing graphic examples of the structure of each template.

A.1.2 Clinical Scope

The supported measurements are located in Calcs packages accessed with the “Calc” hard key on CX50. Measurements for a given SR section may come from several calcs sidebars.

A.2 DICOM STRUCTURED REPORT EXPORT SPECIFICATIONS

A.2.1 PHILIPS HEALTHCARE ULTRASOUND DATA PORTAL WEBSITE

Rather than list the thousands of DICOM export encodings in this document, the Philips Healthcare Ultrasound Data Portal website (see link below) provides detailed DICOM export specifications for all Philips ultrasound products in a convenient downloadable spreadsheet format. These spreadsheets allow users to quickly filter for specific areas of interests such as application, template, label, or DICOM attribute. In addition to DICOM Structured Report specifications, the link also provides many DICOM Structured Report example files and images for import and display testing.

Welcome to the Philips Healthcare Ultrasound Data Portal.

Select a product of interest:

CX50 ▼

Enter your email address to access:

Submit

To access the Philips Healthcare Ultrasound Data Portal,

- Using a browser, to navigate to the link below.
- Select the ultrasound product of interest.
- Provide an email address and press the submit button.
- Download “Philips_CX50_v4.0_DICOM_SR_Specification.xlsx”

Philip Ultrasound Data Portal Website Link: <http://129.33.58.186/portal/index.asp?pid=us>

***** End of Document *****