

# **AGFA HEALTHCARE DICOM Conformance Statement**

## **→ IMPAX Cardiovascular 7.7 and 7.8**

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## Document Information

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## Conformance Statement Overview

The IMPAX Cardiovascular 7.7 and 7.8 Solutions are comprised of a storage facility, client review workstations and connectivity to DICOM modalities and other healthcare information systems. The IMPAX Cardiovascular 7.7 and 7.8 Solutions are comprised of two application entities (AE), a PACS application entity and a Workstation entity.

The IMPAX Cardiovascular 7.7 and 7.8 Solutions:

- store images sent to it by service class users;
- take responsibility for storage of the images;
- allow image queries based on several standard query models;
- retrieve and transmit requested images;
- display images to a user;
- print images to a printer;
- import and export images from/ to portable interchange media;
- and receive and forward modality performed procedure step information

The IMPAX Cardiovascular 7.7 and 7.8 Solutions conform to the DICOM 3.0 2009 standard.

The IMPAX Cardiovascular 7.7 and 7.8 Solutions provide Standard Conformance to the SOP Classes listed in Table 1.1-1. This table lists the Network Services Supported as they appear in DICOM PS 3.2, Table A.1-2. The shaded items represent SOP classes that have been retired (so no longer appear in DICOM PS 3.2) but are still supported by the IMPAX CV PACS AE.

If the **User of Service (SCU)** or the **Provider of Service (SCP)** column has the value "Option", then the functionality is either configurable or can be purchased as an option. The **Display** column indicates whether or not the graphical user interface will display the DICOM objects. In some cases only storage of the object may be provided by the IMPAX Cardiovascular 7.7 and 7.8 Solutions.

**Table 1.1-1: Network Services Supported**

SOP Class Name	User of Service (SCU)	Provider of Service (SCP)	Display
<b>Transfer</b>			
CT Image Storage	Yes	Yes	Yes
Ultrasound Multi-frame Image Storage (Retired)	Yes	Yes	Yes
Ultrasound Multi-frame Image Storage	Yes	Yes	Yes
MR Image Storage	Yes	Yes	Yes
Nuclear Medicine Image Storage (Retired)	Yes	Yes	Yes
Ultrasound Image Storage (Retired)	Yes	Yes	Yes
Ultrasound Image Storage	Yes	Yes	Yes
Secondary Capture Image Storage	Yes	Yes	Yes
Grayscale Softcopy Presentation State Storage	Yes	Yes	No
X-Ray Angiographic Image Storage	Yes	Yes	Yes
Nuclear Medicine Image Storage	Yes	Yes	Yes
Computed Radiography Image Storage	Yes	Yes	No
Digital Mammography X-Ray Image Storage - For Presentation	Yes	Yes	No
Multi-frame Single Bit Secondary Capture Image Storage	Yes	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	Yes	Yes	Yes

SOP Class Name	User of Service (SCU)	Provider of Service (SCP)	Display
Multi-frame Grayscale Word Secondary Capture Image Storage	Yes	Yes	Yes
Multi-frame True Color Secondary Capture Image Storage	Yes	Yes	Yes
Basic Text SR	Yes	Yes	Yes <sup>1</sup>
Enhanced SR	Yes	Yes	Yes <sup>1</sup>
Comprehensive SR	Yes	Yes	Yes <sup>1</sup>
Procedure Log Storage	Yes	Yes	No
Mammography CAD SR	Yes	Yes	No
Key Object Selection Document	Yes	Yes	No
Chest CAD SR	Yes	Yes	No
Encapsulated PDF Storage	Yes	Yes	No
Toshiba Private Data Storage	Yes	Yes	No
<b>Query/ Retrieve</b>			
Patient Root Query/Retrieve Information Model – FIND	Yes	Yes	N/A
Patient Root Query/Retrieve Information Model – MOVE	Yes	Yes	N/A
Study Root Query/Retrieve Information Model – FIND	Yes	Yes	N/A
Study Root Query/Retrieve Information Model – MOVE	Yes	Yes	N/A
<b>Workflow Management</b>			
Modality Performed Procedure Step SOP Class	Yes	Yes	N/A
Storage Commitment Push Model SOP Class	Yes	Yes	N/A
<b>Print Management</b>			
Basic Film Session SOP Class	Yes	No	N/A
Basic Film Box SOP Class	Yes	No	N/A
Basic Grayscale Print Management Meta SOP Class	Yes	No	N/A
Basic Grayscale Image Box SOP Class	Yes	No	N/A
Basic Color Image Box SOP Class	Yes	No	N/A
Printer SOP Class	Yes	No	N/A
Basic Color Print Management Meta SOP Class	Yes	No	N/A

**Table 1.1-2: Media Services Supported**

Media Storage Application Profile	Write Files (FSC or FSU)	Read Files (FSR)
<b>Compact Disk – Recordable</b>		
General Purpose CD-R Interchange (STD-GEN-CD)	FSC	Yes
Basic Cardiac X-Ray Angiographic Studies on CD-R Media (STD-XABC-CD)	FSC	Yes
1024 X-Ray Angiographic Studies on CD-R Media (STD-XA1K-CD)	FSC	Yes
CT/MR Studies on CD-R (STD-CTMR-CD)	FSC	Yes
Ultrasound Studies on CD (STD-US-CD)	FSC	Yes
<b>DVD – Recordable</b>		
General Purpose DVD Interchange with JPEG (STD-GEN-DVD-JPEG)	FSC	Yes

<sup>1</sup> For details of the DICOM SR templates supported for measurement import and display, see section 6.3.

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# 1 INTRODUCTION

## 1.1 Revision Record

DICOM Conformance Statement Template node ID: 8818332		
Revision Number	Date	Reason for Change
1.0	January 2007	Final revision
1.1	June 2007	Add table with template node ID of DCS in Revision Record. Minor cosmetic changes
1.2	September 2009	Add Livelink NodeID on front page and in header Add column 'Display' in table 1.1-1: Network Services Supported General layout review
1.3	December 2009	Update chapter 6.2 Data Dictionary of private attributes Chapter 6.5 Standard Extended / Specialized / Private SOPs Following decision of HCST

DICOM Conformance Statement for IMPAX Cardiovascular 7.7 and 7.8		
Revision Number	Date	Reason for Change
1.0	03/03/2010	Initial Draft Version
1.1	09/07/2010	Initial Version for review
1.2	09/30/2010	Updated based on internal review comments. Version for approval.
1.3	01/30/2012	Updates made to correct minor errors found during review of a related conformance statement.
1.4	02/07/2014	Added missing Toshiba Private SOP Class for storage.
1.5	03/27/2014	Added correction/ clarification to display support for GSPS and DICOM SR SOP classes
1.6	12/10/2014	Updates made to Table 6.3-1 to reflect new DICOM SR support added in CV 7.8.SU6.
1.7	04/27/2015	Updates made to Table 6.3-1 to reflect new DICOM SR support added in CV 7.8.SU7.

## 1.2 Purpose and Intended Audience of this Document

This document is a DICOM Conformance Statement for the DICOM Services of the IMPAX Cardiovascular 7.7 and 7.8 Solutions.

The user of this document is involved with system integration and/or software design. We assume that the reader is familiar with the terminology and concepts that are used in the DICOM 3.0 standard and the IHE Technical Framework.

Readers not familiar with DICOM 3.0 terminology should first read the appropriate parts of the DICOM standard itself, prior to reading this conformance statement.

Although the use of this conformance statement in conjunction with the DICOM 3.0 standard is intended to facilitate communication with Agfa's IMPAX Cardiovascular solution, it is not sufficient to guarantee, by itself, the inter-operation of the connection. Section 1.3 outlines issues that need to be considered to ensure interoperability.



## 1.3 General Remarks

### 1.3.1 Integration and Validation Activities

The integration of any device into a system of interconnected devices goes beyond the scope of the DICOM 3.0 standard and this conformance statement when *interoperability* is desired. The responsibility for analyzing the applications requirements and developing a solution that integrates the Agfa equipment with other vendors' systems is the user's responsibility and should not be underestimated.

In some circumstances it might be necessary to perform a validation to make sure that functional interoperability between the Agfa equipment and non-Agfa devices works as expected. The user should ensure that any non-Agfa provider accepts responsibility for any validation required for their connection with the Agfa equipment.

### 1.3.2 Future Evolution

As the DICOM 3.0 standard evolves to meet the user's growing requirements and to incorporate new features and technologies, Agfa will follow the evolution of the standard. This evolution of the standard may require changes to devices that have implemented DICOM 3.0. The user should ensure that any non-Agfa provider, who connects with Agfa devices, also plans for future evolution of the DICOM standard. A refusal to do so may result in the loss of functionality and/or connectivity between the different products.

## 1.4 Acronyms 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
ACSE	Association Control Service Element
CD-R	Compact Disk Recordable
DICOM	Digital Imaging and Communications in Medicine
DICOMservice	An internal application component responsible for most of the DICOM communication in the IMPAX CV PACS product.
FSC	File-Set Creator
FSU	File-Set Updater
FSR	File-Set Reader
GSDF	Grayscale Standard Display Function
GSPS	Grayscale Softcopy Presentation State
IE	Information Entity
IOD	(DICOM) Information Object Definition
ISO	International Standard Organization
MPPS	Modality Performed Procedure Step
PDU	DICOM Protocol Data Unit
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)

SOP	DICOM Service-Object Pair
SR	Structured Report
UID	Unique Identifier
VR	Value Representation

## 1.5 Related Documents

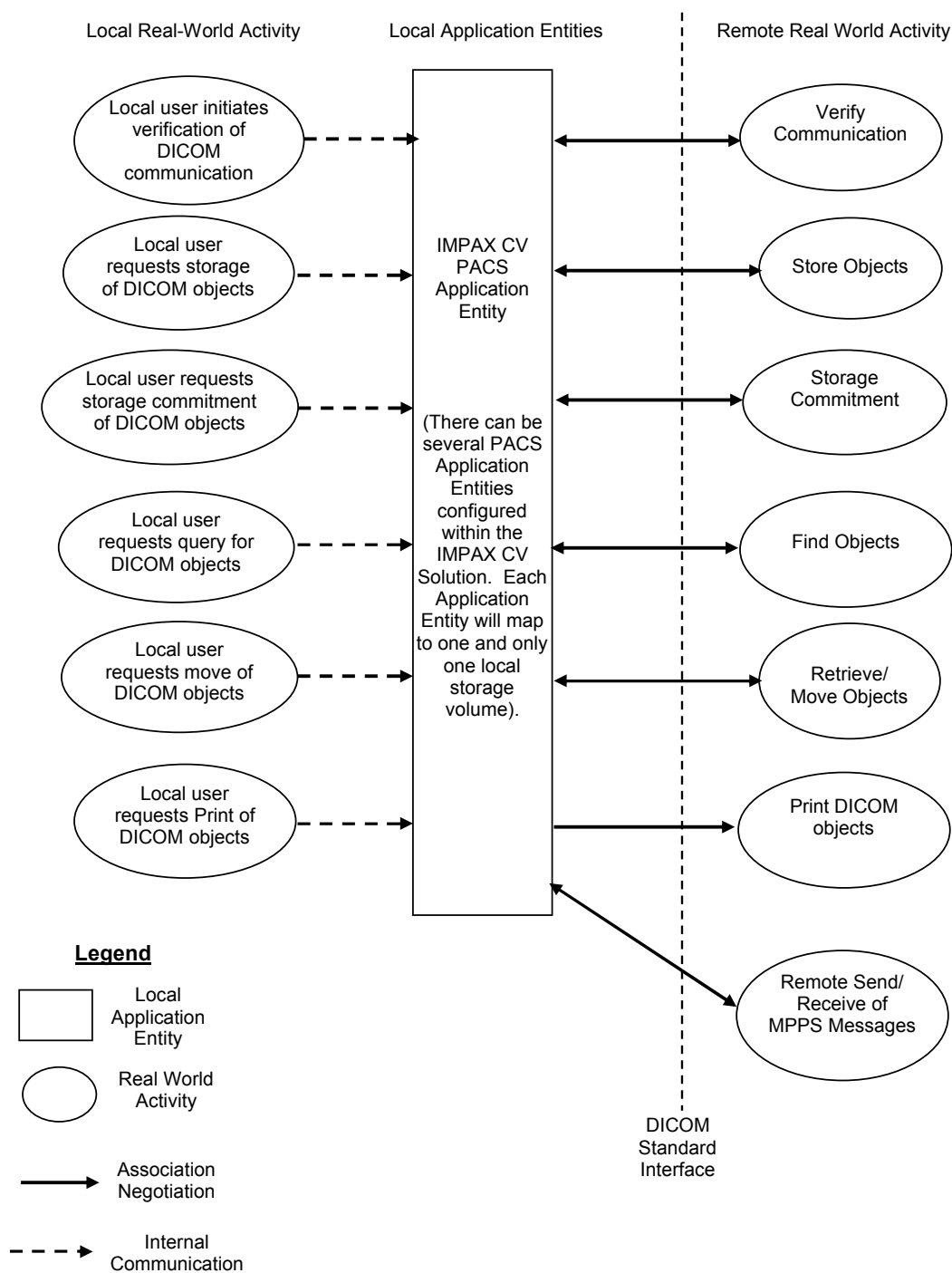
- ACR-NEMA Digital Imaging and Communications in Medicine (DICOM) V3.0 2011.
- IHE Cardiology Technical Framework Revision 4.0 – Final Text, August 2011

## **2 NETWORKING**

### **2.1 Implementation Model**

#### **2.1.1 Application Data Flow Diagram**

The Application Data Flow Diagram in Figure 2.1-1 depicts the DICOM data flow to and from the individual application entities (AEs) that are included in the IMPAX Cardiovascular 7.7 and 7.8 Solutions. The tail of the arrow between a local AE and the remote real world activity indicates the party (local AE or remote real world activity) that initiates the association negotiation.



**Figure 2.1-1: Functional Overview – Application Data Flow**

The following data flows are depicted in Figure 2.1-1:

- In the remote real-world activity labeled “Verify Communication”, a remote application entity (AE) can initiate an association and verify communications with the IMPAX CV PACS. The IMPAX CV PACS AE can also initiate an association and verify communications with a remote AE.
- In the remote real-world activity “Store Objects”, a remote AE initiates an association with the IMPAX CV PACS AE and sends one or more objects. When the IMPAX CV PACS AE receives an object, it stores the object in short term cache and registers the object in the database. The IMPAX CV PACS AE can also initiate an association and send one or more objects to a remote AE.
- In the remote real-world activity “Request Storage Commitment”, a remote AE initiates an association with the IMPAX CV PACS AE and requests commitment for the safekeeping of one or more composite SOP instances on the IMPAX CV PACS AE. The IMPAX CV PACS AE will open a new association with the remote AE to indicate success or failure. The IMPAX CV PACS AE can also initiate an association and request commitment for the safekeeping of one or more composite SOP instances to a remote AE.
- In the remote real-world activity “Find Objects”, a remote AE initiates an association with the IMPAX CV PACS AE and sends a query. The IMPAX CV PACS AE will search the database for possible matches with composite SOP instances. The results of the query are returned to the remote AE using the same association. The IMPAX CV PACS AE can also initiate an association and send a query to a remote AE.
- In the remote real-world activity “Retrieve/ Move Objects”, a remote AE initiates an association with the IMPAX CV PACS AE and requests some composite SOP instances be retrieved. The IMPAX CV PACS AE will search the database for possible matches with composite SOP instances. The resulting composite SOP instances are transferred to either the same AE that requested the retrieval or to another AE over a new association. The IMPAX CV PACS AE can also initiate an association and request some composite SOP instances be retrieved from a remote AE.
- In the remote real-world activity “Print DICOM objects”, the IMPAX CV PACS AE initiates an association with a remote printer AE. The IMPAX CV PACS AE constructs and sends one or more composite SOP instances to the remote AE.
- In the remote real world activity “Remote Send/ Receive of MPPS Messages”, a remote AE initiates an association with the IMPAX CV PACS AE and sends a DICOM MPPS message. The IMPAX CV PACS AE receives the MPPS message and initiates an association with another remote AE and forward an MPPS message that it has received from the first remote AE. This is needed to conform to the IHE specification for an Image Manager in the CATH or ECHO Workflow Profiles.

### 2.1.2 Functional Definitions of AE's

The IMPAX Cardiovascular 7.7 and 7.8 Solutions contain an internal application component called “DICOMService” that is responsible for most of the DICOM communication to and from the IMPAX Cardiovascular Solution.

The IMPAX Cardiovascular Solution contains an Application Entity (AE) database. Both local and remote Aes are configured in the same database. A local AE can also be configured as a remote AE for loop back operation.

An AE is defined as “local” if it is mapped to an information volume on the same machine as the AE. An AE can be mapped to one and only one information volume. However, a single information volume can be mapped to by more than one AE.

A “remote” AE is any AE that has an IP address and port number that is used as the connection point when using the AE as a target of a DICOM association.

It is also possible for “local” Aes to configure another local IMPAX CV PACS AE network connection endpoint as a “remote” AE. This allows a user using the IMPAX CV DICOMservice application’s GUI to specify a “local” AE as a “remote” AE. This is loop back operation and can be used for testing purposes and moving studies from one local information volume to another.

Each of the following subsections contains a functional definition for a logical AE that is part of the IMPAX Cardiovascular 7.7 and 7.8 Solutions. These definitions describe the functions to be performed by the AE in response to one of the remote real-world activities, and the DICOM services used to accomplish these functions (both DICOM service classes and lower level DICOM services such as Association Services).

### **2.1.2.1 Verify Communication**

The IMPAX CV PACS AE will respond to a DICOM C-Echo request from a remote AE and verify communications.

A user can initiate a DICOM C-Echo command from the IMPAX CV PACS AE and request verification from a remote AE. The results of the verification are displayed to the user.

### **2.1.2.2 Store Objects**

The IMPAX CV PACS AE stores an image received via a DICOM C-Store command in its entirety in its internal data store with optional compression for some types of studies. The IMPAX CV PACS AE stores each image with the File Meta Information attached to it. The IMPAX CV PACS AE then extracts patient, study, series and image metadata and stores this information within its internal database.

The user can initiate the transmission and storage of a set of DICOM objects to other compatible devices. The IMPAX CV PACS AE, acting on behalf of the user, performs the DICOM C-Store to the remote AE. The results of the storage are displayed to the user.

### **2.1.2.3 Request Storage Commitment**

The IMPAX CV PACS AE acts as a Service Class Provider of Storage Commitment to take responsibility explicitly for storing DICOM objects received.

When received, the IMPAX CV PACS AE will enter the request in a queue. The queue shall be checked periodically to verify the availability of listed SOP Instances in the local storage. If all of the SOP Instances are available, the IMPAX CV PACS AE will respond with a positive storage commitment message for the listed SOP instances. If a preconfigured time limit has passed without a successful commitment, the IMPAX CV PACS AE will positively commit to the received SOP instances and fail the commit on the SOP instances that are not available.

### **2.1.2.4 Find Objects**

The IMPAX CV PACS AE responds to remote query requests (DICOM C-Find) based on the records stored in its database. The local AE will process the C-Find request by searching the local database for matching records. All query results are then passed back to the remote AE.

The user can initiate a query for DICOM object stored on a remote AE. The IMPAX CV PACS AE will issue a DICOM C-Find, on behalf of the user, to see if a patient, study, series or image is available on a remote AE. The results of the C-Find request are displayed to the user.

### 2.1.2.5 Retrieve/ Move Objects

The IMPAX CV PACS AE acts as a Service Class Provider of C-Move to retrieve DICOM objects. It does so by obtaining an object location reference from the database and then obtaining the object itself from the local data store. The requested study, series, or image is then sent by the IMPAX CV PACS AE to the remote destination AE as defined in the Move request. It does so by acting as a Service Class User of the DICOM C-Store command to transmit the objects.

The user can initiate a retrieve (or DICOM C-Move) of a selected study, series or image contained on a remote AE to a destination AE. The results of the C-Move operation are displayed to the user.

### 2.1.2.6 Print DICOM objects

The user can initiate the printing of selected images on a remote DICOM printer. The IMPAX CV PACS AE proposes a print context, constructs a Print Meta SOP class and transfers a DICOM print object to the requested, compatible device.

### 2.1.2.7 Remote Send/ Receive of MPPS Messages

The IMPAX CV PACS AE can act as both a Service Class Provider and Service Class User of the Modality Performed Procedure Step (MPPS) Service to forward received MPPS messages to a configured remote Application Entity. This is needed to conform to the IHE specification for an Image Manager in the Cardiac Catheterization (CATH) and Echocardiography (ECHO) Workflow Integration Profiles.

## 2.1.3 Sequencing of Real World Activities

See the sequencing of real world activities defined for each service class later in this document.

## 2.2 AE Specifications

There is one type of Application Entity supported within the IMPAX Cardiovascular 7.7 and 7.8 Solutions. However, there may be several instances of this type of Application Entity available in any given deployment of the IMPAX Cardiovascular Solution. This section outlines the specifications for the Application Entity type that is part of the IMPAX Cardiovascular 7.7 and 7.8 Solutions.

### 2.2.1 The IMPAX CV PACS AE Specification

#### 2.2.1.1 SOP Classes Supported

The IMPAX CV PACS AE provides Standard Conformance to the SOP Classes listed in Table 2.2 1. The shaded items represent SOP classes that have been retired (so no longer appear in PS 3.2) but are still supported by the IMPAX CV PACS AE.

If the **User of Service (SCU)** or the **Provider of Service (SCP)** column has the value "Option", then the functionality is either configurable or can be purchased as an option. The **Display** column indicates whether or not the IMPAX CV PACS AE Client will display the DICOM objects. In some cases only storage of the object may be provided by the IMPAX CV PACS AE.

**Table 2.2-1: SOP Class(es) for IMPAX CV PACS AE**

SOP Class Name	SOP Class UID	SCU	SCP	Display
<b>Verification</b>				
Verification	1.2.840.10008.1.1	Yes	Yes	N/A
<b>Transfer</b>				
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes	Yes	Yes
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	Yes	Yes	Yes
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	Yes	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes	Yes	Yes
Nuclear Medicine Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.5	Yes	Yes	Yes
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	Yes	Yes	Yes
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	Yes	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	Yes	Yes
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Yes	Yes	No
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Yes	Yes	Yes
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	Yes	Yes
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes	Yes	No
Digital Mammography X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Yes	Yes	No
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	Yes	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes	Yes	Yes
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Yes	Yes	Yes
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	Yes	Yes
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Yes	Yes	Yes <sup>2</sup>
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Yes	Yes	Yes <sup>2</sup>
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Yes	Yes	Yes <sup>2</sup>
Procedure Log Storage	1.2.840.10008.5.1.4.1.1.88.40	Yes	Yes	No
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	Yes	Yes	No
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Yes	Yes	No
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	Yes	Yes	No
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	Yes	No
Toshiba Private Data Storage	1.2.392.200036.9116.7.8.1.1.1	Yes	Yes	No
<b>Workflow Management</b>				
Modality Performed Procedure Step SOP Class	1.2.840.10008.3.1.2.3.3	Yes	Yes	N/A
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	Yes	Yes	N/A
<b>Query Retrieve</b>				
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	Yes	N/A
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	Yes	N/A
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	Yes	N/A
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	Yes	N/A
<b>Print Management</b>				
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	Yes	No	N/A
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	Yes	No	N/A

<sup>2</sup> For details of the DICOM SR templates supported for measurement import and display, see section 6.3.



SOP Class Name	SOP Class UID	SCU	SCP	Display
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Yes	No	N/A
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4	Yes	No	N/A
Basic Color Image Box SOP Class	1.2.840.10008.5.1.1.4.1	Yes	No	N/A
Printer SOP Class	1.2.840.10008.5.1.1.16	Yes	No	N/A
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	Yes	No	N/A

### 2.2.1.2 Default Transfer Syntaxes Supported

The IMPAX CV PACS AE provides Standard Conformance to the default transfer syntaxes listed in Table 2.2-2.

**Table 2.2-2: Default Transfer Syntaxes**

Transfer Syntax Name	Transfer Syntax UID
Implicit VR Little Endian	1.2.840.10008.1.2

### 2.2.1.3 Extended Transfer Syntaxes Supported

The IMPAX CV PACS AE provides Standard Conformance to the extended transfer syntaxes listed in Table 2.2 3 for the purposes of storage and retrieval.

**Table 2.2-3: Extended Transfer Syntaxes**

Transfer Syntax Name	Transfer Syntax UID
Explicit VR Little Endian	1.2.840.10008.1.2.1
Explicit VR Big Endian	1.2.840.10008.1.2.2
RLE Lossless	1.2.840.10008.1.2.5
JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50
JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70

### 2.2.1.4 Association Establishment Policies

#### 2.2.1.4.1 General

The DICOM standard Application context name will be proposed and recognized by the IMPAX CV PACS AE.

**Table 2.2-4: DICOM Application Context**

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

The maximum PDU size negotiation as determined by Part 7 is handled in association establishment requests.

The IMPAX CV PACS AE will honor any request by a Remote Application Entity to limit the maximum PDU size during association negotiation. This is done via the maximum length to send sub-item. The IMPAX CV PACS AE is capable of receiving a maximum PDU size of 1

Mbyte. The default received PDU size for the IMPAX CV PACS AE is 1 Mbyte, and is configurable.

There is no maximum number of supported Presentation Context Items that can be presented to the IMPAX CV PACS AE.

#### 2.2.1.4.2 Number of Associations

The IMPAX CV PACS AE supports multiple concurrent associations, as both an SCU and as an SCP, at any given time with any configured Application Entity. All local and remote Application Entities must be configured into the IMPAX Cardiovascular database before use.

**Table 2.2-5: Number of Associations as an Association Initiator for IMPAX CV PACS AE**

<b>Maximum number of simultaneous associations initiated</b>	1 per user session
--------------------------------------------------------------	--------------------

During storage of a study or a series as an SCU, the IMPAX CV PACS AE shall request only one association at a time. However, multiple users may request image storage as an SCU at the same time. Since the IMPAX CV PACS AE is multithreaded it is possible that there will be multiple SCU sessions being processed at the same time to support different users.

**Table 2.2-6: Number of Associations as an Association Acceptor for IMPAX CV PACS AE**

<b>Maximum number of simultaneous associations accepted</b>	(See note 1)
-------------------------------------------------------------	--------------

#### Note 1:

The IMPAX CV PACS AE is multithreaded and shall create a new thread for each connection request it receives. There is no inherent limit to the number of simultaneous associations that will be accepted by the IMPAX CV PACS AE other than limits imposed by the computer operating system.

#### 2.2.1.4.3 Asynchronous Nature

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

**Table 2.2-7: Asynchronous Nature as an Association Initiator for IMPAX CV PACS AE**

<b>Maximum number of outstanding asynchronous transactions</b>	1
----------------------------------------------------------------	---

#### 2.2.1.4.4 Implementation Identifying Information

The IMPAX CV PACS AE will respond with the implementation identifying parameters listed in the following table.

**Table 2.2-8: DICOM implementation Class and Version for IMPAX CV PACS AE**

<b>Implementation Class UID</b>	1.2.840.113815.4.2.buildnum
<b>Implementation Version Name</b>	Heartlab DICOMTK

The suffix after the Agfa HealthCare Implementation Class UID root: 1.2.840.113815 is subject to change without notice.

### 2.2.1.4.5 SCU/SCP Role Negotiation

When acting as an SCU, SCU/SCP Role Negotiation is configurable to be present or not present in the association request made by the IMPAX CV PACS AE, to a Remote Application Entity. The default is to be present. If present, the IMPAX CV PACS SCU will identify itself as operating as an “SCU only.” SCU/SCP role selection negotiation is required and supported for Storage Commitment, allowing the association requestor to act as SCP for the N-EVENT-REPORT DIMSE service.

When acting as an SCP, the IMPAX CV PACS AE will respond to any SCU/SCP Role Negotiation requests when accepting an association. The IMPAX CV PACS AE will identify itself as operating as “SCP only.”

### 2.2.1.5 Association Initiation Policies

As an SCU, the IMPAX CV PACS AE shall initiate a new association when a user initiates a DICOM SCU command, such as Verification or Storage, between two Application Entities, a new association is initiated to perform the SCU command. The association terminates following the completion of each command.

All IMPAX CV PACS AE initiated associations support a “command watchdog timer”. The default is 600 seconds (10 minutes) but is user configurable. When the association becomes idle during the processing of a command the watchdog timer starts. If the association is idle long enough for the timer to expire, then the IMPAX CV PACS AE sends an A-ABORT PDU and closes the association.

### 2.2.1.5.1 Real World Activity – Verify Communication (SCU)

#### 2.2.1.5.1.1 Description and Sequencing of Activity

The IMPAX CV PACS AE will issue Verification requests in response to UI mediated requests from the user to test the validity of a DICOM connection.

#### 2.2.1.5.1.2 Proposed Presentation Contexts

For the real world activity of Verification, the IMPAX CV PACS AE requests the Presentation Contexts listed in Table 2.2-9:

**Table 2.2-9: Presentation Contexts Proposed by the IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

#### 2.2.1.5.1.3 SOP Specific Conformance – Verification

The IMPAX CV PACS AE provides standard conformance to the DICOM Verification Service Class as an SCU.

## 2.2.1.5.2 Real World Activity – Store Objects (SCU)

### 2.2.1.5.2.1 Description and Sequencing of Activity

The IMPAX CV PACS AE will transmit images that have been sent to it previously, initiated by either a user request made via the telnet or the IMPAX CV DICOMservice application GUI or in response to a C-Move command made on another DICOM association. An association is established when the user initiates a transmit request.

The IMPAX CV PACS AE supports the following storage SOP classes as an SCU. As an SCU, the storage SOP Classes shall store the designated SOP Instances to a Remote Application Entity. As an SCP, received SOP Instances shall be stored in an Agfa HealthCare Information Volume that is associated with the receiving Application Entity.

### 2.2.1.5.2.2 Proposed Presentation Contexts

The IMPAX CV PACS AE acting as SCU reads in the file as stored on the disk and asks for an association based on the Abstract Syntax UID and Transfer Syntax UID found in the file. If the Remote Application Entity cannot accept the proposed transfer syntaxes then the transfer does not take place.

**Table 2.2-10: Presentation Contexts Proposed by IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
All SOP Classes listed in the 'Transfer' section of Table 2.2-1		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
		RLE Lossless, PackBits	1.2.840.10008.1.2.5	SCU	None
		JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50	SCU	None
		JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70	SCU	None

### 2.2.1.5.2.3 SOP Specific Conformance – Store Objects

The IMPAX CV PACS AE provides Standard conformance to the DICOM Storage Service Class as an SCU.

A “non-failure” C-Store response status (i.e., a Success or any Warning status) will not generate any actions.

**Table 2.2-11: DICOM Command Response Status Handling Behavior**

Service Status	Further Meaning	Error Code	Behavior
Success	Successful Store	0000	Successful Store
Warning	Warning Element Coercion	B000	Successful Store
Warning	Warning Elements Discarded	B006	Successful Store
Warning	Warning Dataset Not SOP Class	B007	Successful Store
Failure	Processing Failure	0110	Failed Store

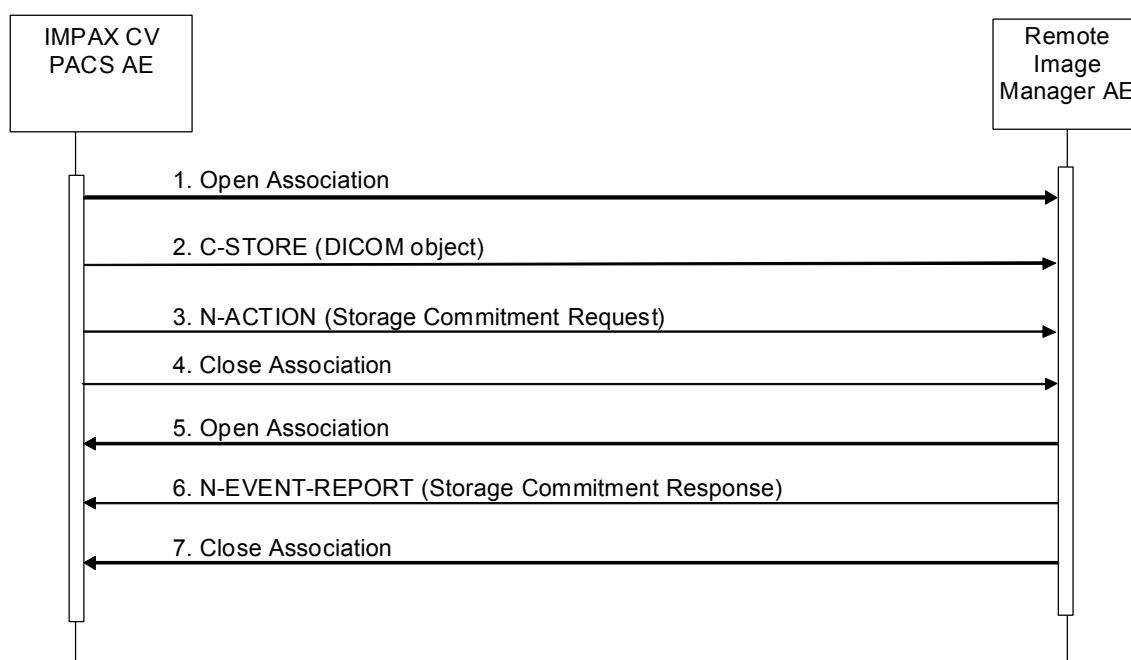
### 2.2.1.5.3 Real World Activity – Request Storage Commitment (SCU)

#### 2.2.1.5.3.1 Description and Sequencing of Activity

The IMPAX CV PACS AE stores images that are sent to it from an SCU. In some configurations the IMPAX CV PACS AE may send images to another SCP, such as a PACS, for permanent storage. The request for storage commitment may then be transmitted from the IMPAX CV PACS AE together with a list of references to one or more SOP instances. This action is invoked through the DIMSE N-ACTION primitive. The following message is supported:

- Request Storage Commitment – to request the safekeeping of a set of SOP instances

The following sequence diagram outlines the sequencing that the IMPAX CV PACS AE follows to support Storage Commitment.



**Figure 2.2-1: Storage Commitment Sequencing Diagram**

Each Storage Commitment Request that the IMPAX CV PACS AE sends is uniquely identified by the Transaction UID Attribute (0008,1195) value that is generated by the IMPAX CV PACS AE. After sending a Storage Commitment Request, the IMPAX CV PACS AE expects an N-EVENT-REPORT from the Remote SCP. The IMPAX CV PACS AE will then respond with an N-EVENT-REPORT response primitive with a status code.

#### 2.2.1.5.3.2 Proposed Presentation Contexts

The IMPAX CV PACS AE may request any of the Presentation Contexts listed in Table 2.2-12 for Storage Commitment.

**Table 2.2-12: Presentation Contexts Proposed by IMPAX CV PACS AE**

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

### 2.2.1.5.3.3 SOP Specific Conformance – Request Storage Commitment

The IMPAX CV PACS AE provides partial conformance to the DICOM Storage Commitment Service Class as an SCU. The Action Type and Action Information specified in Table 2.2-13 are supported. The IMPAX CV PACS AE does not support explicit role negotiation.

**Table 2.2-13: Storage Commitment Request – Action Information**

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

- The IMPAX CV PACS AE will generate an N-ACTION primitive if the local configuration setting for the remote AE is enabled for storage commitment.
- The IMPAX CV PACS AE will keep the Transaction ID applicable indefinitely.
- The IMPAX CV PACS AE does not support the optional Storage Media File-Set ID and UID Attributes in the N-Action.
- The IMPAX CV PACS AE will respond to an N-EVENT-REPORT with an N-EVENT-REPORT response primitive using one of the status codes listed in Table 2.2-14.
- The IMPAX CV PACS AE can be configured with the destination AE Title for the Storage Commit. By default, this is the AE Title where the storage request is sent.

**Table 2.2-14: DICOM Command Response Status Handling Behavior**

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	Successful notification

### 2.2.1.5.4 Real World Activity – Find Objects (SCU)

#### 2.2.1.5.4.1 Description and Sequencing of Activity

The user, via the telnet or GUI interface, can initiate DICOM queries as a C-FIND SCU to inquire about studies, series or SOP instances on a Remote Application Entity. The IMPAX CV PACS AE can query a remote AE for composite objects to the Patient or Study Levels. Searches can be restricted via the matching key attributes listed in the tables in section 2.2.1.5.4.3.

### 2.2.1.5.4.2 Proposed Presentation Contexts

The IMPAX CV PACS AE will initiate any of the Presentation Contexts listed in Table 2.2-15 for Query. The IMPAX CV PACS AE will initiate one C-Find Presentation Context per association request. Any single Abstract Syntax may be specified more than once in an association request, if the Transfer Syntaxes differ between the Presentation Contexts.

The IMPAX CV PACS AE uses the presentation contexts shown in the following table to support the C-Find service.

**Table 2.2-15: Presentation Contexts Proposed by IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

### 2.2.1.5.4.3 SOP Specific Conformance – Find Objects

The IMPAX CV PACS AE supports hierarchical queries and not relational queries with all mandatory Key Attributes. Attributes are only returned if requested in the query with the exception of Retrieve AE Title, Instance Availability, and Query-Retrieve Level which are always required by IHE and DICOM. Table 2.2-16 through Table 2.2-19 describe the Key Attributes supported at a given query/retrieve information model.

Specific Character Set (0008,0005) will be included if needed at every query level. If present in the response, Specific Character Set will be used to identify character sets other than the default character set for display of strings.

The following notation is used in the Matching Key Attribute tables below to describe which matching types are supported:

An “S” indicates the identifier attribute uses Single Value Matching, an “R” indicates Range Matching, an “\*” indicates Wildcard Matching, a “U” indicates Universal Matching, and an “L” indicates that UID lists are sent. “UNIQUE” indicates that this is the Unique Key for that query level, in which case Universal Matching or Single Value Matching is used depending on the query level.

Wildcard matching conforms to the specification in DICOM PS3.4, section C.2.2.2 with the following exceptions:



- Case sensitive matching is not performed
- '?' does not include the blank " " character.
- In a PN value representation, the last three name components, middle initial, prefix and suffix are treated as a '\*' if the field is blank.
- The free form name is contained in the last name field.
- The comma (,) can also be used as a delimiter along with the DICOM standard caret (^) delimiter.

**Table 2.2-16: Patient Level Matching Key Attributes**

Description	Tag	Matching Types
Patient Name	(0010,0010)	S, *, U
Patient ID	(0010,0020)	UNIQUE (for Patient Root Model) S, *, U (for Study Root Model)
Patient Birth Date	(0010,0030)	S, R, U
Patient Sex	(0010,0040)	S, U

**Table 2.2-17: Study Level Matching Key Attributes**

Description	Tag	Matching Types
Study Instance UID	(0020,000D)	UNIQUE, S, L
Study ID	(0020,0010)	U
Study Date	(0008,0020)	S, R, U
Study Time	(0008,0030)	U
Accession Number	(0008,0050)	U
Modalities in Study	(0008,0061)	U
Study Description	(0008,1030)	U
Referring Physician	(0008,0090)	S, *, U

**Table 2.2-18: Series Level Matching Key Attributes**

Description	Tag	Matching Types
Series Instance UID	(0008,000E)	UNIQUE, S, L
Series Number	(0020,0011)	U
Modality	(0008,0060)	S, U
Series Date	(0008,0021)	S, R, U
Series Time	(0008,0031)	U
Series Description	(0008,103E)	U
Performing Physician (see note 1)	(0008,1050)	S, *, U

**Table 2.2-19: Instance Level Matching Key Attributes**

Description	Tag	Matching Types
SOP Instance UID	(0008,0018)	UNIQUE, S
Image Number	(0020,0013)	U

**Note 1:**

The 'Performing Physician' key is not part of the standard Query and Retrieve Service Class, but is included because of customer necessity.



**Table 2.2-20: DICOM C-FIND Response Status Handling Behavior**

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete – No final identifier is supplied	0000	Matching dataset found successfully and no matching identifier is supplied.
Pending	Matches are continuing	FF00	Current match is supplied and any Optional keys were supported in the same manner as Required keys.
Pending	Matches are continuing	FF01	Warning that one or more Optional keys were not supported for existence and/or matching for this identifier.
Failure	Failed at performing DIMSE service user.	C001	Operation failed
Cancel	C-FIND terminated due to Cancel request	FE00	Due to C-FIND Cancel indication primitive.

### 2.2.1.5.5 Real World Activity – Retrieve/ Move Objects (SCU)

#### 2.2.1.5.5.1 Description and Sequencing of Activity

The IMPAX CV PACS AE can retrieve composite objects from a remote AE. An association is established when the user, via the telnet or GUI interface, initiates a DICOM C-Move as an SCU to copy a study, series or SOP instance to a destination Application Entity.

#### 2.2.1.5.5.2 Proposed Presentation Contexts

The IMPAX CV PACS AE negotiates the Presentation Contexts listed in Table 2.2-21 when initiating the C-Move service.

**Table 2.2-21: Presentation Contexts Proposed by IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian,	1.2.840.10008.1.2	SCU	None
		Explicit VR Big Endian,	1.2.840.10008.1.2.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian,	1.2.840.10008.1.2	SCU	None
		Explicit VR Big Endian,	1.2.840.10008.1.2.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

#### 2.2.1.5.5.3 SOP Specific Conformance – Retrieve/ Move Objects

The IMPAX CV PACS AE provides standard conformance to the DICOM Query/Retrieve Service Class as an SCU.

The IMPAX CV PACS AE will try to establish an association with the move destination specified in the Move request. One or more of the Presentation Contexts listed in the Store Objects section of this document may be negotiated in this association.

## 2.2.1.5.6 Real World Activity – Print DICOM objects (SCU)

### 2.2.1.5.6.1 Description and Sequencing of Activity

The user, via the telnet or GUI interface, can initiate DICOM print as an SCU to print one or more frames contained in one or more SOP Instances on a remote DICOM printer. The IMPAX CV PACS AE does not support any DICOM PRINT SOP Classes as an SCP.

### 2.2.1.5.6.2 Proposed Presentation Contexts

The IMPAX CV PACS AE uses the following Presentation Contexts to support the Print service.

**Table 2.2-22: Presentation Contexts Proposed by IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Implicit VR Little Endian,	1.2.840.10008.1.2	SCU	None
		Explicit VR Big Endian,	1.2.840.10008.1.2.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	Implicit VR Little Endian,	1.2.840.10008.1.2	SCU	None
		Explicit VR Big Endian,	1.2.840.10008.1.2.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

### 2.2.1.5.6.3 SOP Specific Conformance – Print DICOM objects

The IMPAX CV PACS AE provides standard conformance to the DICOM Print Meta SOP Classes as an SCU (as listed in Table 2.2-22). This means that the IMPAX CV PACS AE only supports the mandatory services and attributes (as defined by the DICOM Standard) associated with the Print Meta SOP Classes listed above.

When the IMPAX CV PACS AE services a print request, the print service shall scan all of the image types in the print request for the photometric interpretation. The following rules shall be applied to the printing of images:

- If any images are compressed, they shall be uncompressed before sending to a printer.
- If all of the images are grayscale, then the Grayscale Print Management SOP Class shall be used.
- For mixed color and grayscale images, if the default option is used, then the grayscale images shall be converted to RGB color and the Color Print Management SOP Class shall be used.
- For mixed color and grayscale images, if the “Grayscale” option is specified, then the color images shall be converted to grayscale and the Grayscale Print Management SOP Class shall be used.
- If all of the images are color, then the Color Print Management SOP Class shall be used unless the “Grayscale” option is specified. If it is, then the images are converted to grayscale and the Grayscale Print Management SOP Class shall be used.

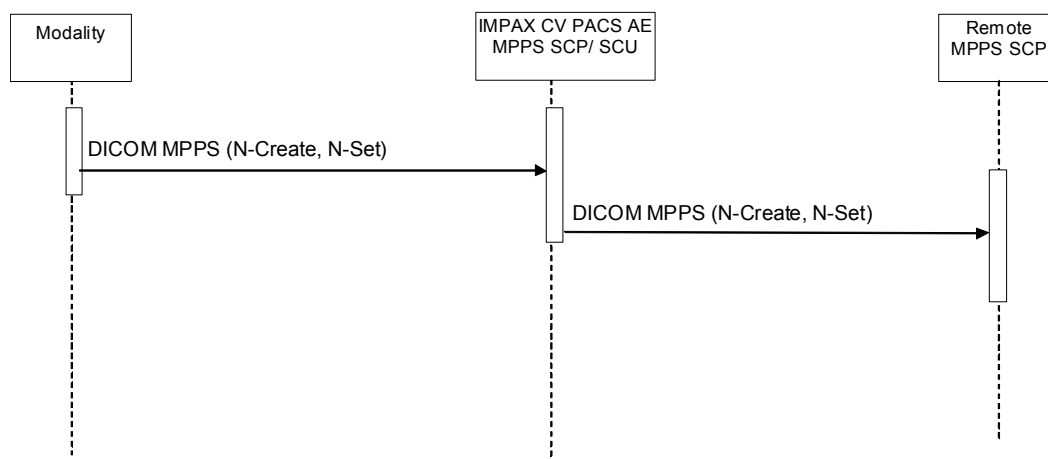
- Color images that have a photometric interpretation other than RGB shall be converted to the RGB photometric interpretation before sending to a printer.

## 2.2.1.5.7 Real World Activity – Remote Send/ Receive of MPPS Messages (SCU)

### 2.2.1.5.7.1 Description and Sequencing of Activity

The IMPAX CV PACS AE acts as an MPPS SCU only when it is configured to route DICOM N-CREATE or N-SET Modality Performed Procedure Step messages to one or more destinations in response to receiving N-CREATE or N-SET MPPS from an acquisition device. The IMPAX CV PACS AE sends the attribute values as received from the originator of the Modality Performed Procedure Step.

The following diagram shows the sequence of real world activities when the Integration Services AE receives a DICOM MPPS:



**Figure 2.2-2: DICOM Performed Procedure Step Sequence Diagram**

### 2.2.1.5.7.2 Proposed Presentation Contexts

**Table 2.2-23: Presentation Contexts Proposed by IMPAX CV PACS AE**

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

### 2.2.1.5.7.3 SOP Specific Conformance – Remote Send/ Receive of MPPS Messages

The IMPAX CV PACS AE provides standard conformance to the DICOM Modality Performed Procedure Step Service Class as an SCU.

## 2.2.1.6 Association Acceptance Policies

As an SCP, the IMPAX CV PACS AE accepts associations that meet these requirements: the Called-AE title is a local AE Title, the Calling-AE title is a Remote AE Title, the Presentation Context list contains an acceptable SOP Class UID, and one of the associated Transfer Syntaxes is an Acceptable Transfer Syntax. For SCP services, the IMPAX CV PACS AE listens for association requests on one or more designated IP network endpoints and waits for Remote Application Entities to initiate an association.

If the IMPAX CV PACS AE rejects an association it provides this information:

**Table 2.2-24: Association Rejection Reasons**

Result	Source	Reason/ Diag	Explanation
1 – rejected permanent	2 – DICOM UL service-provider	1 – no-reason given	No Presentation Context is acceptable
1 – rejected permanent	1 – DICOM UL service-user	3 – calling-Aetitle-not recognized	
1 – rejected permanent	1 – DICOM UL service-user	7 – called-Aetitle-not recognized	

### 2.2.1.6.1 Real World Activity – Verify Communication (SCP)

#### 2.2.1.6.1.1 Description and Sequencing of Activity

The IMPAX CV PACS AE responds to verification requests as an SCP to provide an SCU with the ability to determine if the IMPAX CV PACS AE is receiving DICOM requests.

#### 2.2.1.6.1.2 Accepted Presentation Contexts

The IMPAX CV PACS AE will accept any of the Presentation Contexts listed in Table 2.2-25 for Verification.

**Table 2.2-25: Accepted Presentation Contexts for IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

#### 2.2.1.6.1.3 SOP Specific Conformance – Verify Communication

The IMPAX CV PACS AE provides standard conformance to the DICOM Verification Service Class as an SCU. The IMPAX CV PACS AE returns one of the following status codes.

**Table 2.2-26: Verification Response Status**

Service Status	Further Meaning	Error Code	Reason
Success	Success	0000	Operation performed properly.

### 2.2.1.6.1.4 Presentation Context Acceptance Criterion – Verify Communication

The IMPAX CV PACS AE will always accept a Presentation Context for the Verification SOP Class with the default DICOM transfer syntax listed in Table 2.2-25.

### 2.2.1.6.1.5 Transfer Syntax Selection Policies – Verify Communication

Since no DICOM data object is associated with a Verification command, only the default DICOM transfer syntax is required/ supported.

### 2.2.1.6.2 Real World Activity – Store Objects (SCP)

#### 2.2.1.6.2.1 Description and Sequencing of Activity

As an SCP, when the IMPAX CV PACS AE receives SOP Instances they shall be stored in a local information volume that is associated with the receiving AE. The IMPAX CV PACS AE uses other internal services to store the images and register the metadata into the IMPAX CV database.

#### 2.2.1.6.2.2 Accepted Presentation Contexts

IMPAX CV PACS AE acting as Storage SCP will accept any Transfer Syntax in a Presentation Context which is in its list of Accepted Transfer Syntaxes in Table 2.2-27.

**Table 2.2-27: Accepted Presentation Contexts for IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
All SOP Classes listed in the 'Transfer' section of Table 2.2-1		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	See Note 1
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	See Note 1
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	See Note 1
		RLE Lossless, PackBits	1.2.840.10008.1.2.5	SCP	See Note 1
		JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50	SCP	See Note 1
		JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70	SCP	See Note 1

#### Note 1:

The IMPAX CV PACS AE acts as a Level 2 (FULL) SCP, but this is not explicitly negotiated as an Extended Negotiation sub-item.

#### 2.2.1.6.2.3 SOP Specific Conformance – Store Objects

The IMPAX CV PACS AE conforms to the DICOM Storage Service Class as a Level 2 (Full) SCP. No elements are discarded or coerced by the IMPAX CV PACS AE. All Type 1, Type 2 and Type 3 attributes will be retained. Private attributes will be stored and included when the object is sent out again.

Upon successful storage of objects contained within a study the study can be returned in response to a retrieval request. Studies may be manually transferred, archived or deleted through the graphical user interface.

When an object is received that has a SOP Instance UID (0008,0018) of an object that is already present on the IMPAX CV PACS AE the object will be accepted and will overwrite the previous version of the object.

The IMPAX CV PACS AE will return the C-STORE status codes shown in Table 2.2-28.

**Table 2.2-28: Storage Response Status**

Service Status	Further Meaning	Error Code	Reason
Success	Success	0000	Successful Store
Failure	Processing Failure	0110	Processing Failure
Failure	Missing Attribute	0120	Required Attribute not present in Store Command.
Failure	Unrecognized Operation	0211	Invalid Command
Failure	Refused: Out of Resources	A700	Disk Full
Failure	Error: Data Set does not match SOP Class	A900	(0000,0002) is different SOP class
Failure	Error: Cannot Understand	C000	Invalid DUL protocol

#### **2.2.1.6.2.4 Presentation Context Acceptance Criterion – Store Objects**

The IMPAX CV PACS AE will accept any number of Storage Presentation Contexts per association request. Any single Abstract Syntax may be specified more than once in an association request, if the Transfer Syntaxes differ between the Presentation Contexts.

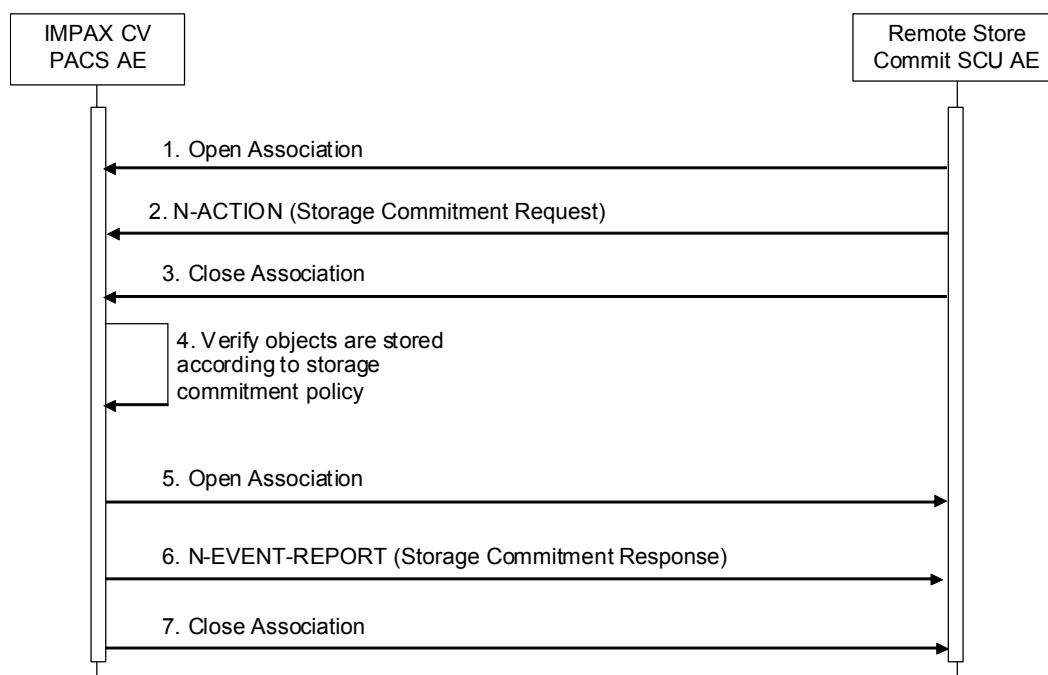
#### **2.2.1.6.2.5 Transfer Syntax Selection Policies – Store Objects**

The IMPAX CV PACS AE supports all transfer syntaxes listed in Table 2.2-27.

#### **2.2.1.6.3 Real World Activity – Request Storage Commitment (SCP)**

##### **2.2.1.6.3.1 Description and Sequencing of Activity**

After receiving a Storage Commitment Push Model N-ACTION request the IMPAX CV PACS AE may wait a configurable time until the listed SOP instances are indexed into the Database. An Association Request is then sent to the peer AE and upon successful negotiation of the required Presentation Context and the outstanding N-EVENT-REPORT is sent. The maximum number of times the IMPAX CV PACS AE will attempt to resend an N-EVENT-REPORT is configurable, along with the amount of time to wait between attempts to resend.



**Figure 2.2-3: Storage Commitment Sequencing Diagram**

### 2.2.1.6.3.2 Accepted Presentation Contexts

**Table 2.2-29: Accepted Presentation Contexts for IMPAX CV PACS AE**

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

### 2.2.1.6.3.3 SOP Specific Conformance – Request Storage Commitment

The IMPAX CV PACS AE provides standard conformance to the DICOM Storage Commitment Service Class as an SCP. The IMPAX CV PACS AE supports the Action Type and elements listed in Table 2.2-30 for this SOP class. The Transaction UID Attribute (0008,1195) value uniquely identifies each Storage Commitment Request.

**Table 2.2-30: Storage Commitment Request – Action Information**

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

The IMPAX CV PACS AE will store SOP Instances indefinitely unless the instances are manually deleted by a user with appropriate system permissions. The capacity is limited only



by the availability of archive storage and volatility is dependent on the archive medium used. The IMPAX CV PACS AE will stop accepting new objects for storage to ensure the availability of objects for which a successful storage commitment response has been sent.

The IMPAX CV PACS AE can be configured to not archive objects received from a remote AE. A successful storage commitment request will be returned to the remote AE, however the persistence of storage will be dependent on the amount of storage capacity available on the IMPAX CV PACS AE and disk management configuration settings of the system.

#### 2.2.1.6.3.4 Storage Commitment Result

If the IMPAX CV PACS AE determines that it has successfully completed storage commitment, the IMPAX CV PACS AE issues an N-EVENT-REPORT to the SCU including references to the successfully stored SOP Instances contained in the N-ACTION.

In the event that the IMPAX CV PACS AE cannot commit to storing SOP Instances, the IMPAX CV PACS AE issues an N-EVENT-REPORT to the SCU including references to the failed SOP Instances contained in the N-ACTION.

The N-EVENT-REPORT contains the Transaction UID value contained in the initiating N-ACTION. The N-EVENT-REPORT is sent on a separate association from the N-ACTION operation.

The IMPAX CV PACS AE supports the Event Information as specified in Table 2.2-31. The IMPAX CV PACS AE does not support the optional Storage Media, File-Set ID, UID or Retrieve AE Title (0008,0054) Attributes in the N-EVENT-REPORT.

**Table 2.2-31: Storage Commitment Result – Event Information**

Action Type Name	Event Type ID	Attribute Name	Tag
Storage Commitment Request Successful	1	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		>Referenced SOP Class UID	(0008,1150)
		>Referenced SOP Instance UID	(0008,1155)
Storage Commitment Request Complete-Failures Exist	2	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		>Referenced SOP Class UID	(0008,1150)
		>Referenced SOP Instance UID	(0008,1155)
		Failed SOP Sequence	(0008,1198)
		>Referenced SOP Class UID	(0008,1150)
		>Referenced SOP Instance UID	(0008,1155)
		>Failure Reason	(0008,1197)

#### 2.2.1.6.4 Real World Activity – Find Objects (SCP)

##### 2.2.1.6.4.1 Description and Sequencing of Activity

The IMPAX CV PACS AE supports DICOM queries as an SCP from a Remote Application Entity. The incoming Find is converted to a query of the mapped information volume. The



returned query results from the information volume are passed on the Remote Application Entity.

#### 2.2.1.6.4.2 Accepted Presentation Contexts

**Table 2.2-32: Accepted Presentation Contexts for IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian,	1.2.840.10008.1.2	SCP	None
		Explicit VR Big Endian,	1.2.840.10008.1.2.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian,	1.2.840.10008.1.2	SCP	None
		Explicit VR Big Endian,	1.2.840.10008.1.2.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

#### 2.2.1.6.4.3 SOP Specific Conformance – Find Objects

The IMPAX CV PACS AE supports hierarchical queries and not relational queries with all mandatory Key Attributes. Attributes are only returned if requested in the query with the exception of Retrieve AE Title, Instance Availability, and Query-Retrieve Level which are always required by IHE and DICOM. Table 2.2-33 through Table 2.2-36 describe the Key Attributes supported at a given query/retrieve information model.

Specific Character Set (0008,0005) will be included if needed at every query level. If present in the response, Specific Character Set will be used to identify character sets other than the default character set for display of strings.

If patient demographics have been updated or reconciled from a trusted source system (e.g., Hospital Information System (HIS)), the updated information is used to determine matches against the IMPAX CV PACS database and is returned in C-FIND responses to the destination AE.

The following notation is used in the Matching Key Attribute tables below to describe which matching types are supported:

An “S” indicates the identifier attribute uses Single Value Matching, an “R” indicates Range Matching, an “\*” indicates Wildcard Matching, a “U” indicates Universal Matching, and an “L” indicates that UID lists are sent. “UNIQUE” indicates that this is the Unique Key for that query level, in which case Universal Matching or Single Value Matching is used depending on the query level.

Wildcard matching conforms to the specification in DICOM PS3.4, section C.2.2.2 with the following exceptions:

- Case sensitive matching is not performed
- '?' does not include the blank " " character.
- In a PN value representation, the last three name components, middle initial, prefix and suffix are treated as a '\*' if the field is blank.
- The free form name is contained in the last name field.
- The comma (,) can also be used as a delimiter along with the DICOM standard caret (^) delimiter.

**Table 2.2-33: Patient Level Matching Key Attributes**

Description	Tag	Matching Types
Patient Name	(0010,0010)	S, *, U
Patient ID	(0010,0020)	UNIQUE (for Patient Root Model) S, *, U (for Study Root Model)
Patient Birth Date	(0010,0030)	S, R, U
Patient Sex	(0010,0040)	S, U

**Table 2.2-34: Study Level Matching Key Attributes**

Description	Tag	Matching Types
Study Instance UID	(0020,000D)	UNIQUE, S, L
Study ID	(0020,0010)	U
Study Date	(0008,0020)	S, R, U
Study Time	(0008,0030)	U
Accession Number	(0008,0050)	U
Modalities in Study	(0008,0061)	U
Study Description	(0008,1030)	U
Referring Physician	(0008,0090)	S, *, U

**Table 2.2-35: Series Level Matching Key Attributes**

Description	Tag	Matching Types
Series Instance UID	(0008,000E)	UNIQUE, S, L
Series Number	(0020,0011)	U
Modality	(0008,0060)	S, U
Series Date	(0008,0021)	S, R, U
Series Time	(0008,0031)	U
Series Description	(0008,103E)	U
Performing Physician (see note 1)	(0008,1050)	S, *, U

**Table 2.2-36: Instance Level Matching Key Attributes**

Description	Tag	Matching Types
SOP Instance UID	(0008,0018)	UNIQUE, S
Image Number	(0020,0013)	U

**Note 1:**

The 'Performing Physician' key is not part of the standard Query and Retrieve Service Class, but is included because of customer necessity.

**Table 2.2-37: DICOM C-FIND Response Status Handling Behavior**

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete – No final identifier is supplied	0000	Matching dataset found successfully and no matching identifier is supplied.
Pending	Matches are continuing	FF00	Current match is supplied and any Optional keys were supported in the same manner as Required keys.
Pending	Matches are continuing	FF01	Warning that one or more Optional keys were not supported for existence and/or matching for this identifier.
Failure	Failed at performing DIMSE service user.	C001	Operation failed
Cancel	C-FIND terminated due to Cancel request	FE00	Due to C-FIND Cancel indication primitive.

### 2.2.1.6.5 Real World Activity – Retrieve/ Move Objects (SCP)

#### 2.2.1.6.5.1 Description and Sequencing of Activity

The IMPAX CV PACS AE also supports DICOM C-Move as an SCP from a Remote Application Entity. The incoming Move request shall transfer a copy of the designated study, series or SOP instance to the Destination Application Entity. The Destination Application Entity may or may not be the Application Entity that requested the retrieval of the study, series or SOP instance.

The IMPAX CV PACS AE will establish a new Association with the Remote AE specified in the Move Destination for the C-STORE sub-operations. The IMPAX CV PACS AE will propose the transfer syntax used when the object was initially accepted by the server and Implicit VR Little Endian.

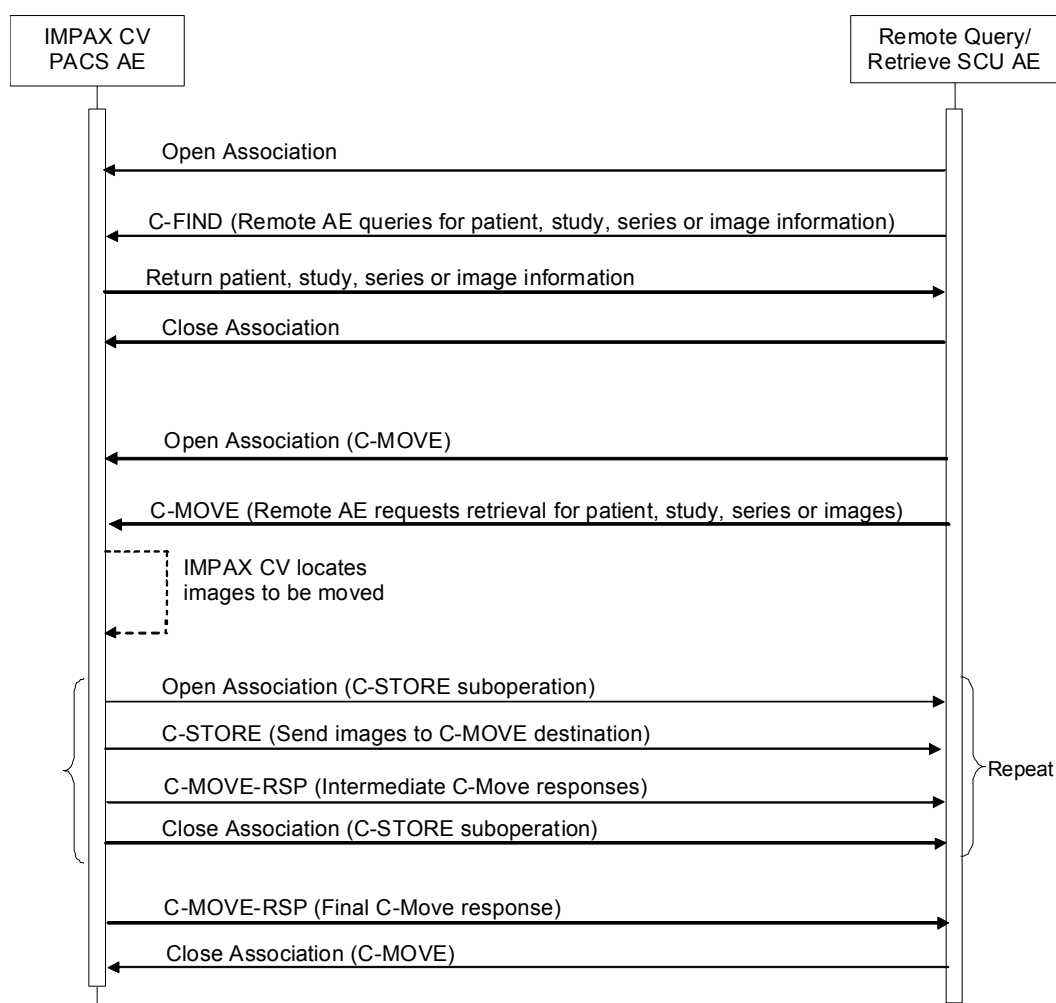


Figure 2.2-4: Query/ Retrieve Sequencing Diagram

### 2.2.1.6.5.2 Accepted Presentation Contexts

Table 2.2-38: Accepted Presentation Contexts for IMPAX CV PACS AE

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian,	1.2.840.10008.1.2	SCP	None
		Explicit VR Big Endian,	1.2.840.10008.1.2.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian,	1.2.840.10008.1.2	SCP	None
		Explicit VR Big Endian,	1.2.840.10008.1.2.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

### 2.2.1.6.5.3 SOP Specific Conformance – Retrieve/ Move Objects

When the IMPAX CV PACS AE services a C-MOVE-RQ as an SCP, it shall query the local information volume to get the file locations of each SOP instance to copy to the Destination Application Entity. It then spawns a secondary association to store each SOP instance on the Destination Application Entity. One association shall store only one SOP instance. So there can be several secondary associations used to store a study or a series. However, the associations are executed one at a time, not all at once. One or more of the Presentation Contexts listed in the Store section of this document may be negotiated in this association.

If patient demographics have been manually updated or reconciled from a trusted source system (e.g., Hospital Information System (HIS)), the updated information is taken from the IMPAX CV PACS database and copied into the objects before sending them to the destination AE.

The IMPAX CV PACS AE returns one of the following status codes to a C-MOVE request.

**Table 2.2-39: Retrieval C-MOVE Response Status**

Service Status	Further Meaning	Status Code	Reason
Success	Success	0000	Operation performed properly.
Failed	Refused: Out of Resources	A702	Unable to perform sub operations.
	Refused: Move destination unknown	A801	The destination of this move request is unknown.
	Unable to process	C000	Indicates that the <i>IMPAX CV PACS AE</i> cannot process this request at this time.
Cancel	Storage terminated due to Cancel Request	FE00	The original requester canceled this operation.
Pending	Pending	FF00	The storage operation is continuing.

When the IMPAX CV PACS AE sends a message with status = Pending (FF00), this will also include a progress report on the Move with:

- Number of Remaining Sub operations (0000,1020)
- Number of Completed Sub operations (0000,1021)
- Number of Failed Sub operations (0000,1022)
- Number of Warning Sub operations (0000,1023)

At the completion of the Move, with no Failed sub operations and even if there are Warning sub operations (C-STORE retries) the status is Success (0000) and includes:

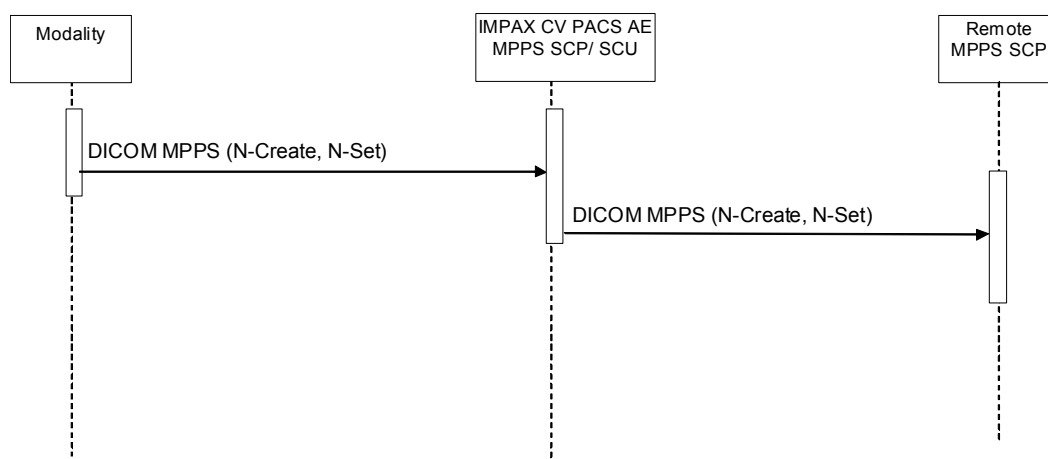
- Number of Remaining Sub operations (0000,1020)
- Number of Completed Sub operations (0000,1021)
- Number of Failed Sub operations (0000,1022)
- Number of Warning Sub operations (0000,1023)

## 2.2.1.6.6 Real World Activity – Remote Send/ Receive of MPPS Messages (SCP)

### 2.2.1.6.6.1 Description and Sequencing of Activity

The IMPAX CV PACS AE acts as an MPPS SCP only when it is configured to route DICOM N-CREATE or N-SET Modality Performed Procedure Step messages to one or more destinations in response to receiving N-CREATE or N-SET MPPS from an acquisition device. The IMPAX CV PACS AE sends the attribute values as received from the originator of the Modality Performed Procedure Step.

The following diagram shows the sequence of real world activities when the Integration Services AE receives a DICOM MPPS:.



**Figure 2.2-5: DICOM Performed Procedure Step Sequence Diagram**

### 2.2.1.6.6.2 Accepted Presentation Contexts

**Table 2.2-40: Accepted Presentation Contexts for IMPAX CV PACS AE**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Performed Procedure Step SOP Class	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

### 2.2.1.6.6.3 SOP Specific Conformance – Remote Send/ Receive of MPPS Messages

The IMPAX CV PACS AE provides standard conformance to the DICOM Modality Performed Procedure Step Service Class as an SCP.

The IMPAX CV PACS AE returns one of the following status codes in the N-SET-RSP:

**Table 2.2-41: Modality Performed Procedure Step SCP Response Status**

Service Status	Further Meaning	Error Code	Reason
Success	Success	0000	Operation performed properly
Failure	Processing Failure: Performed Procedure Step may no longer be updated	0110	Sent when an SCU attempts to update a performed procedure step which is COMPLETED or DISCONTINUED

## 2.3 Network Interfaces

The IMPAX Cardiovascular 7.7 and 7.8 Solutions provide DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8 of the DICOM Standard. The IMPAX Cardiovascular 7.7 and 7.8 Solutions inherit their TCP/IP stack from the computer system upon which they execute.

### 2.3.1 Physical Medium Support

The IMPAX Cardiovascular 7.7 and 7.8 Solutions are indifferent to the physical medium over which TCP/IP executes; it inherits the medium from the computer system upon which it is being executed.

## 2.4 Configuration

Any configuration of the IMPAX Cardiovascular 7.7 and 7.8 Solutions that affect DICOM conformance is described in this section.

### 2.4.1 AE Title/ Presentation Mapping

The IMPAX Cardiovascular 7.7 and 7.8 Solutions contain an Application Entity (AE) database. Both local and remote Aes are configured in the same database. A local AE can also be configured as a remote AE for loop back operation.

An AE is defined as “local” if it is mapped to an information volume on the same machine as the AE. An AE can be mapped to one and only one information volume. However, a single information volume can be mapped to by more than one AE.

A “remote” AE is any AE that has an IP address and port number that is used as the connection point when using the AE as a target of a DICOM association.

It is also possible for “local” Aes to configure another local IMPAX CV AE DICOM network connection endpoint as a “remote” AE. This allows a user using the IMPAX CV DICOMservice application’s GUI to specify a “local” AE as a “remote” AE. This is loop back operation and can be used for testing purposes and moving studies from one local information volume to another.

## 2.4.2 Configuration Parameters

**Table 2.4-1: IMPAX CV PACS AE Configuration Parameter Table**

Parameter	Configurable (Yes/No)	Default Value
<b>AE Specific Parameters</b>		
Listening Hostname	Yes	This is automatically configured by the IMPAX CV DICOMservice component. Multiple addresses are possible
Listening Port number	Yes. Multiple ports are possible	port 104
Remote Application Entity Title	Yes	
Remote Application Entity hostname or IP address	Yes	
Remote Application Entity Port number	Yes	
DICOMDataSet: Enable Group Length Tags	No	0 (false)
DicomUpperLayerServer: Acceptable Transfer Syntax UIDs	No	1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.5 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2
ARTIM Timeout (Association reject/ release timer)	Yes	15
SC Query Timeout Minutes	Yes	60
SC Resend Timeout Minutes	Yes	24*60 = 1440
<b>A-Association-RQ Settings</b>		
Async Operation Window Sub-Item	Yes	0 (false)
MaximumLengthPDU	Yes	0 (unlimited)
Match Offered MaximumLengthPDU	Yes	0 (unlimited)
SCU SCP Role Negotiation Sub-Item	Yes	1 (True)
SOPClass Extended Negotiation Sub-Item	Yes	0 (false)



## 3 MEDIA INTERCHANGE

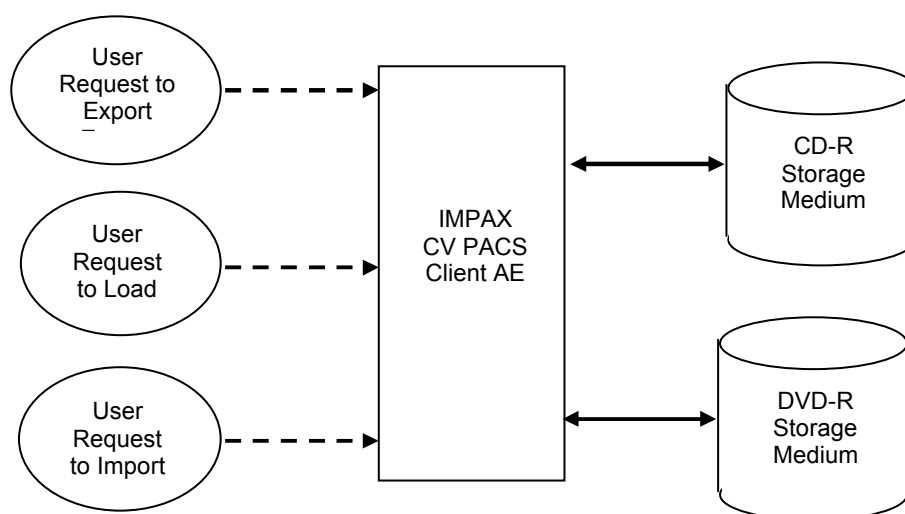
### 3.1 Implementation Model

The IMPAX CV PACS Client AE is a component of the IMPAX Cardiology Review Station (IMPAX CRS) image reviewing software application that reads and displays DICOM compliant x-ray angiographic and cardiac ultrasound studies from interchange media. The IMPAX CRS can also read studies that have been imported from CD-R or DVD-R to the local or network hard disk, or received directly from the modality and stored on a network hard disk.

When requested by the user, the IMPAX CV PACS Client AE opens the x-ray angiographic, cardiac ultrasound, nuclear cardiology, CT, or MRI study from interchange media, and reads the pertinent patient demographic information from the media. When the series is selected, the IMPAX CRS presents icons representing each image.

When the user selects one of these icons, the IMPAX CV PACS Client AE accesses the media to obtain the DICOM image data. The IMPAX CRS then displays the image data.

#### 3.1.1 Application Data Flow Diagram



**Figure 3.1-1: IMPAX CV PACS Client AE Media Application Data Flow Diagram**

The following data flows are depicted in the diagram:

- The IMPAX CV PACS Client AE exports exams to CD-R or DVD-R storage medium. It is associated with the local real-world activity “Export Exams”. It is optional to export a DICOM viewer along with the exams. “Export Exams” is performed upon user request for selected patients, studies, series and instances (images, presentation states and other non-image objects).
- The IMPAX CV PACS Client AE loads exams from the CD-R or DVD-R storage medium. It is associated with the local real-world activity “Load Exams”. It is performed upon user request to browse the content of the CD-R or DVD-R storage medium and then display

selected patients, studies, series or instances (images, presentation states and other non-image objects).

- The IMPAX CV PACS Client AE imports exams from the CD-R or DVD-R storage medium to its associated IMPAX CV PACS AE. It is associated with the real-world activity "Import Exams". It is performed upon user request to import selected patients, studies, series or instances (images, presentation states and other non-image objects).

### 3.1.2 Functional Definition of Aes

The IMPAX CV PACS Client AE performs these function(s):

- Reads the DICOMDIR file for the presentation of basic patient demographics and image thumbnails.
- Displays the DICOM images.
- Copies selected series from a selected source volume to a selected destination volume. The source volume may be either a CD, CD-R or DVD-R disk, or local or network available hard disk. The destination volume can be either a CD-R or DVD-R disk or local or network available hard disk.
- Takes user selected images and creates a DICOMDIR file for selected images when creating a CD-R. It then writes the DICOMDIR file and images out to a CD-R or DVD-R. The resultant CD-R or DVD-R is compliant to the DICOM Part 10 standard.

### 3.1.3 Sequencing of Real World Activities

To view an image, the IMPAX CV PACS Client requires the user to either input a DICOM Part 10 compliant interchange medium or to select a study/series from the available local or network media.

To create a CD-R or DVD-R, the user selects which study/series to write out to the CD-R or DVD-R disk. The user then loads the selected CD-R or DVD-R writer with a blank disk and then tells the IMPAX CV PACS Client to write the disk. IMPAX CV PACS Client alerts the user when it has finished writing the disk.

### 3.1.4 File Meta Information for Implementation Class and Version

**Table 3.1-1: File Meta Information for Implementation Class and Version**

<b>File Meta Information Version</b>	0x00 0x01
<b>Implementation Class UID</b>	1.2.840.113815. 4.2.buildnum (see note 1)
<b>Implementation Version Name</b>	Heartlab DICOMTK

#### **Note 1:**

The suffix after the Agfa HealthCare Implementation Class UID root: 1.2.840.113815 is subject to change without notice.

## 3.2 AE Specifications

### 3.2.1 IMPAX CV PACS Client AE Specification

The IMPAX CV PACS Client AE provides standard conformance to the DICOM Media Storage Device Class.

**Table 3.2-1: AE Related Application Profiles, Real World Activities and Roles**

Supported Application Profiles	Real-World Activities	Roles
STD-GEN-CD	Export Exams; Load Exams; Import Exams	FSC; FSR; FSR
STD-XABC-CD	Export Exams; Load Exams; Import Exams	FSC; FSR; FSR
STD-XA1K-CD	Export Exams; Load Exams; Import Exams	FSC; FSR; FSR
STD-CTMR-CD	Export Exams; Load Exams; Import Exams	FSC; FSR; FSR
STD-US-CD (see note 1)	Export Exams; Load Exams; Import Exams	FSC; FSR; FSR
STD-GEN-DVD-JPEG	Export Exams; Load Exams; Import Exams	FSC; FSR; FSR

**Note 1:**

The DICOM Standard defines a number of “sub-classes” for the Ultrasound (US) Media Application Profiles using the following Profile naming convention: STD-US-XX-YY-{media type} where XX can be one of: ID (= Image Display), SC (= Spatial Calibration) or CC (= Combined Calibration) and where YY can be one of: SF (= single frame) or MF (= multi-frame) (see DICOM PS 3.11 section C.1).

The IMPAX CV PACS Client AE supports all combinations of display/calibration for both single and multi-frame US objects on CD media. The Profile identifier: STD-US-CD will be used throughout the remainder of this Conformance Statement to indicate all of these combinations on CD media.

**3.2.1.1 Real World Activities****3.2.1.1.1 Real World Activity – Export Exams**

The IMPAX CV PACS Client AE acts as a File-Set Creator (FSC) when export patient exams to an interchange media. It creates the DICOM Directory structure with references to the exam objects.

The user will be prompted to insert an empty CD-R or DVD-R for each patient or study exported. The contents of the export will be written together with a corresponding DICOMDIR and optionally a DICOM viewer to a single-session CD-R or DVD-R. Writing in multi-session mode is not supported.

**3.2.1.1.1.1 Media Storage Application Profile Specific Conformance**

The IMPAX CV PACS Client AE supports the STD-GEN-CD, STD-XABC-CD, STD-XA1K-CD, STD-CTMR-CD, STD-US-CD and STD-GEN-DVD-JPEG Application Profiles. It supports the SOP classes and transfer syntaxes listed in Table 3.2-2 through Table 3.2-7.

**Table 3.2-2: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSC for STD-GEN-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
All IODs and SOP Class UIDs listed in the Transfer section of Table 2.2-1		Explicit VR Little Endian	1.2.840.10008.1.2.1

**Table 3.2-3: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSC for STD-XABC-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70

**Table 3.2-4: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSC for STD-XA1K-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70

**Table 3.2-5: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSC for STD-CTMR-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
CT Image	1.2.840.10008.5.1.4.1.1.2	Original File transfer syntax is used	
MR Image	1.2.840.10008.5.1.4.1.1.4	Original File transfer syntax is used	
Secondary Capture Image (grayscale)	1.2.840.10008.5.1.4.1.1.7	Original File transfer syntax is used	

**Table 3.2-6: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSC for STD-US-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Original File transfer syntax is used	
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Original File transfer syntax is used	

**Table 3.2-7: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSC for STD-GEN-DVD-JPEG**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70
CT Image	1.2.840.10008.5.1.4.1.1.2	Original File transfer syntax is used	
MR Image	1.2.840.10008.5.1.4.1.1.4	Original File transfer syntax is used	
Secondary Capture Image (grayscale)	1.2.840.10008.5.1.4.1.1.7	Original File transfer syntax is used	
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Original File transfer syntax is used	
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Original File transfer syntax is used	

### 3.2.1.1.2 Real World Activity – Load Exams

The IMPAX CV PACS Client AE acts as a File Set Reader (FSR) when reviewing images directly off the interchange media. It retrieves the references to the exam objects based on the DICOM Directory structure and then presents a list of all the available exams to the user. Then the user can select a study and display the objects using the location references retrieved from the DICOM Directory structure. The IMPAX CV PACS Client AE will filter out SOP Instances that do not match the supported SOP Class/ Transfer Syntax pairs.

#### 3.2.1.1.2.1 Media Storage Application Profile Specific Conformance

The IMPAX CV PACS Client AE supports the STD-GEN-CD, STD-XABC-CD, STD-XA1K-CD, STD-CTMR-CD, STD-US-CD and STD-GEN-DVD-JPEG Application Profiles. It supports the SOP classes and transfer syntaxes listed in Table 3.2-8 through Table 3.2-12.

**Table 3.2-8: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSR for STD-GEN-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
All IODs and SOP Class UIDs listed in the Transfer section of Table 2.2-1		Explicit VR Little Endian	1.2.840.10008.1.2.1

**Table 3.2-9: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSR for STD-XABC-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70

**Table 3.2-10: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSR for STD-XA1K-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70
Secondary Capture Image (grayscale)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian	1.2.840.10008.1.2.1

**Table 3.2-11: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSR for STD-CTMR-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
CT Image	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian	1.2.840.10008.1.2.1
CT Image	1.2.840.10008.5.1.4.1.1.2	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70
MR Image	1.2.840.10008.5.1.4.1.1.4	Explicit VR Little Endian	1.2.840.10008.1.2.1
MR Image	1.2.840.10008.5.1.4.1.1.4	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70
Secondary Capture Image (grayscale)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian	1.2.840.10008.1.2.1
Secondary Capture Image (grayscale)	1.2.840.10008.5.1.4.1.1.7	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70

**Table 3.2-12: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSR for STD-US-CD**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian	1.2.840.10008.1.2.1
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	RLE Lossless	1.2.840.10008.1.2.5
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian	1.2.840.10008.1.2.1
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	RLE Lossless	1.2.840.10008.1.2.5
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50

**Table 3.2-13: SOP Classes and Transfer Syntaxes supported by IMPAX CV PACS Client AE as an FSR for STD-GEN-DVD-JPEG**

Image Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70
CT Image	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian	1.2.840.10008.1.2.1
CT Image	1.2.840.10008.5.1.4.1.1.2	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70
MR Image	1.2.840.10008.5.1.4.1.1.4	Explicit VR Little Endian	1.2.840.10008.1.2.1
MR Image	1.2.840.10008.5.1.4.1.1.4	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70
Secondary Capture Image (grayscale)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian	1.2.840.10008.1.2.1
Secondary Capture Image (grayscale)	1.2.840.10008.5.1.4.1.1.7	JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian	1.2.840.10008.1.2.1
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	RLE Lossless	1.2.840.10008.1.2.5
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian	1.2.840.10008.1.2.1
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	RLE Lossless	1.2.840.10008.1.2.5
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50

### 3.2.1.1.3 Real World Activity – Import Exams

The IMPAX CV PACS Client AE acts as a File Set Reader (FSR) when importing images from interchange media to local storage. It retrieves the references to the exam objects based on the DICOM Directory structure. Then using the location references retrieved, it transmits the objects to its associated PACS AE via internal mechanisms. The IMPAX CV PACS Client AE will filter out SOP Instances that do not match the supported SOP Class/Transfer Syntax pairs.

#### 3.2.1.1.3.1 Media Storage Application Profile Specific Conformance

The IMPAX CV PACS Client AE supports the STD-GEN-CD, STD-XABC-CD, STD-XA1K-CD, STD-CTMR-CD, STD-US-CD and STD-GEN-DVD-JPEG Application Profiles. It supports the SOP classes and transfer syntaxes listed in Table 3.2-8 through Table 3.2-12.

## 3.3 Augmented and Private Application Profiles

### 3.3.1 Augmented Application Profiles

None

### 3.3.2 Private Application Profiles

None

## 3.4 Media Configuration

None



## 4 SUPPORT FOR EXTENDED CHARACTER SETS

The IMPAX Cardiovascular 7.7 and 7.8 Solutions support the following character sets:

DICOM Defined Term	ISO Registration Number	Character Set
None	ISO-IR 6	ASCII (ISO 646)
ISO_IR 100	ISO-IR 100	Latin Alphabet No. 1
ISO 2022 IR 87	ISO-IR 87	JIS X 0208: Kanji (Kanji and full width kana)
ISO_IR 13	ISO-IR 13	JIS X 0201: Katakana (half width kana)
ISO_IR 13	ISO-IR 14	JIS X 0201: Romaji
ISO 2022 IR 159	ISO-IR 159	JIS X 0212: Supplementary Kanji set

## **5 SECURITY**

### **5.1 Security Profiles**

The IMPAX Cardiovascular 7.7 and 7.8 Solutions do not implement any DICOM security profiles from PS 3.15.

### **5.2 Association Level Security**

The IMPAX Cardiovascular 7.7 and 7.8 Solutions provide association level security by restricting acceptance to association requests only from DICOM Aes configured in the IMPAX Cardiovascular 7.7 and 7.8 Solutions. Association requests from unknown DICOM Aes will be rejected.

### **5.3 Application Level Security**

Administration Tools that are part of the IMPAX Cardiovascular 7.7 and 7.8 Solutions require a valid user name and password pair to login.

## **6 ANNEXES**

### **6.1 IOD Contents**

#### **6.1.1 Created SOP Instance(s)**

The only SOP instances created by the IMPAX CV PACS AE are secondary capture objects based off of existing images. Attributes specific to the secondary capture SOP class being created are populated to ensure the created object complies with the DICOM specification for that SOP class (i.e., only type 1 and type 2 attributes are guaranteed to be present in the objects). All attributes of the created objects are copied from the original objects, or taken from the database cases where patient demographics have been updated or reconciled from a trusted source system (e.g., Hospital Information System (HIS)).

#### **6.1.2 Usage of Attributes from received IODs**

The IMPAX CV PACS AE has no behaviors that depend on specific attributes or attribute values beyond what is specified in the DICOM standard.

#### **6.1.3 Attribute Mapping**

Not Applicable.

#### **6.1.4 Coerced/ Modified Fields**

Not Applicable.

### **6.2 Data Dictionary of Private Attributes**

Not Applicable.

### **6.3 Coded Terminology and Templates**

The IMPAX CV PACS AE can import measurements for subsequent display from the following DICOM SR template IDs (TIDs): TID 5100 – Vascular Ultrasound Report and TID 5200 – Echocardiography Procedure Report. The list of ultrasound cart vendor/ models supported are included in Table 6.3-1.

**Table 6.3-1: Table of DICOM SR templates supported for measurement import per ultrasound cart/model**

Ultrasound Cart Vendor	Ultrasound Cart Model (SW version verified)	TID 5100 Supported	TID 5200 Supported
Philips	iE33 & iU22 (5.1.0.206)	Yes	Yes
Philips	CX50 (CX50_203)	No	Yes
Philips	HD15 (CX50_203)	No	Yes
Philips	EPIQ 5 & EPIQ 7 (EPIQ_1.0.0.2071)	Yes <sup>3</sup>	Yes <sup>4</sup>
Siemens	SC2000 (VA30A)	Yes	Yes
Siemens	S2000 (VB10B)	Yes	Yes
Siemens	X300 (3.12.027)	Yes	Yes
Siemens	Sequoia (12.0)	Yes	Yes
GE	Vivid E9 (108.1.4)	Yes	Yes
GE	Vivid S5/ S6 (11.0.0 build 11)	Yes	Yes
GE	Vivid q (10.1.0 build 65)	Yes	Yes
GE	Vivid I (11.0.0 build 11)	Yes	Yes
GE	Vivid 7 (vivid7:6.1.1)	No	Yes
Aloka	Alpha 10	No	Yes
Zonare	z.one (v4.0.114)	Yes	No

**6.4 Grayscale Image Consistency**

None

**6.5 Standard Extended / Specialized / Private SOPs**

None

**6.6 Private Transfer Syntaxes**

None

<sup>3</sup> Support for the Vascular Ultrasound Procedure Reports (TID 5100) for the Philips EPIQ 5 and EPIQ 7 carts was initially introduced in the IMPAX CV 7.8.SU7 release.

<sup>4</sup> Support for the Adult Echocardiography Procedure Reports (TID 5200) for the Philips EPIQ 5 and EPIQ 7 carts was initially introduced in the IMPAX CV 7.8.SU6 release.