

# AGFA HEALTHCARE DICOM Conformance Statement



## IMPAX Data Center Viewer - Powered by XERO

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## Document Information

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## Conformance Statement Overview

This document is a DICOM Conformance Statement for the DICOM Services of the “IMPAX Data Center Viewer – Powered by XERO” product, henceforward called Xero. Xero is comprised of a server based display client. Xero is a single Application Entity that queries DICOM services for patient, study and object information, and retrieves DICOM objects from these DICOM services for display to a remotely connected client. That is, there are 3 parts: DICOM service, Xero Server acting as an AE, and Xero clients interacting with the Xero service, not using DICOM. The normal method for Xero to access DICOM objects is direct file access to the PACS system, not the standard C-Move. For direct file access, the “accepted” SOP classes should be interpreted as those which can be displayed.

Xero displays objects such as Images, Key Image Notes, Presentation States, Structured Reports and encapsulated PDF. There is also some preliminary support for other object types, indicated in the table below as “Beta”.

Xero acts as a **service class provider (SCP)** for Verification and (temporary) Storage.

Xero acts as a **service class user (SCU)** for Query/Retrieve Service Classes.

Xero conforms to the DICOM 3.0 2008 standard.

Xero provides Standard Conformance to the SOP Classes listed in Table 1.1-1. This table lists the Network Services Supported as they appear in DICOM Supplement 64, Table A.1-2. The italicized items represent SOP classes that have been retired (so no longer appear in Supplement 64) but are still supported by Xero.

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

SOP Class Name	SOP Class UID	SCU	SCP	Display
<b>Verification</b>				
Verification	1.2.840.10008.1.1	No	Yes	N/A
<b>Transfer</b>				
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	No	Yes	Yes
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	No	Yes	Yes
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	No	Yes	Yes
Digital Mammography X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	No	Yes	Yes
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	No	Yes	Yes
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	No	Yes	Yes
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	No	Yes	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	No	Yes	Yes
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	No	Yes	Yes
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	No	Yes	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	No	Yes	Yes
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	No	Yes	Yes
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	No	Yes	Yes
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	No	Yes	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	No	Yes	Yes
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	No	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	No	Yes	Yes
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	No	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP	Display
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	No	Yes	Yes
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	No	Yes	Beta
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	No	Yes	Beta
Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3	No	Yes	Beta
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1	No	Yes	Beta
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1	No	Yes	Beta
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1	No	Yes	Beta
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	No	Yes	Yes
Color Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.2	No	Yes	Yes
Pseudo-Color Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.3	No	Yes	No
Blending Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.4	No	Yes	No
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	No	Yes	Yes
Enhanced XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1	No	Yes	Yes
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	No	Yes	Yes
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1	No	Yes	Yes
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	No	Yes	Yes
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	No	Yes	No
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1	No	Yes	No
Spatial Fiducials Storage	1.2.840.10008.5.1.4.1.1.66.2	No	Yes	Yes
Deformable Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.3	No	Yes	No
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4	No	Yes	No
Real World Value Mapping Storage	1.2.840.10008.5.1.4.1.1.67	No	Yes	No
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	No	Yes	Yes
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	No	Yes	Yes
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	No	Yes	Yes
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	No	Yes	Yes
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	No	Yes	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	No	Yes	Yes
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	No	Yes	Yes
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	No	Yes	Yes
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2	No	Yes	Yes
Stereometric Relationship Storage	1.2.840.10008.5.1.4.1.1.77.1.5.3	No	Yes	No
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	No	Yes	Yes
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	No	Yes	Yes
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	No	Yes	Yes
Procedure Log Storage	1.2.840.10008.5.1.4.1.1.88.40	No	Yes	No
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	No	Yes	Yes <sup>1</sup>
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	No	Yes	Yes
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	No	Yes	Yes <sup>2</sup>
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	No	Yes	Yes
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	No	Yes	Yes
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	No	Yes	Yes
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	No	Yes	Yes
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	No	Yes	Yes
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	No	Yes	No
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	No	Yes	No
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	No	Yes	Yes

<sup>1</sup> Only displayed as regular SR, not custom markups for CAD issues.

<sup>2</sup> Only displayed as regular SR, not custom markups for CAD issues.

SOP Class Name	SOP Class UID	SCU	SCP	Display
RT Brachy Treatment Storage	1.2.840.10008.5.1.4.1.1.481.6	No	Yes	No
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7	No	Yes	No
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8	No	Yes	No
RT Ion Beams Plan Storage	1.2.840.10008.5.1.4.1.1.481.9	No	Yes	No
<i>Hardcopy Grayscale Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.1.29</i>	No	Yes	Yes
<i>Hardcopy Color Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.1.30</i>	No	Yes	Yes
<i>Nuclear Medicine Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.5</i>	No	Yes	Yes
<i>Ultrasound Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.6</i>	No	Yes	Yes
<i>Ultrasound Multi-frame Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.3</i>	No	Yes	Yes
<i>X-Ray Angiographic Bi-plane Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.12.3</i>	No	Yes	Yes
<i>Standalone Overlay Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.8</i>	No	Yes	No
<i>Standalone Curve Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.9</i>	No	Yes	No
<i>Standalone Modality LUT Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.10</i>	No	Yes	No
<i>Standalone VOI LUT Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.11</i>	No	Yes	No
<i>Standalone PET Curve Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.129</i>	No	Yes	No
<i>VL Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.77.1</i>	No	Yes	Yes
<i>VL Multi-frame Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.77.2</i>	No	Yes	Yes
<b>Query/Retrieve</b>				
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	No	
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	No	
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No	
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No	
Patient/Study Only Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	Yes	No	
Patient/Study Only Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	Yes	No	

## Table of Contents

1	Introduction .....	8
1.1	Revision Record .....	8
1.2	Purpose and Intended Audience of this Document .....	8
1.3	General Remarks .....	8
1.3.1	Integration and Validation Activities.....	8
1.3.2	Future Evolution .....	8
1.4	Acronyms and Abbreviations .....	9
1.5	Related Documents .....	9
2	Networking .....	10
2.1	Implementation Model .....	10
2.1.1	Application Data Flow Diagram .....	10
2.1.2	Functional Definitions of AE's .....	10
2.1.2.1	Application Entity: Storage-SCP.....	10
2.1.2.2	Application Entity: Query/Retrieve-SCU .....	11
2.2	AE Specifications.....	12
2.2.1	AE Specification: Storage-SCP, Retrieve-SCU.....	12
2.2.1.1	Default Transfer Syntaxes Supported.....	12
2.2.1.2	Extended Syntaxes Supported.....	12
2.2.1.3	Storage SOP Classes Supported .....	12
2.2.1.4	Association Establishment Policies .....	15
2.2.1.4.1	General .....	15
2.2.1.4.2	Number of Associations .....	15
2.2.1.4.3	Asynchronous Nature .....	15
2.2.1.4.4	Called/Calling Titles .....	15
2.2.1.5	Association Initiation Policies .....	15
2.2.1.5.1	Real World Activity – Query/Retrieve Remote AE (SCU).....	15
2.2.1.5.1.1	Description and Sequencing of Activity.....	15
2.2.1.5.1.2	Proposed Presentation Contexts.....	16
2.2.1.5.1.3	SOP Specific Conformance.....	16
2.2.1.6	Association Acceptance Policies .....	17
2.2.1.6.1	Real World Activity – Image or other Composite DICOM Object Sent by Remote AE (SCP) 17	
2.2.1.6.1.1	Description and Sequencing of Activity.....	17
2.2.1.6.1.2	Accepted Presentation Contexts .....	17
2.2.1.6.1.3	SOP Specific Conformance – Image or other Composite DICOM Object Sent by Remote AE (SCP) .....	19
2.2.1.6.1.4	Presentation Context Acceptance Criterion .....	19
2.2.1.6.1.5	Transfer Syntax Selection Policies .....	19
2.3	Network Interfaces.....	19
2.3.1	Supported Communication Stacks .....	19
2.3.1.1	TCP/IP Stack.....	19
2.3.2	Physical Network Interface .....	19
2.4	Configuration.....	20
2.4.1	AE Title/Presentation Address Mapping .....	20
2.4.1.1	Local AE Titles .....	20
2.4.1.2	Remote AE Title .....	20
2.4.2	Parameters.....	20
3	Media .....	22

---

4	Support for Extended Character Sets.....	23
4.1	Overview .....	23
4.2	Support for Extended Character Sets.....	23
5	Security .....	24
5.1	Security Profiles .....	24
5.2	Association Level Security .....	24
5.3	User Interface Security .....	24
6	Support of Web Access to DICOM Persistent Objects (WADO) .....	25
7	Annexes .....	26
7.1	IOD Contents.....	26
7.2	Created SOP Instances .....	26
7.3	Usage of Attributes from Received IOD's .....	26
7.4	Attribute Mapping .....	26
7.5	Coerced/Modified fields .....	26
7.6	Data Dictionary of Private Attributes.....	26
7.7	Coded Terminology and Templates .....	26
7.8	Grayscale Image Consistency .....	26
7.9	Standard Extended/Specialized/Private SOP Classes.....	26
7.10	Private Transfer Syntaxes.....	26

# 1 INTRODUCTION

## 1.1 Revision Record

DICOM Conformance Statement IMPAX Data Center Viewer – Powered by Xero		
Revision Number	Date	Reason for Change
1.0	2010-02-23	Initial revision (based on Document ID 28966316 – version 3)
1.1	2010-04-12	Update table 1.1-1 : Network services supported

## 1.2 Purpose and Intended Audience of this Document

This document is a DICOM Conformance Statement for the DICOM Services of the IMPAX Data Center Viewer - Powered by XERO product, henceforward called Xero.

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 between IMPAX and other DICOM devices, it is not sufficient to guarantee the interoperation of the two DICOM Application Entities. 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
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
MSPS	Modality Scheduled Procedure Step
MWL	Modality Worklist
NEMA	National Electrical Manufacturers Association
PDU	DICOM Protocol Data Unit
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)
SOP	DICOM Service-Object Pair
TCP/IP	Transmission Control Protocol / Internet Protocol
UID	Unique Identifier
VR	Value Representation

## 1.5 Related Documents

- ACR-NEMA Digital Imaging and Communications in Medicine (DICOM) V3.0.2008.
- IHE Radiology Technical Framework Revision 9 – Final Text, June 2008

## 2 NETWORKING

### 2.1 Implementation Model

#### 2.1.1 Application Data Flow Diagram

The Application Data Flow Diagrams in this section depict the DICOM data flow to and from Xero<sup>3</sup>.

Xero is logically divided into two different DICOM Application Entities:

- Storage-SCP
- Query/Retrieve-SCU

#### Application Entity: Storage-SCP

The **Storage-SCP AE** implements the DICOM Storage Service Class and the Verification Service Class as an SCP.

**NOTE:** In this release of Xero, all of the SCP activities are Beta features, used for connectathons, but not for field trial/installed applications at sites.

In the remote real-world activity labeled “Verify Communication”, a remote application entity (AE) initiates an association and requests verification from Xero. Assuming Xero receives the request, it responds to the remote AE and communication between the two AE’s has been verified.

#### Application Entity: Query/Retrieve-SCU

The **Query/Retrieve-SCU AE** implements the DICOM Query/Retrieve Service Classes as an SCU.

#### 2.1.2 Functional Definitions of AE’s

##### 2.1.2.1 Application Entity: Storage-SCP

*Summary:* Xero stores a received image in its entirety in its internal data store for viewing. Xero stores each image with the File Meta Information attached to it.

Xero does not store (long term archive) or have an index of any stored images, but directly uses the PACS for long term storage. Short term storage is used, but only for fast image display. That is, the patient, study and study organization can all be changed and Xero will see the changes.

*Details:* The Storage-SCP Application Entity waits for another application to connect at the presentation address configured for its Application Entity Title. When another application connects, the Storage-SCP AE expects it to be a DICOM application.

The Storage-SCP AE will accept Associations with Presentation Contexts for SOP Classes of the Verification and Storage Service Classes.

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<sup>3</sup>By default, Xero is configured to act as single Application Entity requesting/receiving information from remote AE’s, but it can also be configured to act as a different AE for each remote AE. Only one SCP AE is configurable, however, so all remote AE’s must be able to communicate with the single SCP AE (which may not be the same as any of the SCU AEs).

DICOM Instances received in a Storage Request are filed on local (attached/mounted) file system(s).

### **2.1.2.2 Application Entity: Query/Retrieve-SCU**

*Summary:* Xero acts as a Service Class User of C-Find to find information about a patient, study or objects, and then uses either C-Move to retrieve DICOM objects for viewing, or proprietary methods for direct DICOM object access.

*Details:* The Query/Retrieve-SCU Application Entity initiates a new association to a Remote Application Entity with the Find and/or Retrieve (Move) Service Classes. It specifies in the request the query parameters to select the study, series or SOP instances of interest to be retrieved or found, and for C-Move specifies the Move Destination AE.

## 2.2 AE Specifications

This section outlines the specifications for the Application Entities included in Xero.

### 2.2.1 AE Specification: Storage-SCP, Retrieve-SCU

#### 2.2.1.1 Default Transfer Syntaxes Supported

Storage-SCP provides Standard Conformance to the default transfer syntaxes listed in the following table:

**Table 2-1: Default Transfer Syntaxes**

Transfer Syntax	UID	SOP Class
Implicit VR Little Endian	1.2.840.10008.1.2	not Video

#### 2.2.1.2 Extended Syntaxes Supported

Storage-SCP provides Standard Conformance to the extended transfer syntaxes listed in the following table for the purposes of storage and retrieval:

**Table 2-2: Extended Transfer Syntaxes**

Transfer Syntax	UID	SOP Class
Explicit VR Little Endian <sup>4</sup>	1.2.840.10008.1.2.1	not Video
Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99	not Video
JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50	only Image
JPEG Process 2,4, extended lossy (12 bit)	1.2.840.10008.1.2.4.51	only Image
JPEG Process 14, lossless, Non-Hierarchical	1.2.840.10008.1.2.4.57	only Image
JPEG Process 14, selection value 1, lossless, Non-Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70	only Image
JPEG-LS Image Compression (Lossless Only)	1.2.840.10008.1.2.4.80	only Image
JPEG-LS Image Compression	1.2.840.10008.1.2.4.81	only Image
JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90	only Image
JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91	only Image
No Pixel Data	1.2.840.10008.1.2.4.96	Image / Video
No Pixel Data Deflate	1.2.840.10008.1.2.4.97	Image / Video
RLE Lossless	1.2.840.10008.1.2.5	only Image
MPEG2 Main Profile @ Main Level	1.2.840.10008.1.2.4.100	only Video

#### 2.2.1.3 Storage SOP Classes Supported

The Storage-SCP AE provides Standard Conformance to the following SOP Classes:

##### Notes

- This table lists the Network Services Supported as they appear in DICOM Supplement 64, Table A.1-2.
- The italicized items represent SOP classes that have been retired (so no longer appear in Supplement 64) but are still supported by IMPAX.

<sup>4</sup> LEE (Explicit Little Endian) is used for all group 2 elements including File Meta Information.

- Accepted support in the SCP column means that the object will be accepted if transmitted, but will not be displayed, and the user will not be able to see the object.
- Beta means the object is accepted, and has some beta level support for display.
- Report means the object is displayed as a report object without special handling.

**Table 2-3: SOP Classes for Storage-SCP**

SOP Class Name	SOP Class UID	SCP
Verification	1.2.840.10008.1.1	Yes
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes
Digital Mammography X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Yes
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Yes
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Yes
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	Yes
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Yes
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	Yes
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Yes
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Beta
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Beta
Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3	Beta
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1	Accepted
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1	Accepted
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1	Beta
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Yes
Color Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.2	Yes
Pseudo-Color Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.3	Accepted
Blending Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.4	Accepted
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Yes
Enhanced XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1	Yes
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Yes
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1	Yes
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Accepted
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1	Accepted
Spatial Fiducials Storage	1.2.840.10008.5.1.4.1.1.66.2	Accepted
Deformable Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.3	Accepted
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4	Accepted
Real World Value Mapping Storage	1.2.840.10008.5.1.4.1.1.67	Accepted
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Yes

SOP Class Name	SOP Class UID	SCP
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	Yes
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Yes
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	Yes
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2	Yes
Stereometric Relationship Storage	1.2.840.10008.5.1.4.1.1.77.1.5.3	Yes
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Yes
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Yes
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Yes
Procedure Log Storage	1.2.840.10008.5.1.4.1.1.88.40	Accepted
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	Report
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Yes
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	Yes
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	Report
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Report
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Report
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Report
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Report
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Report
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	Report
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Report
RT Brachy Treatment Storage	1.2.840.10008.5.1.4.1.1.481.6	Report
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7	Report
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8	Report
RT Ion Beams Plan Storage	1.2.840.10008.5.1.4.1.1.481.9	Report
<i>Hardcopy Grayscale Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.1.29</i>	<i>Yes</i>
<i>Hardcopy Color Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.1.30</i>	<i>Yes</i>
<i>Nuclear Medicine Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.5</i>	<i>Yes</i>
<i>Ultrasound Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.6</i>	<i>Yes</i>
<i>Ultrasound Multi-frame Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.3</i>	<i>Yes</i>
<i>X-Ray Angiographic Bi-plane Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.12.3</i>	<i>Yes</i>
<i>Standalone Overlay Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.8</i>	<i>Yes</i>
<i>Standalone Curve Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.9</i>	<i>Accepted</i>
<i>Standalone Modality LUT Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.10</i>	<i>Accepted</i>
<i>Standalone VOI LUT Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.11</i>	<i>Accepted</i>
<i>Standalone PET Curve Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.129</i>	<i>Accepted</i>
<i>VL Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.77.1</i>	<i>Yes</i>
<i>VL Multi-frame Image Storage (Retired)</i>	<i>1.2.840.10008.5.1.4.1.1.77.2</i>	<i>Yes</i>
Agfa Attribute Presentation State	1.2.124.113532.3500.7	Accepted
Siemens CSA Non-Image Storage	1.3.12.2.1107.5.9.1	Accepted
Dcm4che Encapsulated Document Storage	1.2.40.0.13.1.5.1.4.1.1.104.1	Accepted

## 2.2.1.4 Association Establishment Policies

### 2.2.1.4.1 General

The Storage-SCP AE only accepts Association Requests. The Storage-SCP AE will accept Association Requests for the Verification and Storage Services.

The DICOM standard application context name for DICOM 3.0 is always accepted.

**Table 2-4: DICOM Application Context**

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

Xero contains no limitations for maximum PDU size.

### 2.2.1.4.2 Number of Associations

The Storage-SCP AE can support multiple simultaneous Associations requested by peer AEs. No specific limit is set.

**Table 2-5: Number of Associations as an Association Acceptor for Storage-SCP**

Maximum number of simultaneous associations	Unlimited
---	-----------

### 2.2.1.4.3 Asynchronous Nature

The Storage-SCP AE supports asynchronous communication. Multiple outstanding transactions are supported. It allows more than one invoked and more than one performed operation on an Association. Asynchronous mode of operation is supported.

**Table 2-6: Asynchronous Nature as an Association Acceptor for Storage-SCP**

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

### 2.2.1.4.4 Called/Calling Titles

The AE Title of Xero can be configured at installation or initial configuration time. Multiple hosts within a single Xero installation can use the same or different AE Titles.

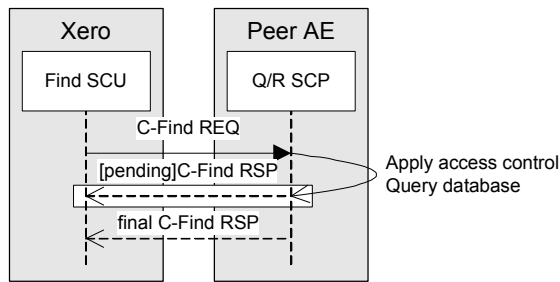
Xero validates the Called AE Title of the requesting SCU during association negotiation. Validation of the Calling AE Title is not performed.

## 2.2.1.5 Association Initiation Policies

### 2.2.1.5.1 Real World Activity – Query/Retrieve Remote AE (SCU)

#### 2.2.1.5.1.1 Description and Sequencing of Activity

Xero queries for patients and studies for a user to view. For a given study, Xero queries for series and images. Finally, for DICOM C-Move back ends Xero performs a Retrieve to the Xero AE. Not all PACS systems use C-Move retrieves in order to improve performance, configuration ease or other reasons.



### 2.2.1.5.1.2 Proposed Presentation Contexts

Xero will propose the Presentation Contexts listed in Table 2-7 for Find.

**Table 2-7: Presentation Contexts Accepted by IMPAX for Find Object (SCP)**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Private Study Root Query Retrieve All Information Model	1.2.40.0.13.1.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU (Query Only)	See Note 1
Patient Root Query/Retrieve IM Find	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	See Note 1
Study Root Query/Retrieve IM Find	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	See Note 1
Patient/Study Only Query/Retrieve IM Find	1.2.840.10008.5.1.4.1.2.3.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	See Note 1
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	

**Note 1:** C-Find Extended Negotiation for relational query will be requested for hierarchical query

### 2.2.1.5.1.3 SOP Specific Conformance

Xero provides standard conformance to the DICOM Query/Retrieve Service Class as an SCU.

Xero will use Relational-queries extended SCP behavior if available, and can fall back to non-Relational queries as required. For displaying a study, Xero requires Object level required return keys Rows, Columns in addition to SOP class, SOP instance UID and Instance Number. It will use other keys as available. For this purpose, it will not use the Patient Root abstract syntax.

**Table 2-8: Keys Used by Xero for Query/Retrieve**

Level	Key	Query Type	Displayed	Required
Patient	Patient Name	Universal Match	Yes	No
	Patient ID	Single Value (Sequence when permitted by remote PACS)	Yes	Yes
	Issuer of Patient ID	Single Value	No	No
Study	Accession Number	Universal Match	Yes	No
	Study Instance UID	UID	No	Yes
	Study ID	Universal Match	No	No
	Referring Physician	Universal Match	Yes	No
	Study Date	Range	Yes	Yes
	Modalities In Study	Single Value (also Sequence)	Yes	Yes
Series	Study Description	None	Yes	No
	Series Number	None	Yes	No
	Series Description	None	Yes	No
	SOP Class	UID	No	Yes
Instance	Instance Number	None	No	Yes
	Rows	None	No	Yes
	Columns	None	No	Yes
	Pixel Spacing	None	No	Yes

## 2.2.1.6 Association Acceptance Policies

### 2.2.1.6.1 Real World Activity – Image or other Composite DICOM Object Sent by Remote AE (SCP)

#### 2.2.1.6.1.1 Description and Sequencing of Activity

Xero will store images that are sent to it from a Storage SCU. Objects cannot be retrieved via DICOM from Xero.

#### 2.2.1.6.1.2 Accepted Presentation Contexts

Xero will accept any of the Presentation Contexts listed in Table 2-9 for Storage.

**Table 2-9: Presentation Contexts Accepted by Xero for Image DICOM Object Sent by Remote AE (SCP)**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	-
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	-
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	-
		RLE Lossless, PackBits	1.2.840.10008.1.2.5	SCP	-

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
		JPEG Process 1, baseline, lossy (8 bit)	1.2.840.10008.1.2.4.50	SCP	-
		JPEG Process 2,4, extended lossy (12 bit)	1.2.840.10008.1.2.4.51	SCP	-
		JPEG Process 14,	1.2.840.10008.1.2.4.57	SCP	-
		JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70	SCP	-
		JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90	SCP	-
		JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91	SCP	-

**Table 2-10: Presentation Contexts Accepted by Xero for Video DICOM Object Sent by Remote AE (SCP)**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
		MPEG2 Main Profile @ Main Level	1.2.840.10008.1.2.4.100	SCP	-

**Table 2-11: Presentation Contexts Accepted by Xero for SR and ECG DICOM Object Sent by Remote AE (SCP)**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	-
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	-
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	-
		Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99	SCP	-

**Table 2-12: Presentation Contexts Accepted by Xero for Other Composite DICOM Object Sent by Remote AE (SCP)**

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	-
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	-
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	-

### 2.2.1.6.1.3 SOP Specific Conformance – Image or other Composite DICOM Object Sent by Remote AE (SCP)

Xero conforms to the DICOM Storage Service Class as a Level 2 (Full) SCP. No elements are discarded or coerced by Xero. All Type 1, Type 2 and Type 3 attributes will be retained.

Xero will silently ignore duplicate objects by returning success (i.e. return status of 0000H).

Xero will return the C-STORE status codes shown in Table 2-13.

**Table 2-13: Verification Response Status for Image or other Composite DICOM Object Sent by IMPAX Storage SCP**

Service Status	Further Meaning	Error Code	Reason
Refused	Out of resources	A700	Indicates that there was not enough storage space to store the image. Recovery from this condition is left to the administrative functions.
Error	Data set does not match SOP Class	A900	Indicates that the Data Set does not encode an instance of the SOP Class specified.
	Processing Failure	110	The operation was not successful.
	Coercion of Data Elements	B000	Values of attributes were modified by the SCP to ensure consistency with former received objects belonging to the same Patient/Study/Series entity.
Success	Success	0000	Operation performed properly.

### 2.2.1.6.1.4 Presentation Context Acceptance Criterion

Xero will accept any number of Storage Presentation Contexts per association request. Any one Abstract Syntax may be specified more than once in an association request, if the Transfer Syntaxes differ between the Presentation Contexts.

### 2.2.1.6.1.5 Transfer Syntax Selection Policies

Xero supports all transfer syntaxes listed in Table 2-9. By default, Xero will choose a transfer syntax other than Implicit VR Little Endian if more than one is requested in a single Presentation Context. Xero will prefer a compressed Transfer Syntax over an uncompressed Transfer Syntax. Lossless Compression is preferred over Lossy Compression and Explicit VR Little Endian is preferred over Implicit VR Little Endian.

## 2.3 Network Interfaces

### 2.3.1 Supported Communication Stacks

DICOM Upper Layer over TCP/IP is supported.

#### 2.3.1.1 TCP/IP Stack

Xero inherits the TCP/IP stack from the installed Java Runtime Environment.

### 2.3.2 Physical Network Interface

Xero is indifferent to the physical medium over which TCP/IP executes; it inherits this from the Java Runtime Environment.

## 2.4 Configuration

Any IMPAX Configuration that affects DICOM conformance is described in this section.

### 2.4.1 AE Title/Presentation Address Mapping

The translation from Application Entity Title to Presentation Address is stored in AE properties files in the server/default/conf directory.

#### 2.4.1.1 Local AE Titles

The local AE Titles and TCP ports are configurable through editing properties files.

#### 2.4.1.2 Remote AE Title

Remote AE Titles, TCP/IP Addresses and ports can be configured through editing or creating properties files.

### 2.4.2 Parameters

The following table shows the Xero configuration parameters relevant to DICOM communication.

**Table 2-14: Parameters**

Parameter	Configurable	Default Value
<b>General Parameters</b>		
PDU Size	Yes	16352 bytes
Time-out waiting for acceptance or rejection Response to an Association Open Request. (Application Level timeout)	No	5 s
General DIMSE level time-out values	No	60 s
Time-out waiting for response to TCP/IP connect() request. (Low-level timeout)	No	None
Time-out waiting for acceptance of a TCP/IP message over the network. (Low-level timeout)	No	None
Time-out for waiting for data between TCP/IP packets. (Low-level timeout)	No	None
Any changes to default TCP/IP settings, such as configurable stack parameters.	No	None
<b>AE Specific Parameters (all AEs)</b>		
Size constraint in maximum object size	No	None
Maximum PDU size the AE can receive (see note 1)	No	16352 bytes
Maximum PDU size the AE can send	No	1048576 bytes
AE specific DIMSE level time-out values	No	None
Number of simultaneous Associations by Service and/or SOP Class	No	Unlimited
SOP Class support	No	All supported SOP Classes always proposed and accepted

Parameter	Configurable	Default Value
Transfer Syntax support	No	All supported Transfer Syntaxes always proposed and accepted
Other parameters that are configurable	No	None

General Parameters		
Listening Port	No	11119
Maximum number of simultaneous Associations	No	Unlimited
Time-out waiting for A-ASSOCIATE RQ on open TCP/IP connection (ARTIM timeout)	No	5s
Time-out waiting on an open association for the next message (DIMSE timeout)	No	60 s
Time-out waiting for acceptance or rejection Response to an Association Open Request. (Application Level timeout)	No	10 s
Time-out waiting on an open association for the next message after sending A-RELEASE RSP or A-ABORT RQ (Closing timeout)	No	50 ms
Maximum PDU size the AE can receive	No	16352 bytes
Maximum PDU size the AE can send	No	1048576 bytes
Pack Command and Data PDVs in one PDU	No	false
Support for the Basic TLS Secure Transport Connection Profile	Yes	Off
Accepted TLS Ciphers	Yes	-
Storage Server AE		
Accepted Called AE Titles	Yes	XERO
Accepted Calling AE Titles	Yes	XERO
Storage Directory Path Prefix	Yes	
Time-out waiting for the A-ASSOCIATE-AC PDU after transmission of the A-ASSOCIATE-RQ to open an association to the Storage Commitment SCU	No	10 s

### 3

### MEDIA

Xero does not support Media Storage.

## 4 SUPPORT FOR EXTENDED CHARACTER SETS

### 4.1 Overview

Support extends to correctly decoding and displaying the correct symbol in the supported character sets for all names and strings received over the network. Xero only uses ISO-IR 192 (Unicode) for querying.

### 4.2 Support for Extended Character Sets

Recommended character sets are default for English, and ISO-IR 192 (UTF-8) for all other languages. Xero supports the following extended character sets:

**Table 4-1: Extended Character Sets**

Character Set Description	Defined Term
Basic G0 Set	ISO-IR 6 (default)
ISO 8859-1 Latin Alphabet No. 1	ISO-IR 100
ISO 8859-2 Latin Alphabet No. 2	ISO-IR 101
ISO 8859-3 Latin Alphabet No. 2	ISO-IR 109
ISO 8859-4 Latin Alphabet No. 2	ISO-IR 110
Cyrillic	ISO-IR 144
Arabic	ISO-IR 127
Greek	ISO-IR 126
Hebrew	ISO-IR 138
Latin alphabet No. 5	ISO-IR 148
Japanese JIS X 0201	ISO-IR 13, ISO-IR 14
Thai TIS 620	ISO-IR 166
Unicode in UTF-8	ISO-IR 192

## **5 SECURITY**

### **5.1 Security Profiles**

Xero supports secure DICOM communication in conformance with the Basic TLS Secure Transport Connection Profile. At default configuration, the TLS option is deactivated.

### **5.2 Association Level Security**

Xero will accept all calling AE titles, and requires that the called AE title be Xero.

### **5.3 User Interface Security**

Xero requires user authentication to view information from any study or object.

## 6 SUPPORT OF WEB ACCESS TO DICOM PERSISTENT OBJECTS (WADO)

Xero supports receiving web access to DICOM persistent objects requests according to DICOM Part 18. It supports the following parameters:

**Table 6-1: Supported Parameters for WADO**

Parameter Name	Description
requestType	Must be set to WADO for standard WADO access. Other values are XERO, STUDY, SERIES, IMAGE, PATIENT, and CFIND for other types of related queries. Only WADO related parameters are documented here.
studyUID seriesUID objectUID contentType	The requested Study Instance UID of the object to be retrieved The requested Series Instance UID of the object to be retrieved The requested SOP Instance UID of the object to be retrieved mimeType of the returned object. Xero supports the value of <b>application/dicom</b> for full-fidelity DICOM object, image/jpeg, image/png, image/gif, text/xml, application/xml, audio/basic (among other audio types), video/mpeg2. JPEG lossless has been added as image/jp11 JPEG-LS has been added as image/jpls 12 bit JPEG as image/jp12
useOrig rows, columns	If true for application/dicom, returns the raw, original DICOM The size of the desired image
transferSyntax	A backslash separated list of transfer syntaxes to use.
region	A 4 value, comma separated list containing the area of the image to return. Will return a sub-image even in application/dicom content types.
presentationUID frame	The UID of the presentation state to apply to the image The frame number of the image to return. For application/dicom, can be a comma and dash (range) list, e.g. frame=1-3,5,9-20.

Xero ignores the Accept field in the HTTP(S) request. It responds according to the contentType value set in the Request-URI. The supported values are listed in Table 6-1. Xero will return the DICOM object in the uncompressed transfer syntax by default as per the standard, or will choose the native transfer syntax if listed, or the first one from the transferSyntax if the native syntax isn't listed.

The URL to access the WADO service on Xero is structured as follows:

`http://<host>/wado2?requestType=WADO`

This URL is access-controlled use form based authentication.

## **7 ANNEXES**

### **7.1 IOD Contents**

### **7.2 Created SOP Instances**

Not applicable.

### **7.3 Usage of Attributes from Received IOD's**

No SOP Class specific fields for images are required, although for best display, the following fields are recommended:

- View Code Sequence – for MG used to display/regroup by view type
- Instance Number – used for multiframe to split/group multiframe belonging to the same multiframe sequence but split into two or more objects for size reasons
- Echo Number – used to split MR series by echo

### **7.4 Attribute Mapping**

Not applicable.

### **7.5 Coerced/Modified fields**

No attributes are coerced/modified, except that all patient, study and series level attributes in C-Move stored objects are co-erced to the values found at the time of display from a C-Find. Thus, updates to patient information will be done via the C-Find request.

### **7.6 Data Dictionary of Private Attributes**

No private attributes are defined.

### **7.7 Coded Terminology and Templates**

The value for Code Meaning will be displayed for all code sequences. No local lexicon is provided to look up alternative code meanings.

### **7.8 Grayscale Image Consistency**

All attached Xero client systems are sent data for calibrated GSDF monitors. Currently there is no option to specify default monitor calibration. The images are sent assuming a calibrated NEMA monitor. A calibration pattern is provided.

### **7.9 Standard Extended/Specialized/Private SOP Classes**

None.

### **7.10 Private Transfer Syntaxes**

None.



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