



BRIT Systems

# **DICOM Conformance Statement**

## **Roentgen Files**

**Release 3.7**

**Document Number: DCS-BRF-003.0-0001**

May 2011



## DICOM Conformance Statement

# Revision History

<b>Date</b>	<b>Release Number</b>	<b>Revised By</b>	<b>Sections Affected</b>	<b>Comments</b>
Unknown	1	R. Barton	All	Initial Release
11/2004	2	R. Barton	All	Updates
1/2007	3	T. Harris	All	New Format
5/31/2011	4	K. Boyd	All	Updates to various sections, Added Extensions



# Table of Contents

- 1 CONFORMANCE STATEMENT OVERVIEW..... 1**
- 2 INTRODUCTION ..... 2**
- 3 IMPLEMENTATION MODEL ..... 2**
  - 3.1.1 *Application Data Flow Diagram* ..... 3
  - 3.1.2 *Functional Definition of Application Entities* ..... 3
  - 3.1.3 *Sequencing of Real World Activities* ..... 4
- 4 AE SPECIFICATIONS ..... 4**
  - 4.1 AE ARCHIVE – SPECIFICATION ..... 4
  - 4.2 Association Establishment Policies ..... 7
    - 4.2.1 *General Association Information* ..... 7
      - 4.2.1.1 Implementation Identifying Information ..... 7
      - 4.2.1.2 *Number of Associations* ..... 7
      - 4.2.1.3 Asynchronous Nature ..... 7
      - 4.2.1.4 PDU Size ..... 7
    - 4.2.2 *C-Move Association Policy* ..... 7
      - 4.2.2.1 Real World Activity- C-Move Association..... 7
    - 4.2.3 *C-Store Association Policy* ..... 8
      - 4.2.3.1 Real World Activity- C-Store Association ..... 8
      - 4.2.3.2 Presentation Context Table..... 9
      - 4.2.3.3 Presentation Context Acceptance Criteria ..... 11
      - 4.2.3.4 Transfer Syntax Selection Policies ..... 11
      - 4.2.3.5 SOP Class Storage and Conformance..... 11
      - 4.2.3.6 Storage Validation and Errors..... 12
    - 4.2.4 *Query Retrieve Policy* ..... 12
      - 4.2.4.1 SOP Class Query Conformance ..... 12
      - 4.2.4.2 Real World Activity - Query Retrieve ..... 14
    - 4.2.5 *Storage Commitment Policy*..... 15
    - 4.2.6 *Real World Activity - Storage Commitment Policy* ..... 15
    - 4.2.7 Performed Procedure Step Policy..... 15
      - 4.2.7.1 *Real World Activity - Performed Procedure Step*..... 15
      - 4.2.7.2 *Presentation Context Table* ..... 15
    - 4.2.8 *Detached Study Management Policy* ..... 16
      - 4.2.8.1 *Real World Activity - Detached Study Management* ..... 16
      - 4.2.8.2 *Attribute Table* ..... 16
    - 4.2.9 Instance Availability Notification Policy ..... 17
      - 4.2.9.1 *Real World Activity - Instance Availability Notification* ..... 17
      - 4.2.9.2 *Presentation Context Table* ..... 17
    - 4.2.9.3 *C-Echo Verification Policy* ..... 18
      - 4.2.9.4 Real World Activity - C-Echo Verification ..... 18
      - 4.2.9.5 *Presentation Context Table* ..... 18
- 5 COMMUNICATION PROFILES..... 19**
  - 5.1 TCP/IP STACK..... 19
    - 5.1.1 *TCP/IP API*..... 19
    - 5.1.2 *Physical Media Support*..... 19
- 6 EXTENSIONS/SPECIALIZATIONS/ PRIVATIZATIONS ..... 19**
  - 6.1 PRIVATE ELEMENT POLICY ..... 19
  - 6.2 ATTRIBUTE TABLE..... 19
- 7 SECURITY FEATURES..... 21**



# DICOM Conformance Statement

---

7.1	Association Level Security .....	21
7.2	Application Level Security .....	21
7.3	Audit Records.....	22
<b>8</b>	<b>CONFIGURATION.....</b>	<b>22</b>
8.1	SCP Configuration.....	22
8.2	LIVING CONFIGURATION .....	22
8.2.1	APPLICATION ENTITY CONFIGURATION.....	22
8.2.2	Auto Routing and Prefetching Configuration .....	22
8.3	SUPPORT OF EXTENDED CHARACTER SETS.....	22



# 1 Conformance Statement Overview

Table 1 - SOP Classes Overview

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
<b>Image Transfer</b>		
Image STORE	Yes	Yes
Storage Commitment	No	Yes
<b>Query / Retrieve</b>		
Patient Root Model FIND	No	Yes
Study Root Model FIND	Yes	Yes
Study Root Model MOVE	Yes	Yes
Study GET	Yes	Yes
<b>Workflow Management</b>		
Modality Worklist Query FIND	No	Yes
Performed Procedure Step	Yes	Yes
Instance Availability Notification	Yes	No
Detached Study Management	No	Yes
<b>General</b>		
Verification ECHO	Yes	Yes



## 2 Introduction

The BRIT Systems Roentgen Files is a fully integrated system that provides the tools necessary to implement a filmless radiology department. The Archive is the component of the Roentgen Files that manages the long term storage of images. Depending on the customer need, the Archive can be configured to include Disk Arrays, Tape Drives, CD-ROM writer, and Jukeboxes. The Archive manages archival and retrieval of data between the various storage devices. The Archive also manages conversion of data format for images stored in the Archive (ex. convert DICOM to JPEG).

The Archive uses DICOM and HL7 as an interface to the external world. The Archive accepts DICOM association requests for the purpose of storing images, image query and retrieve, and modality workflow management. The Archive will initiate DICOM association requests for the purpose of sending images to an external server and to retrieve images via image query and retrieve. The Archive also responds to requests via the World Wide Web (www). The Archive accepts HL7 request for the purpose of storing orders and reports. The archive initiates HL7 sends for the purpose of forwarding orders and reports to other devices like a CD Burner. BRIT Systems also offers diagnostic quality viewing stations that can communicate with the Archive either with a proprietary interface or pure DICOM.

## 3 Implementation Model

The Archive is designed to be highly customizable so it can be molded to fit very unique workflows. It is built on a Unix platform and runs as a single node or in a HA environment. The system saves data to both a relational database and files on the server.

- **DICOM Access** – The Archive may be defined to allow any calling application entity access or only allow a defined application entity access. Filters may be applied to any defined application entity to limit access, give permissions, or improve performance.
- **Image Transfer** – The Archive can receive images from multiple sources simultaneously. Then based on the configured rules the Archive will determine which images need to be auto routed and what studies need to be prefetched.
- **Query Retrieve** – The Archive can handle simultaneous query and retrieve request. A filter may be applied to any application entity to determine what studies can be accessed via query retrieve.
- **Workflow Management** – Modalities may make simultaneous request from the Archive at any time. A filter may be applied to the modality work list query (MWLQ) for a variety of reasons. The most common reason is to return a smaller subset of data.
- **Storage** – The Archive has built in processes which run daily to manage cache and long term storage. By default the Archive prefers to store all long term data in lossless format.
- **Synchronization** – The Archive can synchronize itself in real time with another Archive using proprietary methods and DICOM. This process provides instant redundancy and is transparent to all users.
- **User Access** - A user interface is provided to manage the day to day task. The Archive logs all patient access including every user who views or accesses a study.

### 3.1.1 Application Data Flow Diagram

Figure 1 shows the relationship of the Archive to external applications. Other functions, like space management, pre-fetching, worklist generation, etc., are performed by the Archive automatically or via an explicit external request.

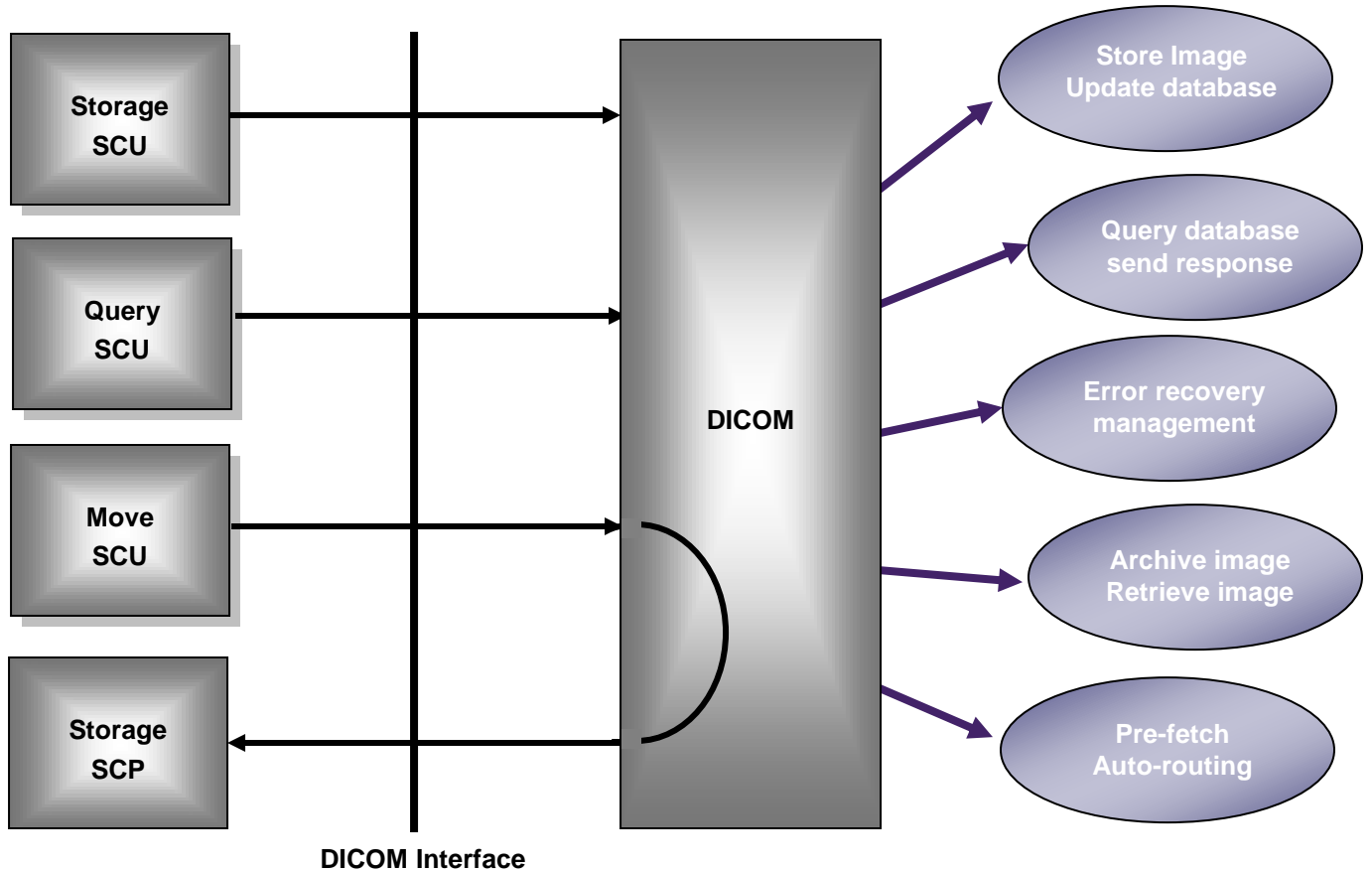


Figure 1 - The Archive Implementation Model

### 3.1.2 Functional Definition of Application Entities

The Archive is implemented as a single application entity used in both SCP and SCU roles. The title of the Archive's application entity may and should be customized.

The Archive may be defined to allow any calling application entity access or only allow a defined application entity access. Once an application entity is defined, a user may apply filters to this entity to limit access, give permission, or improve performance.



### 3.1.3 Sequencing of Real World Activities

An example of a study with a matching order:

- 1) The Archive receives an order for the patient John Doe via HL7 from the RIS.
- 2) A modality queries the Archive for a list of scheduled orders. The archive returns the complete list with the order for John Doe.
- 3) The modality starts sending a new study to the Archive for John Doe.
- 4) Once the modality association is closed, the Archive marks the John Doe study as ready to read.
- 5) A radiologist will dictate the study and mark the study as READ in the Archive.
- 6) The reporting engine will send the Archive the radiologist report via HL7.
- 7) The Archive will save the report with the study and mark the John Doe study as COMPLETE.

Note. Under this scenario the Archive believes the study is ready to read immediately after the modality DICOM association is closed. It is better to configure the Archive with MPPS which tells the Archive the study is complete.

An example of a study without a matching order:

- 1) The Archive receives an order for the patient Jane Fisher via HL7 from the RIS.
- 2) A modality starts sending a new study to the Archive for Jane Smith.
- 3) Once the modality association is closed, the Archive marks the Jane Smith study as unmatched.
- 4) A PACS Administrator will use the interface to match the Jane Smith study with the Jane Fisher order. The interface will give them the ability to choose the correct name, ID, and accession number.
- 5) Once matched, the Archive will mark the study as ready to read.
- 6) A radiologist will dictate the study and mark the study as READ in the Archive.
- 7) The reporting engine will send the Archive the radiologist report via HL7.
- 8) The Archive will save the report with the study and mark the study as COMPLETE.

## 4 AE Specifications

The Archive may invoke multiple server processes and instances to handle each SCP and SCU job on a single machine. All of the processes and instances may operate simultaneously.

### 4.1 AE Archive – Specification

The Archive provides Standard Conformance to the following DICOM 3.0 SOP Classes as a Storage Class User (SCU) and as a Storage Class Provider (SCP).





## DICOM Conformance Statement

**Table 2 - SOP Classes Supported by Archive as an SCU and SCP**

SOP Class Name	SOP Class UM	SCU	SCP
<b>Image Transfer</b>			
CR (Computed Radiography) Image Information Object Storage	1.2.840.10008.5.1.4.1.1.1	Yes	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes	Yes
US Multi-Frame Image Storage 1993	1.2.840.10008.5.1.4.1.1.3	Yes	Yes
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes	Yes
MR Enhanced Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Yes	Yes
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	Yes	Yes
NM Image Storage	1.2.840.10008.5.1.4.1.1.5	Yes	Yes
US Image Storage 1993	1.2.840.10008.5.1.4.1.1.6	Yes	Yes
US Image Information Object Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	Yes
SC (Secondary Capture) Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	Yes
SC (Secondary Capture) Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	Yes
Stand Alone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	Yes	Yes
Stand Alone Curve Storage	1.2.840.10008.5.1.4.1.1.9	Yes	Yes
Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1	Yes	Yes
SECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Yes	Yes
SECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Yes	Yes
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Yes	Yes
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Yes	Yes
X-Ray Angiographic Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	Yes	Yes
Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10	Yes	Yes
VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11	Yes	Yes
NM Image Storage	1.2.840.10008.5.1.4.1.1.120	Yes	Yes
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	Yes	Yes
PET Curve Storage	1.2.840.10008.5.1.4.1.1.129	Yes	Yes
VL Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	Yes
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	Yes
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Yes	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	Yes
Digital Mammo – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes	Yes
Digital Mammo – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes	Yes



## DICOM Conformance Statement

SOP Class Name	SOP Class UM	SCU	SCP
Digital Mammo – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Yes	Yes
Digital Mammo – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	Yes
Digital Mammo – For Presentation	1.2.840.10008.5.1.4.1.1.3.	Yes	Yes
Digital Mammo – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Yes	Yes
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Yes	Yes
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Yes	Yes
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Yes	Yes
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	Yes	Yes
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Yes	Yes
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6	Yes	Yes
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	No	Yes
Storage Commitment Pull Model SOP Class (Retired)	1.2.840.10008.1.20.2	No	Yes
<b>Query / Retrieve</b>			
Patient Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	No	Yes
Patient Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	No	Yes
Patient Root Query/Retrieve Model – GET	1.2.840.10008.5.1.4.1.2.1.3	No	Yes
Study Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	Yes
Study Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	Yes
Study Root Query/Retrieve Model – GET	1.2.840.10008.5.1.4.1.2.2.3	Yes	Yes
Patient/Study Root Q/R Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	Yes	Yes
Patient/Study Root Q/R Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	Yes	Yes
Patient/Study Root Q/R Model – GET	1.2.840.10008.5.1.4.1.2.3.3	Yes	Yes
<b>Workflow Management</b>			
Modality Worklist Model – FIND	1.2.840.10008.5.1.4.31	No	Yes
Performed Procedure Step SOP Class	1.2.840.10008.3.1.2.3.3	Yes	Yes
Instance Availability Notification SOP Class	1.2.840.10008.5.1.4.33	Yes	No
Detached Study Management SOP Class (Retired)	1.2.840.10008.3.1.2.3.1	No	Yes
<b>General</b>			
Verification SOP Class	1.2.840.10008.1.1	Yes	Yes



## 4.2 Association Establishment Policies

### 4.2.1 *General Association Information*

#### 4.2.1.1 *Implementation Identifying Information*

The Archive will provide an implementation class UID of 1.2.840.113797.2.1.  
The Archive will provide an implementation version name of BRITMODDOCT96.

#### 4.2.1.2 *Number of Associations*

The number of simultaneous associations that will be accepted by the Archive is limited by a configuration parameter. Once this limit is reached, incoming association requests will wait until a thread becomes available.

#### 4.2.1.3 *Asynchronous Nature*

The Archive does not support asynchronous operations and will not perform asynchronous window negotiation.

#### 4.2.1.4 *PDU Size*

The maximum PDU size that can be transmitted by the Archive is fixed at 128KB. The default maximum PDU size that can be received by the Archive is configurable with a maximum value of 128KB.

### 4.2.2 *C-Move Association Policy*

The Archive may act as the SCP or SCU for a C-MOVE operation.

As the SCP the archive attempts to initiate an association in response to C-MOVE requests from other Application Entities. The Archive will only initiate associations in response to valid C-MOVE requests for images that are known to the server (stored in the database). Images will be automatically retrieved from other media if necessary.

As the SCU the archive may request a C-MOVE operation in when prefetching from a third party server (remote server).

#### 4.2.2.1 *Real World Activity- C-Move Association*

Example of real world activity as an SCP,

- 1) A third party server sends a C-MOVE request to the Archive
- 2) The archive will verify the destination is an application entity defined in the database
  - a. If not defined, then an error message is returned.
- 3) The archive will verify it has the study to be moved.
  - a. If not an error, an error message is returned.
- 4) If the images are not in cache, the Archive will pull them from long term storage.



## DICOM Conformance Statement

---

- 5) The archive begins a C-Store operation with the destination server
- 6) The original third party server will be notified of the progress and success.

Example of real world activity as an SCU,

- 1) The archive starts receiving a study from a modality.
- 2) The archive checks the routing rules to see if a prefetch for this study is required. If a prefetch is required it then checks if a remote destination is configured or if we are prefetching from long term storage to cache.
  - a. If not a remote destination, then we are done.
- 3) If we are prefetching from a remote destination, then a C-MOVE may be required.
- 4) We query the remote destination and check if a match is found (comp).
- 5) If a comp is found, the Archive initializes a C-MOVE from the third party server to itself.

### 4.2.3 C-Store Association Policy

The Archive may act as the SCP or SCU for a C-STORE operation.

As the SCP the Archive accept a C-STORE request from a modality, a DICOM Workstation, QC Workstation, CD Importer, another archive, and more.

- Modality – The archive will accept images from any DICOM modality.
- DICOM Workstation – A DICOM Workstation like BRIT Vision and PACS View may be configured to send PR and KO images to the Archive
- QC Workstation – A QC Workstation may be configured to send images to the Archive
- CD Importer – A CD Importer may be configured to send images to the Archive.
- Another Archive – Another PACS archive may be configured to C-STORE images to the Archive.

As the SCU the Archive may request a C-STORE for auto routing, as part of a C-MOVE operation, or to fulfill a user request.

- Auto Routing – The server may send up to x number of images per association where x is configurable. This means it may send 1 complete study, only part of a study, or images for more than 1 study during an association.
- Part of a C-MOVE Operation – The server will initiate a C-STORE operation in order to fulfill a C-MOVE request.
- Fulfill a user request – A user may request to send a complete study, series, or an individual image via C-STORE using the interface.

#### 4.2.3.1 Real World Activity- C-Store Association

Example of real world activity as an SCP,

- 1) A modality requests a C-MOVE request to the Archive.
- 2) The Archive checks to see if it can accept images from the modality.
  - a. If not, an error is returned.
- 3) The Archive begins accepting images from the modality.



## DICOM Conformance Statement

- 4) The Archive validates each image as it is received.
  - a. An error message is returned for the following conditions:
    - i. Study UID exist under another patient (May not apply to QC store)
    - ii. Series UID exist under another study (May not apply to QC store)
    - iii. Image UID exist under another series/study/patient (May not apply to QC store)
    - iv. Patient name does not match (May not apply to QC store)
    - v. Out of disk space
- 5) The images are saved to cache and the Archive's database is updated.
- 6) Once all the images are received and the association is closed, the archive marks the study as ready to read.

Example of real world activity as an SCU,

- 1) A new image arrives from a modality.
- 2) The image matches 1 of the Archive auto routing rules.
- 3) The Archive adds the image to the route list
- 4) The Archive routing process initiates a C-STORE request to route the image to specified routing destination (may occur while the study is still being received)
- 5) If the other destination accepts the C-STORE request and image the route queue event for the image is updated to SENT. If not the event shows FAILED along with the reason.

### 4.2.3.2 Presentation Context Table

Any of the Presentation Contexts shown in Table 3 are acceptable to the Archive for receiving images.

**Table 3 - Acceptable Presentation Contexts for the Archive**

Abstract Syntax Name	UID	Transfer Syntax				Role
		ILE	ELE	EBE	JPEG	
Computed Radiography Image	1.2.840.10008.5.1.4.1.1	Yes	Yes	Yes	Yes	SCP
CT Image	1.2.840.10008.5.1.4.1.1.2	Yes	Yes	Yes	Yes	SCP
US Multi-Frame Image Storage 1993	1.2.840.10008.5.1.4.1.1.3	Yes	Yes	Yes	Yes	SCP
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	Yes	Yes	Yes	SCP
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes	Yes	Yes	Yes	SCP
MR Enhanced Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Yes	Yes	Yes	Yes	SCP
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	Yes	Yes	Yes	Yes	SCP
NM Image Storage	1.2.840.10008.5.1.4.1.1.5	Yes	Yes	Yes	Yes	SCP
US Image 1993	1.2.840.10008.5.1.4.1.1.6	Yes	Yes	Yes	Yes	SCP
US Image	1.2.840.10008.5.1.4.1.1.6.1	Yes	Yes	Yes	Yes	SCP
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Yes	Yes	Yes	Yes	SCP
SC (Secondary Capture) Image	1.2.840.10008.5.1.4.1.1.7.4	Yes	Yes	Yes	Yes	SCP



## DICOM Conformance Statement

Abstract Syntax		Transfer Syntax				Role
Name	UID	ILE	ELE	EBE	JPEG	
Storage						
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	Yes	Yes	Yes	Yes	SCP
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9	Yes	Yes	Yes	Yes	SCP
Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1	Yes	Yes	Yes	Yes	SCP
SECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Yes	Yes	Yes	Yes	SCP
SECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Yes	Yes	Yes	Yes	SCP
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Yes	Yes	Yes	Yes	SCP
X-Ray RadiofluoroScopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Yes	Yes	Yes	Yes	SCP
X-Ray Angiographic Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	Yes	Yes	Yes	Yes	SCP
Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10	Yes	Yes	Yes		SCP
VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11	Yes	Yes	Yes		SCP
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	Yes	Yes	Yes	SCP
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	Yes	Yes	Yes	Yes	SCP
PET Curve Storage	1.2.840.10008.5.1.4.1.1.129	Yes	Yes	Yes	Yes	SCP
VL Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	Yes	Yes	Yes	SCP
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	Yes	Yes	Yes	SCP
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Yes	Yes	Yes	Yes	SCP
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	Yes	Yes	Yes	SCP
Digital Mammo – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes	Yes	Yes	Yes	SCP
Digital Mammo – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes	Yes	Yes	Yes	SCP
Digital Mammo – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Yes	Yes	Yes	Yes	SCP
Digital Mammo – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	Yes	Yes	Yes	SCP
Digital Mammo – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Yes	Yes	Yes	Yes	SCP
Digital Mammo – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Yes	Yes	Yes	Yes	SCP
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Yes	Yes	Yes	Yes	SCP
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Yes	Yes	Yes		SCP
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Yes	Yes	Yes		SCP
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	Yes	Yes	Yes		SCP
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Yes	Yes	Yes		SCP
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6	Yes	Yes	Yes		SCP
Structured Report	1.2.840.10008.5.1.4.1.1.88.11	Yes	Yes	Yes		SCP



## DICOM Conformance Statement

Abstract Syntax		Transfer Syntax				Role
Name	UID	ILE	ELE	EBE	JPEG	
Structured Report	1.2.840.10008.5.1.4.1.1.88.22	Yes	Yes	Yes		SCP
Structured Report	1.2.840.10008.5.1.4.1.1.88.33	Yes	Yes	Yes		SCP
Greyscale Presentation State	1.2.840.10008.5.1.4.1.1.11.1	Yes	Yes	Yes		SCP

ILE = Implicit Little Endian = 1.2.840.10008.1.2

ELE = Explicit Little Endian = 1.2.840.10008.1.2.1

EBE = Explicit Big Endian = 1.2.840.10008.1.2.2

JPEG = Lossy and Lossless, 8 and 12-16 bit,

DICOM compression = 1.2.840.10008.1.2.840.100081.2.4.5.1 and 1.2.840.10008.1.2.4.70

The Archive will attempt to generate Explicit images from those received implicitly and will provide "Unknown" as the attribute type if the elements were not known to the Archive. An external dictionary can be updated to add additional private elements.

Any additional SOP Classes can be added to the archive by editing a configuration file.

### 4.2.3.3 *Presentation Context Acceptance Criteria*

The Archive accepts any number of storage SOP classes that are listed in Table 3 above, provided that the requesting application is known to the Archive and has been enabled to store images on the Archive (via a configuration step). The Archive defines no limit on the number of presentation contexts accepted. In the event that the Archive runs out of resources when trying to accept multiple presentation contexts, the Archive will reject the association request.

### 4.2.3.4 **Transfer Syntax Selection Policies**

The Archive supports multiple transfer syntaxes. If the first proposed transfer syntax is supported by the Archive, it will be accepted. If not, the Implicit VR Little Endian transfer syntax will be chosen.

### 4.2.3.5 *SOP Class Storage and Conformance*

An Archive implements Level 2 (Full) Conformance for the Storage SOP Class.

The Archive may be configured to modify any of the values in the DICOM header. The following attributes are always modified by converting the characters to upper case before the data is stored..

1. Patient Name
2. Patient ID
3. Accession Number
4. Study ID



### **4.2.3.6 Storage Validation and Errors**

Before accepting the image, the Archive will test validity of the Patient Name, Patient ID, Study Instance UID, Series Instance UID, and SOP Instance UID against the values already in the database. If a conflict is detected, the image may be rejected. Specific details will be included in the DICOM Attribute Error Comment (0x00000902).

In the event that an image is successfully stored by the Archive, it may be accessed by requesting associations with the Archive and performing query/retrieve operations. The Archive stores images for a configurable period.

The Archive returns the following status values in response to a C-STORE request:

0000H	Image successfully stored
A700H	Refused – out of resources (unable to create local file, or other failure)
A900H	Error – data set does not match SOP Class
C000H	Error – cannot understand

In the case of an error storing an image, notification via e-mail or other mechanism can be performed based on configured setting.

### **4.2.4 Query Retrieve Policy**

The Archive may act as the SCP or SCU for a query retrieve operation.

As the SCP the Archive accepts a Patient or Study C-FIND request, C-MOVE request, and C-GET request.

As the SCU the Archive may request a Patient or Study C-FIND request and a C-MOVE request.

Note: Modality Worklist PUSH model can be made available upon request.

#### **4.2.4.1 SOP Class Query Conformance**

The Archive supports both Patient and Study Root Information Model searching.

- Patient Root Information Model – Table 4 shows all keys supported by this query type.
- Study Root Information Model – Table 4, 5, 6, and 7 show all keys supported by this query type.
- Patient/Study Root Information Model – Table 4, 5, 6, and 7 show all keys supported by this query type.





## DICOM Conformance Statement

**Table 4 - Keys Supported for Patient Root Information Model**

Level	Description	Tag	Type
Patient	Patient Name	00100010	R
Patient	Patient ID	00100020	U
Patient	Patient Birth Date	00100030	O
Patient	Patient Birth Time	00100032	O
Patient	Patient Sex	00100040	O
Patient	Number of Patient Related Studies	00201200	O
Patient	Number of Patient Related Series	00201202	O
Patient	Number of Patient Related Images	00201204	O
Patient	Current Patient Location	00380300	O

**Table 5 - Keys Supported for Patient and Study Root Information Model**

Level	Description	Tag	Type
Study	Study Date	00080020	R
Study	Study Time	00080030	R
Study	Accession Number	00800050	R
Study	Study ID	00200010	R
Study	Study Instance UID	00200000	U
Study	Referring Physician Name	00080090	O
Study	Study Description	00081030	O
Study	Patient's Age	00101010	O
Study	Patient's Weight	00101030	O
Study	Patient's Size	00101020	O
Study	Number of Study Related Series	00201206	O
Study	Number of Study Related Images	00201208	O
Study	Study Status ID	0032000A	O
Study	Body Part Examined	00180015	O
Study	Modalities in Study	00080061	O
Study	Modality	00080060	O



## DICOM Conformance Statement

**Table 6 - Keys Supported for Patient and Study Root Information Model**

Level	Description	Tag	Type
Series	Modality	00080060	R
Series	Series Number	00200011	R
Series	Series Instance UID	0020000E	U
Series	Series Description	0008103E	O
Series	Number of Series Related Images	00201209	O
Series	View Position	00185101	O
Series	Body Part Examined	00180015	O

**Table 7 - Keys Supported for Patient and Study Root Information Model**

Level	Description	Tag	Type
Image	Image Number	00200013	R
Image	SOP Instance UID	00080018	U
Image	SOP Class UID	00080016	O
Image	Samples per Pixel	00280002	O
Image	Rows	00280010	O
Image	Columns	00280011	O
Image	Bits Allocated	00280100	O
Image	Bits Stored	00280101	O
Image	Image Location	00280020	O
Image	Patient Orientation	00200020	O
Image	Photometric Interpretation	00280004	O
Image	Pixel Representation	00280103	O

### **4.2.4.2 Real World Activity - Query Retrieve**

An example of a C-FIND query,

- 1) Another archive wishes to query the Archive for a list of today's studies.
- 2) The other archive with initiate a Study Root Model C-FIND.
- 3) The Archive validates the calling ae title.
- 4) The Archive applies configured filters for the calling ae title and performs the search.
- 5) The Archive returns the results to the other archive



### 4.2.5 Storage Commitment Policy

The Archive can be configured to allow or not allow storage commit for each known application entity.

### 4.2.6 Real World Activity - Storage Commitment Policy

The real world activity associated with Storage Commitment is that an external node wishes to request that the archive commit images/studies to long term storage. At the completion of the commitment operation, the archive will contact the external node using a separate association and send a storage commitment N-Event report to inform the external node that images/studies have been committed.

The PUSH model is supported.

### 4.2.7 Performed Procedure Step Policy

The Archive accepts Performed Procedure Step associations and forwards these transactions to nodes that act as IHE Order Fillers.

#### 4.2.7.1 Real World Activity - Performed Procedure Step

The real world activity associated with the Modality Performed Procedure Step is as follows:

Upon receipt of a N-CREATE of an MPPS object, the Archive will store an object and forward this object to any Application Entities that are specified as OrderFillers using an N-EVENTREPORT.

Later, the MPPS object can be update using the N-SET command. The values specified in the N-SET will be merged into the MPPS object and it will be forwarded to all OrderFillers using an N-EVENTREPORT.

#### 4.2.7.2 Presentation Context Table

Table 8 shows the Presentation Contexts that may be accepted by the Archive for verification operations.

Table 8 - Acceptable Presentation Contexts for the Archive for MPPS CREATE and SET

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
MPPS N-SET N-CREATE	1.2.840.10008.3.1.2.3.3	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None



## DICOM Conformance Statement

**Table 9 - Acceptable Presentation Contexts for the Archive for MPPS N-Event Report**

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
MPPS N-EVENT REPORT	1.2.840.10008.3.1.2.3.5	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

### 4.2.8 Detached Study Management Policy

If configured the Archive accepts Detached Study Management messages from known application entity titles.

#### 4.2.8.1 Real World Activity - Detached Study Management

The real world activity associated with the Detached Study Management Set/Get is that an external node wishes to update values at the study level. Examples would be to set the Status to READ or to correct an incorrect Accession Number. The Patient ID cannot be changed, nor can a study be moved from one patient to another.

#### 4.2.8.2 Attribute Table

Table 10 shows the attributes that can be obtained/changed by Detached Study Management.

**Table 10 - Detached Study Management Get/Set Attributes**

Description	Tag	Type
Study Date	00080020	O
Study Time	00080030	O
Accession Number	00080050	O
Patient ID	00100020	O (Get Only)
Study ID	00200010	O
Study Instance UID	0020000D	U
Referring Physician Name	00800090	O
Study Description	00081030	O
Patient Birth Time	00100032	O
Patient Sex	00100040	O



## DICOM Conformance Statement

Description	Tag	Type
Patient's Age	00101010	O
Patient's Size	00101020	O
Number of Patient Related Studies	00201200	O
Number of Patient Related Series	00201202	O
Number of Patient Related Images	00201204	O
Current Patient Location	00380300	O
Number of Study Related Series	00201206	O
Number of Study Related Images	00201208	O
Study Status ID	0032000A	O
Body Part Examined	00180015	O
Modalities in Study	00080061	O
Modality	00080060	O
Patient's Weight	00101030	O

### 4.2.9 Instance Availability Notification Policy

The Archive sends Instance Availability Notification messages after receiving a Performed Procedure Steps message for a known image.

#### 4.2.9.1 Real World Activity - Instance Availability Notification

The real world activity associated with the Instance Availability Notification is to notify Order Fillers when all the images associated with a Performed Procedure Step have arrived. Upon completion of a successful STORE operation, after disconnecting the association, the Archive will search through Performed Procedure Step objects to determine if a study is complete based on the list of UIDs specified in that object. If a study is complete, the Instance Availability Notification message will be sent to any Application Entities specified as OrderFillers.

#### 4.2.9.2 Presentation Context Table

Table 11 shows the Presentation Contexts that may be initiated by the Archive for Instance Availability Notification operations.



Table 11 - Acceptable Presentation Contexts for the Archive for Instance Availability Notification

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
MPPS N-SET N-CREATE	1.2.840.10008.5.1.4.33	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

### 4.2.9.3 C-Echo Verification Policy

The Archive accepts C-ECHO request from any device without restrictions. The verification process can check the following information:

- Ip Address
- Port Number
- Calling AE Title – The Archive will respond to any calling AE Title
- Called AE Title – The Archive will respond successfully even if the called ae title is wrong.
- Network – Confirms the device which initiated the verification can communicate with the Archive across the network. It does not confirm the stability of the network.

### 4.2.9.4 Real World Activity - C-Echo Verification

An example of a verification process,

- 6) A new modality is being installed.
- 7) The tech configures the Archive’s ip address and port number
- 8) The tech performs a C-ECHO verification test from the modality to the Archive. If successful the tech knows the ip address and port number are correct and the modality can see the Archive across the network.

### 4.2.9.5 Presentation Context Table

Table 11 shows the Presentation Contexts that may be accepted by the Archive for verification operations.

Table 11 - Acceptable Presentation Contexts for the Archive for Verification

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



## 5 Communication Profiles

### 5.1 TCP/IP Stack

The Archive provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

#### 5.1.1 TCP/IP API

The Archive uses the TCP/IP stack from the UNIX system upon which it executes. It uses a subroutine library that is based on a Berkeley socket interface.

#### 5.1.2 Physical Media Support

The Archive exists as a software application that can be compiled on various UNIX platforms. As such, it places no restrictions on the physical network. The Archive has been tested using TCP/IP over Ethernet (Thick Wire, Thin Wire, 10BaseT), ATM, and PPP modem connections.

## 6 Extensions/Specializations/ Privatizations

### 6.1 Private Element Policy

BRIT Systems' software products use the private group number **0x0021**. Each product complies with the DICOM specification for assignment and use of private elements (PS 3.5-2007, Sec. 7.8).

### 6.2 Attribute Table

Table 12 shows the attributes that can be added by the Archive.

Table 12 – BRIT Object Action IOD Attribute Table

Attribute Name	Tag	Type	Description
PrivateCreatorData	(0021,00xx)	<i>Auto</i>	<b>DICOM standard identifier for private tags.</b> The value in this element should always be " <b>BRIT Systems, Inc.</b> ". This element will be automatically added by all BRIT DICOM toolkits when any BRIT private element is added to an object, if it does not already exist. If it exists, all BRIT DICOM toolkits will automatically use this element to identify and adjust the element numbers used with any BRIT Private elements



## DICOM Conformance Statement

Attribute Name	Tag	Type	Description
BritOriginalSenderAETitle	(0021,xx90)	1	<p><b>The AE Title of the original sending modality.</b> This represents the first AE to send this object to a BRIT Systems DICOM SCP. This element is required if it does not already exist. Once it exists, it should <b>never</b> be changed or removed.</p> <p><i>There is no way to record which AEs have handled or processed an object before it arrived at the first BRIT Systems SCP.</i></p>
BritObjectActionSequence	(0021,xxA0)	1	<p><b>Sequence of items describing actions performed on the object by BRIT software products that resulted in the object being received or modified.</b> This sequence is required if it does not already exist. Whenever a BRIT application receives or modifies a DICOM object, this sequence should be appended with a new item describing the action performed.</p>
>PrivateCreatorData	(0021,00yy)	<i>Auto</i>	<p><b>DICOM standard identifier for private tags.</b> The value in this element should always be "<b>BRIT Systems, Inc.</b>". This element will be automatically added by all BRIT DICOM toolkits when any BRIT private element is added to an object, if it does not already exist. If it exists, all BRIT DICOM toolkits will automatically use this element to identify and adjust the element numbers used with any BRIT Private elements.</p>
>BritSoftwareTitle	(0021,yy91)	1	<p><b>Name of the BRIT software package that inserted this item into the sequence.</b></p>
>BritSoftwareVersion	(0021,yy92)	1	<p><b>Version of the BRIT software package that inserted this item into the sequence.</b></p>
>BritSerialNumber	(0021,yy93)	2	<p><b>Serial number of the system running the BRIT software that inserted this item into the sequence, if known.</b> BRIT PC numbers can be used as serial numbers. This is intended as a way to trace events back to specific hardware.</p>
>BritObjectAction	(0021,yyA1)	1	<p><b>Description of the action performed.</b></p>
>BritObjectActionDate	(0021,yyA2)	1	<p><b>Date when the action was performed.</b></p>
>BritObjectActionTime	(0021,yyA3)	1	<p><b>Time when the action was performed.</b></p>
>BritObjectActionUser	(0021,yyA4)	2	<p><b>Login name of the user logged in when this item was inserted into the sequence, if available.</b> This element is required for client</p>





## DICOM Conformance Statement

Attribute Name	Tag	Type	Description
			applications (e.g. viewers, RRis client). Actions performed by BRIT server products may choose to omit this element or insert some other identifying information (e.g. AE title and IP of the server).
>BritLocalAETitle	(0021,yyA5)	2	<b>AE Title assigned to the BRIT software/SCU performing the action.</b>
>BritLocalIPAddress	(0021,yyA6)	2	<b>IP Address assigned to the BRIT software/SCU performing the action.</b> If a DICOM association is used to transfer the object being acted upon, the IP address should be obtained from the open socket as this will represent the actual network adapter being used which can be useful on a multi-homed system. Otherwise, the value assigned to the host in its configuration files should be used.
>BritRemoteAETitle	(0021,yyA7)	2	<b>AE Title disclosed by the remote AE.</b> This element is only required in the sequence item if the object being acted upon is being received by (or sent to) a remote AE.
>BritRemoteIPAddress	(0021,yyA8)	2	<b>IP Address of the remote AE.</b> This element is only required in the sequence item if the object being acted upon is being received by (or sent to) a remote AE. The IP address stored here should be obtained from the open socket for the association, if possible.

## 7 Security Features

### 7.1 Association Level Security

The Archive may be configured to accept associations from any calling aetitle and ip address, or the application may be configured to only accept request from a known aetitle and ip address. The aetitle and ip address is considered known only if it is defined in the Archive prior to the association attempt.

### 7.2 Application Level Security

The Archive uses conventional (non-secure) DICOM communication and is expected to be used within a secure environment should include:

- Virtual Private Network (VPN) access to devices outside of the secured local network.
- Firewall or router protection to ensure only authorized devices have access



### 7.3 Audit Records

The Archive only gives authorized users the ability access and change data. A user's actions are recorded in audit records which can be used to answers the following types of questions:

- Who accessed the study or report?
- Who exported the study or report and where did they send it?
- Who changed the status of the study or report?
- Who made the change?
- Who deleted the object?

## 8 Configuration

The Archive has a very large set of configurable parameters which can be mixed and matched based on the desired workflow. Some of the configuration options are saved directly in the database while other options are saved in files on the server.

### 8.1 SCP Configuration

The following parameters may be configured for the Archive:

- Application Entity Title
- TCP/IP Port Number
- Number of Concurrent Threads

### 8.2 Living Configuration

Similar to a living document the Archive configuration may evolve overtime to fulfill the needs of the workflow. The Archive has a very large set of configurable options which can be mixed and matched based on the desired workflow. Once saved most configuration options take effect immediately, and a few of the options require a process restart. Two of the common configurations options are shows below:

#### 8.2.1 *Application Entity Configuration*

A user may use the provided interface to manage a list of application entities used by the Archive. Below is a list of some options you can manage.

- Manage the ip address, port number, and title
- Add filters
- Setup the preferred transfer syntax
- Storage Commit options

#### 8.2.2 *Auto Routing and Prefetching Configuration*

The server may be configured to auto routing and prefetch studies with the following options:

- Add rules to determine if a study should be auto routed and where it should be routed
- Number of concurrent auto routing and prefetching processes

### 8.3 Support of Extended Character Sets

The Archive provides no support for extended character sets.