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GE Healthcare

Technical Publications

Direction **DOC0094938**
Revision **2**
Date **2006-6-1**

Centricity Enterprise Archive Version 3.0 CONFORMANCE STATEMENT for DICOM

1 CONFORMANCE STATEMENT OVERVIEW

The Enterprise Archive, or EA, implements the necessary DICOM services to facilitate the archiving and image management role in the healthcare departments. It enables the capabilities to archive instances from any networked DICOM modality, inform other DICOM peers or Information Systems, and route them anywhere they're needed in the medical facility.

All common Storage SOP classes defined as of DICOM PS 3- 2006 can be received, stored, and transmitted. Table 4 explicitly lists all supported Storage SOP classes. Several private storage SOP classes are also supported; these are listed in Table 5.

The table below provides an overview of the additional non-storage SOP classes supported by EA. All retrieve SOP classes support the relational query option.

Table 1 Non-Storage SOP Classes

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Verification	Yes	Yes
Query / Retrieve		
Patient Root Query/Retrieve Model – FIND	Yes	Yes
Patient Root Query/Retrieve Model – MOVE	Yes	Yes
Study Root Query/Retrieve Model – FIND	Yes	Yes
Study Root Query/Retrieve Model – MOVE	Yes	Yes
Patient/Study Only Query/Retrieve Model – FIND	Yes	Yes
Patient/Study Only Query/Retrieve Model – MOVE	Yes	Yes
Workflow Management		
Storage Commitment Push Model	Yes	Yes
Modality Worklist Information Model – FIND	Yes	No
Detached Study Management	Yes	Yes
Modality Performed Procedure Step	Yes	Yes
Detailed Detached Study Management (private)	Yes	Yes

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3 INTRODUCTION

3.1 SCOPE AND FIELD OF APPLICATION

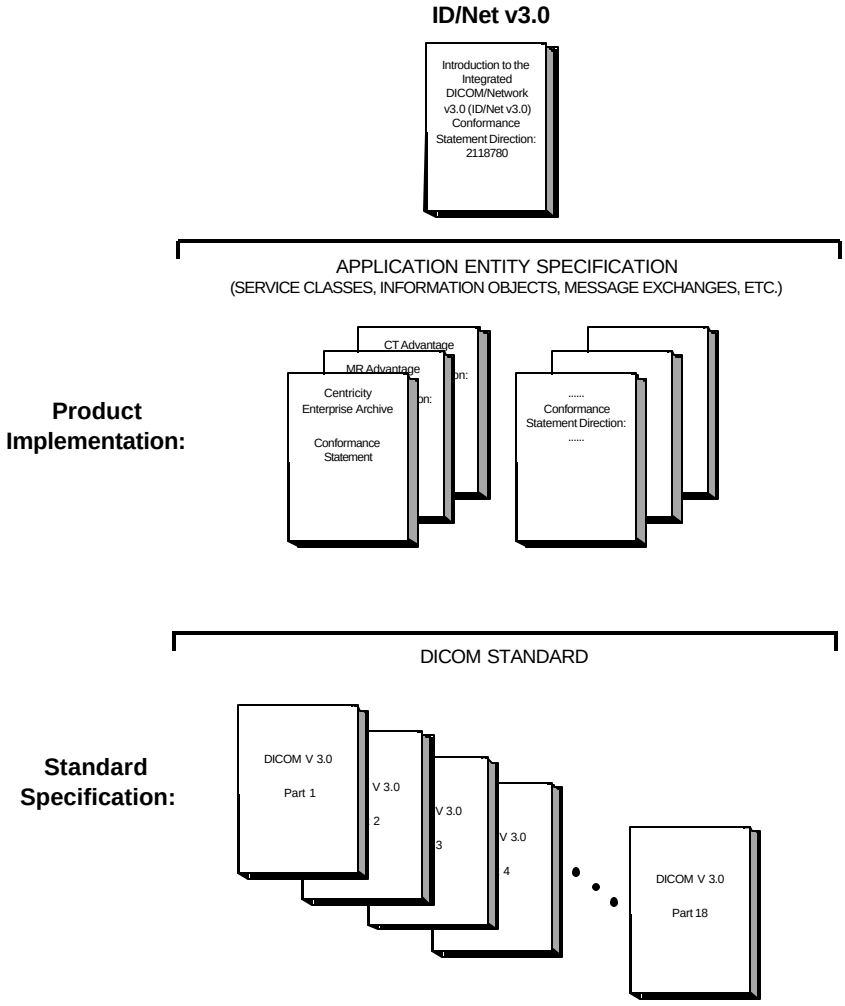
This document is the DICOM Conformance Statement for version 3.0 of the Enterprise Archive (EA) product line of GE Healthcare IT. The purpose of this document is to describe how the EA product suite collaborates in a DICOM network with other medical imaging applications that conform to the DICOM 3.0 standard.

3.2 OVERVIEW

This DICOM Conformance Statement is divided into Sections as described below:
Section 1 (Introduction), which describes the overall structure, intent, and references for this Conformance Statement
Section 2 (Networking), which describes the implementation model, AE specifications, network interfaces, and configuration for DICOM associations.
Section 3 (Media Interchange) , which describes the supported DICOM media profiles.
Section 4 (Extended Character Sets), which describes the character sets supported by EA.
Section 5 (Security), which describes the communication stack behavior.
Section 6 (Annexes), which describes the private features of EA that are public available.

3.3 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GE Healthcare Conformance Statements and their relationship with the DICOM Conformance Statements is shown in the Illustration below.



This document specifies the DICOM implementation. It is entitled:

Centricity Enterprise Archive
Conformance Statement for DICOM
Direction DOC0094938

This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required to interoperate with the GE Healthcare network interface. Introductory information, which is applicable to all GE Healthcare Conformance Statements, is described in the document:

Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0)
Conformance Statement
Direction: 2118780.

This Introduction familiarizes the reader with DICOM terminology and general concepts. It should be read prior to reading the individual products' GE Healthcare Conformance Statements.

The GE Healthcare Conformance Statement, contained in this document, also specifies the Lower Layer communications, which it supports (e.g., TCP/IP). However, the Technical Specifications are defined in the DICOM Part 8 standard.

For more information including Network Architecture and basic DICOM concepts, please refer to the Introduction.
For more information regarding DICOM, copies of the Standard may be obtained on the Internet at http://medical.nema.org. Comments on the Standard may be addressed to:

DICOM Secretariat
NEMA
1300 N. 17th Street, Suite 1847
Rosslyn, VA 22209
USA
Phone: +1.703.841.3200

3.4 INTENDED AUDIENCE

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM Standards and with the terminology and concepts that are used in those Standards.
If readers are unfamiliar with DICOM terminology they should first refer to the document listed below, then read the DICOM Standard itself, prior to reading this DICOM Conformance Statement document.

Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0)
Conformance Statement
Direction: 2118780

3.5 SCOPE AND FIELD OF APPLICATION

It is the intent of this document, in conjunction with the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*, to provide an unambiguous specification for GE Healthcare implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GE Healthcare medical data exchanged using DICOM. The GE Healthcare Conformance Statements are available to the public.
The reader of this DICOM Conformance Statement should be aware that different GE Healthcare devices are capable of using different Information Object Definitions. For example, a GE Healthcare CT Scanner may send instances using the CT Information Object, MR Information Object, Secondary Capture Object, etc.
Included in this DICOM Conformance Statement are the Module Definitions, which define all data elements, used by this GE Healthcare implementation. If the user encounters unspecified private data elements while parsing a GE Healthcare Data Set, the user is well advised to ignore those data elements (per the DICOM standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all of the private data elements that are sent by GE Healthcare devices.

3.6 IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be successful**. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non–GE systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.
- **Validation** - Testing the complete range of possible interactions between any GE device and non–GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non–GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non–GE device and the stability of the image data for the intended applications. Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.
- **Future Evolution -** GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. The GE Healthcare protocol is based on DICOM as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices that have implemented DICOM. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) reflected on by these DICOM Conformance Statements.** The user should ensure that any non–GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.
- **Interaction** - It is the sole responsibility of the **non–GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

3.7 REFERENCES

A list of references, which is applicable to all GE Healthcare Conformance Statements, is included in the Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780.

3.8 DEFINITIONS

A set of definitions, which is applicable to all GE Healthcare Conformance Statements, is included in the Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780.

3.9 SYMBOLS AND ABBREVIATIONS

A list of symbols and abbreviations, which is applicable to all GE Healthcare Conformance Statements, is included in the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*.

3.10 REVISION HISTORY

Revision	Date	**Description**
1	Nov 2005	Initial version for EA 3.0
2	May 2006	Removed the statement about the C-GET service Applied the latest DICOM 3.0 2006 guidelines Removed unsupported private tags Removed the statement about asynchronous DICOM. Replaced with text about asynchronous store. Added the MPEG2 Main Profile @ Main Level transfer syntax for receive and send.

3.11 IMPORTANT CONSIDERATIONS FOR THE READER

This DICOM Conformance Statement by itself is not sufficient to guarantee successful connectivity between EA and equipment from other vendors. The following considerations should be made:
The integration of equipment from different vendors (including GE Healthcare) goes beyond the scope of the DICOM 3.0 standard and the DICOM Conformance Statements from GE Healthcare and other vendors. It is the responsibility of the user (or user's agent) to assess the application requirements and to design a solution that integrates GE Healthcare equipment with equipment from other vendors.
When the comparison of this DICOM Conformance Statement with a DICOM Conformance Statement from another vendor indicates that connectivity should be possible it is the responsibility of the user (or user's agent) to verify this by carrying out validation tests and to check whether all required functionality is met.
With regard to the future evolution of the DICOM 3.0 standard GE Healthcare reserves the right tomake changes to the EA architecture described in this document. The user (or user's agent) should ensure that any equipment connected via DICOM to GE Healthcare equipment also follows the future evolution of the DICOM 3.0 standard. Failure to do so may result in (partial) loss of connectivity.

3.12 ACKNOWLEDGEMENT OF T RADE NAMES

All trade names mentioned in this document are recognized. Centricity Enterprise Archive is a registered trademark of GE Healthcare.

4 NETWORKING

4.1 IMPLEMENTATION MODEL

Enterprise Archive, or EA, is implemented as a set of services with a configurable set of archives, each represented by an Application Entity. These Archive Application Entities can initiate associations with remote application entities and accept associations from them as well.
A data migration feature uses an additional Application Entity to initiate data migration.

4.1.1 Application Data Flow Diagram

The Implementation Model for the EA is depicted in the diagrams below.

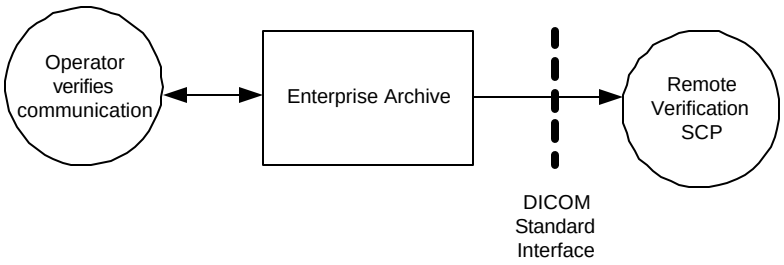


Figure 1 Verify a Remote System

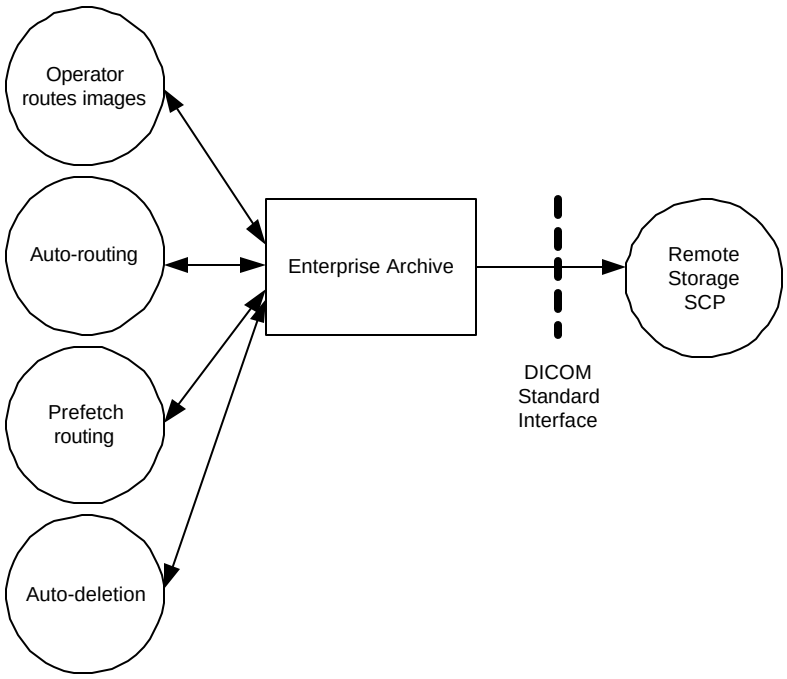


Figure 2 Send Instances to a Remote System

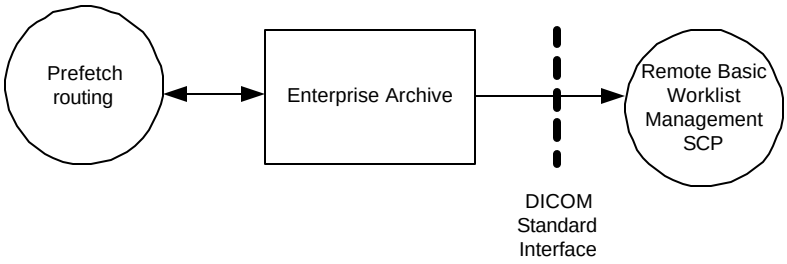


Figure 3 Retrieve a Modality Worklist from a Remote System

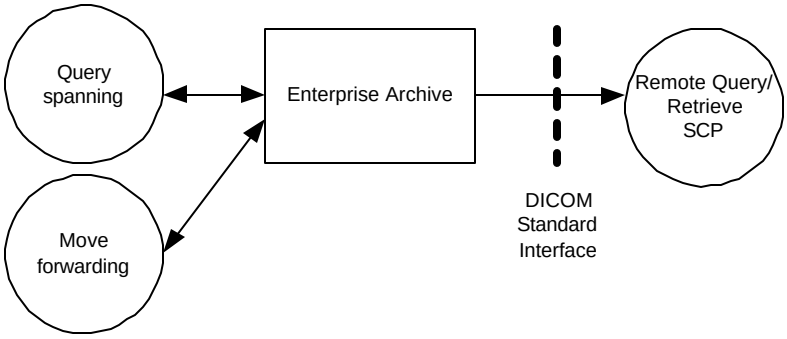


Figure 4 Query Spanning or Move Forwarding

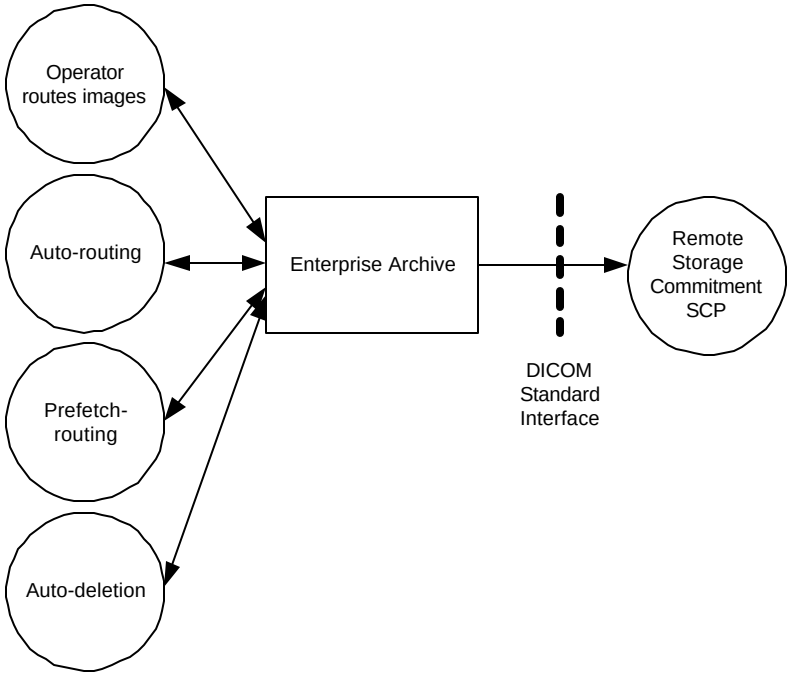


Figure 5 Verify the Committed Storage of Instances on a Remote System

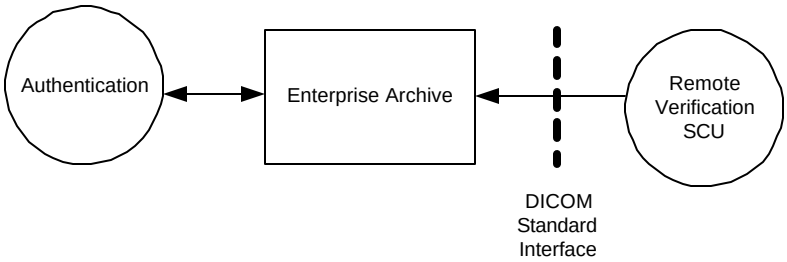


Figure 6 Verify communication with a remote system

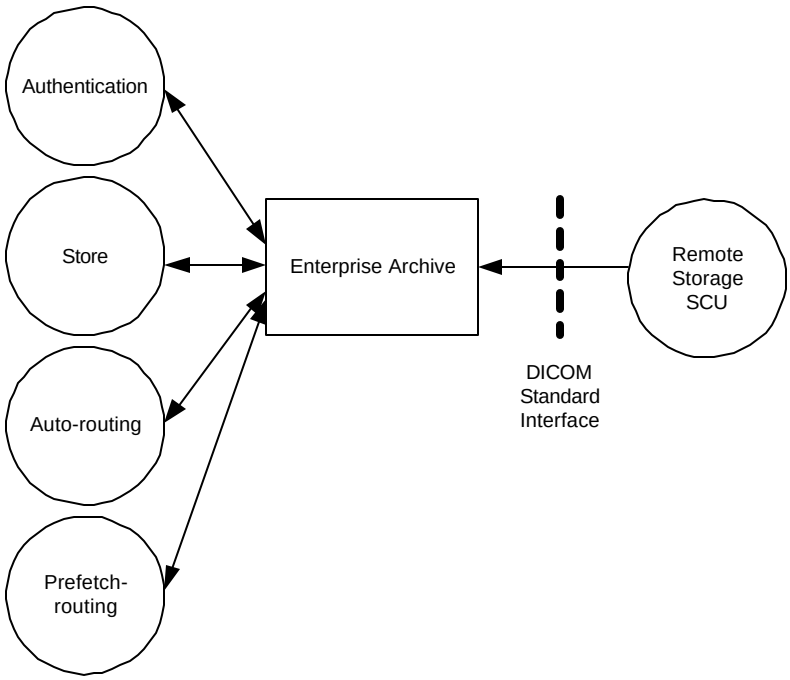


Figure 7 Receive Instances from a Remote System

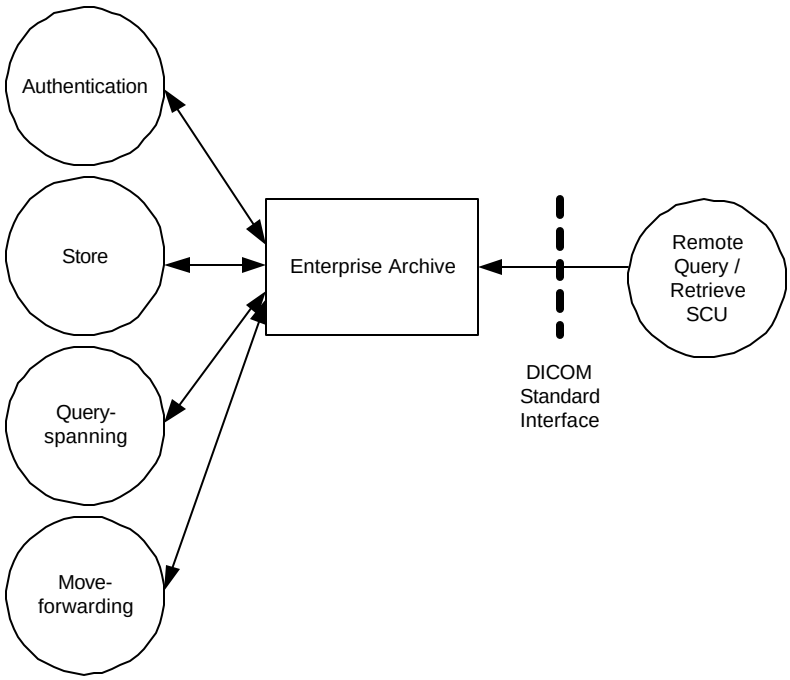


Figure 8 External SCU Queries the EA Database

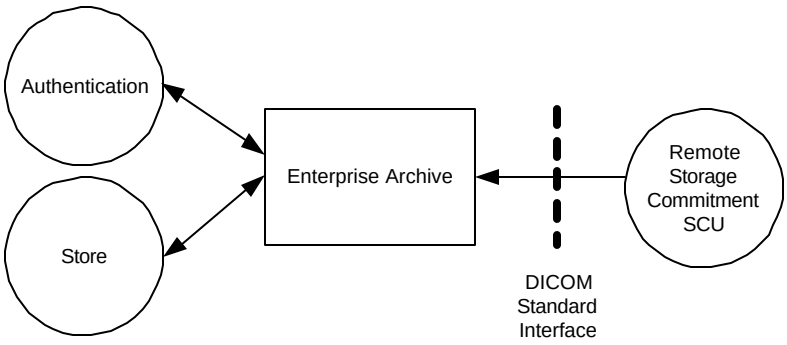


Figure 9 Commit Storage of Instances in the EA Database

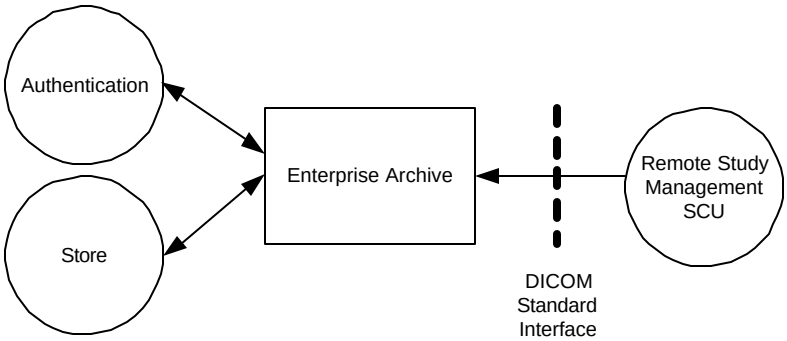


Figure 10 Receive a Study Status Change Request or Event from a Remote System

4.1.2 Functional Definitions of Application Entities

EA can be configured into multiple “partitions” or archives. Each archive is presented to the outside world as an Application Entity with its own AE title. Each archives provides its own physical storage and index database. For example, if a single instance is sent to two EA archives, two copies of the instance are store: one in each archive. Instances stored in one archive cannot be obtained via another archive.

All DICOM functionality, both SCP and SCU roles, is available for each archive, but each archive can be configured differently.

4.1.3 Sequencing of Real World Activities

The following scenarios relate different activities in time:

Auto Routing
Receive Instances => Send Instances
EA supports auto-routing to facilitate the distribution of instances to other Application Entities. If auto-routing is enabled, each study is also routed to one or more remote Application Entities after its arrival in EA.

Prefetching and Routing
Receive Instances => Send Instances
EA supports prefetching of prior studies based on incoming instance characteristics to facilitate the availability of historical information. If prefetching for incoming studies is enabled, each incoming study triggers the prefetch of priors. These priors can then be routed to one or more remote Application Entities.

Query Spanning
Query => Span a Query
EA supports query-spanning to facilitate querying instances that are distributed over several Application Entities. If the query-spanning feature is enabled, a query performed on EA will cause EA to span the query to one or more remote Application Entities. Both the results from the local query and the remote queries will be merged and returned to the querying client.

Auto-Delete
Receive Instances => Commit Storage of Instances
If auto-deletion is enabled, the stored instances are not permanently kept into AE. A storage commitment request can thus return a failure for deleted instances.

Move-Forwarding
Receive Move Request => Forward a Move Request

4.2 AE SPECIFICATIONS

4.2.1 Application Entity - Archive

The detail of the Application Entity of an archive is specified under this section. Note that there can be one or more of these archives configured in the system.

4.2.1.1 SOP Classes

This Application Entity provides Standard Conformance to the following SOP Classes:

Table 2 Standard Non-Storage SOP Classes

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	Yes	Yes
Patient Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	Yes
Patient Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	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
Patient/Study Only Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	Yes	Yes
Patient/Study Only Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	Yes	Yes
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	Yes
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	No
Detached Study Management	1.2.840.10008.3.1.2.3.1	Yes	Yes
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Yes	Yes

Additionally EA supports the following private non-storage SOP classes.

Table 3 Private Non-Storage SOP Classes

SOP Class Name	SOP Class UID	SCU	SCP
GE Private Detailed Detached Study Management	1.2.528.1.1001.3.1.2.3.1	Yes	Yes

The following standard storage SOP classes are supported:

Table 4 Standard Storage SOP Classes

SOP Class Name	SOP Class UID	SCU	SCP
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes	Yes
Digital X-Ray Image (Presentation) Storage	1.2.840.10008.5.1.4.1.1.1.1	Yes	Yes
Digital X-Ray Image (Process) Storage	1.2.840.10008.5 .1.4.1.1.1.1.1	Yes	Yes
D X Mammography Image (Presentation) Storage	1.2.840.10008.5.1.4.1.1.1.2	Yes	Yes
D X Mammography Image (Process) Storage	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	Yes
D X Intra-oral Image (Presentation) Storage	1.2.840.10008.5.1.4.1.1.1.3	Yes	Yes
D X Intra-oral Image (Process) Storage	1.2.840.10008.5.1.4.1.1.1.3.1	Yes	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes	Yes
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	Yes	Yes
US Multi-frame Image Storage (Retired)	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
Enhanced MR 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 (Retired)	1.2.840.10008.5.1.4.1.1.5	Yes	Yes
US Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	Yes	Yes
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	Yes
Multi-Frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	Yes	Yes
Multi-Frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes	Yes
Multi-Frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Yes	Yes
Multi-Frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	Yes
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	Yes	Yes
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9	Yes	Yes
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Yes	Yes
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Yes	Yes
Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3	Yes	Yes
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2 .1	Yes	Yes
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1	Yes	Yes
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1	Yes	Yes
Standalone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10	Yes	Yes
Standalone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11	Yes	Yes
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	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 (Retired)	1.2.840.10008.5.1.4.1.1.12.3	Yes	Yes
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	Yes
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes	Yes
VL Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.77.1	Yes	Yes

VL Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.77.2	Yes	Yes
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	Yes
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Yes	Yes
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	Yes
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	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
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Yes	Yes
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Yes	Yes
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Yes	Yes
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Yes	Yes
Mammography CAD SR Storage	1.2.840.10008.5.1.4.1.1.88.50	Yes	Yes
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Yes	Yes
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	Yes	Yes
Encapsulated PDF Storage	1.2.840.10008.5 .1.4.1.1.104.1	Yes	Yes
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Yes	Yes
Standalone PET Curve Storage (Retired)	1.2.840.10008.5.1.4.1.1.129	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
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7	Yes	Yes

The following private storage SOP classes are also supported both as SCU and SCP.

Table 5 Private Storage SOP Classes

SOP Class Name	SOP Class UID	SCU	SCP
Collage Storage	1.2.528.1.1001.5.1.1.1	Yes	Yes
GE eNTEGRA Storage (Xeleris/eNTEGRA Protocol Data or NM Genie)	1.2.840.113619.4.27	Yes	Yes
GE 3D Model Image Storage (GE Advantage 3D XR)	1.2.840.113619.4.26	Yes	Yes
GE PET Advance Raw Data Storage (GE Advantage Workstation Raw)	1.2.840.113619.4.30	Yes	Yes

4.2.1.2 Association Policies

This section describes the general association establishment and acceptance policies for the Archive AE.

4.2.1.2.1 General

The Application Context Name is 1.2.840.10008.3.1.1.1.

The SOP class extended negotiation is not supported.

The user information Items sent by this product are:
- Maximum PDU length
- Implementation UID
- Implementation Version Name

By default EA will accept the PDU length as proposed by the association initiator, with a configurable maximum per association initiator.

EA supports Asynchronous Operation Window but it is only effective for C-MOVE requests.

EA rejects association requests from applications of which the AE Title is not registered within EA's administration. The same applies to the case where the remote system uses an AE Title that is unknown to EA.

Each AE Title maps to an archive; per archive registration specifies which services are available to a remote system. If the remote system is not listed in the registration of the connected archive (AE Title) the association is declined.
If the remote system is not authorized a the requested SOP class it is rejected.

4.2.1.2.2 Number of Associations

EA supports multiple associations both as an SCU and SCP.

Enterprise Archive has a maximum number of simultaneous initiated and accepted associations. This limit exists to offload Enterprise Archive and to ensure quality of service. The optimal number depends on the used hardware, network speed etc.
Some of these associations can be reserved for high priority C-STORE, resulting from a high priority C-MOVE.
Enterprise Archive also has a configurable maximum number of associations that it can initiate toward one Application Entity.

4.2.1.2.3 Asynchronous Nature

EA does not support asynchronous communication (multiple outstanding transactions over a single Association). All association requests must be completed and acknowledged before a new operation can be initiated.
It has however the option called asynchronous storage. If this option is enabled post-processing of a store operation is decoupled from the network store service. The SCU should in this case always use the storage commit service to ensure that the post-processing was successful and EA has taken ownership of the instances.

4.2.1.2.4 Implementation Identifying Information

The Implementation Class UID is: 1.2.528.1.1001.2.800.5.0.<buildnumber>
The version name is: EA 5.0.<buildnumber>

where <buildnumber> is the Enterprise Archive software build number.

4.2.1.3 Association Initiation Policy

4.2.1.3.1 Activity – Verify Connectivity

Description and Sequencing of Activities

The operator can choose to verify a remote Application Entity. EA sends out a verification request to a remote Application Entity.

Proposed Presentation Contexts

Table 6 Presentation Context Table for Verify Connection

Abstract Syntax		Transfer Syntax		Role	Extended
Name	**UID**	**Name**	**UID**		**Negotiation**
Verification	1.2.840.10008.1.1	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None

SOP Specific Conformance Statement

EA provides standard conformance. In case of failure the verification is not retried.

4.2.1.3.2 Activity – Send Instances

Description and Sequencing of Activities

The following activities can trigger EA to send instances to one or more remote Application Entities:

- The operator requesting the transmission of a study.
- EA accepts the move request of a remote Application Entity.
- The prefetch engine determines the route of a historical study (prior).
- EA automatically routes an incoming study.

Proposed Presentation Contexts

Table 7 Presentation Context Table for Send Instances

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**			
Default Application SOP Classes	See § 4.2	See below	SCU	None

Table 8 Transfer Syntaxes for Send Instances

Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
Explicit VR Big Endian	1.2.840.10008.1.2.2
JPEG Baseline, Lossy JPEG 8-Bit Image Compression	1.2.840.10008.1.2.4.50
JPEG Extended, Lossy JPEG 12-Bit Image Compression	1.2.840.10008.1.2.4.51
JPEG Lossless, Non-Hierarchical, First-Order Prediction, Lossless JPEG Image Compression	1.2.840.10008.1.2.4.70
JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90
JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91
MPEG2 Main Profile @ Main Level	1.2.840.10008.1.2.4.100

RLE Lossless	1.2.840.10008.1.2.5

SOP Specific Conformance Statement

EA provides full (level 2) conformance. This means that upon sending an instance received via DICOM it will send out all attributes that it received (this includes private attributes from other vendors).

In case of failure, the transfer is retried at a later time. The number of retries and the interval between them can be configured. If EA fails to complete the transfer within the maximum number of retries the transfer is marked as failed and EA will no longer retry the transfer.
EA keeps a log of all pending and completed transfers.

When a remote system requires an explicit transfer syntax, and the instance stored in EA is implicit, EA will behave conform supplement 14 "Unknown Value Representation". Consequently it will encode unknown attributes as "UN" when sending them to the remote system.

By default EA proposes the transfer syntax as it is found in the stored instance file and the default transfer syntax. (Note what is referred to, as 'the default transfer' can be more than one transfer syntax. By default Explicit Little Endian and Implicit Little Endian are used as 'default transfer syntax').

For compressed images this leads to the following situation. An image can be present EA with a specific compression scheme (either because it was sent compressed, or because it was compressed by EA upon reception). When sending this image, the first proposed Transfer Syntax by EA is the transfer syntax of the image. If the client does not support the required Transfer Syntax, the image will be converted to the best-fit transfer syntax before it is sent.

If the instance is stored in the JPEG 2000 (Lossless Only) Transfer Syntax EA will also offer the JPEG Lossless Transfer Syntax. If this is the only transfer syntax accepted EA will convert the instance before it is sent.

Instances stored in the MPEG2 Main Profile @ Main Level transfer syntax are only offered in this transfer syntax. EA will in this case not offer the default transfer syntax.

4.2.1.3.3 Activity – Span a Query

Description and Sequencing of Activities

EA can be used as a gateway for other Application Entities in the sense that queries on EA return information on instances present in EA *and* in the Application Entities for which EA is used as a gateway. This is accomplished by spanning queries to remote Application Entities and returning all results to the requesting system.

Proposed Presentation Contexts

Table 9 Presentation Context Table for Span a Query

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Study Root Query/ Retrieve Model – FIND	1.2.840.10008.5.1.4.1 .2.2.1	Explicit VR, Little Endian	1.2.840.10008. 1.2.1	SCU	None
		Implicit VR, Little Endian	1.2.840.10008. 1.2		

SOP Specific Conformance Statement

Standard conformance is provided.

When the query-spanning feature is enabled, EA will forward queries unmodified, so it is the querying client that identifies the tags used in this request.

EA expects the support for Retrieve AE Title and Instance Availability on the Application Entity.

When the configured maximum number of query results is reached, EA aborts the query.

EA expects the remote Application Entity to perform all of the matching methods that are supported by EA itself.

4.2.1.3.4 Activity – Forward a Move

Description and Sequencing of Activities

The term move forwarding means retrieving from a remote system on request of a DICOM peer.

EA is used as a gateway for other Application Entities in the sense that queries on EA return information on instances present in EA *and* in the Application Entities for which EA is used as a gateway. Furthermore instances that are present in the other Application Entities can be retrieved as if they where stored locally in EA.

Proposed Presentation Contexts

Table 10 Presentation Context Table for Forward a Move

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Study Root Query/ Retrieve Model - MOVE	1.2.840.10008.5.1.4.1 .2.2.2	Explicit VR, Little Endian	1.2.840.10008. 1.2.1	SCU	None
		Implicit VR, Little Endian	1.2.840.10008. 1.2		

SOP Specific Conformance Statement

Standard conformance is provided.

If the move-forwarding feature is enabled for a remote DICOM database, the query results for that remote DICOM database will be modified such that the Retrieve AE title (0008, 0054) contains the AE title of the EA archive that is queried.

4.2.1.3.5 Activity - Retrieve a Modality Worklist

Description and Sequencing of Activities

The prefetch/routing mechanism queries an external system, e.g. a RIS, to determine which priors must be prefetched and routed.

Proposed Presentation Contexts

Table 11 Presentation Context Table for Retrieve a Modality Worklist

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

SOP Specific Conformance Statement

EA provides standard conformance.

The query is configurable and can be extended. Any of the returned attributes can be used to trigger prefetching or routing.

In addition to the required attributes the following returned attributes for the Modality Worklist Management are used by default:

Table 12 Additional Default Attributes for Modality Worklist Management

Module	Description	Tag	Type
Study Identification	Study ID	(0020,0010)	O
	Study Description	(0008,1030)	O

The configurable query can make use of the following attribute matching:

- Single Value Matching
- Universal Matching
- Wildcard Matching
- Range Matching

4.2.1.3.6 Activity - Verify the Committed Storage of Instances

Description and Sequencing of Activities

When EA completes a transmission of instances it can optionally verify whether the instances have not only been received but also been stored successfully (committed) at the other end.

Proposed Presentation Contexts

Table 13 Presentation Context Table Verify the Committed Storage of Instances

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

SOP Specific Conformance Statement

Standard conformance is provided.

If storage commitment is enabled for a remote system, EA will, after sending the instances to the remote system, issue a storage commitment request (N-ACTION). After that EA closes the association. Since EA does not wait for a reply from the SCP, the N-EVENT-REPORT must occur on a different association.

If the N-EVENT-REPORT indicates that the instances are successfully stored, EA considers the transfer successfully completed. If, however, the N-EVENT-REPORT indicates that the instances are not successfully stored, EA will resend all instances to the remote system and reissue the storage commit request. If the maximum number of retries is reached, EA will mark the transfer as failed.

When storage commitment is requested for multiple studies, multiple requests are made, each on a separate association.

The validity of the Transaction UID that is generated for the storage commitment request is based on the system configuration. By default an answer must be obtained from the SCP within a configurable number of hours (default: 30 hours). After this the Transaction UID is no longer valid.

EA does not support the optional Storage Media File-Set ID & UID attributes.

4.2.1.3.7 Activity - Convey a Study Status Change

Description and Sequencing of Activities

EA sends out a notification (N-EVENT-REPORT) to remote DICOM system, indicating that the study status of that system has changed.

Accepted Presentation Contexts

Table 14 Presentation Context Table for Convey a Study Status Change

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Detached Study Management	1.2.840.10008.3.1.2.3.1	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR, Little Endian	1.2.840.10008.1.2.1		
GE Private Detailed Detached Study Management	1.2.528.1.1001.3.1.2.3.1	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR, Little Endian	1.2.840.10008.1.2.1		

SOP Specific Conformance Statement

EA provides standard conformance.

As the behavior of the delete N-EVENT-REPORT is modified in a not compatible manner EA uses a private SOP class to send these kind of delete notifications.

Table 15. Delete N-EVENT-REPORT Attributes (including important command elements). The italic attributes are an extension to the standard delete notification.

Attribute Name	Tag	Requirement Type (SCU/SCP)
Affected SOP Class UID	(0000,0002)	1/1 (always 1.2.528.1.1001.3.1.2.3.1)
Affected SOP Instance UID	(0000,1000)	1/1
Event Type ID	(0000,1002)	1/1 (always value 8)
Query/Retrieve Level	(0008,0052)	1/1
Referenced Series Sequence	(0008,1115)	1C/1C
>Series Instance UID	(0020,000E)	1C/1C
Referenced Image Sequence	(0008,1140)	1C/1C
>Referenced SOP Instance UID	(0008,1155)	1C/1C

When EA receives a Delete N-EVENT-REPORT notification from a SCP and is configured to accepts these notifications it will delete all SOP instances referenced in the N-EVENT-REPORT. EA only supports study, series and instance deletes requests (The level tag must be set to 'STUDY', 'SERIES', or 'IMAGE'). All delete actions will be done synchronous.
When a referenced instance is not contained in EA the final status code will be set to 'no such SOP Instance' and the processing will continue.
When EA fails to delete a referenced instance or series EA will set the status code to 'processing failure' and stops the processing of the N-EVENT-REPORT.
If EA is not configured to accept N-EVENT-REPORT requests the SCP will be unable to set up an association. An error in the N-EVENT-REPORT request will result in a response with the appropriate standard N-EVENT-REPORT status type code (see PS 3.7 -2003, 10.1.1.1.8 for a full list of these codes).
A SCU that sends this notification to EA and want to be able to track in detail which SOP instances/ series are successful deleted should only reference 1 SOP instance or series in the N-EVENT-REPORT notification message.

4.2.1.3.8 Activity – Forward Performed Procedure Step

Description and Sequencing of Activities

EA can be configured to forward a Modality Performed Procedure Step to other Application Entities.

Accepted Presentation Contexts

Table 16 Presentation Context Table for Forward Performed Procedure Step

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

SOP Specific Conformance Statement

EA provides standard conformance. The Performed Procedure Step message is sent as it has been received, so both N-SET or N-EVENT-REPORT.

4.2.1.4 Association Acceptance Policy

4.2.1.4.1 Activity – Receive Connectivity Verification

Description and Sequencing of Activities

A remote Application Entity verifies its ability to communicate with EA by sending a verification request.

Accepted Presentation Contexts

Table 17 Presentation Context Table for receive Connectivity Verification

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Verification	1.2.840.10008.1.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

SOP Specific Conformance Statement

Standard conformance is provided.

4.2.1.4.2 Activity - Receive Instances

Description and Sequencing of Activities

A remote system sends instances to Enterprise Archive for archival or temporary storage.

Accepted Presentation Contexts

Table 18 Presentation Context Table for Receive Instances

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**			
Default Application SOP Classes	See XXX § 1.6.2	See below	SCP	None

Table 19 Transfer Syntaxes for Receive Instances

Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
Explicit VR Big Endian	1.2.840.10008.1.2.2

JPEG Baseline, Lossy JPEG 8-Bit Image Compression	1.2.840.10008.1.2.4.50
JPEG Extended, Lossy JPEG 12-Bit Image Compression	1.2.840.10008.1.2.4.51
JPEG Lossless, Non-Hierarchical, First-Order Prediction, Lossless JPEG Image Compression	1.2.840.10008.1.2.4.70
JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90
JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91
MPEG2 Main Profile @ Main Level	1.2.840.10008.1.2.4.100
RLE Lossless	1.2.840.10008.1.2.5

SOP Specific Conformance Statement

EA conforms to the full (level 2) conformance of the Storage SOP class. All Type 1, Type 2 and Type 3 attributes will be retained. In addition private attributes will be stored and included when the instance is sent out again.

When an instance is received that has a SOP Instance UID (0008,0018) that is already present in EA the transfer itself will complete successfully, but the existing instance in Enterprise Archive will be overwritten.

Depending on the configuration, images can be validated, repaired, and compressed upon reception. Based on user defined rules, an image can be stored uncompressed, JPEG Lossless compressed or with JPEG Lossy compression.
Images that are already lossy compressed will not be recompressed lossless or lossy, Images that were lossy compressed in the past (which can be derived from the value “01” from tag (0028, 2110)) will not be lossy compressed again. When images are lossy compressed, the value of tag (0028, 2110) is set to “01”.
Images that are received with the MPEG2 Main Profile @ Main Level transfer syntax will always be stored in that transfer syntax.

For unsuccessful storage requests, EA returns one of the following error status codes in synchronous mode.

Table 20 Return Statuses for Receive Instances

Error code	Description
0106	Invalid attribute value
0110	Processing failure
0112	No such object instance
0114	No such argument
0115	Invalid argument value
0120	Missing attribute
0122	Refused: SOP class not supported
0211	Unrecognized operation
0213	Resource limitation
A700	Out of resources
A701	Storage quota has been reached
A702	Matching storage library is offline

EA can be configured to store a study asynchronously. In this case some of the above failures might not be returned. Storage commitment must be used to verify the storage of an instance. This configuration is unsuited in deployments where re-archiving is part of the workflow, because the storage commitment model does not discriminate between recent and old instance archival.

Asynchronous storage also implies that instances cannot be queried and retrieved directly after reception.

The EA system can be configured to automatically delete studies or series from its local database when certain criteria are met, like after a specific time.

EA will accept the first Transfer Syntax from the list it accepts. In case of problems there are configuration options to turn off the acceptance of one or more specific Transfer Syntaxes, in order to make EA select a different Transfer Syntax.

4.2.1.4.3 Activity - Query

Description and Sequencing of Activities

A remote system wants to query the contents of EA or one of the remote archives that are managed by EA.

Accepted Presentation Contexts

Table 21 Presentation Context Table for Query

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Patient Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		
Study Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		
Patient/Study only Query/Retrieve – FIND	1.2.840.10008.5.1.4.1.2.3.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

No verification is performed to ensure that a query contains all required tags.

SOP Specific Conformance Statement

A query that is handled by EA returns data that is retrieved from the index database in EA. Fieldnames in this database are equivalent to the DICOM tags. Each field in the database can be queried for.

Additional fields can be added to this database at installation time. By default, the following fields are present in the database.

Security configuration in Enterprise Archive can restrict the incoming query to a subset of the data in EA.
EA limits the number of query results to a configurable maximum (by default 500) and return successful status. EA supports the C-CANCEL request during a query operation.

Table 22 Supported Attributes for Query

Level	Description	Tag
Patient	Patient Name	(0010,0010)
Patient	Patient ID	(0010,0020)
Patient	Issuer of Patient ID	(0010,0021)
Patient	Patient Birth Date	(0010,0030)
Patient	Patient Sex	(0010,0040)
Patient	Other Patient ID	(0010,1000)
Study	Study Date	(0008,0020)
Study	Study Time	(0008,0030)
Study	Accession Number	(0008,0050)
Study	Study ID	(0020,0010)
Study	Study Instance UID	(0020,000D)
Study	Modality in Study	(0008,0061)
Study	Institution Name	(0008,0080)
Study	Referring Physician's Name	(0008,0090)
Study	Station Name	(0008,1010)
Study	Study Description	(0008,1030)
Study	Institution Dep. Name	(0008,1040)
Study	Pref. Phys.	(0008,1050)
Study	Read Phys.	(0008,1060)
Study	Number of Study related Series	(0020,1206)
Study	Number of Study related Images	(0020,1208)
Study	Series in Study	(0020,1000)
Study	Study Status ID	(0032,000A)
Study	Reason for Study	(0032,1030)
Series	Modality	(0008,0060)
Series	Series Number	(0020,0011)
Series	Series Instance UID	(0020,000E)
Series	Series Description	(0008,103E)
Series	Body Part Examined	(0018,0015)
Series	Protocol Name	(0018,1030)
Series	Frame of reference UID	(0020,0052)
Series	Images in Acquisition	(0020,1002)
Series	Number of Series Related Images	(0020,1209)
Series	Series Date	(0008,0021)
Series	Series Time	(0008,0031)
Instance	Image Number	(0020,0013)
Instance	SOP Instance UID	(0008,0018)
Instance	Transfer syntax UID	(0002,0010)
Instance	Image Type VR:CS, VM:1-n	(0008,0008)
Instance	SOP class UID	(0008,0016)
Instance	Imager Pixel Spacing	(0018,1164)
Instance	Cassette Orientation	(0018,1402)
Instance	Cassette Size	(0018,1403)

Instance	Acquisition Number	(0020,0012)
Instance	Image Position (Patient)	(0020,0032)
Instance	Image Orientation (Patient)	(0020,0037)
Instance	Slice Location	(0020,1041)
Instance	Photometric Interpretation	(0028,0004)
Instance	Number of Frames	(0028,0008)
Instance	Rows	(0028,0010)
Instance	Columns	(0028,0011)
Instance	Pixel Spacing	(0028,0030)
Instance	Pixel Aspect Ratio	(0028,0034)
Instance	Bits Allocated	(0028,0100)
Instance	Pixel Representation	(0028,0103)
Instance	Window Center	(0028,1050)
Instance	Window Width	(0028,1051)
Instance	Rescale Intercept	(0028,1052)
Instance	Rescale Slope	(0028,1053)
Instance	Rescale Type	(0028,1054)
Instance	Window Explanation	(0028,1055)
Instance	Thumbnail	(0088,0200)
Instance	Presentation Label	(0070,0080)
Instance	Presentation Description	(0070,0081)
Instance	Presentation Creation Date	(0070,0082)
Instance	Presentation Creation Time	(0070,0083)
Instance	Presentation Creator's Name	(0070,0084)
Instance	Content Date	(0008,0023)
Instance	Content Time	(0008,0033)

Attributes for the Series and Image Level of the Study Root Query/Retrieve Information Model are the same as the Attributes for the Series Level of the Patient Root Query/Retrieve Information Model.

The following types of attribute matching are supported:

- Single Value Matching
- Universal Matching
- Wild Card Matching
- Range Matching
- Sequence Matching
- List of UID Matching

Enterprise Archive uses case insensitive matching.

For optimal support of Structured Reporting, the following tags should be added to the instance table (via the Management Console). When added, they can be used for querying.

Table 23 Additional Attributes for Non-Image Objects

Level	Description	Tag
Instance	Completion Flag	(0040, A491)
Instance	Verification Flag	(0040, A493)
Instance	Observer Date Time	(0040, A032)
Instance	Concept Name Code Sequence	(0040, A043)*
Instance	Verifying Observer Sequence	(0040, A073)*

*) When a sequence tag is, at storage the whole sequence value is indexed and an Application Entity can query for all containing tags.

When querying at instance level, a number of private tags can be used. An overview is given in the next table.

Table 24 Query Private for Query

Attribute Name	Tag	VR	VM	Attribute Description
Block descriptor	(3113, 00xx)	LO	1	Applicare/RadStore/Version 1.0
State	(3113, xx12)	LO	1	Instance state: "1"= Writable "2"= Read-only "3"= Frozen "4"= Archived "5"= Out-of-Cache
DateLastAccessed	(3113,xx14)	DT	1	Last accessed date - timestamp of study
ByteSize	(3113,xx16)	FD	1	Instance size in bytes
Origin	(3113,xx1E)	LO	1	Instance origin
Version	(3113,xx21)	SL	1	Number of latest version of stored instance.
InstanceFileLocation	(3113,xx23)	ST	1	Location of instance file

If query spanning has been configured, AE also returns the results from the spanned queries.

If move forwarding is enabled EA modifies the following attributes in the spanned query result:
Retrieve AE Title (0008, 0054) (set to EA's AE title)
Instance Availability (0008, 00xx) (set to near-line, if external system reports on\near-line)

If the move-forwarding feature is disabled, the results are sent unaltered to the querying client. If the move-forwarding feature is enabled, the results are modified: the Retrieve AE title (0008, 0054) is changed into the AE title of the EA archive that is queried.

4.2.1.4.4 Activity - Retrieve an Instance Move Request

Description and Sequencing of Activities

A remote system wants to retrieve instances stored on EA and issues a retrieve command.

Accepted Presentation Contexts

Table 25 Presentation Context Table for Retrieve an Instance Move Request

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Patient Root Query/Retrieve 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
Study Root Query/Retrieve 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
Patient Study Only Query/Retrieve	1.2.840.10008.5.1.4.1.2.3.2	Implicit VR, Little	1.2.840.10008.1.2	SCP	None

Model – MOVE	Endian			

SOP Specific Conformance Statement

Standard conformance is provided.

In addition to this, EA offers relational retrieve whereby for the Patient Root Query/Retrieve Model all studies of a particular patient can be retrieved by providing a Patient ID. Also, for both the Patient Root Query/Retrieve Model and the Study Root Query/Retrieve Model, all instances of a study/series can be retrieved by providing a Study/Series Instance UID.

The Priority attribute (0000,0700) of a C-MOVE command can is used by EA to prioritize the request.

EA supports a C-CANCEL request during a retrieve operation.

If the destination AE Title of a C-MOVE is the AE Title of EA itself, the request is interpreted as a prefetch request, and the required instances are added to the prefetch queue.

EA supports a filtering mechanism for Patient level C-MOVE requests. The following private tags can be used to limit the number of studies that will be matched during a patient C-MOVE request.

Attribute Name	Tag	VR	VM	Attribute Description
Private block id	(0907, 00xx)	LO	1	GEIIS PACS
GEIIS_PREFETCH_ALGORITHM	(0907, xx21)	US	1	0 = “all” 1 = "last_n_months" or 2 = "newestN1_oldestN2" or 3 = "newestN1_oldestN2_Modality
GEIIS_LIMIT_RECENT_STUDIES	(0907, xx22)	US	1	
GEIIS_LIMIT_OLDEST_STUDIES	(0907, xx23)	US	1	
GEIIS_LIMIT_RECENT_MONTHS	(0907, xx24)	US	1	The number of months to go back. Any study older than that will not be retrieved. The start date will have the same day of the month as the current month. If that day does not exist in that month, the last day of the month is used.
GEIIS_EXCLUDE_STUDY_UIDS	(0907, xx31)	UI	1-n	

4.2.1.4.5 Activity - Commit Storage of Instances

Description and Sequencing of Activities

After sending instances to EA, a remote system wants to confirm the proper storage of these instances in EA. To this purpose the remote systems sends a storage commit request to EA.
Note however that depending on the configuration EA might not provide long term archiving and that therefore there is no guarantee that the committed instances will remain on the system for a longer period of time (see also below).

Accepted Presentation Contexts

Table 26 Presentation Context Table for Commit Storage of Instances

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

SOP Specific Conformance Statement

Standard conformance is provided.
Note that, although EA supports the repetitive storage of an instance, this model uses the instance UID to determine the identity of an instance and does not guarantee that the last version has been archived.

EA will open a new association to the SCU for transmitting the N-EVENT-REPORT response to the storage commit inquirer.

By default, EA will commit instances as soon as they are stored on short-term storage. However, EA can be configured to only commit instances when they are stored on long-term media.

EA does not always provide commitment for the storage of instances. This is due to the fact that the system can be configured to auto delete studies based on priority rules or only store instances to a low reliable disk.

Committed instances can be retrieved via the normal Query/Retrieve mechanism.

Upon receiving a storage commitment EA will first wait for a configurable interval (30 seconds by default).

After this initial wait, EA will verify that the instances are present in the system and, in most cases, send a storage commit responds to the inquirer.

However, EA will not send a storage commit responds if some of the instances are present in the system, but do not have the correct state. This can be the case when EA is configured to only commit storage for instances on long-term storage, and some of the requested instances are not migrated yet. In this case EA will re-evaluated the storage commit request after the periodic migration process has executed.

To prevent an endless wait for storage commit, each storage commit request gets an expiry date. When a storage commit request expires, EA sends a storage commit response to the requesting AE. Instances present in the system with an incorrect state are reported as uncommitted.

4.2.1.4.6 Activity - Receive a Study Status Change

Description and Sequencing of Activities

An Application Entity modifies a study that is sto red in EA. The Application Entity sends a notification message (to EA) to ensure that the study stored in EA is also updated.

Accepted Presentation Contexts

Table 27 Presentation Context Table for Receive a Study Status Change

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Detached Study Management	1.2.840.10008.3.1.2.3.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		
GE Private Detailed Detached Study Management	1.2.528.1.1001.3.1.2.3.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

SOP Specific Conformance Statement

Standard conformance is provided.

Study Update is the only event type that is handled by EA. The instances referenced by the event and stored in EA are updated accordingly.

As the behavior of the delete N-EVENT-REPORT is modified in a not compatible manner EA uses a private SOP class to receive these kind of delete notifications.

When EA transmits this N-EVENT-REPORT to a SCU it will include the attributes as defined in Table 15. It will expect as response the standard N-EVENT-REPORT defined status codes. If the status code is not 'success' or not 'no such SOP Instance' (see PS 3.7-2003, 10.1.1.1.8) it will log this issue as an error and will schedule the event report to be retransmitted.
Delete N-EVENT-REPORT notification messages are transmitted asynchronously. EA will complete the delete instance process before the N-EVENT-REPORT is confirmed or even started.
EA distinguish 3 levels of delete: Study, Series and Image. Depending on the type of delete EA will set (0008, 0052) to the values 'STUDY', 'SERIES' or 'IMAGE'. If the type of delete is 'SERIES' EA will fill in the 'Referenced Series' sequence. If the type of delete is 'IMAGE' EA will fill in the 'Referenced Image' sequence. The Affected SOP Instance UID will always be set to the deleted study uid.
If the notified instance or series is the last item of a study EA will remove the study from the its internal database. No special event is sent for this action.

4.2.1.4.7 Activity - Receive a Performed Procedure Step

Description and Sequencing of Activities

An Application Entity can forward a Performed Procedure Step message that it has received from a Modality.

Accepted Presentation Contexts

Table 28 Presentation Context Table for Receive a Performed Procedure Step

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

SOP Specific Conformance Statement

Standard conformance is provided.

4.2.2 Application Entity - Data Migrator

The details of the Application Entity of the data migrator are specified under this section. The data migratory determines the contents of two Application Entities, called source and destination, and starts requesting moves for the contents of the source to the destination.

4.2.2.1 SOP Classes

This Application Entity provides Standard Conformance to the following SOP Classes:

Table 29 Standard Non-Storage SOP Classes

SOP Class Name	SOP Class UID	Role
Study Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	SCU
Study Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCU

4.2.2.2 Association Policies

This section describes the general association establishment and acceptance policies for the data migrator AE.

4.2.2.2.1 General

The Application Context Name is 1.2.840.10008.3.1.1.1.

4.2.2.2.2 Number of Associations

For the Query activity the migratory initiates one association. For the Request Move activity by default a maximum of 4 associations are initiated to one Application Entity, with a default total of 20 outstanding associations.

4.2.2.2.3 Asynchronous Nature

The Data Migrator does not support asynchronous communication (multiple outstanding transactions over a single Association). All association requests must be completed and acknowledged before a new operation can be initiated.

4.2.2.2.4 Implementation Identifying Information

The Implementation Class UID is: 1.2.528.1.1001.2.800.5.0.<buildnumber>
The version name is: EA 5.0.<buildnumber>

where <buildnumber> is the Enterprise Archive software build number.

4.2.2.3 Association Initiation Policy

The Application Entity initiates associations for the following activities:
The data migratory queries and moves studies between two DICOM peers or a DICOM peer and one of the Archive AE titles.

4.2.2.3.1 Activity - Query

Description and Sequencing of Activities

EA can query an Application Entity for its contents.

Proposed Presentation Contexts

Table 30 Presentation Context Table for Query

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Study Root Query/ Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Explicit VR, Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR, Little Endian	1.2.840.10008.1.2		

SOP Specific Conformance Statement

Standard conformance is provided.

Enterprise Archive uses the Study Date by default to partition the queries from recent to historical studies.

4.2.2.3.2 Activity – Request Move

Description and Sequencing of Activities

The data migratory can request the move of instances from a source Application Entity to a destination Application Entity.

Proposed Presentation Contexts

Table 31 Presentation Context Table for Request Move

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Study Root Query/ Retrieve Model - MOVE	1.2.840.10008.5.1.4.1 .2.2.2	Explicit VR, Little Endian	1.2.840.10008. 1.2.1	SCU	None
		Implicit VR, Little Endian	1.2.840.10008. 1.2		

SOP Specific Conformance Statement

Standard conformance is provided.

The move requests use by default a relational query with a Series UID.

4.2.2.4 Association Acceptance Policy

The data migrator Application Entity does not accept associations.

4.3 NETWORK INTERFACES

4.3.1.1 Physical Network Interface

The application is indifferent to the physical medium over the underlying operating system and hardware.

4.3.2 Additional Protocols

EA conforms to the following additional protocols defined in PS3.15

Table 32 System Management Profiles Table

Profile Name	Actor	Protocols Used	Optional Transactions	Security Support
Network Address Management	DHCP Client	DHCP	N/A	
	DNS Client	DNS	N/A	
Time Synchronization	NTP Client	DTP	Find NTP Server	
	DHCP Client	DHCP	N/A	

4.3.2.1 DHCP

DHCP can be used to obtain TCP/IP network configuration information. Support for DHCP can be configured via the operating system. If DHCP is not in use, TCP/IP network configuration information can be manually configured.

4.3.2.2 DNS

DNS can be used for address resolution. If DHCP is not in use or the DHCP server does not return any DNS server addresses, the identity of a DNS server can be configured. If a DNS server is not in use, local mapping between hostname and IP address can be manually configured.

4.3.2.3 NTP

The NTP client implements the optional Find NTP Server transaction. The NTP client will issue an NTP broadcast to identify any local NTP servers. If no local servers can found via NTP broadcast, the NTP servers identified by DHCP will be used as time references. Additionally, one or more NTP servers can be configured via the operating system. If no NTP Servers are identified then the local clock will be used as a time reference and a warning written to the system log files.

4.4 CONFIGURATION

The configuration of the EA DICOM services is stored in the Windows Registry and several XML files. Only accounts (secured by passwords) with the right level of security will be able to change the configuration; support personnel will typically do this.

4.4.1 AE Title/Presentation Address Mapping

The AE title shared by the EA services and front-end application is configurable and defaults to AE_<hostname>. The port on which the EA Connection Service listens is also configurable and defaults to 104.

All remote systems that want to communicate with the EA Connection Service have to be configured manually. For these DICOM systems the following information is needed:
The AE title.
The host name or IP address.
The port number (optional).

4.4.2 Configurable Parameters

The following general parameters are configurable for EA.

Table 33 General Configurable Parameters

Name	Values	Description
Local IP address	<automatic>	IP address
Local IP netmask	<automatic>	IP netmask
Local port number	104	Listening port number for all services
Max. Number of Associations	1…20, default 10	Maximum number of simultaneous accepted associations.
Max. Number of Reserved Associations	1…20, default 5	Maximum number of simultaneous accepted associations for high priority services.
Maximum PDU Send Size	default 16KB, minimum 512 bytes	Enterprise Archive uses the proposed peer PDU size.
Maximum PDU Receive Size	1KB – 10MB, default 16KB	The maximum accepted PDU size for an association.
Maximum number of query results	500	Maximum number of query results return on a C-Find request.
DICOM Validation	True, False	Accept or reject incoming DICOM IODs when they contain type 1 violations.
Storage Commit SCP request timeout	24 hours	If the requested instances are not in EA, the storage commitment will time out after this period.
Storage Commit SCU response timeout	6 hours	EA will consider storage commitment as failed if the peer does not respond within this time.
Maximum number of concurrent SCU associations	4	Maximum number of simultaneous initiated associations to one remote AE.
Send Explicit VR	True, False	Determines whether or not Explicit Little Endian Transfer syntax is proposed when acting as a CStore SCU.
Association operation inactivity timer	3600 s.	Timeout after which an idle association will be aborted.

The following general parameters are configurable for every locally created archive.

Table 34 Configurable Parameter per Archive

Name	Values	Description
Local AE Title	AE_<archive name>, per archive	Each archive has its own AE title
IP Verification	True / False	EA can validate that association request of a specific AE are coming from a specific IP address. A configuration option turns this checking on or off.
Association timeout	3600 seconds	If an association is idle for this period of time, EA will abort the association.

The following specific parameters are configurable for every remote DICOM AE.

Table 35 Configurable Parameters per Remote AE

Name	Values	Description
Hostname or IP Address		Hostname or IP address of Application Entity
AE Title		Title of Application Entity
Port Number	104	Port number of Application Entity
Maximum PDU Length	default 16KB	Maximum PDU length supported by Application Entity
Supported Services	Flags exist for storage, query, retrieve, verification, storage commitment, MPPS, and detached study status management	The set of services for which this the peer has been authorized.
Query Restrictions		Additional query restrictions for this peer.

5 MEDIA INTERCHANGE

EA does not support Media Storage.

6 SUPPORT OF CHARACTER SETS

6.1 OVERVIEW

In addition to the default character repertoire EA offers support for single-byte, multi-byte and universal character sets. The implementation level is ISO 2022 Level 4 – Re-designation of Graphic Character Sets within a Code (Code level identifier 14).

6.2 CHARACTER SETS

EA offers full support for the following character sets (possibly with code extension techniques):

Table 36 Supported Single-byte Character Sets without code extensions

Character Set Description	Defined Term
Default repertoire	None
Latin alphabet No. 1	ISO_IR 100
Latin alphabet No. 2	ISO_IR 101
Latin alphabet No. 3	ISO_IR 109
Latin alphabet No. 4	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	ISO_IR 13

Table 37 Supported Single-byte Character Sets with code extensions

Character Set Description	Defined Term
Default repertoire	ISO 2020 IR 6
Latin alphabet No. 1	ISO 2020 IR 100
Latin alphabet No. 2	ISO 2020 IR 101
Latin alphabet No. 3	ISO 2020 IR 109
Latin alphabet No. 4	ISO 2020 IR 110
Cyrillic	ISO 2020 IR 144
Arabic	ISO 2020 IR 127
Greek	ISO 2020 IR 126
Hebrew	ISO 2020 IR 138
Latin alphabet No. 5	ISO 2020 IR 148
Japanese	ISO 2020 IR 13

Table 38 Supported Multi-byte Character Sets with code extensions

Character Set Description	Defined Term

Japanese	ISO 2022 IR 87
	ISO 2022 IR 159
Korean	ISO-2022 IR 149

In addition EA offers suppo rt for the following multi -byte character sets without code extensions:

Table 39 Supported Multi-byte Character Sets without code extension

Character Set Description	Defined Term
Unicode in UTF-8	ISO_IR 192
GB18030 (GBK Chinese)	GB18030

6.3 CHARACTER SET CONFIGURATION

The support for reading DICOM data for any of these character sets is default behavior. Likewise, EA will only write or send DICOM data using these character sets if the original data contained those. EA can be configured to create or modify data using either of the universal character sets described above.

As well as supporting these extended character sets for DICOM messaging, the EA database and user interface can support the expected handling and display of this character set.

7 SECURITY

It is assumed that EA is used within a secured environment. It is assumed that a secured environment includes at a minimum:
Firewall or router protections to ensure that only approved external hosts have network access to EA.
Firewall or router protections to ensure that EA only has network access to approved external hosts and services.
Any communication with external hosts and services outside the locally secured environment use appropriate secure network channels, e.g., such as a Virtual Private Network (VPN).
Other network security procedures such as automated intrusion detection may be appropriate in some environments. Additional security features may be established by the local security policy and are beyond the scope of this conformance statement.

7.1 SECURITY PROFILES

EA only conforms to the bit preserving Digital Signatures Security Profile if the following restrictions apply.

- EA has not been configured to change the transfer syntax of the archived instance. This implies that compression, or decompression, has been disabled.
- The DICOM SCU AE accepts the current transfer syntax of the archived instance such that EA does not need to convert the transfer syntax of the instance.
- No user or operator has been authorized to edit demographics
- No HL7 host has been configured. This implies that no HL7 host, e.g., a RIS, can send patient or study updates that could modify the instance.
- No DICOM host has been configured to allow to send Study Detached Status updates
- No re-archiving takes place in the workflow of the PACS.

7.2 ASSOCIATION LEVEL SECURITY

EA can be configured to check the following DICOM values when determining whether to accept Association Open Requests:
Called AE Title
Calling AE Title

- Application Context

Each called AE, i.e. archive, can be configured to accept association requests from only a limited list of calling AE titles. The called AEs can have different lists. In addition the IP address of the requestor can be checked.

7.3 APPLICATION LEVEL SECURITY

None supported.

8 ANNEXES

8.1 IOD CONTENTS

8.1.1 Created SOP Instances

EA creates SOP instances from received or archived SOP instances if lossy compression has been configured.

To enable the traceability of instances within a PACS, EA can be configured NOT to change the UID of an instance at lossy compression. This should only be used in workflow situations such as a GE-PACS that relies on the fact that instance UIDs are unchanged.

Enterprise Archive does not support the use of alternate representations.

8.1.2 Usage of Attributes from received IOD's

The received IOD's must conform to the following requirements to enable EA to archive and process the instance correctly.

- Contain study, series, and instance UIDs

8.1.3 Attribute Mapping

When attributes are used by different SOP Classes, e.g. Modality Worklist, Storage and Modality Performed Procedure Step, this mapping shall be specified. For devices that specify other external protocols, such as HL7, mapping of their fields into the DICOM attributes is not required but highly recommended.

8.2 DATA DICTIONARY OF PRIVATE ATRIBUTES

Enterprise Archive defines private attributes with Block Descriptor (3113, 00xx) = "Applicare/RadStore/Version 1.0".

Table 40 Private EA Attributes

Attribute Name	Tag	VR	VM	Attribute Description
Id1	(3113, xx02)	SL	1	Internal Id of Study
Id2	(3113, xx03)	SL	1	Internal Id of Series
Id3	(3113, xx04)	SL	1	Internal Id of Instance
State	(3113, xx12)	LO	1	Instance state: "1"= Writable "2"= Read-only "3"= Frozen "4"= Archived "5"= Out-of-Cache
DateLastModified	(3113,xx13)	DT	1	Last modified date-timestamp of instance
DateLastAccessed	(3113,xx14)	DT	1	Last accessed date-timestamp of study
ByteSize	(3113,xx16)	FD	1	Instance size in bytes
LibraryId	(3113,xx17)	LO	1	Id of Library
Origin	(3113,xx1E)	LO	1	Instance origin
Version	(3113,xx21)	SL	1	Number of latest version of stored instance.
InstanceFileLocation	(3113,xx23)	ST	1	Location of instance file

8.3 STANDARD EXTENDED/SPECIALIZED/PRIVATE SOP CLASSES

Enterprise Archive uses a private SOP Class called detailed detached study management in the activities Convey a Study Status Change and Receive a Study Status Change.

Table 41 Private EA SOP Class

SOP Class	UID	SCU	SCP
GE Private Detailed Detached Study Management	1.2.528.1.1001.3.1.2.3.1	Yes	Yes