CARESTREAM

Extensible Integration Software

DICOM Conformance Statement

CONFORMANCE STATEMENT OVERVIEW

The CARESTREAM Extensible Integration Software (EIS), version 3, and implements the necessary DICOM services to:

- Provide worklists to modalities.
- Accept & Send Modality Performed Procedure Step Updates
- Accept & Send General Purpose Performed Procedure Step Updates
- Accept & Send General Purpose Scheduled Procedure Step Updates
- Query for Patient Studies (Priors)
- Request the Movement of Patient Studies

The following table provides an overview of the network services supported by EIS v3.

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Workflow Management		
Modality Worklist Information Model - FIND	No	Yes
Modality Performed Procedure Step	Yes	Yes
General Purpose Scheduled Procedure Step	Yes	Yes
General Purpose Performed Procedure Step	Yes	Yes
Query / Retrieve		
Study Root Query/Retrieve Information Model – FIND	Yes	No
Study Root Query/Retrieve Information Model – MOVE	Yes	No

Table 1. EIS Network Services

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Figures and Tables:

Section 1 Introduction

1.1 Revision History

Document Version	Date of Issue	Description
1.0	Apr 25, 2008	Initial version for EIS v3.

1.2 Audience

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

1.3 Remarks

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

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

The scope of this Conformance Statement is to facilitate communication between EIS V3 and other vendors' Medical equipment. The Conformance Statement should be read and understood in conjunction with the DICOM Standard [DICOM]. However, by itself it is not guaranteed to ensure the desired interoperability and a successful interconnectivity.

The user should be aware of the following important issues:

- ❑ The comparison of different conformance statements is the first step towards assessing interconnectivity between EIS V3 and other medical equipment.

- ❑ Test procedures should be defined to validate the desired level of connectivity.

- ❑ The DICOM standard will evolve to meet the users' future requirements. CARESTREAM HEALTH is actively involved in developing the standard further and therefore reserves the right to make changes to its products or to discontinue its delivery.

1.4 Definitions, Terms, and Abbreviations

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

Abbreviations and terms are as follows:

AE	DICOM Application Entity
ACSE	Association Control Service Element
DICOM	Digital Imaging and Communications in Medicine
IOD	DICOM Information Object Definition
ISO	International Standards Organization
LUT	Lookup Table
MPPS	Modality Performed Procedure Step
GPSPS	General Purpose Scheduled Procedure Step
GPPPS	General Purpose Performed Procedure Step
PDU	DICOM Protocol Data Unit
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)
SOP	DICOM Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
VM	Value Multiplicity
VR	Value Representation

1.5 References

[DICOM] Digital Imaging and Communications in Medicine (DICOM), NEMA PS 3.1-3.16, 2007

Section 2 Networking

2.1   Implementation Model

All DICOM Applications are implemented within a single Java application. The DICOM SCU(s) and SCP(s) are implemented within a single EIS "adapter", running as part of the application. This Adapter communicates with other Adapters within EIS by converting DICOM messages to and from a common XML model (XIM). These Adapters may initiate DICOM operations by sending XIM messages to the DICOM Adapter, and may serve DICOM operations by receiving XIM messages from the DICOM Adapter.

In EIS V3, the Adapters communicating with the DICOM Adapter include the SQL Adapter and the XML Adapters (socket and file based). The SQL Adapter provides a SQL based database for storing and retrieving scheduled procedure information to be used in the servicing of Modality Worklist queries. The XML Adapters provide an XML bases interface to external XML devices, allowing them to initiate messages to and receive messages from EIS.

The configuration parameters of the EIS AEs are stored in an XML file and are accessible via the EIS Configuration GUI. All AEs log to a text file, with configurable log facilities and levels.

2.1.1 Application Data Flow Diagram

This section discusses the flow of data to and from EIS V3. Figure 1 depicts the DICOM Implementation Model and illustrates the flow of DICOM data.
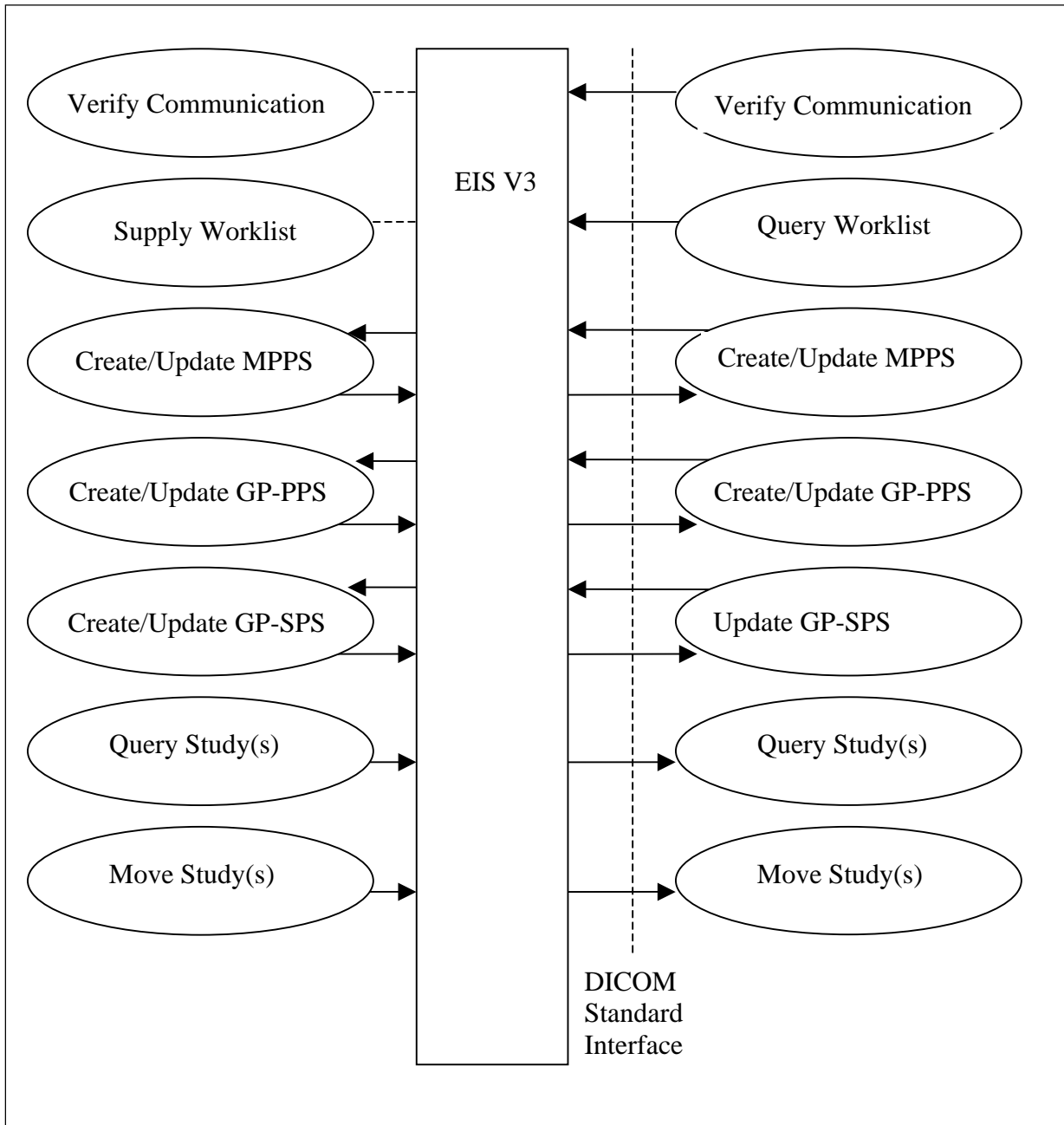
Figure 2.1 - Application Data Flow Diagram

2.1.2 Functional Definition of AE's

2.1.2.1 Functional Definition of EIS Application Entity

The EIS V3 Application Entity acts in both the SCU & SCP roles.

In the SCP role, the AE accepts incoming connections, expecting a DICOM application on the other end of the connection. The AE accepts the incoming association request in accordance with its configuration parameters and the configuration parameters of the connecting AE.

Upon successful association establishment, the AE then waits for the remote AE to initiate a DICOM operation. This operation must be part of one of the following service classes, and will result in the associated behavior described below.

Verification Service Class – Communications between the AEs is verified, and information regarding supported SOP classes, transfer syntaxes, etc. is exchanged.

Basic Worklist Management Service Class – A query is accepted from the remote AE, and the appropriate information is retrieved from the SQL Adapter's database. This information is then returned to the remote AE.

Procedure Step SOP Classes – The messages of the Procedure Step SOP Classes (MPPS, GP-SPS & GP-PPS) are supported by EIS v3 but do not affect the contents of the SQL database. These messages are passed to or from the DICOM device and to or from another device (possibly in another protocol).

In the SCU role, the EIS AE initiates connections to DICOM devices. Upon successful connection, the EIS AE requests an association with the device, suggesting contexts in accordance with its configuration parameters.

Upon successful association establishment, the AE then initiates a DICOM operation with the remote AE. This operation will be part of one of the following service classes.

Verification Service Class – Communications between the AEs is verified, and information regarding supported SOP classes, transfer syntaxes, etc. is exchanged.

Query / Retrieve Service Class – This operation is normally triggered within EIS by the reception of an XML request by one of the XML Adapters. It will result in a FIND or MOVE request being sent to the remote DICOM AE and the return of any received responses to the XML device.

Procedure Step SOP Classes – This operation is normally triggered within EIS by the reception of an XML request by one of the XML Adapters. It will result in the appropriate request (N-SET, N-CREATE, or N-ACTION) being sent to the remote DICOM AE and the return of any received responses to the XML device.

2.1.3 Sequencing of Real World Activities

All SCU & SCP activities are performed asynchronously and do not require any sequencing.

2.2 AE Specification

2.2.1 EIS Application Entity Specification

2.2.1.1 SOP Classes

The EIS AE provides Standard Conformance to the following SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	Yes	Yes
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	No	Yes
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Yes	Yes
General Purpose Scheduled Procedure Step	1.2.840.10008.5.1.4.32.2	Yes	Yes
General Purpose Performed Procedure Step	1.2.840.10008.5.1.4.32.3	Yes	Yes
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No

Table 2. SOP Classes supported by EIS Application Entity

2.2.1.2 Association Policies

2.2.1.2.1 General

The EIS AE recognizes the following Application Context Names:

Standard DICOM Application Context Name	1.2.840.10008.3.1.1.1

Table 3. Application Context for EIS AE SSCP

The maximum PDU size used by the EIS AE during association-negotiation is configurable. The AE has no internal limits regarding PDU sizes. It can use the value zero (0) which indicates that the Calling AE may send PDUs of any length (i.e. no maximum length).

Maximum PDU size received	Configurable; default is 0 (no maximum size)

Table 4. Maximum PDU Size Received for EIS AE

The EIS AE determines the length of PDUs that it sends based on the maximum available size that is used by the Calling AE and an internal configuration parameter that can set a local limit. The length of PDUs that are created and sent by the AE is the smaller of these two values. However, if the Calling AE uses the value zero (0) (interpreted by the EIS AE as no maximum length) and the local limit indicates no maximum length, the EIS AE creates and sends one PDU per message.

The EIS AE implements a DIMSE timer to optionally limit the length of time an association can be kept open. In an SCU role, this timer specifies the amount of time allowed between sending a DIMSE request and receiving a response. In an SCP role, this timer specifies the amount of time the association is allowed to be idle. In both cases, the expiration of the timer will cause the association to be aborted.

This timer can be specified globally (applies to all associations), per local AE (applies only to associations with the specified local AE), and/or per remote AE (applies to all connections with the remote AE). The timer can also be disabled at any of these levels, allowing a remote AE to keep an association open indefinitely.

2.2.1.2.2   Number of Associations

The EIS AE supports an unlimited number of associations, with the option of imposing an upper limit. If no upper limit is specified (by specifying 0), the number of associations is bounded only by the available system resources. If this upper limit is specified, any new association requests above this limit will be rejected with a reason of "temporary congestion".

It should be noted that response time for an association degrades with increasing simultaneous associations. This slow response may trigger timers in remote systems.

Maximum number of simultaneous associations	Configurable (unlimited or fixed limit); default is 20

Table 5. Number of Associations Accepted for EIS AE

2.2.1.2.3 Asynchronous Nature

The EIS AE does not support asynchronous communication (multiple outstanding transactions over a single Association).

Maximum number of outstanding asynchronous transactions	1

Table 6. Asynchronous Nature as a SCP for EIS AE

2.2.1.2.4 Implementation Identifying Information

The EIS AE provides the following set of implementation identifying information.

Implementation Class UID	1.2.840.113674.6.15.95
Implementation Version Name Note: *YYYYMMDD* represents the date of manufacture.	XIS*YYYYMMDD*W

Table 7. Implementation Identifying Information for EIS AE

2.2.1.3 Association Initiation Policy

The EIS AE initiates associations under the following activities:

- Query Study
- Move Study
- Create / Update MPPS
- Create / Update GP-PPS
- Update GP-SPS

2.2.1.3.1 Activity – Query Study

2.2.1.3.1.1 *Description and Sequencing of Activities*

The EIS AE will initiate associations in order to query for lists of prior studies.
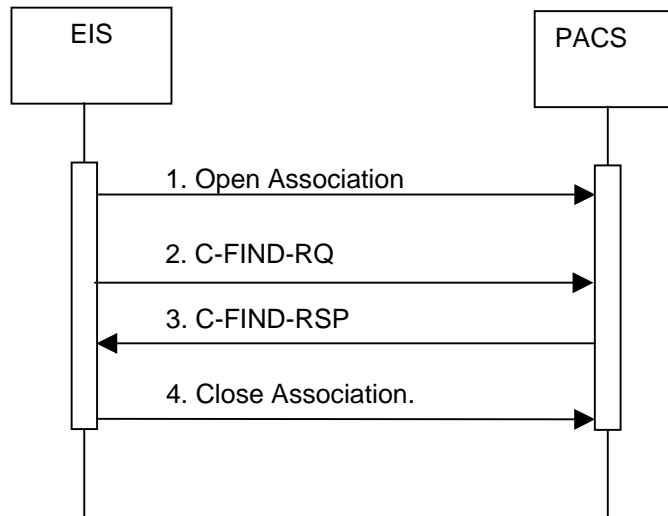
A possible sequence of interactions between the EIS AE and another application Entity (usually PACS) is illustrated above:

1. The EIS AE initiates a new association with the PACS.

2. The EIS AE sends a C-FIND request containing parameters for querying the prior studies.

3. The PACS replies with C-FIND responses containing matching studies.

4. The EIS AE closes the association with the PACS.

2.2.1.3.1.2 Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negot.
Name	**UID**	**Name List**	**UID List**		
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2		None

Table 8. Query Study Proposed Presentation Contexts

2.2.1.3.1.3 SOP Specific Conformance

Optional Keys

EIS supports all optional keys specified by this SOP class. The optional keys included in the query are determined by the originator (usually an XML device) of the query to EIS, and will vary dependant on the originator.

Relational Queries

EIS does not generate relational queries, nor does it support extended negotiation of relational queries.

Matching Extended Negotiation

EIS does not support extended negotiation of combined date-time matching or of fuzzy semantic matching of person names.

Specific Character Set

The character set used to encode queries is configurable per DICOM device. If another DICOM default character set is used, that character set will be specified in the Specific Character Set (0008, 0005) attribute. All appropriate fields in the query will be encoded using the character set.

When handling the responses to the query, EIS will examine the contents of the Specific Character Set (0008, 0005) attribute and interpret the contents of the appropriate fields using this character set.

2.2.1.3.2 Activity – Move Study

2.2.1.3.2.1 Description and Sequencing of Activities

The EIS AE will initiate associations in order to request the movement of studies from one AE to another.
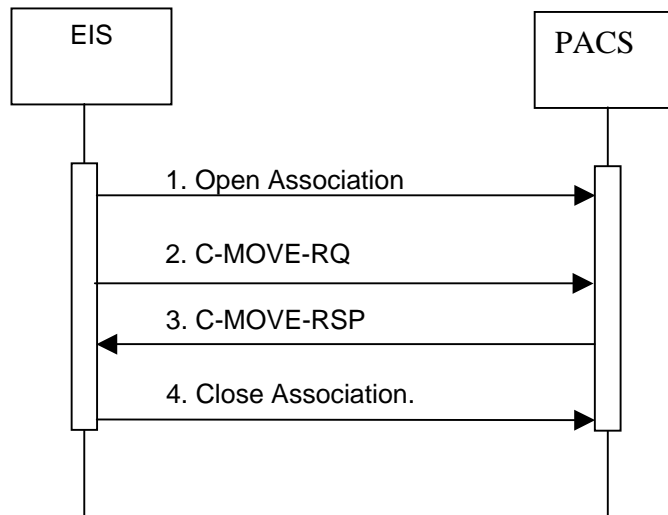
A possible sequence of interactions between the EIS AE and a PACS is illustrated above:

1. The EIS AE initiates a new association with the PACS.
2. The EIS AE sends a C-MOVE request containing parameters for specifying the study(s) to be moved.
3. The PACS AE replies with C-MOVE responses for each instance moved.
4. The EIS AE closes the association with the PACS.

2.2.1.3.2.2   *Proposed Presentation Contexts*

Abstract Syntax		Transfer Syntax		Role	Extended Negot.
Name	**UID**	**Name List**	**UID List**		
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2		None

Table 9. Move Study Proposed Presentation Contexts

2.2.1.3.2.3   *SOP Specific Conformance*

The EIS AE conforms to Base SCU Behavior for this SOP class, and supports transfers against the Query/Retrieve Information Model described
In DICOM PS 3.4, Section C.6.2.1 using the C-MOVE SCU Behavior described in DICOM PS 3.4, Section C.4.2.2.

2.2.1.3.3   **Activity – Create / Update MPPS**

2.2.1.3.3.1   *Description and Sequencing of Activities*

The EIS AE will initiate associations in order to notify AEs of the creation of or changes in Modality Performed Procedure Steps.
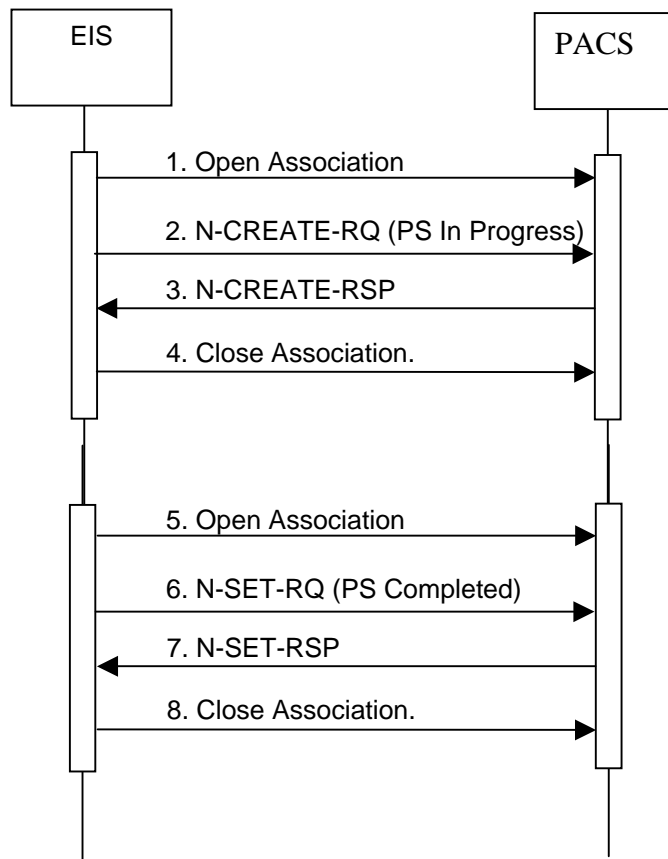
A possible sequence of interactions between the EIS AE and a PACS is illustrated above:

1. The EIS AE initiates a new association with the PACS AE.

2. EIS sends an N-CREATE request containing parameters describing the Performed Procedure Step currently being performed, as well as its current status (usually IN PROGRESS).

3. The PACS AE replies with an N-CREATE response.

4. The EIS AE closes the association with the PACS.

5. The EIS AE initiates a new association with the PACS AE.

6. EIS sends an N-SET request containing parameters describing the Performed Procedure Step currently being performed, as well as its new status (usually COMPLETED).

7. The PACS AE replies with an N-CREATE response.

8. The EIS AE closes the association with the PACS.

2.2.1.3.3.2   Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negot.
Name	**UID**	**Name List**	**UID List**		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.4	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2		None

Table 10. Create / Update MPPS Proposed Presentation Contexts

2.2.1.3.3.3   SOP Specific Conformance

Attributes Provided

The attributes that will be provided in both the N-SET and N-CREATE Services of this SOP class are specified by the originator of the message to EIS, and as such will vary dependant on the originator.

All values specified in DICOM PS 3.4 – Table F.7.2-1 might potentially be present in these messages.

Real World Triggers

The creation of the SOP class instance and the subsequent modification of its attributes, are triggered by the reception of an appropriate message by EIS. This message may originate from another DICOM device, or one of various other devices supported by EIS (egg. a device communicating with EIS via the XML protocol).

2.2.1.3.4   Activity – Create / Update GP-PPS

2.2.1.3.4.1   *Description and Sequencing of Activities*

The EIS AE will initiate associations in order to create General Purpose – Performed Procedure Step SOP Instances and to update the status of these SOP Instances.
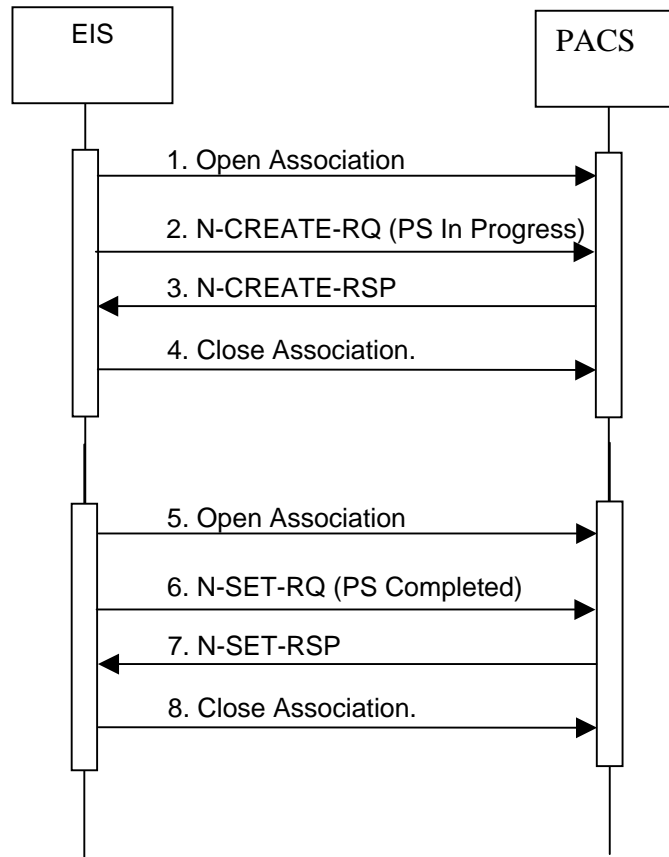
A possible sequence of interactions between the EIS AE and a Modality is illustrated above:

1. The EIS AE initiates a new association with the PACS AE.

2. EIS sends an N-CREATE-RQ message to the PACS to create the GP-PPS SOP Instance with a status of IN PROGRESS.

3. The PACS responds with an N-CREATE-RSP message, indicating the success of the SOP Instance creation.

4. The EIS AE closes the association with the PACS.

5. The EIS AE initiates a new association with the PACS AE.

6. EIS sends an N-SET-RQ message to the PACS to update the status of the GP-PPS SOP Instance to COMPLETED or DISCONTINUED.

7. The PACS responds with an N-SET-RSP message, indicating the success of the status update.

8. The EIS AE closes the association with the PACS.

2.2.1.3.4.2   *Proposed Presentation Contexts*

Abstract Syntax		Transfer Syntax		Role	Extended Negot.
Name	**UID**	**Name List**	**UID List**		
General Purpose Performed Procedure Step	1.2.840.10008.5.1.4.32.3	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2		None

Table 11. Create / Update GP-PPS Proposed Presentation Contexts

2.2.1.3.4.3   *SOP Specific Conformance*

Attributes Provided

The attributes that will be provided in both the N-SET and N-CREATE Services of this SOP class are specified by the originator of the message to EIS, and as such will vary dependant on the originator.

All values specified in DICOM PS 3.4 – Table F.11.2-1 might potentially be present in these messages.

Real World Triggers

The creation of the SOP class instance and the subsequent setting of the Procedure Step Status (0040, 4002) to COMPLETED or DISCONTINUED, are triggered by the reception of an appropriate message by EIS. This message may originate from another DICOM device, or one of various other devices supported by EIS (eg. a device communicating with EIS via the XML protocol).

2.2.1.3.5   Activity – Update GP-SPS

2.2.1.3.5.1   Description and Sequencing of Activities

The EIS AE will initiate associations in order to request the modification of Attribute Values of an instance of the General Purpose Scheduled Procedure Step SOP Class and provide information about a specific real-world General Purpose Scheduled Procedure Step.
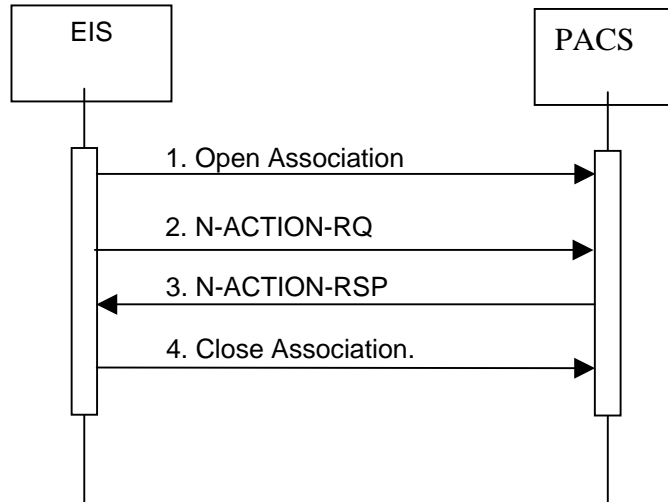
A possible sequence of interactions between the EIS AE and a Modality is illustrated above:

1. The EIS AE accepts a new association with the Modality AE.

2. The modality sends a C-FIND request containing parameters for querying the wordlist. The EIS AE replies with C-FIND responses containing matching wordlist items.

3. The Modality AE closes the association with the EIS.

2.2.1.3.5.2 Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended
Name	**UID**	**Name List**	**UID List**	**Role**	**Negot.**
General Purpose Scheduled Procedure Step	1.2.840.10008.5.1.4.32.2	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2		None

Table 12. Update GP-SPS Proposed Presentation Contexts

2.2.1.3.5.3 SOP Specific Conformance

Real World Triggers

The request to modify the value of the "General Purpose Scheduled Procedure Step Status" (0040,4001) attribute is triggered by the reception of an appropriate message by EIS. This message may originate from another DICOM device, or one of various other devices supported by EIS (egg. a device communicating with EIS via the XML protocol).

This message will contain the value to which the status is to be updated, and will be one of "IN PROGRESS", "SUSPENDED", COMPLETED", "DISCONTINUED", or "SCHEDULED".

2.2.1.4 Association Acceptance Policy

The EIS AE accepts associations under the following activities:

- Query Wordlist
- Create / Update MPPS
- Create / Update GP-PPS
- Create GP-SPS

Note that the accepted abstract syntaxes and transfer syntaxes are affected by the EIS DICOM configuration. Abstract syntaxes (SOP classes) can be enabled / disabled globally or by remote AE (device). Transfer syntaxes can be enabled / disabled per local AE.

2.2.1.4.1 Transfer Syntax Selection Policy

Two transfer syntax selection policies are available and configurable via the EIS GUI:

1. Selection is the first Transfer Syntax in the set of proposed Transfer Syntaxes that is also present in the set of configured Transfer Syntaxes for acceptance. (FIRST_PROPOSED)

2. Selection is the first Transfer Syntax in the set of configured Transfer Syntaxes that is set to be accepted and also present in the set of proposed Transfer Syntaxes. (FIRST_CONFIGURED)

2.2.1.4.2 Activity — Query Wordlist

2.2.1.4.2.1 Description and Sequencing of Activities

The EIS AE will accept associations in order to service wordlist queries from
modalities.
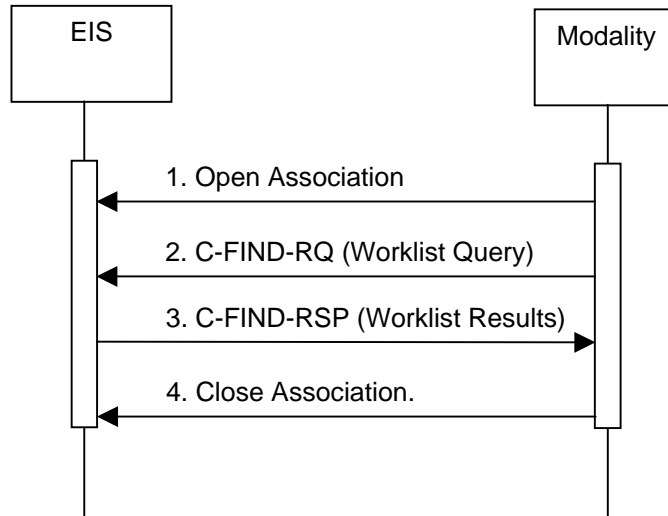
A possible sequence of interactions between the EIS AE and a Modality is
illustrated above:

1. The EIS AE accepts a new association with the Modality AE.

2. The modality sends a C-FIND request containing parameters for querying
   the wordlist.

3. The EIS AE replies with one or more C-FIND responses containing
   matching wordlist items.

4. The Modality AE closes the association with the EIS.

2.2.1.4.2.2 Accepted Presentation Contexts

The EIS AE will accept presentation contexts as shown below.

Abstract Syntax		Transfer Syntax		Role	Extended Negot.
Name	**UID**	**Name List**	**UID List**		
Modality Wordlist Model - Find	1.2.840.10008.5.1.4.31	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

Figure 2.2 - Acceptable Presentation Contexts for Wordlist Query

The Transfer Syntax Selection Policy described in section 2.2.1.4.1 is employed
to select transfer syntax for each presentation context.

2.2.1.4.2.3 SOP Specific Conformance

Standard Conformance

The EIS supports queries against the Wordlist Information Model described in DICOM PS 3.4, section K.6.1.2 using the C-FIND SCP Behavior described in DICOM PS 3.4, section K.4.1.3.

Optional Matching Key Attributes

EIS services MWL queries in one of two ways. Queries can either be forwarded to another device (DICOM, XML, etc.) to be serviced, or the query can be serviced directly by the EIS database. This behavior is decided by the EIS configuration.

If the query is to be serviced by an external device, that device determines the optional matching key attribute support. EIS itself will support all attributes listed in DICOM PS 3.4 table K.6-1, and will pass these attributes to the servicing device.

If the query is to be serviced by the EIS database, then the optional attributes listed in the following table are supported

Description	Tag
Scheduled Procedure Step	
Scheduled Procedure Step Sequence	(0040, 0100)
>Scheduled Procedure Step Description	(0040, 0007)
>Scheduled Station Name	(0040, 0010)
>Scheduled Procedure Step Location	(0040, 0011)
>Pre-Medication	(0040, 0012)
>Scheduled Procedure Step ID	(0040, 0009)
>Requested Contrast Agent	(0032, 1070)
>Scheduled Procedure Step Status	(0040, 0020)
Requested Procedure	
Requested Procedure ID	(0040, 1001)
Requested Procedure Description	(0032, 1060)
Requested Procedure Code Sequence	(0023, 1064)
>Code Value	(0008, 0100)
>Coding Scheme Designator	(0008, 0102)
>Coding Scheme Version	(0008, 0103)
>Code Meaning	(0008, 0104)
Study Instance UID	(0020, 000D)
Referenced Study Sequence	(0008, 1110)
>Referenced SOP Instance UID	(0008, 1155)
Requested Procedure Priority	(0040, 1003)
Patient Transport Arrangements	(0040, 1004)
Requested Procedure Location	(0040, 1005)

Imaging Service Request	
Accession Number	(0008, 0050)
Requesting Physician	(0032, 1032)
Referring Physician's Name	(0008, 0090)
Requesting Service	(0032, 1033)
Visit Identification	
Admission ID	(0038, 0010)
Visit Status	
Current Patient Location	(0038, 0300)
Visit Status ID	(0038, 0008)
Patient's Institution Residence	(0038, 0400)
Patient Identification	
Patient's Name	(0010, 0010)
Patient ID	(0010, 0020)
Other Patient Names	(0010, 1001)
Other Patient IDs	(0010, 1000)
Patient Demographic	
Patient's Birth Date	(0010, 0030)
Patient's Birth Time	(0010, 0032)
Patient's Sex	(0010, 0040)
Patient's Age	(0010, 1010)
Patient's Size	(0010, 1020)
Patient's Weight	(0010, 1030)
Ethnic Group	(0010, 2160)
Occupation	(0010, 2180)
Confidentiality Constraint on Patient Data Description	(0040, 3001)
Patient Medical	
Patient State	(0038, 0500)
Pregnancy Status	(0010, 21C0)
Medical Alerts	(0010, 2000)
Contrast Allergies	(0010, 2110)

Table 13 - Modality Wordlist Query Optional Matching Key Attributes

Optional Return Key Attributes

EIS services MWL queries in one of two ways, by an external device, or by its local database.

If the query is to be serviced by an external device, the optional (type 3) return that device determines key attribute support. EIS will support the return of all attributes listed in DICOM PS 3.4 table K.6-1, and will pass these attributes from the servicing device.

If the query is to be serviced by the EIS database, then the optional return key attributes listed in the following table are supported

Description	Tag
Scheduled Procedure Step	
Scheduled Procedure Step Sequence	(0040, 0100)
>Scheduled Procedure Step Status	(0040, 0020)
Requested Procedure	
Requested Procedure Code Sequence	(0023, 1064)
>Coding Scheme Version	(0008, 0103)
Requested Procedure Location	(0040, 1005)
Imaging Service Request	
Requesting Service	(0032, 1033)
Visit Status	
Visit Status ID	(0038, 0008)
Patient's Institution Residence	(0038, 0400)
Patient Identification	
Other Patient Names	(0010, 1001)
Other Patient IDs	(0010, 1000)
Patient Demographic	
Patient's Birth Time	(0010, 0032)
Patient's Age	(0010, 1010)
Patient's Size	(0010, 1020)
Ethnic Group	(0010, 2160)
Occupation	(0010, 2180)
Patient Medical	
Additional Patient History	(0010, 21B0)

Table 14. Modality Wordlist Query Optional Return Key Attributes

PN type Attribute Case-insensitive Matching

EIS supports case-insensitive matching for attributes with a VR of PN.

Fuzzy Semantic Matching of Person Names

EIS does not support extended negotiation for fuzzy semantic matching of a person's name.

Specific Character Sets

When processing incoming MWL C-FIND requests, EIS will examine the contents of the Specific Character Set (0008, 0005) attribute. If this attribute is present and contains a valid DICOM character set enumeration, that character set will be used to interpret the appropriate attributes in the query dataset.

If the Specific Character Set (0008, 0005) attribute is missing or does not contain a valid DICOM character set, then the DICOM default character set will be assumed. (Note: The system default character set is used in this case. This is to maintain compatibility with previous functionality, but will still conform to the DICOM standard, as the default DICOM character set (ASCII) will be a subset of the system character set, allowing correct interpretation of the query attributes.)

Response Statuses

The following table lists the possible status codes returned by an EIS C-FIND response.

Service Status	Further Meaning	Status Codes	Further Meaning
Success	Success	0000	Query was completed successfully.
Refused	Out of Resources	A700-A7FF	System resources were not available to service the request at this time.
Error	General Failure	C000	Cannot understand – general processing failure.
	Processing Failure	0110	Processing failure. A failure occurred either internally to EIS, or while servicing the request through the SQL Adapter. Additional info may be provided in the (0000, 0902) Error Comment attribute.
Pending	Matches are continuing	FF00	A match has been returned and further matches may be pending.
Pending	Matches are continuing – warning that one or more optional keys were not supported.	FF01	A match has been returned and further matches may be pending. One or more optional key matching elements specified in the query was not used to perform the match.

Figure 2.3 - Worklist Query Response Statuses

2.2.1.4.3   Activity — Create / Update MPPS

2.2.1.4.3.1   *Description and Sequencing of Activities*

The EIS AE will accept associations in order to receive Modality Performed Procedure Step creation and update requests from modalities.
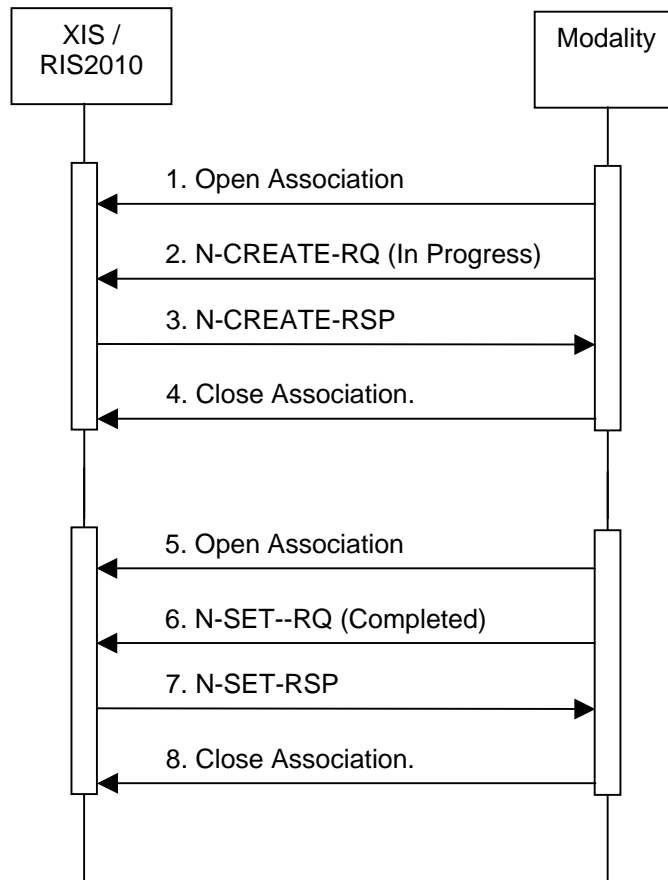
```
┌──────────┐                          ┌──────────┐
│ XIS /    │                          │ Modality │
│ RIS2010  │                          │          │
└──────────┘                          └──────────┘
        1. Open Association
                2. N-CREATE-RQ (In Progress)
                3. N-CREATE-RSP
                4. Close Association.

                5. Open Association
                6. N-SET--RQ (Completed)
                7. N-SET-RSP
                8. Close Association.
```

A possible sequence of interactions between the EIS AE and a Modality is illustrated above:

1. The EIS AE accepts a new association from the Modality AE.

2. The modality sends an N-CREATE request containing parameters describing the Performed Procedure Step currently being performed, as well as its current status (usually IN PROGRESS).

3. EIS AE replies with an N-CREATE response.

4. The Modality AE closes the association with EIS.

5. The modality initiates a new association with the EIS AE.

6. The modality sends an N-SET request containing parameters describing the Performed Procedure Step currently being performed, as well as its new status (usually COMPLETED).

7. The EIS AE replies with an N-CREATE response.

8. The modality closes the association with EIS.

2.2.1.4.3.2   *Accepted Presentation Contexts*

The EIS AE will accept presentation contexts as shown below.

Abstract Syntax		Transfer Syntax		Role	Extended Negot.
Name	**UID**	**Name List**	**UID List**		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.4	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

Figure 2.4 - Acceptable Presentation Contexts for Create / Update MPPS

The Transfer Syntax Selection Policy described in section 2.2.1.4.1 is employed to select transfer syntax for each presentation context.

2.2.1.4.3.3   *SOP Specific Conformance*

Attributes Supported

The support for attributes provided in both the N-CREATE and N-SET messages of this SOP class are determined by the final destination of these messages. EIS does not service these messages itself, but passes them to be serviced by either another DICOM device or some other external device (i.e. an XML client device). Solely this device determines the support of optional attributes.

Real World Behavior

EIS does not control or maintain the SOP instances created by this SOP class, but instead passes the N-CREATE and N-SET requests to devices that do. Therefore, any behaviors resulting from the reception of these messages are initiated by these devices, and are determined solely by them. These devices may be a DICOM device or another external device (i.e. an XML client device).

Response Statuses

The following table lists the possible status codes returned by EIS N-CREATE and N-SET responses.

Service Status	Further Meaning	Status Codes	Further Meaning
Success	Success	0000	Operation completed successfully.

Service Status	Further Meaning	Status Codes	Further Meaning
Error	General Failure	C000	Cannot understand – general processing failure.
	Processing Failure	0110	Processing failure. A failure occurred either internally to EIS, or while attempting to deliver the message to an external device. Additional info may be provided in the (0000, 0902) Error Comment attribute.

Figure 2.5 - MPPS Response Status

2.2.1.4.4   Activity — Create / Update GP-PPS

2.2.1.4.4.1   Description and Sequencing of Activities

The EIS AE will accept associations in order to receive General Purpose Performed Procedure Step creation and update requests from devices.
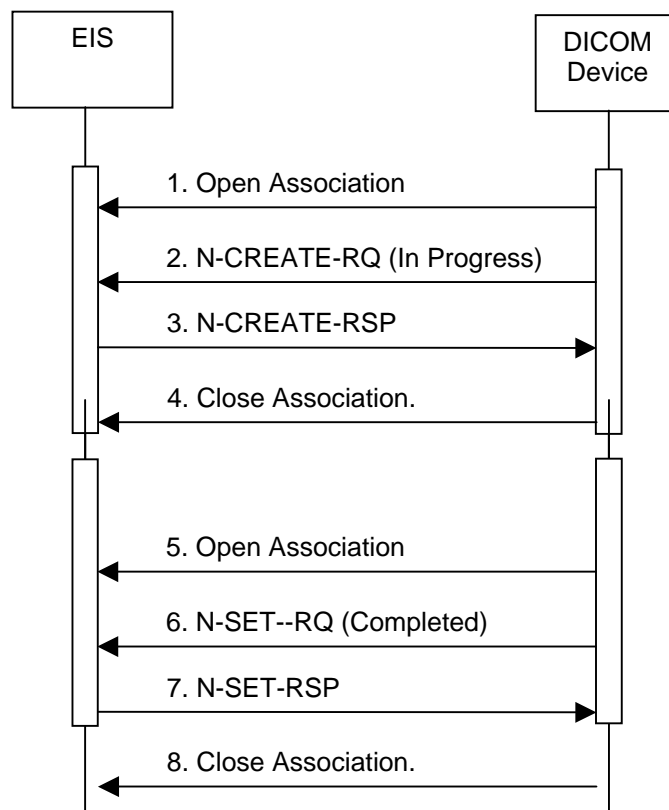
A possible sequence of interactions between the EIS AE and a DICOM device is illustrated above:

1. The EIS AE accepts a new association from the Device's AE.

2. The device sends an N-CREATE request containing parameters describing the General Purpose Performed Procedure Step currently being performed, as well as its current status.

3. EIS AE replies with an N-CREATE response.

4. The Device AE closes the association with EIS.

5. The device initiates a new association with the EIS AE.

6. The device sends an N-SET request containing parameters describing the General Purpose Performed Procedure Step currently being performed, as well as its new status.

7. The EIS AE replies with an N-CREATE response.

8. The device closes the association with EIS.

2.2.1.4.4.2 Accepted Presentation Contexts

The EIS AE will accept presentation contexts as shown below.

Abstract Syntax		Transfer Syntax		Role	Extended Negot.
Name	**UID**	**Name List**	**UID List**		
General Purpose Performed Procedure Step	1.2.840.10008.5.1.4.32.3	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

Figure 2.6 - Acceptable Presentation Contexts for Create / Update GP-PPS

The Transfer Syntax Selection Policy described in section 2.2.1.4.1 is employed to select transfer syntax for each presentation context.

2.2.1.4.4.3 SOP Specific Conformance

Attributes Supported

The support for attributes provided in both the N-CREATE and N-SET messages of this SOP class are determined by the final destination of these messages. EIS does not service these messages itself, but passes them to be serviced by either another DICOM device or some other external device (i.e. an XML client device). Solely this device determines the support of optional attributes.

Real World Behavior

EIS does not control or maintain the SOP instances created by this SOP class, but instead passes the N-CREATE and N-SET requests to devices that do. Therefore, any behaviors resulting from the reception of these messages are initiated by these devices, and are determined solely by them. These devices may be a DICOM device or another external device (i.e. an XML client device).

Response Statuses

The following table lists the possible status codes returned by EIS N-CREATE and N-SET responses.

Service Status	Further Meaning	Status Codes	Further Meaning
Success	Success	0000	Operation completed successfully.
Error	General Failure	C000	Cannot understand – general processing failure.
	Processing Failure	0110	Processing failure. A failure occurred either internally to EIS, or while attempting to deliver the message to an external device. Additional info may be provided in the (0000, 0902) Error Comment attribute.

Figure 2.7 – GP-PPS Response Status

2.2.1.4.5   Activity — Update GP-SPS

2.2.1.4.5.1   *Description and Sequencing of Activities*

The EIS AE will accept associations in order to accept status updates of General Purpose Scheduled Procedure Step Instances.
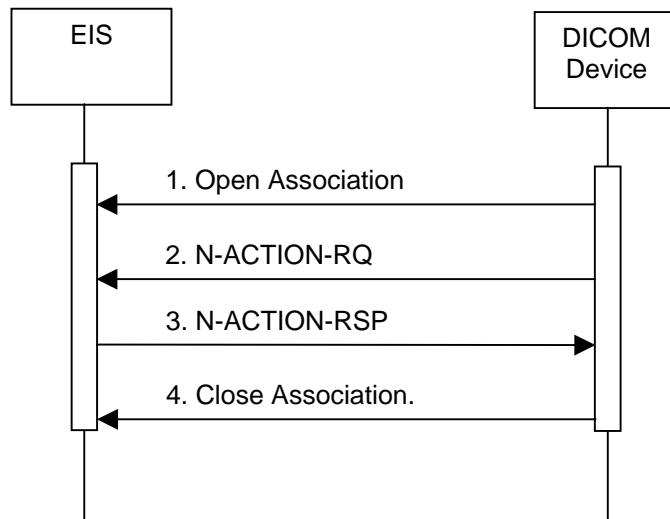
A possible sequence of interactions between the EIS AE and a Modality is illustrated above:

1. The EIS AE accepts a new association with the Device's AE.

2. The device sends an N-ACTION request containing parameters identifying the GP-SPS instance to be updated.

3. The EIS AE replies with an N-ACTION response.

4. The device AE closes the association with the EIS.

2.2.1.4.5.2   Accepted Presentation Contexts

The EIS AE will accept presentation contexts as shown below.

Abstract Syntax		Transfer Syntax		Role	Extended
Name	**UID**	**Name List**	**UID List**		**Negot.**
General Purpose Scheduled Procedure Step	1.2.840.10008.5.1.4.32.2	Explicit VR Big Endian Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

Figure 2.8 - Acceptable Presentation Contexts for Update GP-SPS

The Transfer Syntax Selection Policy described in section 2.2.1.4.1 is employed to select transfer syntax for each presentation context.

2.2.1.4.5.3   SOP Specific Conformance

The EIS AE does not create or manage instances of the General Purpose Scheduled Procedure Step SOP class, but simply acts as an interface to applications or devices that do. Subsequently, the EIS AE:

- Does not create GP-SPS SOP Instances

- Does not assert any requirements or conditions for the update of the General Purpose Scheduled Procedure Step Status (0040, 4001) attribute.

- Does not enforce requirements as to what attributes can be updated when a GP-SPS instance is in a particular state.

- Does not control the length of time a GP-SPS instance will persist after its state has been set to "COMPLETED" or "DISCONTINUED"

The following table lists the possible status codes returned by an EIS N-ACTION response.

Service Status	Further Meaning	Status Codes	Further Meaning
Success	Success	0000	Query was completed successfully.
Error	General Failure	C000	Cannot understand – general processing failure.

Service Status	Further Meaning	Status Codes	Further Meaning
	Processing Failure	0110	Processing failure. A failure occurred either internally to EIS, or while attempting to deliver the message to an external device. Additional info may be provided in the (0000, 0902) Error Comment attribute.

Figure 2.9 – GP-SPS Response Statuses

2.3 Network Interfaces

2.3.1 Physical Network Interface

EIS provides the DICOM V3.0 TCP/IP network communication support as defined in Part 8 of the DICOM Standard.

EIS uses the TCP/IP stack from the operating system on which it executes and is indifferent to the physical medium over which TCP/IP executes, for example; Ethernet, IEEE 802.3, ATM, or FDDI.

2.3.2 Additional Protocols

2.3.2.1 System Management Profiles

EIS conforms to the following System Management Profiles as defined in DICOM PS 3.15

Profile Name	Actor	Protocols Used	Optional Transactions
Basic Network Address Management	DHCP Client	DHCP	N/A
Basic Network Address Management	DNS Client	DNS	N/A
Basic Time Synchronization	NTP Client	NTP	None
Basic TLS Secure Transport Connection	TLS Client TLS Server	TLS	N/A
AES TLS Secure Transport Connection	TLS Client TLS Server	TLS	N/A

Table 15. Supported System Management Profiles

The DHCP, DNS and NTP protocols and associated services are provided by the operating system on which EIS is running. All configuration is done via the operating system.

The TLS configuration information, including port number, certificate and key information, is located in the EIS DICOM Adapter configuration file. Keys and certificates are stored in local files and/or Java keystores.

2.3.3 IPv4 and IPv6 Support

IP protocol support is provided by the operating system on which EIS is running. Any IPv4 or IPv6 support would be provided by and dependent on that operating system.

2.4 Configuration

EIS is a highly configurable product. This section highlights the parameters that are configurable. Details on the implementation and specification of these configuration parameters are provided in the "XIS Integrators Guide" (Part # 5H0696).

2.4.1 AE Title/Presentation Address Mapping

The translation from AE Title to Presentation Address is achieved solely using persistent configuration data. This is accessible by directly modifying the XML configuration files, or via the EIS configuration interface.

EIS does not supply or require consistent, predefined AE definitions. Local and remote AE parameters, including presentation address, are completely defined within the configuration file.

2.4.2 Configurable Parameters

Parameter	Configurable	Default Value
General Parameters		
Time-out waiting for an Association Open Request. (Application Level timeout)	Yes [2,A]	2 minutes
Time-out waiting for acceptance or rejection Response to an Association Open Request. (Application Level timeout)	Yes	5 seconds
General DIMSE level time-out values	Yes [2,B]	Not set; no time-out.
Time-out waiting for response to TCP/IP connect () request. (Low-level timeout)	Yes [1]	See note.
Time-out waiting for acceptance of a TCP/IP message over the network. (Low-level timeout)	Yes [1]	See note.
Time-out for waiting for data between TCP/IP packets. (Low-level timeout)	Yes [1]	See note.
Any changes to default TCP/IP settings, such as configurable stack parameters.	Yes [1]	See notes.
Maximum PDU size the AE can receive	Yes [2,D]	64 KB
Maximum PDU size the AE can send	Yes [2,E]	64 KB
AE specific DIMSE level time-out values	Yes [2]	Defaults to the general parameter value.
Number of simultaneous Associations by Service and/or SOP Class	No	
Presentation Context Acceptance Criterion	Yes [2,F]	See note.
Transfer Syntax Selection Policy	Yes [2,G]	The first transfer syntax in the list of proposed transfer syntaxes that matches one of the configured transfer syntaxes for the abstract syntax is accepted.
SOP Class support (e.g. Multiframe vs. single frame vs SC support), when configurable	No	

Transfer syntax support, e.g. JPEG, Explicit VR, when configurable	No	
AE Specific Parameters		
Size constraint in maximum object size	No	
Other Parameters		
General number of simultaneous associations	Yes [2,H]	
Number of threads in thread pool	Yes [2,J]	10
DICOM logging information	Yes [2,K]	None
Character set used when sending to a device	Yes	DICOM default
Override character set used in responses	Yes	False
Notes		
1. The parameter is configurable by the operating system. See the documentation for the operating system for the affected system-level parameters. 2. The parameter is configurable by the application. A. This is the initial value of the ARTIM (Association Request, Reject, Release) Timer in Part 8 of the DICOM Standard. B. This is referred to as the "Association Idle Timer" in the configuration user interface. The consequence of this timeout is an automatic abort of the association. D. There are no internal limits regarding the length of received P-DATA PDUs. The EIS AE can be configured to advertise any particular maximum length and can also be configured to advertise no maximum length. E. An upper limit on the length of P-DATA PDUs that are sent can be imposed. F. A set of presentation context items can be specified. When the EIS AE receives an A-ASSOCIATE-RQ PDU, the presentation context items contained within it are compared to the configured set of presentation context items. The response (A-ASSOCIATE-AC PDU or A-ASSOCIATE-RJ PDU) and its exact contents are based on the outcome of this comparison. No prioritization rules are imposed upon the acceptance of presentation contexts. G. There are two transfer syntax selection policies: (i). First proposed and configured. The first transfer syntax that is proposed and also included the list of transfer syntaxes configured for the abstract syntax is accepted. Note: The order of the transfer syntaxes configured is not important. (ii) First configured to accept. The first transfer syntax that is configured for the abstract syntax and also included in the list of transfer syntaxes proposed is accepted. Note: The order of the transfer syntaxes configured is important. H. An upper limit on the number of simultaneous associations may be imposed or the number of simultaneous associations may be unlimited. J. An initial number of processing threads can be specified which are dispatched to handling association establishment and DIMSE messages on a first come first serve basis. Also, a specific number of threads can be created to service individual DIMSE services. Note: There is no relationship between the number of threads and the number of simultaneous associations.		

K. Certain messages can be logged based upon their severity (e.g. informational, warning, error) and type (e.g. message exchange, compression/decompression operations).

Table 16. Configurable Parameters

Section 3 Media Interchange

EIS does not support Media Storage.

Section 4 Support of Character Sets

EIS supports the following character sets when both sending and receiving DIMSE messages.

DICOM Character Term	Description
DICOM Default (ISO_IR 6)	Default repertoire
ISO_IR 100	Latin alphabet No. 1
ISO_IR 101	Latin alphabet No. 2
ISO_IR 109	Latin alphabet No. 3
ISO_IR 110	Latin alphabet No. 4
ISO_IR 144	Cyrillic I
ISO_IR 127	Arabic
ISO_IR 126	Greek
ISO_IR 138	Hebrew
ISO_IR 148	Latin alphabet No. 5
ISO_IR 13	Japanese
ISO_IR 166	Thai
ISO_IR 192	UTF-8
GB18030	GB18030

Table 17. - Supported Charater Sets

Unsupported Character Sets

If an unsupported or unknown character set is encountered in an incoming DICOM message, a warning message will be logged, and the default character set will be used to interpret the message.

Configuration

EIS has the ability to configure the following parameters that control how character sets are used in outgoing DIMSE messages. These parameters are specified per remote AE.

- Outbound Character Encoding – specifies the character set to use when sending messages to a remote AE. The Specific Character Set (0008, 0005) element will be populated with this character set name, and all appropriate attributes will be encoded using this character set.

- ForceOutboundEncodingForResposnes – By default, responses will be sent using the same character set used in the corresponding request. If this parameter is set to true, the character set specified in the 'Outbound Character Encoding' parameter will be used.

Query Support

The use of non-default character sets does not affect the behavior of the query functionality within EIS. Both the MWL and Query Service classes will support the matching on and the return of fields containing non-default character sets in the same manner as with the default character set.

If an external device is servicing queries, this device may impose some limitations on the support of non-default character sets used in a query.

Presentation

Currently, logging is the only occasion when EIS presents character data to a user. The logging support in EIS does not currently support extended character sets, and logs are written exclusively in ASCII text. This will cause extended characters to be incorrectly displayed in the log files, in most cases displaying them as escaped character codes.

EIS provides support for some security measures; however it is assumed that EIS is used within a secured environment. It is assumed that a secured environment includes at a minimum:

  (a) Firewall or router protections to ensure that only approved external hosts have network access to EIS.

  (b) Firewall or router protections to ensure that EIS only has network access to approved external hosts and services.

  (c) 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.

5.1   Security Profiles

EIS optionally supports the Basic TLS Secure Transport Connection Profile and the AES Secure Transport Connection Profile for use by the EIS Application Entities only.

EIS provides a configuration parameter for each local AE and associated port number for which it accepts connections. This configuration parameter indicates whether or not the port is designated as handling TLS connections or non-TLS connections.

EIS also provides a configuration parameter for each Remote AE for which it initiates connections. This configuration parameter indicates whether or not the Remote AE is designated as handling TLS connections or non-TLS connections.

EIS must be configured with the appropriate private key, certificate, cipher suites, and seed for the pseudo-random number generator. These parameters are used for TLS connections with all applicable Remote Application Entities.

A private key is managed as a file in the file system. A private key may optionally be encoded with a password in which case it must be configured for use by EIS. The password is managed in the same manner as other configuration parameters: it is stored within a configuration file in the file system.

EIS provide a configuration parameter for verifying peer certificates.

When an integrity check fails, the transport connection is closed, an authentication failure event is deposited in the audit log, and a message is logged to the EIS log file.

EIS does not provide any support for digital signatures.

5.2   Association Level Security

EIS optionally performs some verification of DICOM values when determining whether to accept Association Open Requests:

Parameter	Verified	Notes
IP Address of requestor	Optional	An IP address or DNS host name can be configured or associated with a Calling AE Title. If this option is enabled, then the configured value is compared with the value received in the IP header from the requestor. If a DNS host name is configured, then DNS is consulted for IP address (es) that is (are) associated with the host name before performing the comparison.
Calling AE Title	Optional	The Calling AE Title is always compared to the set of Remote AE Titles that have been configured. However, if there is no explicit match then an implicit match is made with a special default or wild card Remote AE. This special Remote AE may be configured such that all Storage SOP Classes, or a subset thereof, are accepted. The Remote AE may also be configured such that only the Verification SOP Class is the only accepted SOP Class (default).
Called AE Title	Always	
Application Context	Always	The Application Context must be the Standard DICOM Application Context.

Table 18. Verification of an Association Open Request by the EIS AE

5.3 Application Level Security

The usage of the workstation requires the user to log on using a password-controlled user account. After a pre-set amount of time where there is no activity on the workstation, the user is automatically logged out.

Section 6 Annexes

6.1   IOD Contents

6.1.1   Created SOP Instances

EIS does not create SOP instances.

6.1.2   Usage of Attributes from Received IOD's

EIS is not dependent upon nor enforces the maximum length requirements of Value Representation for DICOM attributes. EIS also accepts DICOM attributes whose value exceeds the maximum length requirements for their Value Representation.

In general, EIS is not dependent upon nor enforces the character set requirements of Value Representation for DICOM attributes. However, there are some specific exceptions to this behavior. Common exceptions are attributes that have a Date or a Date-Time Value Representation.

In general, EIS is not dependent upon nor enforces any particular number of values for an attribute. That is the VM for an attribute in the Data Dictionary has no bearing on the acceptance of an attribute. This behavior enables EIS to support Standard Extended SOP Classes. However, there are some specific exceptions to this behavior. These usually have to do with attributes that identify certain DICOM objects such as Patient's Name, Patient ID, Study Instance UID, etc.

EIS is not dependent upon nor enforces the value of Group Length attributes when decoding Data Sets. In fact, Group Length attributes are usually filtered out of incoming messages and are usually not presented in outgoing messages (with the exception of (0000, 0000) which is mandatory in all command sets).

6.1.3   Attribute Mapping

Not applicable.

6.1.4   Coerced/Modified fields

EIS provides a very flexible and powerful attribute mapping system, which allows for the intentional modification of incoming and outgoing DICOM attributes. These modifications are normally used to accommodate incompatibilities in 3rd party systems and will vary by installation.

6.2   Data Dictionary of Private Elements

EIS does not reserve or define any private elements. Other's private elements can be sent and received by EIS.

6.3   Coded Terminology and Templates

No coded terminology or templates are used.

6.4   Grayscale Image Consistency

Not applicable.

6.5   Standard Extended / Specialized / Private SOP Classes

EIS does not use any extended, specialized, or private SOP classes.

6.6   Private Transfer Syntaxes

No Private Transfer Syntaxes are supported.

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