



GE Medical Systems

Technical Publications

**Direction 5144074
Revision 2**

HiSpeed ZX/i 10.x, 11.x CONFORMANCE STATEMENT

for DICOM(ID/Net v3.0)

- HiSpeed ZX/i,LX/i,FX/i,DX/i,DX/iB (10.x, 11.x)
- ProSpeed AI, FI (10.x)
- CT/e (10.x)

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REVISION HISTORY

REV	DATE	REASON FOR CHANGE
1	May 26, 2005	Initial Release for Version 11.0 Based upon HiSpeed ZX/i 6.x Conformance Statement.
2	Dec 8, 2005	Update for Version 10.0

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1 INTRODUCTION

1.1 OVERVIEW

This is DICOM Conformance Statement for HiSpeed ZX/i CT Scanner series, which is divided into Sections as described below:

Section 1 (Introduction), which describes the overall structure, intent, and references for this Conformance Statement

Section 2 (Network Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Networking features.

Section 3 (Media Storage Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Media Storage features.

Section 4 (CT Information Object Definition), define the technical specifications required to interoperate with a GE Medical Systems (GEMS) ID/Net v3.0 network interface. They define the technical details of the Information Object Definitions (IOD's) listed in the Conformance statement.

Section 5 (Modality Worklist Information Model Definition) , which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Basic Worklist Management Service.

Section 6 (Print SCU Conformance Statement) , which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of DICOM Print SCU application. This product uses DICOM Print SCU to print the images to DICOM Compliant Printers.

Section 7 (DICOM Storage Commitment SCU) , which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of DICOM Storage Commitment SCU application. This product uses DICOM Storage Commitment Push Model to store the images using remote DICOM entity which is Storage Commitment SCP.

Section 8 (Performed Procedure Step SCU) , which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Performed Procedure Step (PPS) SCU features.

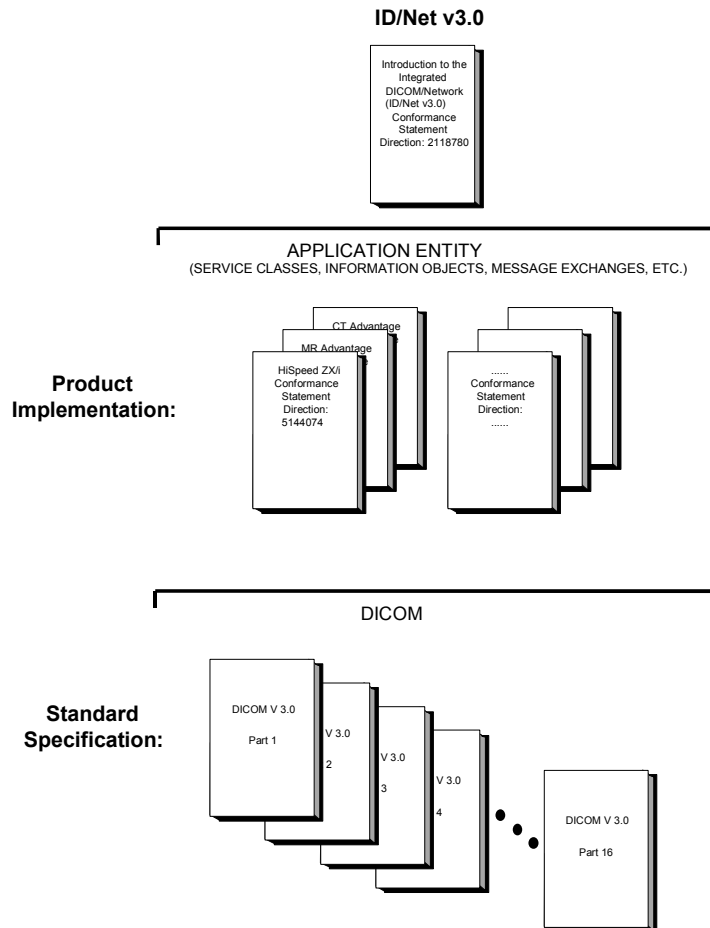
Appendix A , which specifies the private data element definition for CT IOD.

Appendix B , which specifies the DICOMDIR directory information.

Appendix C , which specifies the data element definition for MR/SC IOD.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEMS 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:

HiSpeed ZX/i 10.x, 11.x
Conformance Statement for DICOM
Direction 5144074

This document also covers all HiSpeed series products listed on the cover page.

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

Introduction to the Integrated DICOM/Network (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' GEMS Conformance Statements.

The GEMS 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

1.3 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 which 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 (ID/Net v3.0)
Conformance Statement
Direction: 2118780*

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document, in conjunction with the *Introduction to the Integrated DICOM/Network (ID/Net v3.0) Conformance Statement, Direction: 2118780*, to provide an unambiguous specification for GEMS implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GEMS medical data exchanged using DICOM. The GEMS Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEMS devices are capable of using different Information Object Definitions. For example, a GEMS CT Scanner may send images 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 GEMS implementation. If the user encounters unspecified private data elements while parsing a GEMS 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 which are sent by GEMS devices.

1.5 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 GEMS protocol is based on DICOM as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which 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.

1.6 REFERENCES

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

1.7 DEFINITIONS

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

1.8 SYMBOLS AND ABBREVIATIONS

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

2 NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant **Networking** features on this GEMS product. Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section.

HiSpeed ZX/i product uses DICOM services to import images for further analysis and/or processing. It also uses DICOM services to export images to other DICOM-compliant machines.

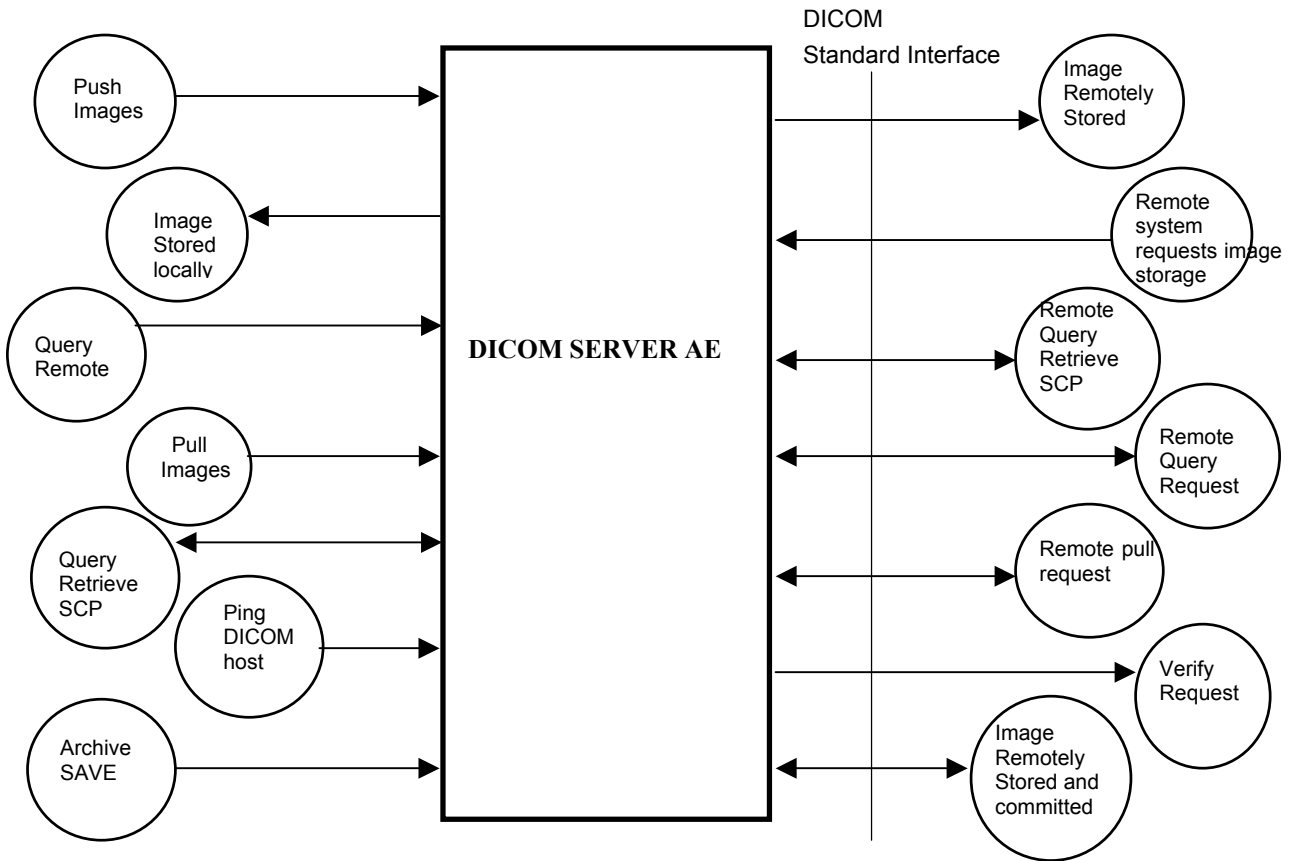
Note the format of this section follows the format of the DICOM Standard Part 2 (conformance) Annex A hence the paragraph numbering scheme. Please refer to that part of the standard while reading this section

2.2 IMPLEMENTATION MODEL

All DICOM functionality on the HiSpeed ZX/i product is handled by the DICOM Server Application Entity (AE). The DICOM Server AE is commanded to perform DICOM services through the buttons and menu selections on the main user interface panel. The DICOM Server AE is also listening to a pre-defined port for incoming connections

2.2.1 Application Data Flow Diagram

The Basic and Specific Application models for this device are shown in the following illustration:



There are five Real-World Activities that will cause the DICOM Server Application Entity (DICOM Server AE) to initiate a DICOM association to a remote DICOM Application Entity.

The *Choose "Push" Option* Real-World activity consists of an operator selecting one or more study, series or image in the local database manager and choosing either "Push Examination", "Push Series" or "Push Image" from the "Network" pulldown menu on the local database manager to send the image(s) to a selected destination.

Real-World Activity, *Query Remote*, causes the DICOM Server AE to initiate an association to the Remote DICOM AE and request the list of all studies. Once the DICOM Server AE receives the list of studies, it will select the first study (as determined through the local database manager list sort criterion) and request the list of series for that study. After receiving the list of series the DICOM Server AE will ask for the list of images for the first series in the list. The operator can then select any study in the study list to retrieve the list of series and images.

Real-World Activity, *Choose "Pull" Option*, will be available once the *Query Remote* activity is performed. The operator can now select one or more study (series or image) and ask the DICOM Server AE to retrieve the selected image(s) from the Remote DICOM AE by choosing either "Get Examination", "Get Series", or "Get Images".

Real-World Activity, *Choose "Ping DICOM host" Option*, consists of an operator selecting "Ping DICOM host" from the "Network" pull down menu. This will cause the DICOM Server AE to initiate a "DICOM Verification Request" to the remote AE, to verify the remote system activeness.

The *Choose "storage commitment" Option* Real-World activity consists of an operator configuring the remote node as an "archive node". Select "choose media" option under "Archive" pull down menu. Select "Remote Node" in that menu. Select one or more study, series or image in the local database manager and choose either "Save Exam" or "Save Series" from the "Archive" pull down menu. This will cause the DICOM server AE to send the image(s) to the selected destination and wait for the storage commitment from the remote node. The remote node should be a storage commitment provider.

There is no Real-World activity required for the DICOM Server AE to respond to an incoming DICOM store, query or retrieve. The DICOM Server AE is always prepared to respond to a DICOM Store, Query, or Retrieve by any remote DICOM AE.

The DICOM Server AE will perform the Real-World activity *Image Installation* after the remote AE sends an image to the HiSpeed ZX/i product.

Once a *Query* request is received, the DICOM Server AE will search the local database for all entries that match the keys requested by the Remote DICOM AE and send back the list of matches. The DICOM Server AE will also respond to an incoming retrieval request from a Remote AE by sending the image(s) to the Destination AE.

2.2.2 Functional Definition of AE's

DICOM Server Application Entity initiates the following operations:

- *Ping DICOM Host(Verification)*: The DICOM Server initiates an association and sends a C-ECHO-RQ message to the remote DICOM AE, the remote DICOM Server will send back a C-ECHO-RSP message with a status of "success".
- *Push*: Initiate an association to a Remote AE to send image(s). If the Remote AE accepts the presentation context applicable to the image(s) being sent, the DICOM Server AE will send the image(s) by invoking C-STORE- RQ operation for each image on the same association.
- *Query*: Initiate an association with a Remote AE to query for images on the remote host. A Study-Root Study-Level C-FIND-RQ request will be sent to the Remote AE once an association has been established. After all responses are received, DICOM Server AE will issue a Series-Level C-FIND- RQ request to get the series for a study in the list. An Image-Level C-FIND- RQ will be

issued for the first series in the series list.

- *Get*: Send a C-MOVE-RQ request to a Remote AE after successful association establishment. The DICOM Server AE's Storage SCP will receive the images over a separate association.

The DICOM Server AE waits for association requests from Remote AEs that wish to perform the following operations:

- *Verification*: If a C-ECHO-RQ message is received, the DICOM Server AE will send back a C-ECHO-RSP message with a status of "success".
- *Image Storage*: If a C-STORE-RQ message is received, the DICOM Server AE will receive the image and try to update the local database. If the image is stored successfully on storage media and the database updated a status of "success" will be returned in a C-STORE-RSP message.
- *Query*: If a C-FIND-RQ message is received the DICOM Server AE will search the database for the requested attributes and send back a C-FIND-RSP message containing a match and a status of "pending". After all matching records have been sent, a status of "success" will be returned in a C-FIND-RSP message. The Remote AE can terminate the query by sending a C-CANCEL-FIND-RQ message.
- *Retrieve*: If a C-MOVE-RQ message is received the DICOM Server AE will lookup its list of configured Remote AEs for the Destination AE. If the Destination AE is configured, the DICOM Server AE will open a new association to the Destination AE and use C-STORE-RQ to send the image(s). The DICOM Server AE will send a C-MOVE-RSP message with a status of "pending" after every five images are sent. When all images are sent or if DICOM Server AE receives a C-CANCEL-MOVE-RQ a final C-STORE-RSP will be sent back with an appropriate status.

2.2.3 Sequencing of Real-World Activities

Real-World Activity *Query Remote* must be performed before *Choose Pull Option* can be performed.

2.3 AE SPECIFICATIONS

2.3.1 DICOM Server AE Specification

This Application Entity provides Standard Conformance to the following DICOM SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Verification SOP class	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Storage Commitment Push Model	1.2.840.10008.1.20.1

This Application Entity provides Standard Conformance to the following DICOM SOP Classes as a SCP:

SOP Class Name	SOP Class UID
Verification SOP Class	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2

2.3.1.1 Association Establishment Policies

2.3.1.1.1 General

The DICOM Application Context Name (ACN), which is always proposed is:

Application Context Name	1.2.840.10008.3.1.1.1

The Maximum Length PDU negotiation is included in all association establishment requests.

The maximum length PDU for an association initiated by the DICOM Server AE is:

Maximum Length PDU	51Kbytes
---------------------------	-----------------

The SOP Class Extended Negotiation is not supported.

The maximum number of Presentation Context Items that will be proposed is 60. Note that the same Abstract Syntax may be offered multiple times with different Transfer Syntaxes.

2.3.1.1.2 Number of Associations

The DICOM Server AE (SCU) will initiate only one DICOM association at a time to perform an image store to a remote host or retrieve image(s) from a Remote AE.

The DICOM Server AE (SCP) can have a maximum of four DICOM associations open simultaneously to receive and store image or respond to an echo.

2.3.1.1.3 Asynchronous Nature

Asynchronous mode is not supported. All operations will be performed synchronously.

2.3.1.1.4 Implementation Identifying Information

The Implementation UID/Version Name for this DICOM Implementation is:

HiSpeed ZX/i Implementation UID	1.2.840.113619.6.22
HiSpeed ZX/i Implementation Version Name	10.x* or 11.x*

*Note: The same value as Software Version (0018,1020) is set

2.3.1.2 Association Initiation by Real-World Activity

This AE attempts to initiate a new association due to a “Push” operation initiated by the user. A new association is also initiated when the user performs a “Query Remote” operation or issues a retrieve operation by performing a “Get” operation at Study/Series/Image level.

2.3.1.2.1 Push Image(s) to Remote AE

2.3.1.2.1.1 Associated Real-World Activity

The operator must first select a destination by choosing “Select Remote Host” from the “Network” pull-down menu on the local database manager and then choose a hostname.

The “Push” operation will cause the DICOM server AE to initiate an Association when the operator selects one or more study, series, or images in the local database manager and then chooses either “Push Examination”, “Push Series”, or “Push Image” from the “Network” pull-down menu on the local database manager.

Note: If multiple study, series, or images are chosen to be pushed, one association will be established for each of the studies, series, or images.

2.3.1.2.1.2 Proposed Presentation Context Table

The following table shows the proposed presentation contexts for the DICOM Server AE after Real-World Activity “Push” Operation has been performed.

**Table 2.3.1.2.1.2-1
Proposed Presentation Contexts for DICOM Server AE and Real-World activity Push Image(s)**

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

NOTE: Other Presentation Contexts with private SOP class names may be offered when establishing an association. These are private SOP classes that may be ignored. See section 2.5.2

2.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for Image Storage SOP Classes

This implementation can perform multiple C-STORE operations over a single association. A single association for a single series will be used for the multiple C-STORE operations necessary for the images in the series

Upon receiving a C-STORE confirmation containing a successful status, this implementation will perform the next C-STORE operation. The association will be maintained if possible.

Upon receiving a C-STORE confirmation containing a Refused status, this implementation will terminate the association.

Upon receiving a C-STORE confirmation containing any status that is not Success or Refused, this implementation will consider the current request to be a failure but will continue to attempt to send the remaining images in the request on the same association.

Each C-STORE operation supports an "Association Timer". This timer starts when the association request is sent and stops when the association is established. The time-out is 300 seconds.

Each C-STORE operation also supports an "Operation Inactivity Timer". This time-out starts once the first C-STORE request has been issued (on association) or received and is reset each time a C-STORE response has been received or when subsequent C-STORES are sent. This time-out is 300 seconds.

Each C-STORE operation also supports a "Session Timer". This timer starts when the association is established and stops when the association is ended. This time-out is 60 minutes.

If any of the three timers mentioned above expires, the connection is closed and the operation in progress is considered failed.

When DICOM Server AE initiates an association to issue a C-STORE, one of the following two operations will be performed:

If the image is stored locally on the HiSpeed ZX/i in DICOM format ("Dic" appears in the "Fmt" column at the exam level of the local database manager), the image will be transmitted by the DICOM Server AE with the same elements as was originally received or created locally (for the standard elements only).

If the image is stored locally on the HiSpeed ZX/i in a non-DICOM Advantage format (Adv appears in the Fmt field at the exam level of the local database manager), the image will be translated and then transmitted by the DICOM Server AE to the identical profiles specified by the CT Advantage Conformance Statement for DICOM (Direction 2118781) and the MR Signa Advantage Conformance Statement for DICOM (Direction 2118782).

2.3.1.2.2 Query Remote AE

2.3.1.2.2.1 Associated Real-World Activity

The operator must first select a destination by choosing "Select Remote Host" from "Network" pull-down menu on the local database manager and then choose a hostname. To do custom queries select "Yes" for "Custom search" option.

Note: Custom queries can be done on the following fields "Last Name contains", "Exam Number", "Patient Id", "Accession Number".

To initiate a Query select "Receive" from "Network" pull-down menu.

Note: If "Custom Search" option is set then a small GUI will show up. Operator will be able to enter custom query fields. Entering values in "Last Name contains" field will initiate wild card query for patient name.

The "Query" operation will cause the DICOM Server AE to initiate an association to the selected Remote AE when the "Query Remote Host" entry is selected from the "Network" pull-down menu. Once a list of Study/Series/Image is retrieved, the operator can invoke the "Get" operation by choosing "Get Exam" or "Get Series" or "Get Image" from the "Network" pull-down menu.

2.3.1.2.2.2 Proposed Presentation Contexts

When the Real-World activity "Query" or "Pull" is initiated all presentation contexts shown in table 2.3.1.2.1.2-1 are proposed during association establishment, but only the Query/Retrieve-FIND related contexts are applicable to this activity.

Table 2.3.1.2.2.2-1
Proposed Presentation Contexts for DICOM Server AE and Real-World activity Query Remote AE

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

2.3.1.2.2.2.1 SOP Specific Conformance Statement for C-FIND SCU

After the *Query* operation is initiated, the DICOM Server AE will perform a study-root C-FIND-RQ request at each of the three levels (Study, Series, and Image) in succession. The Initial Study-Level request will ask for all studies in the Remote database.

The C-FIND SCU will not perform any extended negotiation and so will only perform hierarchical query.

Each C-FIND SCU operation supports an “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with time out values of 300 seconds, 300 seconds and 60 minutes respectively. These values are configurable in dcs.cfg. Configuration should be made by GEMS Field Service engineers.

If a “Cancel” or “Refused” status is returned from the Remote AE the association is closed and the operation terminated.

The DICOM Server AE will parse each matching C-FIND-RSP reply and ignore the entries that do not contain a valid DICOM data stream. No VR validation is performed which means those syntax errors will be ignored.

Tables 2.3.1.2.2.2.1-1 – 2.3.1.2.2.2.1-3 shows the various fields that are requested at the Study, Series, and Image levels of the C-FIND request.

Table 2.3.1.2.2.1-1: Requested Study Level Keys

Description	Type	Tag	Value
Study date	R	0008,0020	Zero length
Study time	R	0008,0030	Zero length
Patient's name	R	0010,0010	Zero length
Study id	R	0020,0010	Zero length
Study Instance UID	U	0020,000D	Zero length
Study description	O	0008,1030	Zero length
Private Creator Identification	P	0009,0010	GEMS_IDEN_01
Suite Id	P	0009,1002	Zero Length

Table 2.3.1.2.2.1-2: Requested Series Level Keys

Description	Type	Tag	Value
Modality	R	0008,0060	Zero length
Series number	R	0020,0011	Zero length
Series Instance UID	U	0020,000E	Series UID
Series description	O	0008,103E	Zero length
Manufacturer	O	0008,0070	Zero length
Images in series	O	0020,1002	Zero length

Table 2.3.1.2.2.1-3: Requested Image Level Keys

Description	Type	Tag	Value
Instance number	R	0020,0013	Zero length
SOP Instance UID	U	0008,0018	Image UID

Image type	O	0008,0008	Zero length
Rows	O	0028,0010	Zero length
Columns	O	0028,0011	Zero length
Image position	O	0020,0032	Zero length
Image orientation	O	0020,0037	Zero length
Slice thickness	O	0018,0050	Zero length
Slice spacing	O	0018,0088	Zero length
Gantry tilt	O	0018,1120	Zero length
Convolution kernel	O	0018,1210	Zero length
Reconstruction diameter	O	0018,1100	Zero length
Data collection diameter	O	0018,0090	Zero length
Flip angle	O	0018,1314	Zero length
Echo number	O	0018,0086	Zero length
Echo time	O	0018,0081	Zero length
Inversion time	O	0018,0082	Zero length
Repetition time	O	0018,0080	Zero length
Private Creator Identification	P	0019,00xx	GEMS_ACQU_01
Dfov Rect	P	0019,xx1E	Zero Length
Midscan Time	P	0019,xx24	Zero Length
Azimuth	P	0019,xx26	Zero Length
Number of Echo	P	0019,xx7E	Zero Length
Private Creator Identification	P	0021,00xx	GEMS_RELAX_01
Scout Anref	P	0021,xx4A	Zero Length
Private Creator Identification	P	0027,00xx	GEMS_IMAG_01
Location RAS	P	0027,xx40	Zero Length
Location	P	0027,xx41	Zero Length
Center R Coordinate	P	0027,xx42	Zero Length

Center A Coordinate	P	0027,xx43	Zero Length
Table Start Location	P	0027,xx50	Zero Length
Table End Location	P	0027,xx51	Zero Length
RAS Letter for Side of Image	P	0027,xx52	Zero Length
RAS Letter for Anterior/Posterior	P	0027,xx53	Zero Length
RAS Letter for Scout Start Location	P	0027,xx54	Zero Length
RAS Letter for Scout End Location	P	0027,xx55	Zero Length
Image Dimension X	P	0027,xx60	Zero Length
Image Dimension Y	P	0027,xx61	Zero Length

Note: In the above tables the type field has the following meaning:

R – Required, **U** – Unique, **O** – Optional, **P** - Private

2.3.1.2.3 Get Image(s) from Remote AE

2.3.1.2.3.1 Associated Real-World Activity

The operator must first select a destination by choosing “*Select Remote Host*” from “*Network*” pull-down menu on the local database manager and then choose a hostname. The operator then has to perform the Real-World activity “*Query*” to get a list of Study/Series/Image. Once the list of Study/Series/Image is retrieved, the operator can invoke the “*Get*” operation by choosing “*Get Exam*” or “*Get Series*” or “*Get Image*” from the “*Network*” pull-down menu.

2.3.1.2.3.2 Proposed Presentation Contexts

When the Real-World activity “*Get*” is initiated all presentation contexts shown in table 2.3.1.2.1.2 –1 are proposed during association establishment, but only the Query/Retrieve-MOVE related contexts are applicable to this activity.

2.3.1.2.3.2.1 SOP Specific Conformance Statement for C-MOVE SCU

When the operator starts a *Get* operation at any level (Study, Series, Image) the DICOM Server AE will initiate a C-MOVE-RQ request to the Remote AE with the DICOM Server AE as the Destination AE. The Storage SCP will handle the incoming images as described in section 2.3.1.3.1.

Each C-MOVE SCU operation supports an “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with time out values of 300 seconds, 300 seconds and 60 minutes respectively. These time-outs are configurable in dcs.cfg as *bi_assoc_tio*, *bi_store_tio* and *bi_session_tio* respectively.

The DICOM Server AE will send a C-CANCEL-MOVE-RQ to the Remote AE if the operator “*Pauses*” or “*Clears*” the job from the local database manager Network queue.

2.3.1.2.4 Verify (DICOM Ping)

2.3.1.2.4.1 Associated Real-World Activity

The operator must first select a destination by choosing “*Select Remote Host*” from “*Network*” pull-down menu on the local database manager and then choose a hostname.

The operator must then select the “Ping DICOM host” form “Network” pull-down menu.

The DICOM server will initiate an association with the remote DICOM AE in order to verify communication at the application level. The success or failure of the verification process is displayed to the user.

2.3.1.2.4.2 Presentation Context Table

Refer to the Table 2.3.1.2.1.2-1 for the Proposed Presentation Contexts for DICOM Server AE and Real-World activity Verification

2.3.1.2.4.2.1 SOP Specific DICOM Conformance C_ECHO SCU

The HiSpeed ZX/i DICOM Server AE provides standard conformance to the DICOM Verification Service Class.

Each ECHO operation supports an “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with a time out values of 900 seconds, 30 seconds and 60 minutes respectively

2.3.1.3 Association Acceptance Policy

The DICOM Server AE places no limitations on who may connect to it.

When the DICOM Server AE accepts an association for image storage, it will receive any images transmitted on that association and store the images on disk.

It will also respond to queries from Remote AEs by sending matching entries. Any Remote AE can request and receive a list of images on the local database. The Remote AE must be configured in the local database manager’s list of Remote AE for it to be able to retrieve images from DICOM Server AE.

Any remote AE can open an association to the DICOM Server AE for the purpose of verification.

2.3.1.3.1 Receive Image(s)

This AE is indefinitely listening for associations. No operator action is required to receive an image.

2.3.1.3.1.1 Associated Real-World Activity

The Real-World Activity associated with the Receive Image(s) operation is the storage of the image on the disk drive of the HiSpeed ZX/i

2.3.1.3.1.2 Presentation Context Table

Table 2.3.1.3.1.2 - 1: Acceptable Presentation Contexts for DICOM Server AE and Real-World Activity

Receive Image(s)

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
Secondary Capture	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Secondary Capture	1.2.840.10008.5.1.4.1.1.7	Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2	SCP	None
Secondary Capture	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
Secondary Capture	1.2.840.10008.5.1.4.1.1.7	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None

2.3.1.3.1.2.1 SOP Specific Conformance to Storage SOP Classes

The DICOM Server AE conforms to the SOP’s of the Storage Service Class at level 1 (base). Private elements will be discarded from the image when receiving images containing non-GE private data elements.

Each C-STORE SCP operation supports an “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with time out values of 300 seconds, 300 seconds and 60 minutes respectively.

Image Reception

If the DICOM Server AE returns one of the following status codes, then the C-STORE operation was unsuccessful and no image will be installed:

- 0110 (Processing Failure) indicates that an internal system call has failed while processing an image.
- A711 (Out of Resources) Indicates that probably there was not enough disk space to store the image. The user should attempt recovery by removing some images from the HiSpeed ZX/i system.
- A712 (Out of Resources) Indicates that there was not enough resource (such as memory) to store the image.
- A800 (SOP Class not supported)

In the event of a successful C-STORE operation, the image has successfully been written to disk. The image will then be accessed in the same manner as any other image by the applications on the HiSpeed ZX/i system.

Images may be deleted when instructed to do so by the user. Thus the users of the HiSpeed ZX/i system determine the duration of the storage of the image.

Image Installation

If the image installation is unsuccessful, a message will appear in the Message Log informing the user of the failure and the image will be removed.

If the image installation process finds that an element is not encoded according to the DICOM standard, it will fail to install the image and the file will be removed.

Image Installation of GE Created CT Images

Images that were originally created on recent GE CT scanners will be converted from their native Advantage Proprietary Format to DICOM format for transmission. If the images are stored as full fidelity representations and are subsequently returned to recent GE scanners, then the images will be transformed back to Advantage Proprietary Format.

There is an assumption made by such GE scanners:

The private element (0009,xx01) is used as the full fidelity flag. If this flag contains the string: "GE_GENESIS_FF" when received by a scanner, then it is assumed that the image object was originally a GE created image object and contains all private elements that it was sent with.

If full fidelity flag is present and not all the elements are sent back as sent (i.e., not full fidelity) there are 2 possible actions:

1. the translator will do its best to convert the image and will use default values where DICOM fields are missing
2. If certain critical information is not provided then the image will be stored as a screen save

It is strongly suggested that if GE private element (0009,xx01) is present then all GE private elements originally associated with the image be preserved.

Image Installation of non-GE Created CT Images

Images received from non-GE products are installed as appropriate image object without any of their private data elements. Also if some critical fields (mandatory) are missing, then the image will not be installed.

2.3.1.3.1.3 Presentation Context Acceptance Criteria

No criterion.

2.3.1.3.1.4 Transfer Syntax Selection Policy

The SCP does not have a default acceptance policy if more than one acceptable transfer syntaxes are proposed by the SCU. It is the responsibility of the SCU to make a selection from more than one transfer syntaxes accepted. If multiple transfer syntaxes are proposed in the same presentation context, the SCP will accept the first supported transfer syntax.

2.3.1.3.2 Verification Request from Remote AE

This AE is indefinitely listening for associations. No operator action is required to respond to a *verification* message.

2.3.1.3.2.1 Associated Real-World Activity

The Real-World Activity associated with the verification request is to send a C-ECHO response message with a status of "success" to the requesting AE.

2.3.1.3.2.2 Presentation Context Table

Table 2.3.1.3.2.2-1: Acceptable Presentation Contexts for DICOM Server AE and Real-World Activity Verification Request

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

2.3.1.3.2.2.1 SOP Specific Conformance to Verification SOP Class

The DICOM Server AE provides standard conformance to the DICOM Verification Service Class.

Each ECHO operation supports an “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with time out values of 300 seconds, 300 seconds and 60 minutes respectively.

2.3.1.3.2.3 Presentation Context Acceptance Criteria

No criterion.

2.3.1.3.2.4 Transfer Syntax Selection Policy

None

2.3.1.3.3 Query Request from Remote AE

This AE is indefinitely listening for associations. No operator action is required to respond to a *query* request.

2.3.1.3.3.1 Associated Real-World Activity

The Real-World Activity associated with the query request is to search the local database for entries that match the request and send a C-FIND response message with a status of “pending” for each matching entry.

2.3.1.3.3.2 Presentation Context Table

Table 2.3.1.3.3.2-1: Acceptable Presentation Contexts for DICOM Server AE and Real-World Activity Query Request

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
StudyRoot Query/Retrieve FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.3.1.3.3.2.1 SOP Specific Conformance to C-FIND SCP

Each C-FIND SCP operation supports an “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with time out values of 300 seconds, 300 seconds and 60 minutes respectively.

All Required(R) and Unique(U) study, series, and image level keys for the Study-Root Query/Retrieve information model are supported. Some optional (O) keys are also supported as described in the following tables.

Table 2.3.1.3.3.2.1-1 Supported study level keys

Description	Type	Tag	Usage
Study date	R	0008,0020	Matched
Study time	R	0008,0030	Matched
Accession number	R	0008,0050	Matched
Patient’s name	R	0010,0010	Matched Case Insensitive
Patient id	R	0010,0020	Matched
Study id	R	0020,0010	Matched
Study Instance UID	U	0020,000D	Matched
Study description	O	0008,1030	Returned
Private Creator Identification	P	0009,00xx	GEMS_IDEN_01
Suite Id	P	0009,xx02	Returned

Table 2.3.1.3.3.2.1-2 Supported series level keys

Description	Type	Tag	Usage
Modality	R	0008,0060	Matched
Series number	R	0020,0011	Matched
Series Instance UID	U	0020,000E	Matched
Series description	O	0008,103E	Returned
Manufacturer	O	0008,0070	Returned
Images in series	O	0020,1002	Returned

Table 2.3.1.3.3.2.1-3 Supported image level keys

Description	Type	Tag	Usage
Instance number	R	0020,0013	Matched
SOP Instance UID	U	0008,0018	Matched
Image type	O	0008,0008	Returned
Rows	O	0028,0010	Returned
Columns	O	0028,0011	Returned
Image position	O	0020,0032	Returned
Image orientation	O	0020,0037	Returned
Slice thickness	O	0018,0050	Returned
Slice spacing	O	0018,0088	Returned
Gantry tilt	O	0018,1120	Returned
Convolution kernel	O	0018,1210	Returned
Reconstruction diameter	O	0018,1100	Returned
Data collection diameter	O	0018,0090	Returned
Flip angle	O	0018,1314	Returned
Echo number	O	0018,0086	Returned
Echo time	O	0018,0081	Returned
Inversion time	O	0018,0082	Returned
Repetition time	O	0018,0080	Returned
Trigger time	O	0018,1060	Returned
Private Creator Identification	P	0019,00xx	GEMS_ACQU_01
Dfov Rect	P	0019,xx1E	Returned
Midscan Time	P	0019,1024	Returned
Azimuth	P	0019,1026	Returned
Number of Echo	P	0019,107E	Returned
Private Creator Identification	P	0021,00xx	GEMS_RELTA_01
Scout Anref	P	0021,xx4A	Returned

Private Creator Identification	P	0027,0010	GEMS_IMAG_01
Location RAS	P	0027,1040	Returned
Location	P	0027,1041	Returned
Center R Coordinate	P	0027,1042	Returned
Center A Coordinate	P	0027,1043	Returned
Table Start Location	P	0027,1050	Returned
Table End Location	P	0027,1051	Returned
RAS Letter for Side of Image	P	0027,1052	Returned
RAS Letter for Anterior/Posterior	P	0027,1053	Returned
RAS Letter for Scout Start Location	P	0027,1054	Returned
RAS Letter for Scout End Location	P	0027,1055	Returned
Image Dimension X	P	0027,1060	Returned
Image Dimension Y	P	0027,1061	Returned

Note: In the above tables the type field has the following meaning:

R - Required **U** - Unique **O** - Optional **P** - Private

Only keys with Usage type *Matched* will be matched against values in the database.

Values in keys of type *Returned* will be ignored and will be filled in with data from the database.

If an optional key is requested that does not appear in any of the tables above, that key will be ignored and no corresponding element will be returned.

If the database does not have a value corresponding to any requested optional key a zero-length element will be returned.

Sequence matching is not supported.

Range matching is supported for attributes of type date and time.

Only hierarchical query is supported. Therefore, the C-FIND SCP will not perform any extended negotiation.

2.3.1.3.3.3 Presentation Context Acceptance Criteria

No criterion.

2.3.1.3.3.4 Transfer Syntax Selection Policy

None

2.3.1.3.4 Retrieve Request From Remote AE

This AE is indefinitely listening for associations. No operator action is required to respond to a *retrieve* request.

2.3.1.3.4.1 Associated Real-World Activity

The Real-World Activity associated with the Retrieve Request is to send all images corresponding to the C-MOVE request to the destination AE through a separate association.

2.3.1.3.4.2 Presentation Context Table

Table 2.3.1.3.4.2-1: Acceptable Presentation Contexts for DICOM Server AE and Real-World Activity

Retrieve Request.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
StudyRoot Query/Retrieve MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.3.1.3.4.2.1 SOP Specific Conformance to C-MOVE SCP

The DICOM Server AE provides standard conformance to the baseline Study-root C-MOVE Service Class SCP.

Each C-MOVE SCP operation supports an “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with time out values of 300 seconds, 300 seconds and 60 minutes respectively. These time-outs are configurable in *dcs.cfg* as *bi_assoc_tio*, *bi_store_tio* and *bi_session_tio* respectively

All images requested in a C-MOVE-RQ will be sent over a single association. A C-MOVE-RSP with a “pending” status will be returned to the requester every five images.

The C-MOVE SCP will invoke C-STORE requests for the following SOP classes:

SOP Class Name	SOP Class UID
CT Image Information Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Information Storage	1.2.840.10008.5.1.4.1.1.4
Secondary Capture image storage	1.2.840.10008.5.1.4.1.1.7

In addition to the C-MOVE response status values defined in DICOM part 4 the following status values will be returned:

- C000 - Indicates that an error occurred while retrieving records from the local database.
- C001 - Indicates all other processing error.

- C011 - If the Destination AE returns a “*Storage Full*” condition this status will be returned. This status will only be sent if the Destination AE returns a status of A711 and is only applicable if the Destination AE is a SdC-based product.

2.3.1.3.4.3 Presentation Context Acceptance Criteria

No criterion.

2.3.1.3.4.4 Transfer Syntax Selection Policy

The SCP does not have a default acceptance policy if more than one acceptable transfer syntaxes are proposed for the same SOP class (in separate presentation contexts). It is the responsibility of the SCU to make a selection from the list of accepted presentation contexts that apply to any particular SOP class. If multiple transfer syntaxes are proposed in the same presentation context, the SCP will accept the first one.

2.4 COMMUNICATION PROFILES

2.4.1 Supported Communication Stacks (PS 3.8, PS 3.9)

DICOM Upper Layer (PS 3.8) is supported using TCP/IP.

2.4.2 OSI Stack

OSI stack not supported

2.4.3 TCP/IP Stack

The TCP/IP stack is inherited from a UNIX Operating System.

2.4.3.1 API

Not applicable to this product.

2.4.3.2 Physical Media Support

Ethernet V2.0, IEEE 802.3

2.4.4 Point-to-Point Stack

A 50-pin ACR-NEMA connection is not applicable to this product.

2.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

2.5.1 Specialized Information Object Definition

Following is a list of additional private attributes defined for a standard CT IOD.

(0008,0008) Value 3: CT Image IOD specific specializations
AXIAL
LOCALIZER
SEGMENTED
REFORMATTED
PROCESSED
COMBINED

Value 4 : CT Image implementation specific
MIN IP
MIP
AVERAGE

VOLREN
INTEGRAL
HD MIP
RAYSUM
SURFACE
MINMAX

(0018,0022) Scan Options: Defined Terms
AXIAL MODE
DYNAMIC MODE
SCOUT MODE
AXIAL MODE
STATIC XRON MODE
STATIC XROFF MODE
TUBE HEAT MODE
DAS MODE
TUBE CAL MODE
BIOPSY MODE
CINE
HELICAL
CARDIAC
RESPIRATORY

2.5.2 Private SOP Classes

ID/Net v2.0 Private IODs are based upon the April 1993 draft version of the DICOM . ID/Net v2.0 IODs are supported for backward compatibility. The following private SOP classes are defined:

Abstract Syntax Name	UID
GE Private DICOM CT Image Information Object (ID/Net v2.0 compatible)	1.2.840.113619.4.3
GE Private DICOM Display Information Object (ID/Net v2.0 compatible)	1.2.840.113619.4.4

Note: See the “ID/Net v2.0 Implementation Profiles” (Direction 46-269546G2) for definitions of Information Objects.

2.5.3 Private Transfer Syntaxes

Transfer Syntax Name	UID
Implicit VR Big Endian	1.2.840.113619.5.2

This private transfer syntax is identical to the DICOM Implicit VR Little Endian syntax except for the encapsulation of the pixel data. Pixel data (element 7FE0, 0010) is encoded in Big Endian format for this private transfer syntax. All other elements are encoded in Little Endian format as dictated by the DICOM standard.

The following table shows the presentation contexts that are proposed for GE private SOP classes.

Presentation Context Table For GE Private SOP Classes- Accepted / Proposed						
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation	
Name	UID	Name List	UID List			
GE Private DICOM CT Image Information Object (ID/Net v2.0 compatible)	1.2.840.113619.4.3	Implicit VR Little Endian	1.2.840.10008.1.2	Both	None	
GE Private DICOM CT Image Information Object (ID/Net v2.0 compatible)	1.2.840.113619.4.3	Implicit VR Big Endian (GE Private)	1.2.840.113619.5.2	Both	None	
GE Private DICOM Display Information Object (ID/Net v2.0 compatible)	1.2.840.113619.4.4	Implicit VR Little Endian	1.2.840.10008.1.2	Both	None	
GE Private DICOM Display Information Object (ID/Net v2.0 compatible)	1.2.840.113619.4.4	Implicit VR Big Endian (GE Private)	1.2.840.113619.5.2	Both	None	

2.6 CONFIGURATION

2.6.1 AE Title/Presentation Address Mapping

The HiSpeed ZX/i system allows the user to “add”, “Remove”, or “Update the mapping of remote AE Titles to IP Addresses and Ports. These options can be selected from the “Remote Host Selection” menu displayed by choosing “Select Remote Host” from the “Network” pull-down menu from the local database manager.

2.6.2 Configurable Parameters

The following fields are configurable for the DICOM Server AE:

- Local AE Title (default to the machine hostname but changeable)
- Local IP Address
- Local IP Netmask
- Max PDU length
- Time-outs, which are set for all hosts, are configurable in dcs.cfg:

note: * denotes any SOP class (time in sec)

*Association time-out	- <i>bi_assoc_tio</i>
*Inactivity time-out	- <i>bi_store_tio</i>
*Session timeout	- <i>bi_session_tio</i>
*Move operation time-out	- <i>bi_move_tio</i>
*Find time-out	- <i>bi_find_tio</i>

Note: All configurations should be performed by a GE Field Service Engineer.

Note: The local port on which the HiSpeed ZX/i system receives DICOM incoming TCP connections is port **4006**.

2.7 SUPPORT OF EXTENDED CHARACTER SETS

In addition to the DICOM default character set, *HiSpeed ZX/i* supports the ISO IR 100 Latin alphabet #1 supplementary set for the purpose of interchange.

2.8 CODES AND CONTROLLED TERMINOLOGY

The product uses no coded terminology.

2.9 SECURITY PROFILES

The product does not conform to any defined DICOM Security Profiles.

It is assumed that the product is used within a secured environment. It is assumed that a secured environment includes at a minimum:

1. Firewall or router protections to ensure that only approved external hosts have network access to the product.
2. Firewall or router protections to ensure that the product only has network access to approved external hosts and services.

3. Any communications with external hosts and services outside the locally secured environment use appropriate secure network channels (such as a Virtual Private Network (VPN))

3 MEDIA STORAGE CONFORMANCE STATEMENT

3.1 INTRODUCTION

This section specifies the HiSpeed ZX/i conformance to DICOM Media Interchange. It details the DICOM Media Storage Application Profiles and roles which are supported by this product.

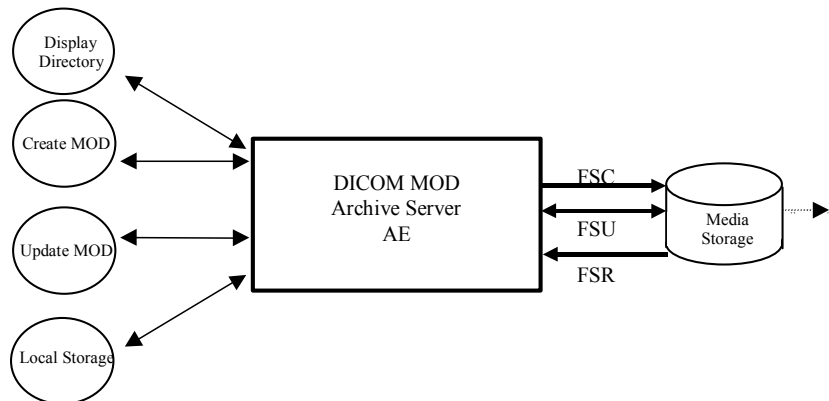
3.2 IMPLEMENTATION MODEL

All DICOM functionality on the HiSpeed ZX/i product is handled by the MOD Archive Server Application Entity (AE). The MOD Archive Server AE is commanded to perform DICOM services through the buttons and menu selections on the main user interface panel.

3.2.1 Application Data Flow Diagram

The MOD Archive Server creates and/or updates the 5.25 inch (130mm) MOD media with various DICOM SOP instances. It can process CT, MR, and Secondary Capture IODs.

ILLUSTRATION 3.2.1-1
SPECIFIC AE APPLICATION MODEL



The product has a local storage that may contain various SOP instances. These may have been obtained by original creation, network transfer (DICOM or proprietary), or by reading removable media from other devices. The origin of SOP instances is outside the scope of this claim.

The MOD Archive Server AE can initialize Media by acting as an FSC to create a new DICOM File-set on a 2.3GB MOD media or a 1.2GB MOD media. It initializes the DICOM File-set and writes the specified SOP instances onto the MOD. The SOP instances written will be limited to instances that match the criteria of one of the Application Profiles that is supported. When updating media, a pre-existing File-set will be updated with the selected SOP instances that match one of the supported Application Profiles.

3.2.2 Functional Definition of AE's

This product has only one Application Entity: the MOD Archive Server AE.

The MOD Archive Server can perform these functions:

- It can initialize (create DOS filesystem) a piece of media, writing a new label and DICOM File-set onto the media. ("LABEL")
- It can update a piece of media by adding new SOP instances to an already existing DICOM File-set from local storage. ("SAVE")
- It can display a directory listing of the File-set on a piece of media. (QUERY)
- It can copy SOP instance from the MOD onto local storage. ("RESTORE")

3.2.3 Sequencing of Real World Activities

The updating function can only be performed on a piece of media that has already had a DICOM File-set created.

The display function can only be performed on a piece of media that has already has a DICOM File-set created. With no SOP instances having been added, the directory will be displayed empty.

The copy function can only be performed with a piece of media that has been updated and has DICOM SOP instances in the File-set.

There are no other sequencing requirements.

3.2.4 File Meta Information for Implementation Class and Version

The File Meta-Information for this implementation is :

File Meta-Information Version	1
HiSpeed ZX/i Implementation UID	1.2.840.113619.6.22
Implementation Version Name	10.x* or 11.x*

*Note: The same value as Software Version (0018,1020) is set

3.3 AE SPECIFICATIONS

3.3.1 MOD Archive Specification

The MOD Archive provides standard conformance to DICOM Interchange Option of the Media Storage Service Class. The Application Profiles and roles are listed in Table 3.3.1-1.

Table 3.3.1-1: Application Profile, Activities and Roles for MOD Update

Application Profiles Supported	Real World Activity	Role	SC Option
STD-CTMR-MOD23 AUG-CTMR-MOD23	Create MOD	FSC	Interchange
	Update MOD	FSU	Interchange
	Display Directory	FSR	Interchange
	Copy To Local Storage	FSR	Interchange
STD-CTMR-MOD12 AUG-CTMR-MOD12	Create MOD	FSC	Interchange
	Update MOD	FSU	Interchange
	Display Directory	FSR	Interchange
	Copy To Local Storage	FSR	Interchange

The MOD Archive Server will query the user before initializing media when a File-set is found on the media and an initialize operation has been requested.

As an FSU role, the system will produce directory sequences for each SOP instance that is added to the File-set consistent with the AUG-CTMRMOD{12,23}.

3.3.1.1 File Meta Information for the Application Entity

Following are the values set in the File Meta Information for this AE Title :

Source Application Entity Title	Not used by the MOD archive application
Private Information Creator UID	Not used by the MOD archive application
Private Information	Not used by the MOD archive application

3.3.1.2 Real-World Activities

3.3.1.2.1 Real-World Activity: Create MOD Request

The MOD Archive Application acts as an FSC using the Interchange option when requested to initialize ("LABEL") the media.

The MOD Archive Application will label the media and take the user provided list of SOP instances, eliminating any SOP instances on that list that does not correspond to one of the Application Profiles in Table 3.3.1-1. These SOP instances are written to the media and a corresponding DICOMDIR sequence record is created.

3.3.1.2.1.1 Application Profiles for the Real-World Activity: Create MOD

The Create MOD RWA applies to all Application Profiles listed in Table 3.3.1-1. For extensions and specializations see section 3.4.

3.3.1.2.1.2 Options:

Following are the SOP Class, Photometric Interpretation, and Transfer Syntax combinations created by this AE as an FSC/FSU.

Table 3.3.1.2.1.2-1 : IODs and Transfer Syntaxes supported for RWA: Create MOD

SOP Class	SOP Class UID	Photometric Interpretation Value	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	-	Explicit VR Little Endian	1.2.840.10008.1.2.1
CT Image	1.2.840.10008.5.1.4.1.1.2	MONOCHROME2	JPEG Lossless Process 14 (selection value 1)	1.2.840.10008.1.2.4.70
CT Image	1.2.840.10008.5.1.4.1.1.2	MONOCHROME2	Explicit VR Big Endian	1.2.840.10008.1.2.2
MR Image	1.2.840.10008.5.1.4.1.1.4	MONOCHROME2	JPEG Lossless Process 14 (selection value 1)	1.2.840.10008.1.2.4.70
MR Image	1.2.840.10008.5.1.4.1.1.4	MONOCHROME2	Explicit VR Big Endian	1.2.840.10008.1.2.2
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	MONOCHROME2	JPEG Lossless Process 14 (selection value 1)	1.2.840.10008.1.2.4.70
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	MONOCHROME2	Explicit VR Big Endian	1.2.840.10008.1.2.2

Notes:

- The Media Archive Server AE does not support writing images using the Explicit VR Little Endian Transfer Syntax as an FSC/FSU of the STD-CTMR profiles.
- The Media Archive Server AE does not support writing Secondary Capture Palette Color images as an FSC/FSU of the STD-CTMR profiles.
- The default Transfer Syntax for writing images is JPEG Lossless. Use of Explicit VR Big Endian Transfer Syntax may be configured by a field service engineer.

3.3.1.2.2 Real-World Activity: Display Directory

The MOD Archive Server acts as an FSR using the Interchange option when requested to provide a directory listing.

When an MOD update Application is requested to provide a directory listing it will read the File-set and display the DICOMDIR directory entries for those Series in the File-set that have Modality value of “CT” or “MR”.

3.3.1.2.2.1 Application Profiles for the RWA: MOD Directory listing

The MOD Display Directory RWA applies to all Application Profiles listed in Table 3.3.1-1. For extensions and specializations see section 3.4.

3.3.1.2.2.2 Options:

None applicable.

3.3.1.2.3 Real-World Activity: Copy to Local Storage

The MOD Archive Server acts as an FSR when copying from the MOD to local storage.

The MOD Archive Server will copy any SOP Instance selected from an MOD Directory list from the MOD to the local storage upon request.

Note:

The MOD Display Directory Real-World Activity will filter out Series that do not match the Modality value of “CT” or “MR”; hence any SOP Instances in non-CT/MR series will not be able to be copied to local storage.

3.3.1.2.3.1 Application Profiles for the RWA: Copy to Local Storage

The MOD Copy to Local Storage RWA applies to all Application Profiles listed in Table 3.3.1-1. For extensions and specializations see section 3.4.

3.3.1.2.3.2 Options:

Following are the SOP Class, Photometric Interpretation, and Transfer Syntax combinations created by this AE as an FSC/FSU.

Table 3.3.1.2.3.2-1 : IODs and Transfer Syntaxes supported for RWA: Copy to Local Storage

SOP Class	SOP Class UID	Photometric Interpretation Value	Transfer Syntax	Transfer Syntax UID
CT Image	1.2.840.10008.5.1.4.1.1.2	MONOCHROME2	Explicit VR Little Endian	1.2.840.10008.1.2.1
CT Image	1.2.840.10008.5.1.4.1.1.2	MONOCHROME2	JPEG Lossless Process 14 (selection value 1)	1.2.840.10008.1.2.4.70
CT Image	1.2.840.10008.5.1.4.1.1.2	MONOCHROME2	Explicit VR Big Endian	1.2.840.10008.1.2.2
MR Image	1.2.840.10008.5.1.4.1.1.4	MONOCHROME2	Explicit VR Little Endian	1.2.840.10008.1.2.1
MR Image	1.2.840.10008.5.1.4.1.1.4	MONOCHROME2	JPEG Lossless Process 14 (selection value 1)	1.2.840.10008.1.2.4.70
MR Image	1.2.840.10008.5.1.4.1.1.4	MONOCHROME2	Explicit VR Big Endian	1.2.840.10008.1.2.2
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	MONOCHROME2	Explicit VR Little Endian	1.2.840.10008.1.2.1
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	MONOCHROME2	JPEG Lossless Process 14 (selection value 1)	1.2.840.10008.1.2.4.70
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	MONOCHROME2	Explicit VR Big Endian	1.2.840.10008.1.2.2

3.3.1.2.4 Real-World Activity: Update MOD

The MOD Archive Server acts as an FSU using the Interchange option when requested to update an MOD.

The MOD Archive Application will take the selected list of SOP instances and eliminate any SOP instance that does not correspond to permissible SOP instances listed in the Application Profiles Table 3.3.1-1. The remaining SOP instances are written to the media that is found in the MOD Archive Application disk drive. The determination of the potentially applicable Application Profile is dependent on the type of media and associated software on which the AE has been invoked.

3.3.1.2.4.1 Application Profiles for the RWA: Update MOD Request

The Update MOD Request RWA applies to the STD-CTMR and AUG-CTMR Application Profiles listed in Table 3.3.1-1. For extensions and specializations see section 3.4.

3.3.1.2.4.2 Options:

See Section 3.3.1.2.1.2.

3.4 AUGMENTED AND PRIVATE APPLICATION PROFILES

3.4.1 Augmented Application Profiles

3.4.1.1 AUG-CTMR-MOD12 and AUG-CTMR-MOD23 Application Profiles

The AUG-CTMR-MOD12 and AUG-CTMR-MOD23 Application Profiles (hereinafter denoted AUG-CTMR) are augmentations of the corresponding STD-CTMR Application Profiles.

3.4.1.1.1 SOP Classes and Transfer Syntaxes

The AUG-CTMR Application Profiles add the following SOP Classes and Transfer Syntaxes to the STD-CTMR Profile:

Table 3.4.1.1.1-1 : Additional IODs and Transfer Syntaxes for AUG-CTMR Application Profiles

Information Object Definition	SOP Class UID	Transfer Syntax and UID	FSC Req.	FSR Req.	FSU Req.
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	O	O
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	O	O
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	O	O

M : Mandatory O : Optional

3.4.1.1.2 Directory Information in DICOMDIR

The modality attribute (0008,0060) value in the DICOMDIR Series records shall be CT or MR.

3.4.1.1.3 Other Parameters

3.4.1.1.3.1 Image Attribute Values

The attributes listed in Table 3.3.3.1.5.1-1 used within the Image files shall take the values specified.

Table 3.3.3.1.5.1-1: AUG-CTMR Profiles Required Image Attribute Values

Table 3.4.1.1.1-1 : Additional IODs and Transfer Syntaxes for AUG-CTMR Application Profiles

Attribute	Tag	Value
Modality	(0008,0060)	CT/MR
Photometric Interpretation	(0028,0004)	MONOCHROME2
Bits Allocated	(0028,0100)	16
Bits Stored	(0028,0101)	16

Note: Overlay data if present shall be encoded in Overlay Data (60XX,3000).

3.5 EXTENSIONS, SPECIALIZATIONS, PRIVATIZATIONS OF SOP CLASSES AND TRANSFER SYNTAXES

3.5.1 Extensions, Specializations, and Privatizations of SOP Classes

The CT/MR SOP Class Images have definitions extended for Defined Terms and include GE specific Private Data elements. The following sections describe the details for these SOP classes.

3.5.1.1 SOP Specific Conformance Statement for CT SOP Class

Refer to **section 2.5** for standard extensions and **Appendix A** for private data elements

3.5.1.2 SOP Specific Conformance Statement for MR SOP Class

Refer to **section 2.5** for standard extensions and **Appendix C** for private data elements

3.6 CONFIGURATION

The MOD Archive Server will have only 2.6GB drive installed.

Table 3.6-1 : Supported Profiles for various Drive Configurations

Disk Drive Installed	Profiles Supported
2.6GB-Optical Disk Drive	STD-CTMR-MOD12
	STD-CTMR-MOD23

3.7 SUPPORT OF EXTENDED CHARACTER SETS

The MOD Archive Server will support copy of SOP instances containing the ISO IR 100 (Latin alphabet No. 1, supplementary set) and DICOM default character sets as defined in PS3.5.

4 CT INFORMATION OBJECT IMPLEMENTATION

4.1 INTRODUCTION

This section specifies the use of the DICOM CT Image IOD to represent the information included in CT images produced by this implementation. Corresponding attributes are conveyed using the module construct. The contents of this section are:

4.2 - IOD Description

4.3 - IOD Entity-Relationship Model

4.4 - IOD Module Table

4.5 - IOD Module Definition

4.2 CT IOD IMPLEMENTATION

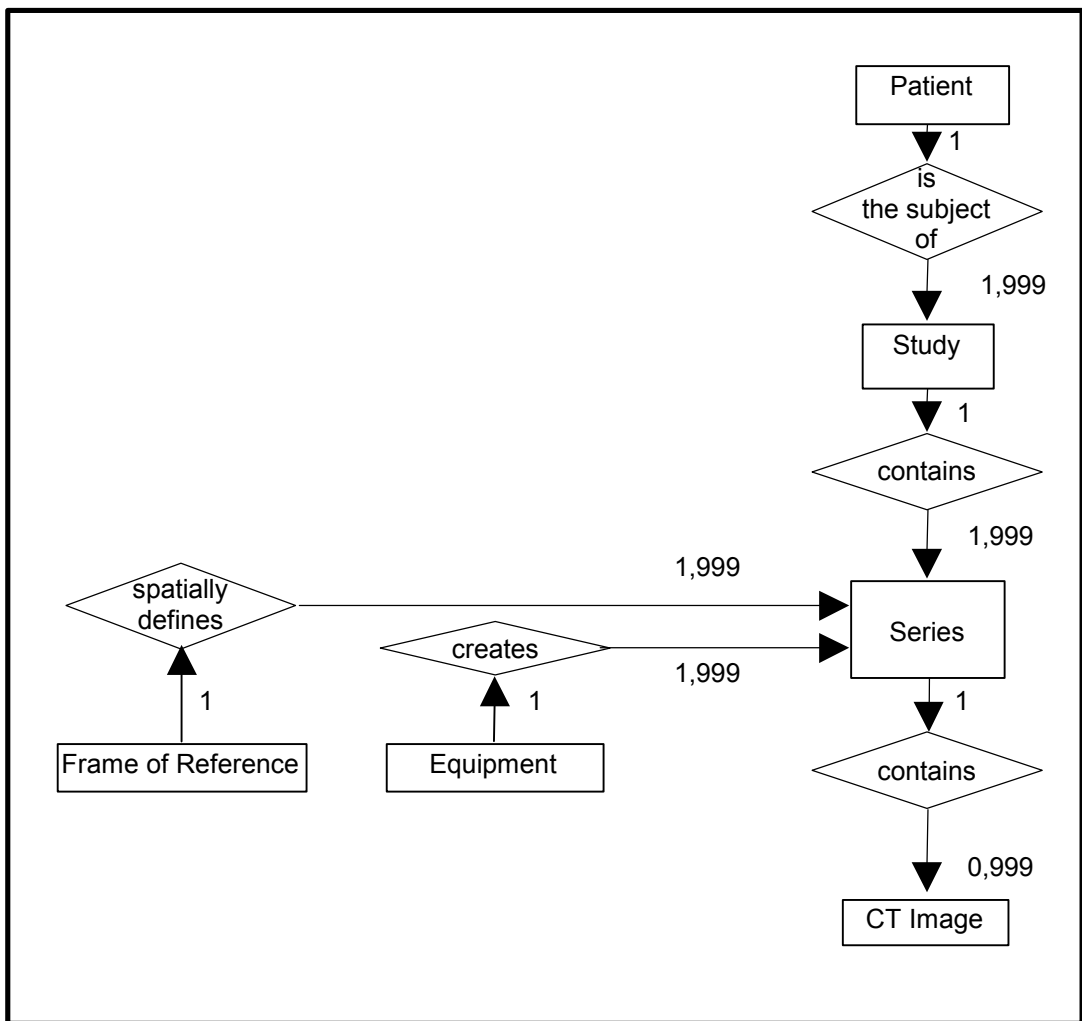
4.3 CT ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the CT Image interoperability schema is shown in Illustration 4-3-1. In this figure, the following diagrammatic convention is established to represent the information organization :

- each entity is represented by a rectangular box
- each relationship is represented by a diamond shaped box.
- the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. In other words, the relationship between Series and Image can have up to 999 Images per Series, but the Patient to Study relationship has 1 Study for each Patient (a Patient can have more than one Study on the system, however each Study will contain all of the information pertaining to that Patient).

ILLUSTRATION 4.3-1
CT IMAGE ENTITY RELATIONSHIP DIAGRAM



4.3.1 ENTITY DESCRIPTIONS

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the CT Information Object.

4.3.1.1 Frame of Reference Entity Description

The *Frame of Reference entity* uniquely identifies the spatial coordinate system which has been used to produce a series of images.

4.4 IOD MODULE TABLE

Within an entity of the DICOM CT IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets.

Table 4.4-1 identifies the defined modules within the entities which comprise the DICOM CT IOD. Modules are identified by Module Name.

See DICOM Part 3 for a complete definition of the entities, modules, and attributes.

**TABLE 4.4-1
CT IMAGE IOD MODULES**

Entity Name	Module Name	Reference
Patient	Patient	4.5.1.1
Study	General Study	4.5.2.1
	Patient Study	4.5.2.2
Series	General Series	4.5.3.1
Frame of Reference	Frame of Reference	4.5.4.1
Equipment	General Equipment	4.5.5.1
Image	General Image	4.5.6.1
	Image Plane	4.5.6.2
	Image Pixel	4.5.6.3
	Contrast/Bolus	4.5.6.4
	VOI LUT	4.5.7.1
	SOP Common	4.5.8.1
	CT Image	4.5.9.1

4.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the CT Information Object.

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained from. It should be noted that they are the same ones as defined in the DICOM Standard Part 3 (Information Object Definitions).

4.5.1 Common Patient Entity Modules

4.5.1.1 Patient Module

This section specifies the Attributes of the Patient that describe and identify the Patient who is the subject of a diagnostic Study. This Module contains Attributes of the patient that are needed for diagnostic interpretation of the Image and are common for all studies performed on the patient.

**TABLE 4.5.1.1-1
PATIENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Patient's full legal name. Truncated to 64 characters.
Patient ID	(0010,0020)	2	Primary hospital identification number or code for the patient. Truncated to 16 characters.
Patient's Birth Date	(0010,0030)	2	Patient's birth date.
Patient's Sex	(0010,0040)	2	Sex of the patient.
Referenced Patient Sequence	(0008,1120)	3	A sequence which provides reference to a Patient SOP Class/Instance pair.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance.

4.5.2 Common Study Entity Modules

The following Study IE Modules are common to all Composite Image IODs which reference the Study IE. These Module contain Attributes of the patient and study that are needed for diagnostic interpretation of the image.

4.5.2.1 General Study Module

This section specifies the Attributes which describe and identify the Study performed upon the Patient.

**TABLE 4.5.2.1
GENERAL STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Unique identifier for the Study.
Study Date	(0008,0020)	2	Date the Study started.
Study Time	(0008,0030)	2	Time the study started.
Referring Physician's Name	(0008,0090)	2	Patient's referring physician. Truncated to 26 characters.
Study ID	(0020,0010)	2	User or equipment generated Study Identifier.
Accession Number	(0008,0050)	2	Patient's accession number. Truncated to 16 characters.
Study Description	(0008,1030)	3	Institution-generated description or classification of the Study performed. Truncated to 22 characters.
Name of Physician(s) Reading Study	(0008,1060)	3	Physician(s) reading the Study. Truncated to 26 characters.
Referenced Study Sequence	(0008,1110)	3	A sequence which provides reference to a Study SOP Class/Instance pair.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP class.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP instance.

4.5.2.2 Patient Study Module

This section defines Attributes that provide information about the Patient at the time the Study was performed.

**TABLE 4.5.2.2
PATIENT STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Age of the patient. Limited to 150.
Patient's Weight	(0010,1030)	3	Weight of the patient. Limited to 204kg
Additional Patient's History	(0010,21B0)	3	Additional information about the Patient's medical history. Truncated to 60 characters.

4.5.3 Common Series Entity Modules

The following Series IE Modules are common to all Composite Image IODs which reference the Series IE.

4.5.3.1 General Series Module

This section specifies the Attributes which identify and describe general information about the Series within a Study.

**TABLE 4.5.3.1
GENERAL SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series.
Series Instance UID	(0020,000E)	1	Unique identifier of the Series.
Series Number	(0020,0011)	2	A number that identifies this Series.
Laterality	(0020,0060)	2C	Laterality of (paired) body part examined.
Series Date	(0008,0021)	3	Date the Series started.
Series Time	(0008,0031)	3	Time the Series started.
Performing Physicians' Name	(0008,1050)	3	Name of the physicians administering the Series. Truncated to 26 characters.
Series Description	(0008,103E)	3	User provided description of the Series. Truncated to 29 characters.
Operators' Name	(0008,1070)	3	Technologist (s) supporting the Series. Truncated to 3 characters.
Referenced Study Component Sequence	(0008,1111)	3	Uniquely identifies the study Component SOP Instances to which the Series is related.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance.
Body Part Examined	(0018,0015)	3	Text description of the part of the body examined. Sent as either "HEAD", "ORBITS", "CSPINE", "SHOULDER", "CHEST", "ABDOMEN", "LSPINE", "PELVIS" or "EXTREMITY".
Patient Position	(0018,5100)	2C	Patient position descriptor relative to the equipment.

4.5.4 Common Frame Of Reference Entity Modules

The following Frame of Reference IE Module is common to all Composite Image IODs which reference the Frame of Reference IE.

4.5.4.1 Frame Of Reference Module

This section specifies the Attributes necessary to uniquely identify a frame of reference which insures the spatial relationship of Images within a Series. It also allows Images across multiple Series to share the same Frame Of Reference. This Frame Of Reference (or coordinate system) shall be constant for all Images related to a specific Frame Of Reference.

**TABLE 4.5.4.1
FRAME OF REFERENCE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	See 4.5.4.1.1.1 for further explanation.
Position Reference Indicator	(0020,1040)	2	See 4.5.4.1.1.2 for further explanation.

4.5.4.1.1 Frame Of Reference Attribute Descriptions

4.5.4.1.1.1 Frame Of Reference UID

The Frame of Reference UID (0020, 0052) shall be used to uniquely identify a frame of reference for a series. Each series shall have a single Frame of Reference UID. However, multiple series within a Study may share a Frame of Reference UID. All images in a Series which share the same Frame of Reference UID shall be spatially related to each other.

4.5.4.1.1.2 Position Reference Indicator

The Position Reference Indicator (0020, 1040) specifies the part of the part of the patient's anatomy which was used as an anatomical reference point associated with a specific Frame of Reference UID. The Position Reference Indicator may or may not coincide with the origin of the mixed frame of reference related to the Frame of Reference UID.

4.5.5 Common Equipment Entity Modules

The following Equipment IE Module is common to all Composite Image IODs which reference the Equipment IE.

4.5.5.1 General Equipment Module

This section specifies the Attributes which identify and describe the piece of equipment which produced a Series of Images.

**TABLE 4.5.5.1
GENERAL EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	"GE MEDICAL SYSTEMS"
Institution Name	(0008,0080)	3	Institution where the equipment is located that produced the digital images. Truncated to 32 characters.
Station Name	(0008,1010)	3	User defined name identifying the machine that produced the digital images. Truncated to 8 characters.
Institutional Department Name	(0008,1040)	3	Department in the institution where the equipment is located that produced the digital images. Always sent as "CT" in this implementation.
Manufacturer's Model Name	(0008,1090)	3	Manufacturer's model number of the equipment that produced the digital images. Sent as "HiSpeed" for HiSpeed system, "ProSpeed" for ProSpeed system and "CT/e" for CT/e system in this implementation.
Device Serial Number	(0018,1000)	3	Manufacturer's serial number of the equipment that produced the digital images. Sent as 0000287.XXXXXXX for HiSpeed system and 0000288.XXXXXXX for ProSpeed system. XXXXXXXX is user defined number.
Software Versions	(0018,1020)	3	Manufacturer's designation of software version of the equipment that produced the digital images. Sent as "10.xx" or "11.xx". X is either 0-9.
Spatial Resolution	(0018,1050)	3	The inherent limiting resolution in mm of the equipment for high contrast objects for the data gathering and reconstruction technique chosen. If variable across the images of the series, the value at the image center. Always sent as "0.350000" in this implementation.
Pixel Padding Value	(0028,0120)	3	See 4.5.5.1.1.1.

4.5.5.1.1 General Equipment Attribute Descriptions

4.5.5.1.1.1 Pixel Padding Value

Pixel Padding Value(0028, 0120) is used to pad non-rectangular images to rectangle format. The native format of some images is not rectangular, for instance circular. It is common for devices with this format to pad the images to the rectangular format required by the DICOM Standard with a specific pixel value that is not contained in the native image. This attribute specifies the value of this padding value.

4.5.6 Common Image Entity Modules

The following Image IE Modules are common to all Composite Image IODs which reference the Image IE.

4.5.6.1 General Image Module

This section specifies the Attributes which identify and describe an image within a particular series.

**TABLE 4.5.6.1
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	A number that identifies this image.
Image Date	(0008,0023)	2C	The date the image pixel creation started. Required if image is part of a series in which the images are temporally related.
Image Time	(0008,0033)	2C	The time the image pixel creation started. Required if image is part of a series in which the images are temporally related.
Image Type	(0008,0008)	3	See 4.5.6.1.1.1.
Acquisition Number	(0020,0012)	3	A number identifying the single continuous gathering of data over a period of time which resulted in this image.
Acquisition Date	(0008,0022)	3	The date the acquisition of data that resulted in this image started.
Acquisition Time	(0008,0032)	3	The time the acquisition of data that resulted in this image started.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance.
Derivation Description	(0008,2111)	3	See 4.5.6.1.1.2.
Source Image Sequence	(0008,2112)	3	See 4.5.6.1.1.2.
Image Comment	(0020,4000)	3	Image Comment. "reconMatrix=n", where n is reconstruction matrix number ,is sent in this implementation.

4.5.6.1.1 General Image Attribute Descriptions

4.5.6.1.1.1 Image Type

The Image Type attribute is multi-valued and shall be provided in the following manner:.

Value 1 shall have the following Enumerated Values:

- ORIGINAL identifies an Original Image
- DERIVED identifies a Derived Image

Value 2 shall have the following Enumerated Values:

- PRIMARY identifies a Primary Image
- SECONDARY identifies a Secondary Image

Value 3 shall identify any image IOD specific specialization (optional)

Other values which are implementation specific (optional)

4.5.6.1.1.2 Derivation Description and Source Image Sequence

If an image is identified to be a Derived image, Derivation description is an optional text description of the way the image was derived. It may be used whether or not the Source Image Sequence is provided. It may also be used in cases when the Derived Image pixel data is not significantly changed from one of the source images and the SOP Instance UID of the Derived Image is the same as the one used for the source image. If an Image is identified to be a Derived image (see C.7.6.1.1.2 Image Type), Source Image Sequence(0008,2112) is an optional list of Referenced SOP Class UID (0008,1150)/ Referenced SOP Instance UID (0008,1150) pairs which identify the source images used to create the Derived image. It may be used whether or not there is a description of the way the image was derived in Derivation Description (0008,2111).

4.5.6.2 Image Plane Module

This section specifies the Attributes which define the transmitted pixel array of a two dimensional image plane.

**TABLE 4.5.6.2
IMAGE PLANE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.
Image Orientation (Patient)	(0020,0037)	1	The direction cosines of the first row and the first column with respect to the patient. If (0008,0008) value 3 is set as "CTINTERVENTION", this value is prescribed value and may not be actual value. Do not use this element for any calculations.
Image Position (Patient)	(0020,0032)	1	The x, y, and z coordinates of the upper left hand corner (first pixel transmitted) of the image, in mm. Note that it is NOT center of the first pixel but upper left hand corner of the first pixel. If (0008,0008) value 3 is set as "CTINTERVENTION", this value is prescribed value and may not be actual value. Do not use this element for any calculations.
Slice Thickness	(0018,0050)	2	Nominal slice thickness, in mm.

Slice Location	(0020,1041)	3	Relative position of exposure expressed in mm. If (0008,0008) value 3 is set as "CTINTERVENTION", this value is prescribed value and may not be actual value. Do not use this element for any calculations.
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4.5.6.2.1 Image Position And Image Orientation

The Image Position (0020,0032) specifies the x, y, and z coordinates of the upper left hand corner of the image; it is the first pixel transmitted. Image Orientation (0020,0037) specifies the direction cosines of the first row and the first column with respect to the patient. These Attributes shall be provide as a pair. Row value for the x, y, and z axes respectively followed by the Column value for the x, y, and z axes respectively.

The direction of the axes are defined fully by the patient's orientation. The x-axis is increasing to the left hand side of the patient. The y-axis is increasing to the posterior side of the patient. The z-axis is increasing toward the head of the patient.

The patient based coordinate system is a right handed system, i.e. the vector cross product of a unit vector along the positive x-axis and a unit vector along the positive y-axis is equal to a unit vector along the positive z-axis.

However, with regard to Image Position, reference point of each axis is not fully patient oriented in this system. As long as table height is changed and landmark button is not pressed between images, it does not cause any practical problem. To determine if two images are spatially related, implementation must see Frame of Reference UID (0020,0052).

CAUTION : It is possible for the operator of this system to change the table height or change the landmark position while scanning a series of images. Therefore, implementations must use the Frame of Reference UID (0020,0052) in conjunction with Image Posision to determine if two images are spatially related.

4.5.6.3 Image Pixel Module

This section specifies the Attributes that describe the pixel data of the image.

**TABLE 4.5.6.3
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	1 is sent in this implementation.
Photometric Interpretation	(0028,0004)	1	MONOCHROME2
Rows	(0028,0010)	1	512 or 256
Columns	(0028,0011)	1	512 or 256
Bits Allocated	(0028,0100)	1	16
Bits Stored	(0028,0101)	1	16
High Bit	(0028,0102)	1	15.
Pixel Representation	(0028,0103)	1	0001H = 2's complement
Pixel Data	(7FE0,0010)	1	A data stream of the pixel samples which comprise the Image.

4.5.6.4 Contrast/Bolus Module

This section specifies the Attributes that describe the contrast /bolus used in the acquisition of the Image.

**TABLE 4.5.6.4
CONTRAST/BOLUS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	Contrast or bolus agent. Sent as "XX..XX & YY..YY" form. XX..XX is agent name for oral contrast and truncated to 16 characters. YY..YY is agent name for IV contrast and truncated to 16 characters. Not sent if (0018,1040) is not specified.
Contrast/Bolus Route	(0018,1040)	3	Administration route of contrast agent Sent as either "Oral", "IV" or "Oral & IV". Not sent if no contrast is prescribe by user.

4.5.7 Common Lookup Table Modules

4.5.7.1 VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

**TABLE 4.5.7.1
VOI LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Window Center	(0028,1050)	3	Window Center for display. Display Window Center only is sent.
Window Width	(0028,1051)	1C	Window Width for display. Required if Window Center (0028,1050) is sent. Display Window Width only is sent.

4.5.8 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

4.5.8.1 SOP Common Module

This section defines the Attributes which are required for proper functioning and identification of the associated SOP Instances. They do not specify any semantics about the Real-World Object represented by the IOD.

**TABLE 4.5.8.1
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Uniquely identifies the SOP Class.
SOP Instance UID	(0008,0018)	1	Uniquely identifies the SOP Instance.
Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set. Required if an expanded or replacement character set is used. Always ISO_IR 100 is sent.
Instance Creation Date	(0008,0012)	3	Date the image file was created shall be encoded. This element shall always be encoded.
Instance Creation Time	(0008,0013)	3	Time the image file was created shall be encoded. This element shall always be encoded.
Instance Creator UID	(0008,0014)	3	Uniquely identifies device which created the SOP Instance.

4.5.9 CT Modules

This Section describes CT Series, Equipment, and Image Modules. These Modules contain Attributes that are specific to CT Image IOD.

4.5.9.1 CT Image Module

The table in this Section contains IOD Attributes that describe CT images.

**TABLE 4.5.9.1
CT IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	See 4.5.9.1.1.1.
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. 1 is sent in this implementation.
Photometric Interpretation	(0028,0004)	1	MONOCHROME2 is sent
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. 16 is sent in this implementation.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. 16 is sent in this implementation.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. 15 is sent in this implementation.

Rescale Intercept	(0028, 1052)	1	The value b in relationship between stored values (SV) and Hounsfield (HU). $HU = m \cdot SV + b$ 0 is sent in this implementation.
Rescale Slope	(0028,1053)	1	m in the equation specified in Rescale Intercept (0028,1052). 1 is sent in this implementation.
Scan Options	(0018,0022)	3	A label for special scan type taken. Sent as either "HELICAL MODE", "HELICALPLUS MODE", "CINE MODE", "CARDIAC MODE", "FLUORO MODE", "RESPIRATORY" or not set for other scan type.
KVP	(0018,0060)	2	Peak kilo voltage output of the x-ray generator used
Acquisition Number	(0020,0012)	2	A number identifying the single continuous gathering of data over a period of time which resulted in this image
Reconstruction Diameter	(0018,1100)	3	Diameter in mm of the region from within which data were used in creating the reconstruction of the image. Data may exist outside this region and portions of the patient may exist outside this region.
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center
Distance Source to Patient	(0018,1111)	3	Distance in mm from source to isocenter (center of field of view)
Gantry/Detector Tilt	(0018,1120)	3	Nominal angle of tilt in degrees of the scanning gantry. Not intended for mathematical computations. If (0008,0008) value 3 is set as "CTINTERVENTION", this value is prescribed value and may not be actual value. Do not use this element for any calculations.
Table Height	(0018,1130)	3	The distance in mm of the top of the patient table to the center of rotation; below the center is positive.
Rotation Direction	(0018,1140)	3	Direction of rotation of the source when relevant, about nearest principal axis of equipment. Enumerated Values: CW = clockwise CC = counter clockwise
Exposure Time	(0018,1150)	3	Time of x-ray exposure in msec. When ImageType Value3 is SEGMENTED, it is calculated by formula Rotation Speed (0019,1027) x 0.652 to set equivalent exposure time for segmented recon.
X-ray Tube Current	(0018,1151)	3	X-ray Tube Current in mA.
Exposure	(0018,1152)	3	The product of exposure time and X-ray Tube Current expressed in mas.

Filter Type	(0018,1160)	3	Label for the type of filter inserted into the x-ray beam.
Generator Power	(0018,1170)	3	Power in kW to the x-ray generator.
Focal Spot	(0018,1190)	3	Size of the focal spot in mm. 1.200000 or x.xxxxxxx in this system
Convolution Kernel	(0018,1210)	3	A label describing the convolution kernel or algorithm used to reconstruct the data. Sent as either "SOFT", "STND", "STD+", "EDGE", "BONE", "DETL", "CHST", or "PFRM".

4.5.9.1.1 CT Image Attribute Descriptions

4.5.9.1.1.1 Image Type

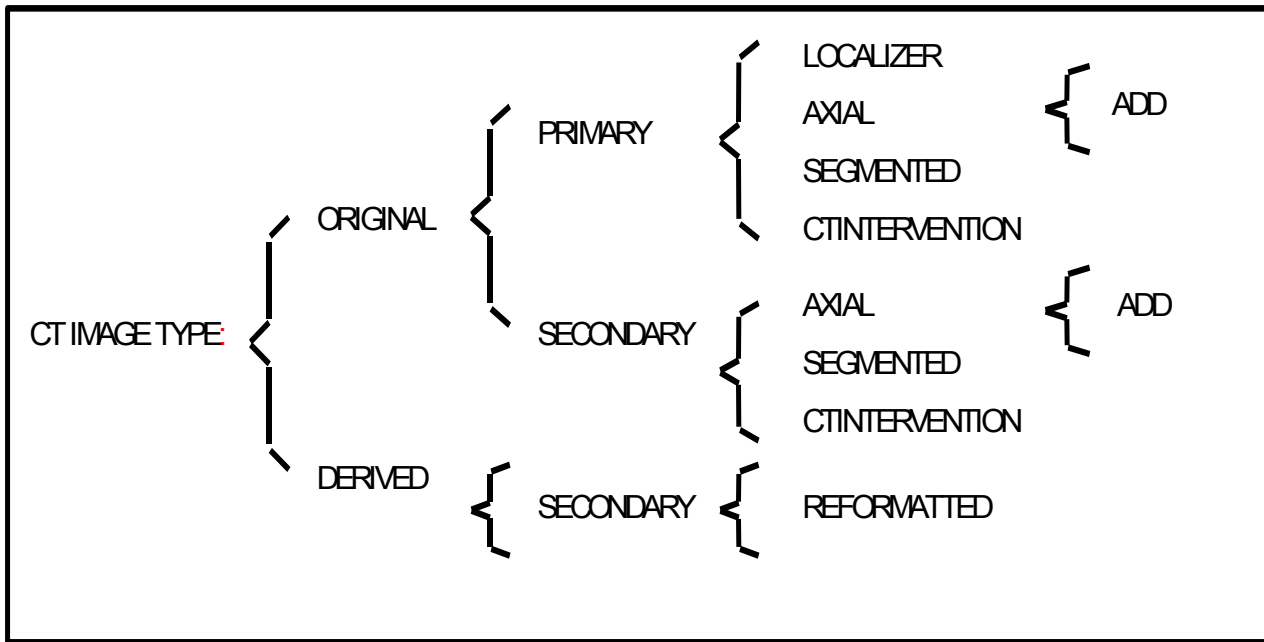
Value 1: Identifies an image to be either an ORIGINAL image or a DERIVED image An ORIGINAL image is an image whose pixel values represent original, non-transformed data. A DERIVED image is an image which has been created by combining two or more images together.

Value 2: Identifies an image to be either a PRIMARY image or a SECONDARY image A PRIMARY image is an image whose pixel values represent original, non-transformed data. A SECONDARY image is an image which has been created by combining two or more images together.

Value 3: Identifies the type of processing which created the image. An AXIAL image is an image which was created as a result of axial CT scanning. A LOCALIZER is an image which was created with the intent of being used as a prescription image for AXIAL scanning. A SEGMENTED image is an AXIAL image whose reconstruction provides time segmented information. A REFORMATTED image is an image which represents a cut plane across a set of AXIAL images. A CTINTERVENTION is an image which was created as a result of CT Fluoroscopy image capture and NOT the intent of being used for diagnostics.

Value 4: Identifies the type of optional processing which created the image. An ADD image is an image which was created as a result of multiple axial CT scanning.

**ILLUSTRATION 4.5.9.1.1.1
CT IMAGE TYPE DECISION TREE**



4.6 PRIVATE DATA DICTIONARY

Refer to Appendix A.

5 PRINT SCU CONFORMANCE

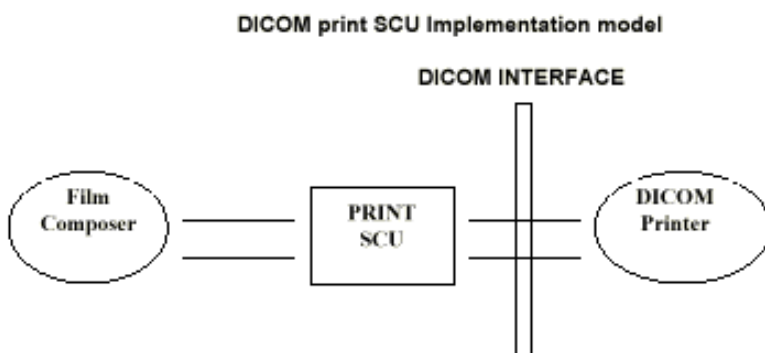
5.1 INTRODUCTION

This conformance statement specifies the HiSpeed ZX/i conformance to the DICOM Print SCU Application Profile. The HiSpeed ZX/i product uses DICOM Print SCU to print images on DICOM Compliant Printers.

5.2 IMPLEMENTATION MODEL : PRINT SCU

The DICOM Print SCU provides the capability to print images to DICOM printers. It acts as an SCU of the DICOM print management SOP class.

5.2.1 Application Data Flow Diagram



The Film Composer is the User interface and this is used to initiate the local real world activity. The user issues the print request using Film Composer. Film composer allows printer selection and it composes the pre-formatted film file. This film file is interpreted by Print SCU and it sends the appropriate messages to DICOM print SCP running on a DICOM printer.

5.2.2 Functional Definition of AE's

DICOM Print SCU Establishes the Association to the requested printer for printing the composed film.

5.2.3 Sequencing of Real-World Activities

- The DICOM printer is installed through a camera installation process. The DICOM printer is selected from the Film Composer Interface for Manual Filming. Autofilming is enabled using the camera setup via the camera installation process.
- Images must be acquired for printing.
- Images are sent to film composer.
-

5.3 AE SPECIFICATIONS

5.3.1 DICOM Print SCU AE Specification

Print SCU provides Standard Conformance to the following DICOM SOP classes as an SCU:

SOP Class Name	SOP Class UID
Basic grayscale print management meta SOP class	1.2.840.10008.5.1.1.9
Print Job SOP class	1.2.840.10008.5.1.1.14

5.3.1.1 Association Establishment Policy

5.3.1.1.1 General

The Film Composer provides options to indicate the printer AE title and Printer host name. These parameters are used by the Print SCU to establish the association with the desired printer.

The DICOM Application Context Name (ACN), which is always proposed, is:

Application Context Name	1.2.840.10008.3.1.1.1
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The Maximum Length PDU negotiation is included in all association establishment requests. The maximum length PDU for association initiated by the DICOM Print SCU AE is:

Maximum Length PDU	16 Kbytes
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5.3.1.1.2 Number of Associations

The Print SCU will initiate only one association with printer. Multiple associations are not supported.

5.3.1.1.3 Asynchronous Nature

The print SCU does not support asynchronous operations. All operations will be performed synchronously.

5.3.1.1.4 Implementation identifying information

The Implementation UID allows unique identification of a set of products that share the same implementation.

The Implementation UID for this ID/Net v3.0 Implementation is:

HiSpeed ZX/i Implementation UID	1.2.840.113619.6.22
---------------------------------	---------------------

5.3.1.2 Association Establishment Policy

Print SCU initiates the association with the Printer.

5.3.1.2.1 Real World Activity

5.3.1.2.1.1 Associated Real-World Activity - "Film Composer"

The Film Composer allows the user to select printers and it also allows the user to drag and drop the images (from the viewer application) into the film. It also allows the user to manipulate some print parameters like film format and

number of copies to print. When the user presses the "Print" Button, the Film composer communicates this request to Print SCU which then tries to establish the association with the requested printer and transmits the images for printing.

- Images may be sent to film composer in the following manner:
 - Images to be printed may be manually dropped from Viewing applications into the manual film composer slots.
 - Images to be printed may be automatically dropped from Viewing applications into the manual film composer slots.
 - Images to be printed may be manually dropped from Viewing applications into the auto film composer slots.
 - Image series to be printed may be automatically dropped from the PrintSeries application into the manual film composer slots.
 - Images to be printed may be automatically dropped from the Scanning Application into the auto film composer slots.
- Based upon the filming mode (and the attributes) used to acquire images into the film composer, films will be automatically printed when the film session is full, or the user must press the Print Button to print the images.
- The Print SCU retrieves the Print SCP status by using the N-GET service of Printer SOP Class. If the printer returns a FAILURE status the print session will be terminated. The printer status is not read.
- The film session is created using the N-CREATE service. The print session will be terminated if the printer fails to create the film session.
- The film box is created using the N-CREATE service. The print session will be terminated if the printer fails to create the film box.
- The images are placed on the film box by using the N-SET. If the printer fails to place the image on the film box, the print session will be terminated.
- The film will be printed using the N-ACTION. Only film box printing is supported. If the printer fails to print the film, the print session will be terminated.
- After the successful N-ACTION, the film box will be deleted using the N-DELETE. Any N-EVENT-REPORTS given to the PRINT SCU will be received but the data is ignored. After the film box is deleted, the association will be closed.

Upon the successful completion of the above sequencing and the association is closed, the user will be notified of the successful print session.

5.3.1.2.1.2 Proposed Presentation Contexts

The Proposed Presentation Context Table for the Print SCU is as shown in following Table.

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name List	UID List		Negotiation
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Verification SOP	1.2.840.10008.1.1	Implicit VR Little	1.2.840.10008.1.2	SCU	None

Class		Endian			
Printer SOP Class	1.2.840.10008.5.1.1.16	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Print Job SOP Class	1.2.840.10008.5.1.1.14	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Note: Certain Presentation Contexts may be negotiated that are not used during the association. See the following sections for the DICOM Print services performed by the HiSpeed ZX/i.

5.3.1.2.2 SOP Specific Conformance Statement

The Print SCU supports the following mandatory SOP classes which are defined under the Basic Grayscale Print Management Meta SOP Class.

The Print SOP Classes supported by Print SCU :

Name	UID
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
Printer SOP Class	1.2.840.10008.5.11.16

The Print SCU does not support any optional SOP Classes.

5.3.1.2.2.1 Basic Film Session SOP Class

The Print SCU supports the following DIMSE Service Elements for the Basic Film Session SOP Class.

N-CREATE - Requests the Print SCP to create an instance of Basic Film Session.

The following Attribute values are supported by the N-CREATE:

Attribute	DICOM Tag	Valid Range	Default Value
* Number of Copies	(2000, 0010)	1-99	Set by user
* Print Priority	(2000, 0020)	HIGH/MED/LOW	HIGH
* Medium Type	(2000, 0030)	CLEAR FILM BLUE FILM PAPER	Set in Configuration File
* Film Destination	(2000, 0040)	MAGAZINE PROCESSOR	Set in Configuration File

Note: * denotes that the attribute is optional for the SCU. However, we do provide values for all of these optional attributes and if the SCP does not support the requested value it may choose to either return a failure status or ignore the value provided and use its default value.

If Failure status is returned during N-CREATE operation of Film session the following action will be taken by Print SCU: 0x213 "Resource Limitation" message will be sent to user interface. All other status "Failure" message will be sent to user interface. In all the cases the print session will be terminated.

5.3.1.2.2.2 Basic Film box SOP Class

The Print SCU supports the following DIMSE Service Elements for the Basic Film Box SOP Class.

N-CREATE - Requests the Print SCP to create an instance of Film Box.

N-ACTION - Requests the Print SCP to print the Film Box onto Printer.

N-DELETE - Requests the Print SCP to delete the Film Box Instance.

The Following Attribute values are supported:

Attribute	DICOM Tag	Valid Range	Default Value
Image Display Format	(2010, 0010)	STANDARD/C,R Printer Dependent	Set in User Interface
Reference Film Session Sequence	(2010, 0500)		
*Film Orientation	(2010, 0040)	PORTRAIT	Set in Configuration File
Film Size ID	(2010, 0050)	Sent zero length	Sent zero length
*Magnification type	(2010, 0060)	BILINEAR CUBIC REPLICATE	Set in Configuration File
*Max Density	(2010, 0130)	0-4095	Set in Configuration File
Configuration Information	(2010, 0150)	Printer Dependent	Set in Configuration File
*Smoothing type	(2010, 0080)	Printer Dependent	Set in Configuration File
*Border density	(2010, 0100)	BLACK WHITE	Set in Configuration File
*Empty image density	(2010, 0110)	BLACK WHITE	Set in Configuration File
*Min density	(2010, 0120)	0-4094	Set in Configuration File
*Trim	(2010, 0140)	NO	NO

Note: Attributes “sent zero length” use the camera default values.

Note: * denotes that the attribute is optional for the SCU. However, we do provide values for all of these optional attributes and if the SCP does not support the requested value it may choose to either return a failure status or ignore the value provided and use its default value.

If Failure status is returned during N-CREATE operation of Film box following action will be taken by Print SCU.
0x213 “Resource Limitation” message will be sent.
0x106 “Unsupported Film Format” message will be sent.
All other status “Failure” message will be sent.
In all the cases the print session will be terminated.

If Failure status is returned during N-ACTION operation of Film box following action will be taken by Print SCU.
0xC602 “Unable to Create Print Job” message will be sent.
All other status “Failure” message will be sent.
In all the cases the print session will be terminated.

If Failure status is returned during N-DELETE operation of Film box following action will be taken by Print SCU. All the return status “Failure” message will be sent and the print session will be terminated.

5.3.1.2.2.3 Basic Grayscale Image Box SOP Class

The Print SCU supports the following DIMSE Service Elements for Grayscale Image Box SOP Class.

N-SET - Requests the Printer to set the image box attributes.

The Following Attribute values are supported:

Attribute	DICOM Tag	Valid Range	Default Value
Image Position	(2020, 0010)	Based on Image Display Format	No Default Value
Pre-formatted Grayscale Image Sequence	(2020, 0110)		
>Samples per pixel	(0028, 0002)	1	1
>Photometric Interpretation	(0028, 0004)	MONOCHROME2	MONOCHROME2
>Rows	(0028, 0010)	Image Dependent	Image Dependent
>Columns	(0028, 0011)	Image Dependent	Image Dependent
>Pixel Aspect Ratio	(0028, 0034)	1/1	1/1
>Bits Allocated	(0028, 0100)	8	8
>Bits Stored	(0028, 0101)	8	8
>High Bit	(0028, 0102)	7	7
>Pixel Representation	(0028, 0103)	0 (unsigned integer)	0 (unsigned integer)
*Polarity	(2020, 0020)	NORMAL	NORMAL

Note: * denotes that the attribute is optional for the SCU. However, we do provide values for all of these optional attributes and if the SCP does not support the requested value it may choose to either return a failure status or ignore the value provided and use its default value.

If Failure status is returned during N-SET operation of Image Box following action will be taken by Print SCU.

0xC605 “Resources temporarily not available” message will be sent.
All other status “Failure” message will be sent.
In all the cases the print session will be terminated.

5.3.1.2.2.4 Printer SOP Class

N-GET DIMSE service is supported for the Printer SOP Class. If an N-EVENT-REPORT DIMSE service is received when the association is active, Print SCU handles the relevant states but the data received is ignored.

Print SCU issues the request to retrieve the following attributes:

Optional Attribute	DICOM Tag	Default Value
--------------------	-----------	---------------

Printer Status	(2110, 0010)	Printer shall return Value
Printer Status Info	(2110, 0020)	Printer shall return Value
Printer Name	(2110, 0030)	Printer shall return Value
Manufacturer	(0008, 0070)	Printer shall return Value
Manufacturer Model Name	(0008, 1090)	Printer shall return Value
Device Serial No	(1800, 1000)	Printer shall return Value
Software Versions	(1800, 1020)	Printer shall return Value
Date Last Calibrated	(1800, 1200)	Printer shall return Value
Time Last Calibrated	(1800, 1201)	Printer shall return Value

The Print SCU issues the N-GET service to retrieve the printer status. The status is processed as follows:

- If Printer status (2110, 0010) is NORMAL, the film is printed.
- If Printer status (2110, 0010) is FAILURE, the print job is terminated. The Printer Status Info (2110, 0020) attribute is not processed.
- If Printer status (2110, 0010) is WARNING, one of three things will happen:
 - a) If the Printer Status Info (2110, 0020) is "SUPPLY LOW" the status is displayed to the user and the print job continues.
 - b) If the Printer Status Info (2110, 0020) is "RECEIVER FULL" or "SUPPLY EMPTY" or "FILM JAM" the status is displayed to the user and the print job is aborted.
 - c) For all other Printer Status Info (2110, 0020) values, the status is ignored and the print job continues.

5.3.1.2.2.5 Print Job SOP Class

At present N-GET DIMSE Service Elements are not supported for Print Job Class.

Print SCU looks for following attributes in N-EVNET REPORT data received from Print SCP.

Attribute Name	DICOM Tag	Default Value
Execution Status	(2100, 0020)	Printer shall return Value
Execution Status info	(2100, 0030)	Printer shall return Value
Print Priority	(2000, 0020)	Printer shall return Value
Creation Date	(2100, 0040)	Printer shall return Value
Creation Time	(2100, 0050)	Printer shall return Value
Printer Name	(2110, 0030)	Printer shall return Value
Originator	(2100, 0070)	Printer shall return Value

5.3.1.3 Association Acceptance Policy

The Print SCU does not accept associations.

5.4 COMMUNICATION PROFILES

5.4.1 Supported Communication Stacks (parts 8,9)

DICOM Upper Layer (Part 8) is supported using TCP/IP.

5.4.1.1 TCP/IP Stack

The TCP/IP stack is inherited from the UNIX Operating System.

5.4.1.1.1 API

Not Applicable

5.4.1.1.2 Physical Media Support

Ethernet v2.0, IEEE 802.3.

5.5 STANDARD EXTENDED/SPECIALIZED/PRIVATE SOPS

None.

5.6 CONFIGURATION

5.6.1 AE Title/Presentation Address Mapping

The Local AE title is "hostname_DCP", where "hostname" is the unique hostname within the network.

The HiSpeed ZX/i system allows the user to "add", "Remove", or "Update" the mapping of remote DICOM Printer AE Titles to IP Addresses and Ports. These options can be selected from the Service Desktop camera installation utility.

5.6.2 Configurable Parameters

The following fields are configurable for the DICOM Print SCU AE:

Note: All configurations should be performed by a GE Field Service Engineer.

- Local IP Address
- Local IP Netmask
- Max PDU length
- The following DICOM print parameters are configurable. The valid ranges are shown in earlier sections of this conformance statement.
 - Medium Type (2000, 0030)
 - Film Destination (2000, 0040)
 - Magnification Type (2010, 0060)
 - Min Density (2010, 0120)
 - Max Density (2010, 0130)
 - Empty Image Density (2010, 0110)

- Border Density (2010, 0100)
- Configuration Information (2010, 0150)
- Smoothing Type (2010, 0080)
- The following network timers are supported and are configurable. When these timers expire the association is terminated. The default values are:
 - Association Time out = 600 seconds
 - Session Time out = 3000 seconds (total time for open association)
 - N-SET Time out = 300 seconds
 - N-ACTION Time out = 300 seconds
 - N-CREATE Time out = 300 seconds
 - N-DELETE Time out = 300 seconds
 - N-GET Time out = 100 seconds
- Time-outs, which are set for all hosts, are configurable in dprint.cfg:
 - *Association time-out - *bi_assoc_tio*
 - *Session timeout - *bi_session_tio*
 - *Create timeout - *bi_ncreate_tio*

Note: All configurations are performed by a GE Field Service Engineer.

5.7 SUPPORT OF EXTENDED CHARACTER SET

The Print SCU does not support any Extended Character Set.

6 DICOM STORAGE COMMITMENT SCU CONFORMANCE

6.1 INTRODUCTION

This section of the DICOM conformance statement specifies the Storage Commitment Push Model SOP class as user, the optional attributes and service elements supported.

6.2 IMPLEMENTATION MODEL

6.2.1 Application data flow diagram

Illustration 7.1.1 shows the data flow diagram of Storage Commitment SCU. There is only one Real-World activity that will cause the DICOM Server Application Entity (DICOM Server AE) to initiate an association to a remote DICOM entity that is a Service Class Provider (SCP) of the Storage Commitment SOP class.

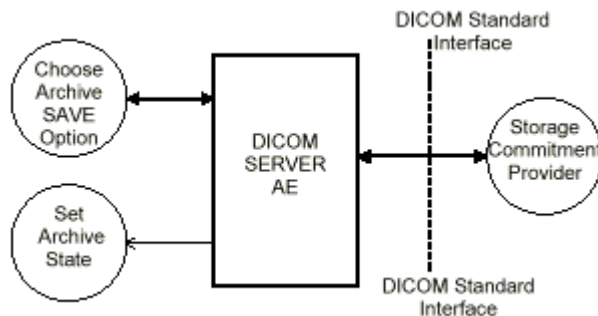
The *Choose Archive save Option* Real-World activity consists of an operator choosing a remote DICOM AE that supports Storage Commitment as provider as the archive device and selecting one or more exam or series from the local database and choosing either

Save Exam or *Save Series* from the archive menu. The images to be committed are sent to the remote provider entity first. The Commitment request for the transferred image instances is sent after the complete image transfer. The Commitment response can come on same association or on a different association.

There is no Real-World activity required for the DICOM Server AE to respond to an incoming Storage Commitment response from the remote DICOM AE.

Illustration 7.1.1

Application Data Flow Diagram



6.2.2 Functional definitions

DICOM Server AE initiates the following operations:

- Negotiates and establishes association with remote Storage Commitment Provider
- Sends the selected images to the remote DICOM AE.
- Closes the association.
- If all the images are transferred without failures the following steps will be executed. If there are any failures the job will marked as failed and the Storage Commitment request will not be sent.

- Establishes a new association for sending the commitment request. Here note that a storage Commitment request does not imply that the acquisition of images is complete.
- Receives the response on same association or on a different association.
- Updates the archive flag information for successful instances. The archive flag will just indicate whether the image has been archived and will not indicate how (and where) it was archived. So the remote archive and the local archive can not be distinguished.

6.2.3 Sequencing of real-world activities

The user has to select the remote commitment provider and the exams/series to be pushed before clicking Save Exam/Series button on the Archive menu.

6.3 AE SPECIFICATIONS

6.3.1 DICOM Storage Commitment SCU specifications

Provides Standard Conformance to the following DICOM 3.0 SOP class as an SCU:

SOP Class Name	SOP Class UID
Storage Commitment Push model SOP class	1.2.840.10008.1.20.1

6.3.1.1 Association establishment policies

6.3.1.1.1 General

The DICOM Application Context Name (ACN), which is always proposed, is:

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

The Maximum Length PDU negotiation is included in all association establishment requests. The maximum length PDU for association initiated by the DICOM Storage Commitment SCU AE is:

Maximum Length PDU	10 Kbytes
--------------------	-----------

6.3.1.1.2 Number of associations

A single association is used to send the commitment request. This waits for the response from commitment provider on the same association for a configurable amount of time. It will also accept an association for receiving the response from commitment provide at any time.

6.3.1.1.3 Asynchronous nature

Asynchronous window negotiation is not supported.

6.3.1.1.4 Implementation identifying information

The Implementation UID for this GEMS Implementation is:

HiSpeed ZX/i Implementation UID	1.2.840.113619.6.22
---------------------------------	---------------------

6.3.1.2 Association initiation policy

An association is initiated by the Storage SCU to the provider to send the images to be committed. A separate association is established to send the commitment request.

6.3.1.3 Real World Activity

6.3.1.3.1 Associated Real World Activity - "Save exam/series"

The user selects the exam/series to be committed. All the images currently in the selected exam/series will be sent to the selected remote archive node(which is also the Storage commitment SCP) using DICOM C-STORE operations. Once all the images are transferred the commitment request will be sent on a separate association.

6.3.1.3.2 Associated Real World Activity - "Auto Archive exam/series"

The Auto archive API's are used to archive the exams/series onto local archive media or the remote archive node (which shall be a Storage Commitment SCP) without manual interface.. If the default device selected for Auto Archive is a remote Storage Commitment SCP then all the images currently in the specified exam/series will be sent to the selected Storage commitment SCP using C-STORE operations. On successful transfer of all the images the Storage Commitment request will be sent.

6.3.1.4 Proposed Presentation Contexts

The Proposed Presentation Context table for the DICOM Storage Commitment SCU is as shown in following Table.

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

The Storage Commitment SCU can send the commitment request for following

DICOM 3.0 SOP classes	NAME UID
CT Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.2
MR Image storage SOP Class	1.2.840.10008.5.1.4.1.1.4
Secondary Capture Storage SOP Class	1.2.840.10008.5.1.4.1.1.7

6.3.1.5 Request Processing

The images in the selected exam/series are sent to the remote commitment provider entity using DICOM C-STORE operations. If there are any failures in the image transfers the Storage commitment request will not be sent. The corresponding job will be marked as failed and user will be notified of the status of job.

If all the images are successfully transferred then the commitment request will be sent on a different association with the list of sop instances.

If the N-ACTION request fails, the job will be marked as failed otherwise following sequence of actions will take place.

The SCU waits for **N-ACTION-Rsp** from provider on the same association for a configurable amount of time. If it does not receive **N-ACTION-Rsp** during this time it will close the association. It changes the Job state to "Wait" indicating the job is waiting for the response from commitment provider. The job will be marked as failed if the response is not received by **stop job time**. Stop job time is the maximum duration the job can wait for responses.

A New transaction uid will be created for each retry by user. The old transaction uid is not applicable for these requests.

The Following DIMSE service Elements are supported for the Storage Commitment request and response processing.

N-ACTION - Requests the remote Storage Commitment SCP to commit to storing the image instances.

N-EVENT-REPORT - The response sent by the remote Storage Commitment SCP.

The following attributes are sent in the N-ACTION request.

Attribute	Tag	Value
Transaction UID	(0008,1195)	Transaction uid
Referenced SOP Sequence	(0008,1199)	
>SOP Class UID	(0008,1150)	
>SOP Instance UID	(0008,1155)	

- Referenced Study Component sequence attribute is not sent.
- Storage Media File-Set ID and Storage Media File-Set UID attributes are not supported.

6.3.1.6 Response Processing

Once the N-EVENT REPORT response is received, the following actions will be taken depending on the status of response.

6.3.1.6.1 Commit response with SUCCESS status

The Archive flag information in the browser for all the successful instances will be updated. The status will be changed to "Y". The job queue entry will be removed

Note: The following attributes are expected as part of **DATA Set** for **N-Event-Request** from SCP

Attribute	Tag	Value
Transaction UID	(0008,1195)	Received from SCP
Referenced SOP Sequence	(0008,1199)	Received from SCP
>SOP Class UID	(0008,1150)	Received from SCP
>SOP Instance UID	(0008,1155)	Received from SCP

N-Event-Response will be sent on the same association itself. No DATA Set will be sent along with the response.

6.3.1.6.2 Commit response with FAILURE status

The following attributes are expected as part of **DATA Set** for **N-Event-Request** from SCP

Attribute	Tag	Value
Transaction UID	(0008,1195)	Received from SCP
Referenced SOP Sequence	(0008,1199)	Received from SCP
>SOP Class UID	(0008,1150)	Received from SCP
>SOP Instance UID	(0008,1155)	Received from SCP
>Failure Reason	(0008,1197)	Received from SCP

In case of complete/partial failure the user will be notified about the status and the job entry will be paused. There is no attempt made to retry automatically the failed sop instances. However the user can manually retry the failed jobs. Such requests will be treated as new requests. This will go through the whole sequence of operations once again.

The failure reason is ignored.

Failed SOP instances will have their archive flag information unaltered.

Note :

The archive status flag in the browser is a shared flag with local archive. When the status is “Y”, it means that the images are archived but doesn’t specify whether on local archive device or remote archive device. It is left to the user’s discretion whether the local sop instances (with their archive flag set to “Y”) are to be deleted.

N-Event-Response will be sent on the same association itself. No DATA Set will be sent along with the response.

6.3.1.7 Association Acceptance Policy

A single association will be accepted at any time to receive Storage Commitment responses.

6.4 COMMUNICATION PROFILES

6.4.1 Supported Communication Stacks (parts 8,9)

DICOM Upper Layer (Part 8) is supported using TCP/IP.

6.4.2 TCP/IP Stack

The TCP/IP stack is inherited from a UNIX Operating System.

6.4.2.1 Physical Media Support

Ethernet v2.0, IEEE 802.3.

6.4.3 Point-to-Point Stack

A 50-pin ACR-NEMA connection is not applicable to this product.

6.5 EXTENSIONS/SPECIALIZATIONS/PRIVATIZATIONS

None.

6.6 CONFIGURATION

Ethernet v2.0, IEEE 802.3.

6.6.1 AE Title/Presentation Address Mapping

The system allows the user to “add”, “Remove”, or “Update the mapping of remote AE Titles to IP Addresses and Ports. These options can be selected from the “Remote Host Selection” menu displayed by choosing “Select Remote Host” from the “Network” pull-down menu from the local database manager. A remote DICOM host can be designated as a “remote archive device” by setting the “Remote archive node” radio button on the remote host configuration panel. Once a DICOM host is designated as a “remote archive device” the host will be available in the “Archive” device selection menu and can be chosen for any subsequent archive operation.

6.6.2 Configurable Parameters

The following fields are configurable for the DICOM Server AE:

- Local AE Title (the machine hostname)
- Local IP Address
- Local IP Netmask
- Max PDU length
- Time-outs, which are set for all hosts, are configurable in dcs.cfg:

note: * denotes any SOP class (time in sec)

*Association time-out - *bi_assoc_tio*

*Inactivity time-out - *bi_store_tio*

*Session time-out - *bi_session_tio*

Note: All configurations should be performed by a GE Field Service Engineer.

6.7 SUPPORT OF EXTENDED CHARACTER SETS

This does not support any Extended Character set.

7 MODALITY WORKLIST INFORMATION MODEL DEFINITION

7.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant **Networking** features on this GEMS product. Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section.

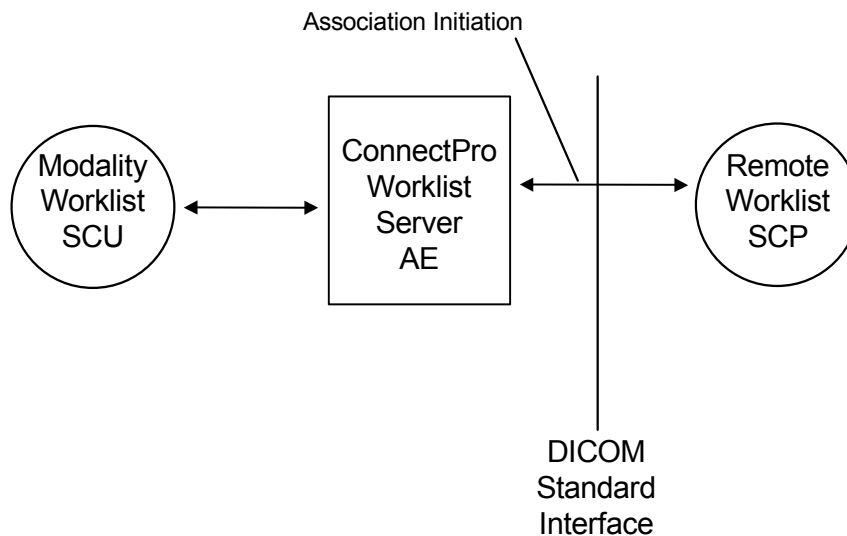
The ModalityWorklist option for HiSpeed ZX/i allows a user to query for and display DICOM modality worklist information from a remote hospital or radiology department information system computer. For example, a user may wish to query for all procedures scheduled to be performed on the scanner. In this situation, ModalityWorklist is providing the DICOM C-FIND service as a service class user (SCU).

7.2 IMPLEMENTATION MODEL

All DICOM functionality provided by the ModalityWorklist feature is logically provided by the Worklist Server DICOM AE. The Worklist Server DICOM AE is commanded to perform DICOM modality worklist query services through the use of the HiSpeed ZX/i user interface.

7.2.1 Application Data Flow Diagram

The Basic and Specific Application models for this device are shown in the following illustration:



7.2.2 Functional definitions

The ModalityWorklist Worklist Server AE is implemented as an application process on the scanner host computer. It runs as a daemon serving requests from the user interface to obtain modality worklists, query remote AEs and return the results to the user interface.

The ModalityWorklist Worklist Server AE initiates the following functions:

- *Query*: Initiates a DICOM association in order to query a remote AE. If the remote AE accepts a presentation context applicable to modality worklist, the Worklist Server AE will issue a modality worklist query request via the C-FIND service.

7.2.3 Sequencing of Real-World Activities

1. The user or the system initiates a modality worklist query (as a modality worklist SCU) to the modality worklist SCP with a given set of query parameters.
2. The modality worklist SCP returns responses which match the query parameters.
3. Items from the returned worklist responses are presented to the user.
4. A subset of the returned worklist responses are included in acquired DICOM images related to the responses.

7.3 AE SPECIFICATIONS

7.3.1 Worklist Server AE Specification

This Application Entity provides Standard Conformance to the following DICOM SOP Classes as an **SCU**:

SOP Class Name	SOP Class UID
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31

7.3.1.1 Association Establishment Policies

7.3.1.1.1 General

The DICOM Application Context Name (ACN), which is always proposed, is:

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

The Maximum Length PDU negotiation is included in all association establishment requests. The maximum length PDU for an association initiated by the DICOM Worklist Server is:

Maximum Length PDU	50 Kbytes
--------------------	-----------

The SOP Class Extended Negotiation is not supported.

The maximum number of Presentation Context Items that will be proposed is 1.

The user information Items sent by this product are:

- Maximum PDU Length
- Implementation UID

7.3.1.1.2 Number of Associations

The Worklist Server AE (SCU) will initiate only one DICOM association at a time to perform a modality worklist query of a single remote AE.

7.3.1.1.3 Asynchronous Nature

Asynchronous mode is not supported. All operations are performed synchronously.

7.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM Implementation is:

7.3.1.2 Association Initiation Policy

The Worklist Server AE initiates a new association due to an update operation being initiated from the HiSpeed ZX/i user interface.

7.3.1.2.1 Real-World Activity: Worklist Query

7.3.1.2.1.1 Associated Real-World Activity

The operator of the system initiates a query for a modality worklist by either opening the Schedule screen or by opening the Schedule screen and pressing the Update button. The choice of which of these two behaviors occurs is user configurable. The Worklist Server will then initiate an association with the remote AE in order to query for the worklist

A user can configure a number of parameters which directly control the worklist query request. The user can request worklist items that are intended for the scanner the user is working at, all items that apply to the modality of the scanner the user is working at or all worklist items available. These selections and their affects on worklist query parameters are given below:

This Scanner:

- Modality, (0008,0060) - set to CT
- Scheduled Station AE Title, (0040,0001) - set to local AE title

This Modality:

- Modality, (0008,0060) - set to CT
- Scheduled Station AE Title, (0040,0001) - zero-length (universal matching)

All Scanners:

- Modality, (0008,0060) - zero-length (universal matching)
- Scheduled Station AE Title, (0040,0001) - zero-length (universal matching)

The scheduled dates of procedures of interest can be specified for query by selecting a specific date range. The date ranges available are Today, Days Before Today, Days After Today and All Days. These selections and their affects on worklist query parameters are given below:

Today:

Scheduled Procedure Step Start Date (0040,0002) - set to YYYYMMDD, where this date is the current date.

Days Before Today and Days After Today:

Scheduled Procedure Step Start Date (0040,0002) - set to YYYYMMDD-YYYYMMDD, where this date range represents the specified number of days before today and/or after today. Note that number of days both before and after can be specified in the same query and that each always includes today.

All Days:

Scheduled Procedure Step Start Date (0040,0002) - zero-length (universal matching)

7.3.1.2.1.2 Proposed Presentation Context Table

The following table shows the proposed presentation contexts for the Worklist Server AE after real-world activity [Worklist Query] has been initiated:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.1.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

7.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for the Worklist SOP Class

If the remote AE does not support the proposed Presentation Context, an appropriate error is logged and the operator is notified.

This implementation can receive multiple C-FIND results over a single association. Only one association is opened at a time.

Each C-FIND response received from the remote AE is parsed to verify the length/type of the items in the response (see section 2.3.1.2.1.2.2 for more information). Upon detecting any error in the response data, the Worklist Server AE will issue a C-FIND-CANCEL and, upon receipt of a C-FIND-RSP (or if an applicable timer expires), will abort the association. All previously received worklist items are retained.

On receipt of any error from the remote AE, the Worklist Server will issue a C-FIND-CANCEL and, upon receipt of a C-FIND-RSP (or if an applicable timer expires), will abort the association. All previously received worklist items are retained. Warnings received from the remote AE are ignored.

Each C-FIND operation supports a configurable [Association Timer]. This timer starts when the association request is sent or received and stops when the association is established. The default time-out value is 30 seconds.

Each C-FIND operation supports a configurable [Session Timer]. This timer starts when an association is established and stops when the association is ended. The default time-out value is 3600 seconds.

If any of the above timers expires, the association is aborted (A-ABORT) and the operation in progress is considered to be failed. Any previously received worklist items are discarded.

7.3.1.2.1.2.2 Record Acceptance Policy

The HiSpeed ZX/i implementation adheres to strict value checking of incoming query responses from the remote AE. Each response received is examined to verify that all Type 1 attributes are present with non-zero length, that all Type 2 attributes are present (possibly with zero length) and that the data for all attributes is consistent with respect to the attributes' value representation (VR).

However, any inconsistencies in the response data, with respect to the categories described above, are not considered errors. Upon detecting any such inconsistencies in the response data, the Worklist Server AE will correct the inconsistencies to send 0 length data or value 0, and will try to accept the incoming valid data as much as possible.

Fields considered Type 1 by the Worklist Server include:

- (0010,0010), Patient Name
- (0010,0020), Patient ID
- (0020,000D), Study Instance UID
- (0040,0001), Scheduled Station AE Title

- (0040,0002), Scheduled Procedure Step Start Date ¹
- (0040,0003), Scheduled Procedure Step Start Time ¹
- (0040,0009), Scheduled Procedure Step ID
- (0040,1001), Requested Procedure ID

¹ Start Date must be of the form YYYYMMDD, exactly eight numeric characters, and Start Time must be of the form HHMMSS, exactly six numeric characters.

Fields considered Type 2 by Worklist Server include:

- (0008,0050), Accession Number
- (0008,0060), Modality
- (0008,0090), Referring Physician Name
- (0010,0030), Patient Date of Birth
- (0010,0040), Patient Sex
- (0010,1030), Patient Weight in kg
- (0010,2000), Medical Alerts
- (0010,2110), Contrast Allergies
- (0010,21C0), Pregnancy Status
- (0032,1032), Requesting Physician
- (0032,1070), Requested Contrast Agent
- (0038,0010), Admission ID
- (0038,0050), Special Needs
- (0038,0300), Current Patient Location
- (0038,0500), Patient State
- (0040,0006), Performing Physician
- (0040,0010), Scheduled Station Name
- (0040,0011), Scheduled Procedure Step Location
- (0040,0012), Pre-order Medication
- (0040,1003), Requested Procedure Priority
- (0040,1004), Patient Transport Arrangements
- (0040,3001), Confidentiality Constraint

7.3.1.3 Association Acceptance Policy

The Worklist Server AE does not respond to attempts by a remote AE to open an association.

7.4 COMMUNICATION PROFILES

7.4.1 Supported Communication Stacks (PS 3.8, PS 3.9)

DICOM Upper Layer (PS 3.8) is supported using TCP/IP.

7.4.2 OSI Stack

The OSI Communication Stack is not supported by this implementation.

7.4.3 TCP/IP Stack

The TCP/IP Communication Stack is inherited from the IRIX operating system.

7.4.3.1 API

Not applicable to this product.

7.4.3.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

7.4.4 Point-to-Point Stack

The Point-to-Point Communication Stack is not supported by this implementation.

7.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

7.5.1 Standard Extended /Specialized/Private SOPs

ModalityWorklist for HiSpeed ZX/i does not implement any private transfer SOP classes.

7.5.2 Private Transfer Syntaxes

ModalityWorklist for HiSpeed ZX/i does not implement any private transfer syntaxes.

7.6 CONFIGURATION

The ModalityWorklist feature is configured by GEMS Field Service engineers. The DICOM configuration items below are configurable or re-configurable by a Field Service Engineer and are not accessible by users through the HiSpeed ZX/i user interface.

7.6.1 AE Title/Presentation Address Mapping

ModalityWorklist allows for the configuration of the following parameters which pertain to the remote AE.

- Remote AE (HIS/RIS) IP address - IP address used to contact the remote AE
- Remote AE (HIS/RIS) IP port - IP port used to contact the remote AE

These parameters define where worklist queries will be directed. Configuration of these parameters is performed by GEMS Field Service engineers using the ModalityWorklist installation facilities.

7.6.2 Configurable Parameters

The following parameters are configurable for the DICOM Worklist Server AE:

- Local (Worklist Server) AE Title (automatically set to host name of scanner)
- Local IP address
- Local IP netmask
- Local IP gateway

The following parameters are configurable by changing their values in the configuration file `/usr/g/config/WLdcm.cfg`. Note that these parameters typically need not be changed. Furthermore, no support is provided for retaining changed settings: the values will require changing again after a system software upgrade.

- Implementation UID
- PDU size
- Association time-out period
- Session time-out period
- C-FIND time-out period

7.7 SUPPORT OF EXTENDED CHARACTER SETS

ModalityWorklist will support only the ISO_IR 100 (ISO 8859-1:1987 Latin alphabet N 1. supplementary set) as extended character sets.

7.8 MODALITY WORKLIST INFORMATION MODEL DESCRIPTION

In order to serve as a Service Class Provider (SCP) of the Modality Worklist Service Class, a DICOM Application Entity (AE) possesses information about the attributes of a number of managed worklist items. These items are

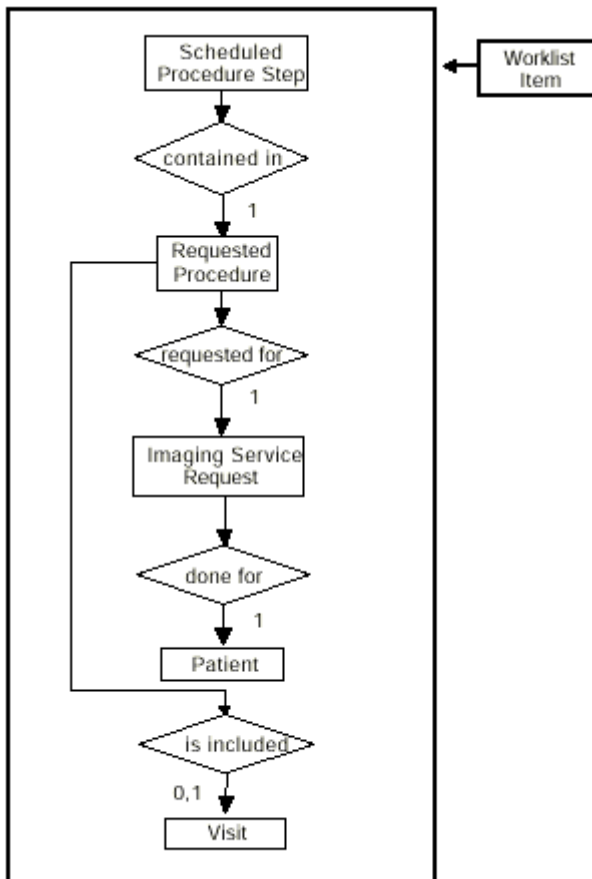
organized into Modality Worklist Information Modules. In this Service Class, the Information Model plays a role similar to an Information Object Definition of most other DICOM Service Classes.

7.9 MODALITY WORKLIST INFORMATION MODEL ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the Modality Worklist Information Model schema is shown in Illustration 5.9-1. It represents the information that composes a Worklist Item. In this figure, the following diagrammatic convention is established to represent the information organization :

- each entity is represented by a rectangular box
- each relationship is represented by a diamond shaped box.
- the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

ILLUSTRATION 7.9-1
MODALITY WORKLIST INFORMATION MODEL E/R DIAGRAM



7.9.1 ENTITY DESCRIPTIONS

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) and PS 3.4 (Service Class Specifications) for a description of each of the Entities contained within the Modality Worklist Information Model.

7.9.1.1 Scheduled Procedure Step

A Scheduled Procedure Step is an arbitrarily defined scheduled unit of service that is specified by the Procedure Plan for a Requested Procedure. It specifies one or more Action Items (events) involving equipment (i.e. imaging modality equipment), human resources, location and time (i.e. start time, stop time, duration).

7.9.1.2 Requested Procedure Entity Description

A Requested Procedure is an instance of a Procedure of a given Procedure Type. An instance of a Requested Procedure includes all of the items of information that are specified by an instance of a Procedure Plan that is selected for the Requested Procedure by the imaging service provider.

7.9.1.3 Imaging Service Request Entity Description

An Imaging Service Request is a set of one or more Requested Procedures selected from a list of Procedure Types. An Imaging Service Request is submitted by one authorized imaging service requester to one authorized imaging service provider in the context of one Service Episode.

7.9.1.4 Visit Entity Description

A Visit is the context in which the treatment or management of an arbitrary subset of a Patient’s medical conditions occurs. A Visit is limited to the description of a Patient’s activities at a single facility.

7.9.1.5 Patient Entity Description

A Patient is a person receiving, or registered to receive, healthcare services.

7.9.2 ConnectPro Mapping of DICOM Entities

**TABLE 7.9.2-1
MAPPING OF DICOM ENTITIES TO CONNECTPRO ENTITIES**

DICOM	ConnectPro Entity
Scheduled Procedure Step	Exam
Requested Procedure	Exam
Imaging Service Request	Exam
Visit	Exam
Patient	Patient

7.10 INFORMATION MODEL MODULE TABLE

Within an entity of the DICOM Modality Worklist Information Model, attributes are grouped together into related set of attributes called modules. A module facilitates the understanding of the semantics concerning the attributes and how the attributes relate to one another. A module grouping does not infer any encoding of information into datasets.

Table 7.10-1 identifies the defined modules within the entities which comprise the DICOM Modality Worklist Information Model. Modules are identified by Module Name.

See DICOM PS 3.3 and PS 3.4 for a complete definition of the entities, modules, and attributes.

**TABLE 7.10-1
MODALITY WORKLIST INFORMATION MODEL MODULES**

Entity Name	Module Name	Reference
Scheduled Procedure Step	SOP Common	7.11.2.1
	Scheduled Procedure Step	7.11.2.2
Requested Procedure	Requested Procedure	7.11.3.1
Imaging Service Request	Imaging Service Request	7.11.4.1
Visit	Visit Identification	7.11.5.1
	Visit Status	7.11.5.2
	Visit Relationship	7.11.5.3
	Visit Admission	7.11.5.4
Patient	Patient Relationship	7.11.6.1
	Patient Identification	7.11.6.2
	Patient Demographic	7.11.6.3
	Patient Medical	7.11.6.4

7.11 INFORMATION MODEL KEYS

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) and PS 3.4 (Service Class Specifications) for a description of each of the Entities contained within the Modality Worklist Information Model.

The following Module descriptions contain the attributes which are present in a C-FIND request message sent by the Worklist Server AE to a remote AE. It should be noted that they are the same as those defined in the DICOM Standard, PS 3.4 (Service Class Specifications) and include:

- Name
- Tag group and element numbers
- Expected Matching Key Type: R-required, O-optional
- Expected Return Key Type:
 - 1 - non-zero value required
 - 1C - conditionally of type 1
 - 2 - required to be present, possibly with zero-length value
 - 3 - optional
- Mapped into The Image - whether this data is mapped into subsequently acquired images
- Notes - clarification of this implementation's use/treatment of this attribute

All data elements in the following Module descriptions are requested by the Worklist Server AE. Values of data elements that are not mapped into images, and are not otherwise dealt with (displayed on the user interface, etc.), are not used and are, thus, discarded upon receipt. See Table B-1 for further information.

Data elements for which values can be sent for matching purposes are described as such. Data elements for which values are not sent are sent with zero length and universal matching will apply. This is the default case if no other description to the contrary is provided.

7.11.1 Supported Matching

The following are the types of matching that can be request by the implementation:

- Single Value matching
- Universal Matching
- Range of date/time

7.11.2 Scheduled Procedure Step Entity

7.11.2.1 SOP Common Module

**TABLE 7.11.2-1
 SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Specific Character Set	(0008,0005)	O	1C	Yes	Matching for this item is supported only for the character set ISO_IR 100. This value is always sent .

7.11.2.2 Scheduled Procedure Step Module

TABLE 7.11.2-2
SCHEDULED PROCEDURE STEP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Scheduled Procedure Step Sequence	(0040,0100)	R	1	No	
>Scheduled Station AE Title	(0040,0001)	R	1	No	Matching is supported as follows: either no AE title is supplied (universal matching), or the scanner's Worklist Server AE title is supplied for matching; this is user selectable.
>Scheduled Procedure Step Start Date	(0040,0002)	R	1	No	Matching is supported as one of the following; this is user selectable: <ul style="list-style-type: none"> • all days • today only, • today and a number of days before today, • today and a number of days after today, • today and a number of days before today and a number of days after today. Number of days before/after is specified by the user. Returned values must be exactly 8 numeric characters in YYYYMMDD format.
>Scheduled Procedure Step Start Time	(0040,0003)	R	1	No	This attribute is sent with zero-length. Returned values must be exactly 6 numeric characters in HHMMSS format.
>Modality	(0008,0060)	R	1	Yes	Matching is supported as follows: either no Modality is supplied (universal matching), or the scanner's Modality is supplied for matching; this is user selectable.
>Scheduled Performing Physician's Name	(0040,0006)	R	2	No	This attribute is sent with zero-length.
>Scheduled Procedure Step Description	(0040,0007)	O	1C	No	

>Scheduled Station Name	(0040,0010)	O	2	No	
>Scheduled Procedure Step Location	(0040,0011)	O	2	No	
>Scheduled Action Item Code Sequence	(0040,0008)	O	1C	No	
>>Code Value	(0008,0100)	O	1C	No	
>>Coding Scheme Designator	(0008,0102)	O	1C	No	
>>Code Meaning	(0008,0104)	O	3	No	
>Pre-Medication	(0040,0012)	O	2C	No	
>Scheduled Procedure Step ID	(0040,0009)	O	1	No	
>Requested Contrast Agent	(0032,1070)	O	2C	No	Displayed on "More Info..." screen.

7.11.3 Requested Procedure Entity

7.11.3.1 Requested Procedure Module

TABLE 7.11.3-1
REQUESTED PROCEDURE MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Requested Procedure ID	(0040,1001)	O	1	No	
Requested Procedure Description	(0032,1060)	O	1C	No	Truncated to 22 characters.
Requested Procedure Code	(0032,1064)	O	1C	No	
>Code Value	(0008,0100)	O	1C	No	
>Coding Scheme Designator	(0008,0102)	O	1C	No	
>Code Meaning	(0008,0104)	O	3	No	
Study Instance UID	(0020,000D)	O	1	No	User can select whether this value is used or not. In case that it is not use, scanner generates study instance UID locally.
Study id	(0020,0010)				Zero length for Study level query. Study Instance UID of study for which matches are requested at a lower level
Referenced Study Sequence	(0008,1110)	O	2	No	
>Referenced SOP Class UID	(0008,1150)	O	1C	No	
>Referenced SOP Instance UID	(0008,1155)	O	1C	No	
Requested Procedure Priority	(0040,1003)	O	2	No	
Patient Transport Arrangements	(0040,1004)	O	2	No	
Requested Procedure Location	(0040,1005)	O	2	No	
Confidentiality Code	(0040,1008)	O	2	No	

7.11.4 Imaging Service Request Entity

7.11.4.1 Imaging Service Request Module

TABLE 7.11.4-1
IMAGING SERVICE REQUEST MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Accession Number	(0008,0050)	O	2	Yes	Truncated to 16 characters.
Requesting Physician	(0032,1032)	O	2	No	
Referring Physician's Name	(0008,0090)	O	2	Yes	Truncated to 26 characters.
Requesting Service	(0032,1033)	O	3	No	

7.11.5 Visit Entity

7.11.5.1 Visit Identification

TABLE 7.11.5-1
VISIT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Admission ID	(0038,0010)	O	2	No	
Institution Name	(0008,0080)	O	3	No	

7.11.5.2 Visit Status

TABLE 7.11.5-2
VISIT STATUS MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Current Patient Location	(0038,0300)	O	2	No	Displayed on "More Info..." screen.

7.11.5.3 Visit Relationship

TABLE 7.11.5-2
VISIT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Referenced Patient Sequence	(0008,1120)	O	2	No	
>Referenced SOP Class UID	(0008,1150)	O	2	No	
>Referenced SOP Instance UID	(0008,1155)	O	2	No	

7.11.5.4 Visit Admission

No data elements are requested from the Visit Admission Module.

7.11.6 Patient Entity

7.11.6.1 Patient Relationship

No data elements are requested from the Patient Relationship Module.

7.11.6.2 Patient Identification

TABLE 7.11.6-1
PATIENT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Patient's Name	(0010,0010)	R	1	Yes	This attribute is sent with zero-length. Truncated to 64 characters.
Patient ID	(0010,0020)	R	1	Yes	This attribute is sent with zero-length. Truncated to 16 characters.

7.11.6.3 Patient Demographic

TABLE 7.11.6-2
PATIENT DEMOGRAPHIC MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Patient's Birth Date	(0010,0030)	O	2	Yes	
Patient's Sex	(0010,0040)	O	2	Yes	
Patient's Weight	(0010,1030)	O	2	Yes	Limited to maximum value of 999 kg.
Confidentiality constraint on	(0040,3001)	O	2	No	
Patient's Size	(0010,1020)	O	3	No	
Patient's Address	(0010,1040)	O	3	No	
Patient's Telephone Numbers	(0010,2154)	O	3	No	

7.11.6.4 Patient Medical

TABLE 7.11.6-2
PATIENT MEDICAL MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Restored Key Type	Mapped onto the Image	Attribute Description
Patient State	(0038,0500)	O	2	No	
Pregnancy Status	(0010,21C0)	O	2	No	Displayed on "More Info..." screen.
Medical Alerts	(0010,2000)	O	2	No	Displayed on "More Info..." screen.
Contrast Allergies	(0010,2110)	O	2	No	Displayed on "More Info..." screen.
Special Needs	(0038,0050)	O	2	No	Displayed on "More Info..." screen.
Additional Patient History	(0010,21B0)	O	3	No	Displayed on "More Info..." screen.

7.12 PRIVATE DATA DICTIONARY

The ConnectPro implementation does not define any Private Attributes within the Modality Worklist Information Mode

7.13 C-FIND REQUEST MESSAGE

This section provides a detailed description of the C-FIND request message data that is provided to the remote AE during a worklist query operation. The dump in Table 7.13-1 below lists, in exact message order, the fields transferred as part of the C-FIND request message for a typical query.

In this particular dump, no values are specified for the Scheduled Procedure Step Start and End Dates (the attributes are sent with zero length). In DICOM this is interpreted as meaning all dates (i.e. universal matching). The Modality is also not specified in this particular dump, meaning all modalities. Note that the user, through the use of the HiSpeed ZX/i user interface, can submit a worklist query that will cause non-zero values to be sent for these attributes.

**TABLE 7.13-1
C-FIND REQUEST MESSAGE DUMP**

(0008,0000)	UL	108	#	4, 1	IdentifyingGroupLength
(0008,0005)	CS	[ISO_IR 100]	#	12, 1	SpecificCharacterSet
(0008,0050)	SH	(no value available)	#	0, 0	AccessionNumber
(0008,0080)	LO	(no value available)	#	0, 0	InstitutionName
(0008,0090)	PN	(no value available)	#	0, 0	ReferringPhysicianName
(0008,1110)	SQ	(Sequence with explicit Length #=1)	#	24, 1	ReferencedStudySequence
(ffffe,e000)	na	(Item with explicit Length #=2)	#	16, 1	Item
(0008,1150)	UI	(no value available)	#	0, 0	ReferencedSOPClassUID
(0008,1155)	UI	(no value available)	#	0, 0	ReferencedSOPInstanceUID
(ffffe,e00d)	na	(ItemDelimitationItem for re-encoding)	#	0, 1	ItemDelimitationItem
(ffffe,e0dd)	na	(SequenceDelimitationItem for re-enc.)	#	0, 1	SequenceDelimitationItem
(0008,1120)	SQ	(Sequence with explicit Length #=1)	#	24, 1	ReferencedPatientSequence
(ffffe,e000)	na	(Item with explicit Length #=2)	#	16, 1	Item
(0008,1150)	UI	(no value available)	#	0, 0	ReferencedSOPClassUID
(0008,1155)	UI	(no value available)	#	0, 0	ReferencedSOPInstanceUID
(ffffe,e00d)	na	(ItemDelimitationItem for re-encoding)	#	0, 1	ItemDelimitationItem
(ffffe,e0dd)	na	(SequenceDelimitationItem for re-enc.)	#	0, 1	SequenceDelimitationItem
(0010,0000)	UL	96	#	4, 1	PatientGroupLength
(0010,0010)	PN	(no value available)	#	0, 0	PatientName
(0010,0020)	LO	(no value available)	#	0, 0	PatientID
(0010,0030)	DA	(no value available)	#	0, 0	PatientBirthDate
(0010,0040)	CS	(no value available)	#	0, 0	PatientSex
(0010,1000)	LO	(no value available)	#	0, 0	Other Patient IDs
(0010,1020)	DS	(no value available)	#	0, 0	PatientSize
(0010,1030)	DS	(no value available)	#	0, 0	PatientWeight
(0010,1040)	LO	(no value available)	#	0, 0	PatientAddress
(0010,2000)	LO	(no value available)	#	0, 0	MedicalAlerts
(0010,2110)	LO	(no value available)	#	0, 0	ContrastAllergies
(0010,2154)	SH	(no value available)	#	0, 0	PatientTelephoneNumber
(0010,2160)	SH	(no value available)	#	0, 0	Ethnic Group
(0010,21b0)	LT	(no value available)	#	0, 1	AdditionalPatientHistory
(0010,21c0)	US	(no value available)	#	0, 0	PregnancyStatus
(0010,4000)	LT	(no value available)	#	0, 0	Patient Comments
(0020,0000)	UL	8	#	4, 1	ImageGroupLength
(0020,000d)	UI	(no value available)	#	0, 0	StudyInstanceUID
(0032,0000)	UL	64	#	4, 1	StudyGroupLength
(0032,1032)	PN	(no value available)	#	0, 0	RequestingPhysician
(0032,1033)	LO	(no value available)	#	0, 0	RequestingService
(0032,1060)	LO	(no value available)	#	0, 0	RequestedProcedureDescription
(0032,1064)	SQ	(Sequence with explicit Length #=1)	#	32, 1	RequestedProcedureCodeSequence
(ffffe,e000)	na	(Item with explicit Length #=3)	#	24, 1	Item
(0008,0100)	SH	(no value available)	#	0, 0	CodeValue
(0008,0102)	SH	(no value available)	#	0, 0	CodingSchemeDesignator
(0008,0104)	LO	(no value available)	#	0, 0	CodeMeaning
(ffffe,e00d)	na	(ItemDelimitationItem for re-encoding)	#	0, 1	ItemDelimitationItem
(ffffe,e0dd)	na	(SequenceDelimitationItem for re-enc.)	#	0, 1	SequenceDelimitationItem
(0038,0000)	UL	32	#	4, 1	VisitGroupLength
(0038,0010)	LO	(no value available)	#	0, 0	AdmissionID
(0038,0050)	LO	(no value available)	#	0, 0	SpecialNeeds
(0038,0300)	LO	(no value available)	#	0, 0	CurrentPatientLocation
(0038,0500)	LO	(no value available)	#	0, 0	PatientState
(0040,0000)	UL	192	#	4, 1	ModalityWorklistGroupLength
(0040,0100)	SQ	(Sequence with explicit Length #=1)	#	136, 1	ScheduledProcedureStepSequence
(ffffe,e000)	na	(Item with explicit Length #=12)	#	128, 1	Item
(0008,0060)	CS	(no value available)	#	0, 0	Modality

```
(0032,1070) LO (no value available) # 0, 0 RequestedContrastAgent
(0040,0001) AE (no value available) # 0, 0 ScheduledStationAETitle
(0040,0002) DA (no value available) # 0, 0 ScheduledProcedureStepStartDate
(0040,0003) TM (no value available) # 0, 0 ScheduledProcedureStepStartTime
(0040,0006) PN (no value available) # 0, 0 ScheduledPerformingPhysiciansName
(0040,0007) LO (no value available) # 0, 0 ScheduledProcedureStepDescription
(0040,0008) SQ (Seq with explicit Length #=1) # 32, 1 ScheduledActionItemCodeSequence
(fffe,e000) na (Item with explicit Length #=3) # 24, 1 Item
(0008,0100) SH (no value available) # 0, 0 CodeValue
(0008,0102) SH (no value available) # 0, 0 CodingSchemeDesignator
(0008,0104) LO (no value available) # 0, 0 CodeMeaning
(fffe,e00d) na (ItemDelimitationItem for re-encoding) # 0, 1 ItemDelimitationItem
(fffe,e0dd) na (SequenceDelimitationItem for re-enc.) # 0, 1 SequenceDelimitationItem
(0040,0009) SH (no value available) # 0, 0 ScheduledProcedureStepID
(0040,0010) SH (no value available) # 0, 0 ScheduledStationName
(0040,0011) SH (no value available) # 0, 0 ScheduledProcedureStepLocation
(0040,0012) LO (no value available) # 0, 0 PreMedication
(fffe,e00d) na (ItemDelimitationItem for re-encoding) # 0, 1 ItemDelimitationItem
(fffe,e0dd) na (SequenceDelimitationItem for re-enc.) # 0, 1 SequenceDelimitationItem
(0040,1001) SH (no value available) # 0, 0 RequestedProcedureID
(0040,1003) SH (no value available) # 0, 0 RequestedProcedurePriority
(0040,1004) LO (no value available) # 0, 0 PatientTransportArrangements
(0040,1005) LO (no value available) # 0, 0 RequestedProcedureLocation
(0040,1008) LO (no value available) # 0, 0 ConfidentialityCode
(0040,1010) PN (no value available) # 0, 0 Names of Intended Recipients
(0040,1400) LT (no value available) # 0, 0 Requested Procedure Comments
(0040,2400) LT (no value available) # 0, 0 Imaging Service Request Comm.
(0040,3001) LO (no value available) # 0, 0 ConfidentialityConstraintOnPatientData
```

If the query is for a particular date range, the ScheduledProcedureStepStartDate will be filled with a valid date range. If either the start or end date are left blank by the user, they will simply be blank in the query.

Below is an example of a date range for August 30, 1997 through October 12, 1997.

```
(0040,0002) DA [19970830-19971012] # 18, 1 ScheduledProcedureStepStartDate
```

Below is an example of a date range for August 30, 1997 through the end of time.

```
(0040,0002) DA [19970830-] # 18, 1 ScheduledProcedureStepStartDate
```

Below is an example of a date range from the beginning of time through August 30, 1997.

```
(0040,0002) DA [-19970830] # 18, 1 ScheduledProcedureStepStartDate
```

If the query is for records for this modality, the Modality will be filled in as follows:

```
(0008,0060) CS [CT] # 2, 1 Modality
```

If the query is for records for this Scanner, the Modality will be filled in with CT as above and the Scheduled Station AE Title will be filled in with the value configured for this system. For example, this station was configured as CTRoom1.

```
(0040,0001) AE [CTRoom1] # 8, 1 ScheduledStationAETitle
```

User will be able to enter the values for [Accession Number] prior to the query. If value is entered then that value will be sent as part of the query. For example, if [1234] is entered then

```
(0008,0050) SH [1234] # 4, 1 AccessionNumber
```

User will be able to enter the values for [Requested Procedure Id] prior to the query. If value is entered then that value will be sent as part of the query. For example, if [3456] is entered then

```
(0040,1001) SH [3456] # 4, 1 RequestedProcedureID
```

7.14 USE OF SPECIFIC DICOM DATA

This section details the use of the DICOM data returned by remote AEs during worklist queries. The HiSpeed ZX/i user interface fields which display the data, along with the data's mapping into resulting acquired and transferred DICOM images, is presented in following table 7.14-2.

**TABLE 7.14-2
SPECIFIC DATA USAGE**

DICOM Worklist Data Element	Patient Schedule Screen Field	HiSpeed ZX/i DICOM Image Data Element
Accession Number (0008,0050)	Req Number	Accession Number Supports maximum of 16 characters.
Patient ID (0010,0020)	Patient ID	Patient ID Supports maximum of 16 characters.
Patient Name (0010,0010)	Patient Name	Patient Name Supports maximum of 64 characters.
Patient's Birth Date (0010,0030)	Patient Age (Patient Birth Date user to calculate age)	Patient Birth Date
Patient's Sex (0010,0040)	Sex	Patient's Sex
Patient's Weight (0010,1030)	Weight in Kg	Patient's Weight
Referring Physician's Name (0008,0090)	Referring Physician	Referring Physician's Name
Requested Procedure Description (0032,1060)	Exam Description	Study Description.
Scheduled Procedure Step Start Date (0040,0002)	Date	Not available.
Scheduled Procedure Step Start Time (0040,0003)	Time	Not available.
Study Instance UID (0020,000d)	Study instance UID (only displayed on the "More Info..." screen)	Study Instance UID, if User has set the preference to "Use MWL Study UID".
Requested Procedure Id (0040,1001)	Requested Proc ID	Requested Procedure Id.
Pregnancy Status (0010,21C0)	Pregnancy Status (only displayed on the "More Info..." screen)	Not available.
Medical Alerts (0010,2000)	Medical Alerts (only displayed on the "More Info..." screen)	Not available.
Contrast Allergies (0010,2110)	Contrast Allergies (only displayed on the "More Info..." screen)	Not available.
Special Needs (0038,0050)	Special Needs (only displayed on the "More Info..." screen)	Not available.
Requested Contrast Agent (0032,1070)	Requested Contrast Agent (only displayed on the "More Info..." screen)	Not available.
Current Patient Location (0038,0300)	Current Patient Location (only displayed on the "More Info..." screen)	Not available.

Additional Patient History (0010,21B0)	Additional Patient History (only displayed on the <input type="checkbox"/> More Info... <input type="checkbox"/> screen)	Patient History.
--	--	------------------

Note that the display of a specific data item on the More Info... screen is contingent on the item being enabled for display. Depending on the preferences of each specific site, data can either be displayed or not. A GE field service engineer can assist in setting these site preferences.

7.15 SETTING USER PREFERENCES

7.15.1 Setting “Use MWL Study UID “ Option

Setting this option to Yes will copy the **Study Instance UID** from work-list into the final **DICOM Image header**. If this option is set to No then a new study instance uid will be generated locally.

- Click on Patient Schedule
- Click on Preferences button
- Set the option Use Study Instance UID, to either Yes or No

7.15.2 Setting Custom Query Option

THIS OPTION WILL ALLOW THE USER TO ENTER VALUES FOR ACCESSION NUMBER AND / OR REQUESTED PROCEDURE ID, WHICH ARE USED FOR CUSTOM QUERY.

- Click on Patient Schedule
- Click on Preferences button
- Set the option Show Update Parameters, to Yes
- To do a query click on Update button
 - A User Interface will show, which has provision to enter values for
 - Accession Number
 - Requested Procedure Id

8 PERFORMED PROCEDURE STEP CONFORMANCE STATEMENT

8.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the Performed Procedure Step feature on this GEMS product. Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section. The PPS option for HiSpeed ZX/i, allows a Modality Performed Procedure Step to be communicated to the Hospital/Radiology information system. The PPS feature is providing the DICOM Modality Performed Procedure Step service as a service class user (SCU).

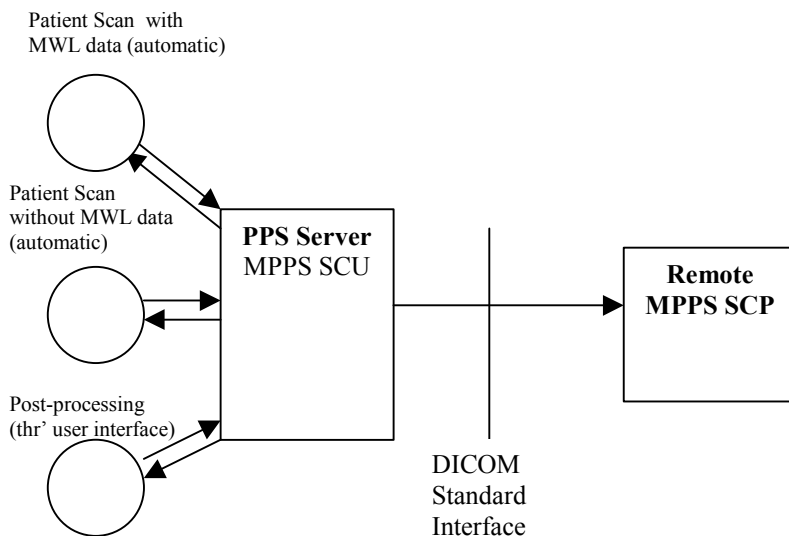
This feature works in conjunction with DICOM Modality Work-list feature, if installed. However the conformance of this feature is independent of Modality work-list feature. For information on conformance of Modality Work-List feature to DICOM standard please refer to the appropriate section or document.

8.2 IMPLEMENTATION MODEL

The DICOM [Performed Procedure Step] service is provided by the PPS Server DICOM AE. The PPS Server DICOM AE is commanded to perform Performed Procedure Step services either automatically or through the user interface.

8.2.1 APPLICATION DATA FLOW DIAGRAM

The basic Application models for the feature are shown in the following illustration:



8.2.2 Functional Definition of AEs

The PPS Server AE is implemented as an application process on the scanner host computer. It runs as a daemon serving requests from other applications to send the PPS information to the remote AE and return the results to the requesting application.

The PPS Server AE initiates the following functions.

- *Start PPS*: Initiates a DICOM association in order to create a DICOM Modality Performed Procedure Step SOP instance in the remote AE. If the remote AE accepts a presentation context applicable to Modality performed Procedure Step, the PPS Server AE will issue a request to create the SOP instance in the remote AE via the N-CREATE service.
- *Complete PPS*: Initiates a DICOM association in order to update a DICOM Modality Performed Step instance that is already created with the remote AE. If the remote AE accepts a presentation context applicable to Modality performed Procedure Step, the PPS Server AE will issue a request to update the SOP instance in the remote AE via the N-SET service. The PPS Status is set to [COMPLETED].
- *Discontinue PPS*: Initiates a DICOM association in order to update a DICOM Modality Performed Step instance that is already created with the remote AE. If the remote AE accepts a presentation context applicable to Modality performed Procedure Step, the PPS Server AE will issue a request to update the SOP instance in the remote AE via the N-SET service. The PPS Status is set to [DISCONTINUED].

8.2.3 Sequencing of Real-World Activities

8.2.3.1 PPS from acquisition system with MWL data

The system has a Modality Work-list Server AE installed. Work-List information is obtained from HIS/RIS system through the use of Basic Work-list Management Service. Use of the information retrieved in the creation of Image SOP instance is described in the Modality Work-list Conformance statement. Use of the information retrieved in MPPS SOP instances is described later in this document.

- The system initiates a 'Start PPS' before starting a scan, i.e. when the image acquisition is started. The system retrieves necessary information related to the Scheduled Procedure Step from Modality Work-list Server. PPS Server AE initiates a MPPS (Modality Performed Procedure Step) N-CREATE request to the remote AE (MPPS SCP), in-order to create a MPPS SOP instance at the remote AE.
- The MPPS SCP returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user. **The DICOM association is closed.**
- System includes the necessary information related to Scheduled Procedure Steps and the Performed procedure Step in the image instances created.
- At the end of image acquisition, system initiates a 'Complete PPS' or 'Discontinue PPS' based on the choice selected by the user using the user interface provided. The user is also given a choice 'Defer PPS' which is described below. PPS Server AE initiates a MPPS N-SET request to the remote AE, in-order to update the MPPS SOP instance, that is already created. **The N-SET is sent over a new DICOM association**
- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.
- At the end of image acquisition, if the user has chosen 'Defer PPS', the user is provided with an interface to 'Complete PPS' or 'Discontinue PPS' at any later time. The user might wish to alter the image set generated through acquisition, before invoking these operations. Note that the user explicitly uses the user interface provided to invoke this operation, as in the case of PPS generated for post-processing, which is described in the following section. **PPS messages N-CREATE (if applicable) and N-SET will be sent over the same DICOM association**
- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

8.2.3.2 PPS from acquisition system without MWL data

The system either does not have a Modality Work-list Server AE installed or a Modality Work-list Server AE installed but no Work-List information is obtained from HIS/RIS system for the current procedure that is being performed. The information required for performing the procedure is supplied through the user interface of the system. The use of this information in MPPS SOP instances is described later in this document.

- The system initiates a 'Start PPS' before starting a scan, i.e. when the image acquisition is started. PPS Server AE initiates a MPPS (Modality Performed Procedure Step) N-CREATE request to the remote AE (MPPS SCP), in-order to create a MPPS SOP instance at the remote AE.

- The MPPS SCP returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.
- System includes the necessary information related to Scheduled Procedure Steps and the Performed procedure Step in the image instances created.
- At the end of image acquisition, system initiates a 'Complete PPS' or 'Discontinue PPS' based on the choice selected by the user using the user interface provided. The user is also given a choice 'Defer PPS' which is described below. PPS Server AE initiates a MPPS N-SET request to the remote AE, in-order to update the MPPS SOP instance, that is already created.
- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.
- At the end of image acquisition, if the user has chosen 'Defer PPS', the user is provided with an interface to 'Complete PPS' or 'Discontinue PPS' at any later time. The user might wish to alter the image set generated through acquisition, before invoking these operations. Note that the user explicitly uses the user interface provided to invoke this operation, as in the case of PPS generated for post-processing, which is described in the following section.
- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

8.2.3.3 PPS from post-processing system

- The user initiates post-processing on the images generated through acquisition.
- The system creates a Modality performed Procedure Step instance locally in the system. If the source image instances has the Scheduled Procedure Step information, it is copied into the image instances created. Also the system includes the necessary information related to the Modality Performed Procedure Step into the image instance.
- At the end of (one or more) post-processing, the user initiates 'Complete PPS' or 'Discontinue PPS' through the user interface provided. PPS Server AE initiates a MPPS (Modality Performed Procedure Step) N-CREATE request to the remote AE (MPPS SCP), in-order to create a MPPS SOP instance at the remote AE (which is actually a replica of the locally created MPPS SOP instance).
- The remote AE returns response indicating the success/failure of the request execution. If the response indicates success, PPS Server AE initiates a MPPS N-SET request to the remote AE, in-order to update the MPPS SOP instance, that is already created, with the additional information.
- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

8.3 AE SPECIFICATION

8.3.1 PPS Server AE Specification

This Application Entity provides Standard Conformance to the following DICOM SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3

8.3.1.1 Association Establishment Policies

8.3.1.1.1 General

The DICOM Application Context Name (ACN), which is always proposed, is:

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

The Maximum Length PDU negotiation is included in all association establishment requests. The maximum length PDU from an association initiated by the PPS Server AE is:

Maximum Length PDU	128 Kbytes
---------------------------	-------------------

The SOP Class Extended negotiation is not supported.

The maximum number of presentation negotiation items that will be proposed is 1.

The user information items sent by this AE are

- Maximum PDU Length
- Implementation UID

8.3.1.1.2 Number of Associations

The PPS Server will initiate only one DICOM association at any time to perform a PPS operation to the remote AE.

8.3.1.1.3 Asynchronous Nature

Asynchronous mode is not supported. All operations are performed synchronously.

8.3.1.1.4 Implementation Identifying information

The implementation UID for this DICOM Implementation is:

PPS Feature for HiSpeed ZX/i Implementation UID	1.2.840.113619.6.22
--	---------------------

8.3.1.2 Association Initiation Policy

The PPS Server AE initiates a new association for every PPS operation initiated.

8.3.1.2.1 Real-World Activity: Performed Procedure Step creation and update

8.3.1.2.1.1 Associated Real-World Activity

The real-world activities are mentioned in section 8.2.3 *Sequencing of Real-World Activities*. Each of the real world activity results in either creating a new Performed procedure Step SOP instance at the remote SCP or updating an already created Performed Procedure Step SOP instance as per the DICOM standard.

8.3.1.2.1.2 Proposed Presentation Context Table

The following table shows the proposed presentation contexts for the PPS Server AE after any of the real-world activity listed in section 8.2.3 *Sequencing of Real-World Activities*, is initiated.

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

8.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for MPPS SOP class

If the remote AE does not support the proposed Presentation context, an appropriate error message logged. Only one association is opened at a time.

All the operations used by this SOP class support an association timer, which is configurable. The timer is started when a request (association request, N-CREATE request or N-SET request) is send and stopped when the respective response is received. The default time-out value is 300 seconds.

All the operations used by this SOP class support a "Session Timer". This timer is started when the association is established and stopped when association is ended. The default time-out value is 3000 seconds.

If any of the above timers expires the association is aborted and the operation in-progress is considered FAILED.

In any case an operation (N-CREATE or N-SET) fails, system updates the state to enable operator to manually invoke the operation at any later time.

8.3.1.3 Association Acceptance Policy

The PPS Server AE does not respond to attempts by remote AE to open an association.

8.4 COMMUNICATION PROFILES

8.4.1 Supported Communication Stacks (PS 3.8)

DICOM Upper Layer (PS 3.8) is supported using TCP/IP.

8.4.2 OSI Stack

The OSI Communication stack is not supported by this implementation.

8.4.3 TCP/IP Stack

The TCP/IP stack is inherited from the IRIX operating system

8.4.3.1 API

Not Applicable to this product.

8.4.3.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

8.4.4 Point-to-Point Stack

The Point-to-Point Stack is not supported by this implementation.

8.5 EXTENSIONS/SPECIALIZATION/PRIVATIZATION

8.5.1 Standard Extended/Specialized/Private SOPs

PPS for HiSpeed ZX/i does not implement any private SOP classes.

8.5.2 Private Transfer Syntaxes

PPS for HiSpeed ZX/i does not implement any private Transfer Syntaxes.

8.6 CONFIGURATION

The PPS feature is configured by GEMS Field Service Engineers. The DICOM configuration items below are configurable or re-configurable by the Field Service Engineer and are not accessible by users through the HiSpeed ZX/i's user interface.

8.6.1 AE Title/Presentation address Mapping

PPS allows for the configuration of the following parameters which pertain to the remote AE.

- Remote MPPS AE IP Address - IP Address used to contact the remote MPPS AE
- Remote AE (HIS/RIS) IP Port - IP Port used to contact the remote MPPS AE
- Remote MPPS AE Title - Application Entity Title used to contact the remote MPPS AE

These parameters define where the MPPS requests will be directed. Configuration of these parameters is performed by GEMS Field Service engineers, using the installation facilities.

8.6.2 Configurable Parameters

The following are configurable for the PPS Server AE:

- Local (PPS Server AE) AE Title (The default is host name of the scanner appended with string “_PPS”)
- Local IP Address
- Local IP net-mask
- Local IP gateway

The following parameters are configurable, but need change only in case of a system software upgrade:

- Implementation UID
- PDU size
- Association time-out period

- Session time-out period

8.7 SUPPORT OF EXTENDED CHARACTER SETS

PPS feature for HiSpeed ZX/i does not support any extended character set.

8.8 N-CREATE & NSET REQUEST MESSAGE

PPS Feature for this product supports all named attributes listed in Table F.7.2.1 in PS3.4 of DICOM standard. That is, attributes that are not explicitly referenced by name in the table are not supported. (Example is last row in the table reads "All other attributes from Radiation Dose Module and Billing and Material Code Module". The attributes referenced here are not supported).

For the MPPS associated with an acquisition, the following attributes are copied from the Modality Work-list SCU into the MPPS request Message, if procedure performed corresponds to the SPS information retrieved through the Modality Work-list.

This product supports the selection of **single** or **multiple** SPS for a scan. The following are applicable.

- Single SPS selection results in single PPS message
- Multiple SPS selection results in single PPS message
- Multiple SPS selection is allowed **only if they all correspond to same patient id**
- A maximum of 5 SPS's can be selected
- Referenced Study Sequence - a maximum of five Item's is supported. *This attribute will be present only if SPS information is available from Modality Work-list SCU.*
- At the end of acquisition the user might choose to 'Defer PPS' and later choose to 'Complete PPS' or 'Discontinue PPS' from the user interface provided in the system. In this case, the date and time when user chooses to 'Complete PPS' or 'Discontinue PPS' is taken as the Performed Procedure Step End Date and Performed Procedure Step End Time respectively (Not the actual end date and end time of acquisition)
- Mapping of SPS data to **MPPS SOP instance** is explained in section 8.10
- Mapping of specific SPS data to **CT DICOM IMAGE HEADER** , for PPS is explained in section 8.11

For the MPPS associated with a post-processing the following restrictions apply on the attributes listed below.

- Referenced Study Sequence – The sequence is not sent in the MPPS message
- Scheduled Step Attribute Sequence – a maximum of ONE item is supported. The attribute will be send only if SPS information is available in the image instance.
- Referenced Patient Sequence – This sequence is not added
- Scheduled action Item Code Sequence – The sequence is not send in the MPPS message
- Performed Procedure Step Start date & Performed Procedure Step start time – The exam date and exam time that is the Start date and Start Time of the associated Study Component (Exam) is used, not the actual time when post-processing started.
- Performed Procedure Step end date & Performed Procedure Step end time - The date and time when user chooses to 'Complete PPS' or 'Discontinue PPS' is taken as the Performed Procedure
- Step End Date and Performed Procedure Step End Time respectively (Not the actual end date and end

time of post-processing).

- Procedure Code Sequence – This sequence is sent with ZERO items in the MPPS message
- Performed Action Item Code Sequence – This sequence is sent with ZERO items in the MPPS message.
- Referenced Standalone SOP Instance Sequence – The sequence is sent with ZERO items in the MPPS message.

8.9 ERROR HANDLING AND RECOVERY

PPS Server AE does not define any extended error codes. The standard error codes are handled. On a response with status 'success' for the N-CREATE or N-SET request, the system updates the state and indicates the same on the user interface. On a response with status other than 'success' the operation is deemed 'Failed' and the system updates the state and indicates the same on the user interface. If the request has failed or response is not received before the association timeout, the operation is deemed 'Failed' and the system updates the state and indicates the same on the user interface.

If the operation is 'Failed', detailed message is logged into system log-file and system provides an alternative mechanism to retry the failed operation through the user interface to ensure that transient failures do not affect the feature performance.

8.10 USE OF SPECIFIC DICOM DATA

The following table gives specific usage of some of attributes in the MPPS SOP instance created, with reference to each of the real-world scenarios mentioned in 8.2.3 of this document.

Attribute Name	Tag	Usage in MPPS Instance		
		Acquisition with MWL data	Acquisition without MWL data	Post-Processing
Specific Character Set	(0008,0005)	Not used, but copied into image header	Not used	Not used, but copied into image header
Scheduled Step Attribute	(0040,0270)	Only one item		Only one item
>Study Instance UID	(0020,000D)	Copied from SPS, if option to copy is selected or else created at the scanner	Created at the scanner	Copied from source image
>Referenced Study Sequence	(0008,1110)	Copied from SPS, if selected	Not sent as part of image header	Not sent as part of image header
>Accession Number	(0008,0050)	Copied from SPS, if selected	User input on the scanner	Copied from source image
>Placer Order Number/Imaging Service Request	(0040,2016)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
>Filler Order Number/Imaging Service Request	(0040,2017)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
>Requested Procedure ID	(0040,1001)	Copied from SPS, if selected	User input on the scanner	Copied from source image
>Requested Procedure Description	(0032,1060)	Copied from SPS, if selected	Not used	Not sent as part of image header

Attribute Name	Tag	Usage in MPPS Instance		
		Acquisition with MWL data	Acquisition without MWL data	Post-Processing
>Placer Order Number/Procedure	(0040,1006)	Not sent as part of image header	Not used	Not sent as part of image header
>Filler Order Number/Procedure	(0040,1007)	Not sent as part of image header	Not used	Not sent as part of image header
>Scheduled Procedure ID	(0040,0009)	Copied from SPS, if selected	Not used	Copied from source image
>Scheduled Procedure Description	(0040,0007)	Copied from SPS, if selected	Not used	Copied from source image
>Scheduled Action Item Code Sequence	(0040,0008)	Copied from SPS, if selected	Not used	Not sent as part of image header
Patient's Name	(0010,0010)	Copied from SPS, if selected	User input on the scanner	Copied from source image
Patient ID	(0010,0020)	Copied from SPS, if selected	User input on the scanner	Copied from source image
Patient's Birth Date	(0010,0032)	Copied from SPS, if selected	User input on the scanner	Copied from source image
Patient's Sex	(0010,0040)	Copied from SPS, if selected	User input on the scanner	Copied from source image
Referenced Patient Sequence	(0008,1120)	Copied from SPS, if selected	Not used	No Item
Performed Procedure Step ID	(0040,0253)	Created at the scanner. Will have the following " PPS_ID_<exam number> "	Created at the scanner. Will have the following " PPS_ID_<exam number> "	New generated, may not be unique
Performed Station AE Title	(0040,0241)	Local AE Title	Local AE Title	Local AE Title
Performed Station Name	(0040,0242)	Local system suite id	Local system suite id	Local system host-name
Performed Location	(0040,0243)	Local system suite id	Local system suite id	Not used
Performed Procedure Step Start Date	(0040,0244)	Same as exam start date	Same as exam start date	Same as exam start date
Performed Procedure Step Start Time	(0040,0245)	Same as exam start time	Same as exam start time	Same as exam start time
Performed Procedure Step Description	(0040,0254)	Copied from SPS, if selected	Not sent as part of image header	Not sent as part of image header
Performed Procedure Step status	(0040,0252)	See Note 1.	See Note 1.	See Note 1.
Performed Procedure Type Description	(0040,0255)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
Procedure Code Sequence	(0008,1032)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header

Attribute Name	Tag	Usage in MPPS Instance		
		Acquisition with MWL data	Acquisition without MWL data	Post-Processing
Performed Procedure Step End Date	(0040,0250)	Date when all images got installed	Date when all images got installed	The date "Complete PPS" or "Discontinue PPS" is invoked, not the actual end of post-processing
Performed Procedure Step End Time	(0040,0251)	Time when all images got installed	Time when all images got installed	The time "Complete PPS" or "Discontinue PPS" is invoked, not the actual end of post-processing
Modality	(0008,0060)	Value "CT" is stored in image header	Value "CT" is stored in image header	Value "CT" is stored in image header
Study ID	(0020,0010)	Same as exam number	Same as exam number	Copied from source image
Performed Action Item Code Sequence	(0040,0260)	Copied from SPS, if selected	Not used	Not used
Performed Series Sequence	(0040,0340)	One item for each series created	One item for each series created	One item for each series created with post-processing
>Performing Physician's Name	(0008,1050)	Copied from SPS, if selected	User input on the scanner	Not sent as part of image header
>Protocol Name	(0018,1030)	The name of the protocol selected on the scanner	The name of the protocol selected on the scanner	Copied from source image
>Operator's Name	(0008,1070)	Copied from SPS, if selected	User input on the scanner	Not sent as part of image header
> Series Instance UID	(0020,000E)	Created at the scanner	Created at the scanner	Created at the scanner
> Series Description	(0008,103E)	User input on the scanner	User input on the scanner	Unique name generated by post-processing
>Retrieve AE Title	(0008,0054)	Local AE Title	Local AE Title	AE Title of the system
>Referenced Image Sequence	(0008,1140)	One item for each image created within the series	One item for each image created within the series	One item for each image generated by post-processing
>Referenced Standalone SOP Instance Sequence	(0040,0220)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
>All other attributes from Performed Series Sequence		Not sent as part of image header	Not sent as part of image header	Not sent as part of image header

Note 1:

- When PPS start (N-CREATE) message is sent, this element will have the value “INPROGRESS”
- When PPS end (N-SET) message is sent, this element will have either “COMPLETE” or “DISCONTINUE” based on user selection

8.11 USAGE IN CT DICOM IMAGE HEADER

Attribute Name	Tag	Description
Patient Level		
Patient Name	(0010,0010)	Copied from SPS if selected
Patient ID	(0010,0020)	Copied from SPS if selected
Patient Birthdate	(0010,0030)	Copied from SPS if selected
Patient Sex	(0010,0040)	Copied from SPS if selected
Referenced Patient Sequence	(0008,1120)	Copied from SPS if selected
>Ref. SOP class uid	(0008,1150)	
>Ref. SOP Instance uid	(0008,1155)	
Study Level		
Study Instance UID	(0020,000D)	Copied from SPS if selected
Study ID	(0020,0010)	Copied from SPS if selected
Referring Physicians Name	(0008,0090)	Copied from SPS if selected
Accession Number	(0008,0050)	If multiple SPS's are selected then accession number from the first selection (determined by the user) is used
Referenced Study Sequence	(0008,1110)	Copied from SPS if selected
>Ref. SOP class uid	(0008,1150)	
>Ref. SOP Instance uid	(0008,1155)	
Series Level		
Modality	(0008,1060)	Value “CT” is copied
Protocol Name	(0018,1030)	Name of the selected protocol is copied
Operator Name	(0008,0090)	Copied from SPS if selected
Referenced Study Component Sequence	(0008,1111)	Will be present only if SPS obtained form HIS/RIS is selected for scanning
>Ref. SOP class uid	(0008,1150)	Value of MPPS SOP class UID
>Ref. SOP Instance uid	(0008,1155)	Scanner generated unique UID
Request Attribute Sequence	(0040,0275)	Will be present only if SPS , obtained form HIS/RIS is selected for scanning. If multiple SPS's are selected then this will contain multiple items one for each SPS. For all other cases this element will not be present
>Requested Procedure ID	(0040,1001)	Copied from SPS if selected
>Scheduled Procedure Step ID	(0040,0009)	Copied from SPS if selected

Attribute Name	Tag	Description
> Scheduled Procedure Step Description	(0040,0007)	Copied from SPS if selected
>Scheduled Action Item Code Sequence	(0040,0008)	Copied from SPS if selected
Performed Procedure Step ID	(0040,0253)	Created at the scanner. The string " PPS_ID_<examnumber> " is used.
Performed Procedure Step Start Date	(0040,0244)	Same as exam start date
Performed Procedure Step Start Time	(0040,0245)	Same as exam start time
Performed Procedure Step Description	(0040,0254)	Exam description is used

APPENDIX A. PRIVATE DATA ELEMENTS

Enclosed is a listing of private data elements used in this implementation for CT Image IOD definition.

A.1 CT IMAGE IOD PRIVATE DATA ELEMENTS DEFINITION

Attribute Name	Tag	Type	VR	VM	Description
Private Creator ID (group 19)	0019,00xx	3	LO	1	Character string "GEMS_ACQ_01" shall be encoded.
Detector Channel	0019,xx02	3	SL	1	816 shall always be encoded.
Table Speed [mm/sec]	0019,xx23	3	DS	1	Real table speed of the scan shall be encoded, that is, following values are to be encoded. axial : 0 helical : slice thickness [mm] * pitch /rotation time cine: 0 This element shall be encoded only for axial images.
Mid Scan Time [sec]	0019,xx24	3	DS	1	Time difference between acquisition time of the first axial scan (including helical or cine scan) in the exam and acquisition time of the first view data that resulted the image shall be encoded. This element shall be encoded only for axial images.
Tube Azimuth [degree]	0019,xx26	3	SL	1	Tube angle shall be encoded if the image is LOCALIZER image.
Rotation Speed [msec]	0019,xx27	3	DS	1	Gantry rotation period shall be encoded. This element shall be encoded only for axial images.
SFOV Type	0019,xx39	3	SS	1	One of the following SFOV type value shall be encoded. This element shall always be encoded. 1: "Ped Head", 2: "Head", 4: "Small", 8: "Medium", 16: "Large", 32: "Wild", 64: "Shoulder L", 128: "No Sfovtype"
Segment Number	0019,xx42	3	SS	1	Segment number shall be encoded if the image is SEGMENTED image. ¹
Total Segments Required	0019,xx43	3	SS	1	Total number of segments shall be encoded if the image is SEGMENTED image. ²

Attribute Name	Tag	Type	VR	VM	Description
Private Creator ID (group 27)	0027,00xx	1C	LO	1	Character string "GEMS_IMAG_01" shall always be encoded. This element shall be encoded only when any data element in this group is encoded.
Scan Start Location	0027,xx50	3	FL	1	Table position when x-ray started shall be encoded. This element shall be encoded only for scout images.
Scan End Location	0027,xx51	3	FL	1	Table position when x-ray terminated shall be encoded. This element shall be encoded only for scout images.
Private Creator ID (group 43)	0043,00xx	1C	LO	1	Character string "GEMS_PARM_01" shall be encoded.
Delta Start Time [msec]	0043,xx1E	3	DS	1	Delta start time shall be encoded if the scan option is HELICAL MODE ,CINE MODE or CARDIAC MODE.
Recon Center Coordinates	0043,xx31	3	DS	3	Reconstruction center shall be encoded.
Raw Data ID	0043,xx63	3	SH	1	Raw data ID shall be encoded.
Image Filter	0043,xx64	3	CS	1-n	Image filter names that applied on the image shall be encoded.
Motion Correction Indicator	0043,xx65	3	US	1	"1" shall be encoded if motion correction was applied on the image, otherwise "0" shall be encoded.
Helical Correction Indicator	0043,xx66	3	US	1	"1" shall be encoded if helical correction was applied on the image, otherwise "0" shall be encoded.
IBO Correction Indicator	0043,xx67	3	US	1	"1" shall be encoded if IBO correction was applied on the image, otherwise "0" shall be encoded.
XT Correction Indicator	0043,xx68	3	US	1	"1" shall be encoded if XT correction was applied on the image, otherwise "0" shall be encoded.
Q-cal Correction Indicator	0043,xx69	3	US	1	"1" shall be encoded if Q-cal correction was applied on the image, otherwise "0" shall be encoded.
AV Correction Indicator	0043,xx6A	3	US	1	"1" shall be encoded if AV correction was applied on the image, otherwise "0" shall be encoded.
L-MDK Correction Indicator	0043,xx6B	3	US	1	"1" shall be encoded if L-MDK correction was applied on the image, otherwise "0" shall be encoded.
Detector Row	0043,xx6C	3	IS	1	"1" shall be encoded.
Area Size	0043,xx6D	3	US	1	Area size (1.0 or 1.6) shall be encoded. For SEGMENTED or LOCALIZER image, this element shall not be encoded.
Auto mA Mode	0043,xx6E	3	SH	1	Auto mA Mode label shall be encoded.
Private Creator ID (group 4B)	004B,00xx	1C	LO	1	Character string "GEMS_HINO_CT_01" shall be encoded.
R Time	004B,xx02	3	DS	1-n	Previous and next R time from center time of the time values is acquisition start time.(for Cardiac Scan only)
HBC number	004B,xx03	3	IS	1	HBC number from acquisition start time, starts with 0. (for Cardiac Scan only)

APPENDIX B. DICOMDIR DIRECTORY INFORMATION

B.1 DICOMDIR DIRECTORY INFORMATION

Enclosed here is a listing of only the optional (conditional) modules and optional attributes used by this implementation in the DICOMDIR definition. All standard attributes as defined in Part 3 Addendum (Basic Directory Information Object) are supported by this implementation but not listed here.

B.1.1 Basic Directory IOD Definition

Module	Reference	Usage	Notes
Directory Information	B.X.3.2.1 (DICOM PS3.10)	U	

B.1.2 Directory Information Module

Attribute Name	Tag	Type	Notes
Offset of the Next Directory Record	(0004,1400)	1C	
Record In-use Flag	(0004,1410)	1C	
Offset of Referenced Lower-Level Directory Entity	(0004,1420)	1C	
Directory Record Type	(0004,1430)	1C	PATIENT, STUDY, SERIES and IMAGE
Referenced File ID	(0004,1500)	1C	Only found in IMAGE Directory Record
Referenced SOP Class UID in file	(0004,1510)	1C	Only found in IMAGE Directory Record
Referenced SOP Instance UID in File	(0004,1511)	1C	Only found in IMAGE Directory Record
Referenced Transfer Syntax UID in File	(0004,1512)	1C	Only found in IMAGE Directory Record

B.1.3 Directory Record Selection Keys

Given below are the list of attributes supported under each of these directories.

B.1.3.1 Patient Keys

Attribute Name	Tag	Type	Notes
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Specific Character Set	(0008,0005)	1C	ISO_IR 100
Patient's Name	(0010,0010)	2	
Patient ID	(0010,0020)	1	

B.1.3.2 Study Keys

Attribute Name	Tag	Type	Notes
Specific Character Set	(0008,0005)	1C	ISO_IR 100
Study Date	(0008,0020)	1	
Study Time	(0008,0030)	1	
Accession Number	(0008,0050)	2	
Study Description	(0008,1030)	2	
Study Instance UID	(0020,000D)	1C	
Study ID	(0020,0010)	1	

B.1.3.3 Series Keys

Attribute Name	Tag	Type	Notes
Specific Character Set	(0008,0005)	1C	ISO_IR 100
Image Type	(0008,0008)	3	
Modality	(0008,0060)	1	
Manufacturer's Id	(0008,0070)	3	
Series Description	(0008,103E)	3	
Manuf. Model Name	(0008,1090)	3	
Series Instance UID	(0020,000E)	1	
Series Number	(0020,0011)	1	

B.1.3.4 Image Keys

Attribute Name	Tag	Type	Notes
Specific Character Set	(0008,0005)	1C	ISO_IR 100
SOP Instance UID	(0008,0018)	3	Redundant to (0004,1511)
Referenced Image Sequence	(0008,1140)	1C	Not included
Sequence Variant	(0018,0021)	3	
Slice Thickness	(0018,0050)	3	
Repetition Time	(0018,0080)	3	
Echo Time	(0018,0081)	3	
Inversion Time	(0018,0082)	3	
Number of Averages	(0018,0083)	3	
Echo Number	(0018,0086)	3	MRI profile only
Spacing Between Slices	(0018,0088)	3	
Data Collection Diameter	(0018,0090)	3	
Contrast/Bolus Route	(0018,1040)	3	
Trigger Time	(0018,1060)	3	
Reconstruction Diameter	(0018,1100)	3	
Gantry/Detector Tilt	(0018,1120)	3	
Convolution Kernel	(0018,1210)	3	
Flip Angle	(0018,1314)	3	
Image Number	(0020,0013)	1	
Image Position (Patient)	(0020,0032)	1C	
Image Orientation (Patient)	(0020,0037)	1C	
Frame of Reference UID	(0020,0052)	1C	
Slice Location	(0020,1041)	3	S value of intersection between image plane and ISO center
Samples Per Pixel	(0028,0002)	1	

Photometric Interpretation	(0028,0004)	1	
Rows	(0028,0010)	1	
Columns	(0028,0011)	1	
Pixel Spacing	(0028,0030)	1C	
Bits Allocated	(0028,0100)	1	
Bits Stored	(0028,0101)	1	MRI - Absent from profiles
High Bit	(0028,0102)	1	MRI - Absent from profiles

APPENDIX C. MR/SC SPECIFIC IOD DEFINITION

Enclosed is a listing of MR/SC IOD definition.

C.1 MR SPECIFIC IOD DEFINITION

C.1-1 MR Image IOD Modules

Entity Name	Module Name	Reference
Patient	Patient	4.5.1.1
Study	General Study	4.5.2.1
	Patient Study	4.5.2.2
Series	General Series	4.5.3.1
Equipment	General Equipment	4.5.5.1
Image	General Image	4.5.6.1
	Image Plane	4.5.6.2
	Image Pixel	4.5.6.3 (Only the type 1 elements are sent.)
	Contrast/Bolus	4.5.6.4
	MR Image	C2
	SOP Common	4.5.8.1

C.1-2 MR Image Module Definitions

Attribute Name	Tag	Type	Attribute Description
Scan Options	(0018,0021)	2	Always sent.
MR Acquisition Type	(0018,0023)	2	2D or 3D depending on acquisition type.
Repetition Time	(0018,0080)	2C	Sent if Scanning Sequence is EP and Sequence Variant is <u>not</u> SK .
Echo Time	(0018,0081)	2	Sent.
Inversion Time	(0018,0082)	2C	Sent.
Echo Train Length	(0018,0091)	2	Sent.
Trigger Time	(0018,1060)	2C	Sent.
Angio Flag	(0018,0025)	3	
Number Of Averages	(0018,0083)	3	
Imaging Frequency	(0018,0084)	3	
Imaged Nucleus	(0018,0085)	3	Zero-length element is sent.
Echo Number	(0018,0086)	3	
Magnetic Field Strength	(0018,0087)	3	Image strength, if 0, NOT sent.
Spacing Between Slices	(0018,0088)	3	
Percent Sampling	(0018,0093)	3	
Percent Phase Field of View	(0018,0094)	3	
Pixel Bandwidth	(0018,0095)	3	
Nominal Interval	(0018,1062)	3	
Heart Rate	(0018,1088)	3	If 0, NOT sent.
Cardiac Number of Images	(0018,1090)	3	If 0, NOT sent.
Trigger Window	(0018,1094)	3	If 0, NOT sent.
Reconstruction Diameter	(0018,1100)	3	
Receiving Coil	(0018,1250)	3	
Transmitting Coil	(0018,1251)	3	

Acquisition Matrix	(0018,1310)	3	
Phase Encoding Direction	(0018,1312)	3	
Flip Angle	(0018,1314)	3	
Variable Flip Angle Flag	(0018,1315)	3	
SAR	(0018,1316)	3	
Temporal Resolution	(0020,0110)	3	

C.2 SC SPECIFIC IOD DEFINITION

C.2-1 SC Image IOD Modules

Entity Name	Module Name	Reference
Patient	Patient	4.5.1.1
Study	General Study	4.5.2.1
	Patient Study	4.5.2.2
Series	General Series	4.5.3.1
Equipment	General Equipment	4.5.5.1
	SC Equipment	C.2-1
Image	General Image	4.5.6.1
	Image Pixel	4.5.6.3 (Only the type 1 elements are sent.)
	SC Image	Not sent (consists entirely of type 3 elements).
	Modality LUT	Only the type 1C elements are sent.
	VOI LUT	4.5.7.1
	SOP Common	4.5.8.1

C.2-2 SC IOD Common Module Definitions

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	3	Modality of original image (CT or MR).

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