Technical Publications

Direction 2274762
Revision 1.2

HiSpeed NX/i 5.0x CONFORMANCE STATEMENT
for DICOM v3.0

- HiSpeed NX/I, NX/I PRO (5.0x)

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REVISION HISTORY

REV	DATE	REASON FOR CHANGE
1.0	May 10,2000	Initial Release
1.1	July 25,2000	Add Section 4.5.6.2.1
		Remove Beam Thickness in Appendix A
		All pages are replaced.
1.2	Sep 12,2000	Change Version Number to 5.0x to cover minor revision

LIST OF EFFECTIVE PAGES

SECTION	NUMBER	SECTION	NUMBER
Title, p.1	1.2	Section 1 – 5, p.9-86	1.1
Revision History / LOEP, p.2	1.2	Section 6 to 7, p.85-100	1.1
Warning / Blank Page, p.3-4	1.2	Appendix A, p.101-102-	1.1
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		Appendix C, p.107	1.1

WARNING

THIS SERVICE MANUAL IS AVAILABLE IN ENGLISH ONLY.

- IF A CUSTOMER'S SERVICE PROVIDER REQUIRES A LANGUAGE OTHER THAN ENGLISH, IT IS THE CUSTOMER'S RESPONSIBILITY TO PROVIDE TRANSLATION SERVICES.
- DO NOT ATTEMPT TO SERVICE THE EQUIPMENT UNLESS THIS SERVICE MANUAL HAS BEEN CONSULTED AND IS UNDERSTOOD.
- FAILURE TO HEED THIS WARNING MAY RESULT IN INJURY TO THE SERVICE PROVIDER,OPERATOR OR PATIENT FROM ELECTRIC SHOCK,MECHANICAL OR OTHER HAZARDS.

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 OVERVIEW

This DICOM Conformance Statement is divided into Sections as described below:

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

Section 2 (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.

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 SC IOD.

1.2   OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEMS Conformance Statements and their relationship with the DICOM v3.0 Conformance Statements is shown in the Illustration below.

ID/Net v3.0

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

APPLICATION ENTITY
(SERVICE CLASSES; INFORMATION OBJECTS, MESSAGE EXCHANGES, ETC.)

Product Implementation:

CT Advantage

MR Advantage

HiSpeed LX/i
Conformance
Statement
Direction:
<number>

......
Conformance
Statement
Direction:
....

DICOM
STANDARD

Standard Specification:

DICOM V 3.0

Part 1

V 3.0

2

V 3.0

3

V 3.0

4

DICOM V 3.0

Part 13

This document specifies the DICOM v3.0 implementation. It is entitled:

HiSpeed NX/I 5.0
Conformance Statement for DICOM v3.0
Direction 2274762

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

This DICOM Conformance Statement documents the DICOM v3.0 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 v3.0 (ID/Net v3.0)
Conformance Statement
Direction: 2118780.

This Introduction familiarizes the reader with DICOM terminology and general concepts. It should be read prior to reading the individual products' 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 v3.0 Part 8 standard.

For more information including Network Architecture and basic DICOM concepts, please refer to the Introduction.

For more information regarding DICOM v3.0, copies of the Standard may be obtained by written request or phone by contacting:

NEMA Publication
1300 North 17th Street
Suite 1847
Rosslyn, VA 22209
USA
Phone: (703) 841-3200

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 v3.0 Standards and with the terminology and concepts which are used in those Standards.

If readers are unfamiliar with DICOM v3.0 terminology they should first refer to the document listed below, then read the DICOM v3.0 Standard itself, prior to reading this DICOM Conformance Statement document.

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

1.4   SCOPE AND FIELD OF APPLICATION

It is the intent of this document, in conjunction with the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*, to provide an unambiguous specification for GEMS implementations. This specification, called a Conformance Statement, includes a DICOM v3.0 Conformance Statement and is necessary to ensure proper processing and interpretation of GEMS medical data exchanged using DICOM v3.0. 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 v3.0 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 v3.0 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 v3.0), 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 v3.0 Standard. DICOM v3.0 will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEMS protocol is based on DICOM v3.0 as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which have implemented DICOM v3.0. **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.

- **To be informed of the evolution of the implementation described in this document, the User is advised to regularly check the GE Internet Server, accessible via anonymous ftp (GE Internet Server Address: ftp.med.ge.com, 192.88.230.11).**

- **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 v3.0 (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 v3.0 (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 v3.0 (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 NX/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.

The ConnectPro option for HiSpeed 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 al procedures scheduled to be performed on the scanner. In this situation, ConnectPro is providing the DICOM C-FIND service as a service class user (SCU).

2.2　IMPLEMENTATION MODEL

2.2.1　Application Data Flow Diagram

The Basic and Specific Application models for this device are shown in the following illustration:
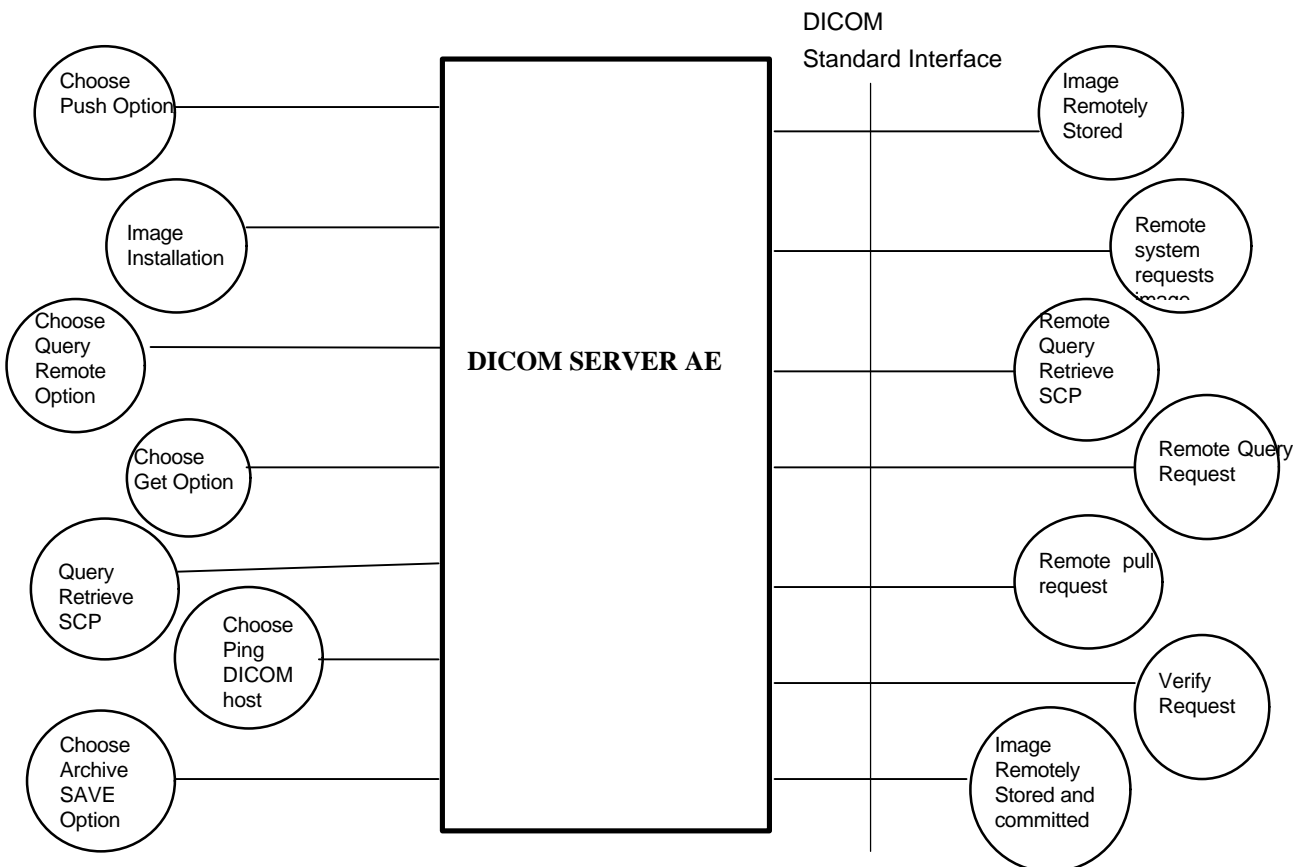
There are three Real-World Activities that will cause the DICOM Server Application Entity (DICOM Server AE) to initiate a DICOM association to a remote DICOM Application Entity.

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 NX/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.

All DICOM functionality provided by the ConnectPro 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 user interface.

The Basic and Specific Application models for this device are shown in the following illustration :
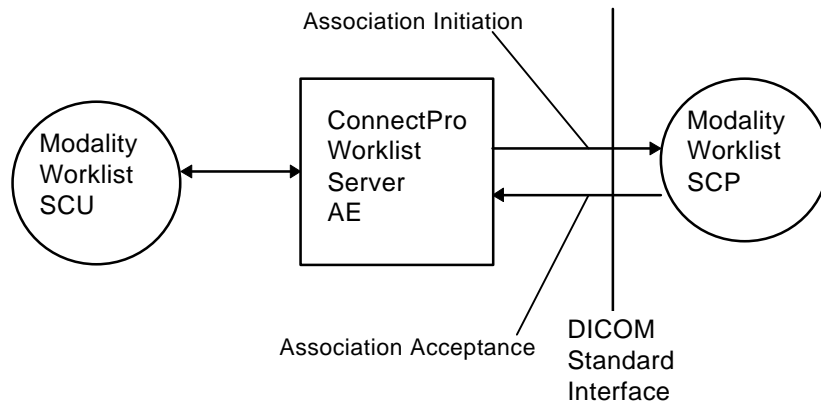
2.2.2 Functional Definition of AE's

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.

The ConnectPro Workllist 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 AE's and return the results to the user interface.

The ConnectPro 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.

2.2.3   Sequencing of Real-World Activities

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

Real-World Activity Modality Worklist :

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.

2.3   AE SPECIFICATIONS

2.3.1   DICOM Server AE Specification

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCU**:

SOP Class Name	SOP Class UID
Verification (Echo)	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
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
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
Storage Commitment Push Model	1.2.840.10008.1.20.1

This Application Entity provides Standard Conformance to the following DICOM V3.0 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
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

Worklist Server Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCU**:

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

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.

The user information Items sent by this product are:

• Maximum PDU Length

• Implementation UID

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.

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

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 v3.0 Implementation is:

HiSpeed NX/i Implementation UID	1.2.840.113619.6.81
HiSpeed NX/i Implementation Version Name	5.00*

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

The Implementation UID for ConnectPro Implementation is:

ConnectPro for HiSpeed NX/i Implementation UID	1.2.840.113619.6.50

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
Name	UID	Name List	UID List		Negotiation
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		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	JPEG Lossless Hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	SCU	None
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		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	JPEG Lossless Hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	SCU	None
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	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little	1.2.840.10008.1.2	SCU	None

Query/Retrieve Information Model - MOVE		Endian			
		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		

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 NX/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 NX/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 v3.0 (Direction 2118781) and the MR Signa Advantage Conformance Statement for DICOM v3.0 (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.

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 *"Pull"* 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.

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 2.3.1.2.2.2.1-1: 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 for Study level query. Study Instance UID of study for which matches are requested at a lower level
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 2.3.1.2.2.2.1-2: 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	Zero length for Series level query. Series instance UID of series for which matches are requested at a lower level
Series description	O	0008,103E	Zero length
Manufacturer	O	0008,0070	Zero length
Images in series	O	0020,1002	Zero length

Table 2.3.1.2.2.2.1-3: Requested Image Level Keys

Description	Type	Tag	Value
Image number	R	0020,0013	Zero length
Image Instance UID	U	0008,0018	Zero length
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	0019,0010	GEMS_ACQU_01
Dfov Rect	P	0019,101E	Zero Length
Midscan Time	P	0019,1024	Zero Length
Azimuth	P	0019,1026	Zero Length
Number of Echo	P	0019,107E	Zero Length

Scout Anref	P	0021,104A	Zero Length
Location RAS	P	0027,1040	Zero Length
Location	P	0027,1041	Zero Length
Center R Coordinate	P	0027,1042	Zero Length
Center A Coordinate	P	0027,1043	Zero Length
Table Start Location	P	0027,1050	Zero Length
Table End Location	P	0027,1051	Zero Length
RAS Letter for Side of Image	P	0027,1052	Zero Length
RAS Letter for Anterior/Posterior	P	0027,1053	Zero Length
RAS Letter for Scout Start Location	P	0027,1054	Zero Length
RAS Letter for Scout End Location	P	0027,1055	Zero Length
Image Dimension X	P	0027,1060	Zero Length
Image Dimension Y	P	0027,1061	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.

2.3.1.3   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 NX/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	Implicit VR Big	1.2.840.113619.5.2	SCP	None

		Endian(GE Private)			
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
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	JPEG Lossless Hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	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
Secondary Capture	1.2.840.10008.5.1.4.1.1.7	JPEG Lossless Hierarchical First-Order Prediction	1.2.840.10008.1.2.4.70	SCP	None

Note: 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.

2.3.1.3.1.2.1   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 NX/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 NX/i system.

Images may be deleted when instructed to do so by the user. Thus the users of the HiSpeed NX/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.

2.3.1.3.2   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.

2.3.1.3.3 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	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little	1.2.840.10008.1.2	SCU	None

FIND		Endian			

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
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	0009,0010	GEMS_IDEN_01
Suite Id	P	0009,1002	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
Image number	R	0020,0013	Matched
Image 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	0019,0010	GEMS_ACQU_01
Dfov Rect	P	0019,101E	Returned
Midscan Time	P	0019,1024	Returned

Azimuth	P	0019,1026	Returned
Number of Echo	P	0019,107E	Returned
Private Creator Identification	P	0021,0010	GEMS_RELA_01
Scout Anref	P	0021,104A	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.

2.3.1.3.4 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
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 V3.0 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 that 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.

2.3.1.3.5   Worklist Query

2.3.1.3.5.1   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 the 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)

2.3.1.3.5.2   Presentation Context Table

**Table 2.3.1.3.5.2-1: Acceptable Presentation Contexts for Worklist
Server AE and Real-World Activity**

Query Request.

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

2.3.1.3.5.2.1 SOP Specific 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. Any previously received worklist items are discarded.

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. Any previously received worklist items are discarded. 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.

2.3.1.3.5.3   Record Acceptance Policy

The HiSpeed NX/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

· (0008,0060), Modality

· (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

· (0040,0100), Scheduled Procedure Step Sequence

· (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

· (0008,0090), Referring Physician Name

· (0008,1110), Referenced Study Sequence

- (0008,1120), Referenced Patient Sequence

- (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), Scheduled Physician's Name

- (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

2.3.1.3.5.4   Association Acceptance Policy

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

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   Private SOP Classes

ID/Net v2.0 Private IODs are based upon the April 1993 draft version of the DICOM v3.0. 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.

ConnectPro for HiSpeed NX/i does not implement any private transfer syntaxes.

2.5.2   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.

ConnectPro for HiSpeed NX/i does not implement any private transfer syntaxes.

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 NX/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.

The ConnectPro 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 NX/i user interface.

ConnectPro 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

· Remote AE (HIS/RIS) Title - Title (name) of the remote AE

· Scanner AE (HIS/RIS) Title - Title (name) of the Scanner AE

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

2.6.2   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 timeout   - *bi_session_tio*

    *Move operation time-out   - *bi_move_tio*

    *Find time-out   - *bi_find_tio*

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

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

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

2.7   SUPPORT OF EXTENDED CHARACTER SETS

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

3.   MEDIA STORAGE CONFORMANCE STATEMENT

3.1   INTRODUCTION

This section of the conformance statement (CS) specifies the HiSpeed NX/i compliance to DICOM Media Interchange. It details the DICOM Media Storage Application Profiles and roles which are supported by this product in its version 4.0

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.

3.2   IMPLEMENTATION MODEL

All DICOM functionality on the HiSpeed NX/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.

3.2.1   Application Data Flow Diagram

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

ILLUSTRATION 3.2.1-1
SPECIFIC AE APPLICATION MODEL
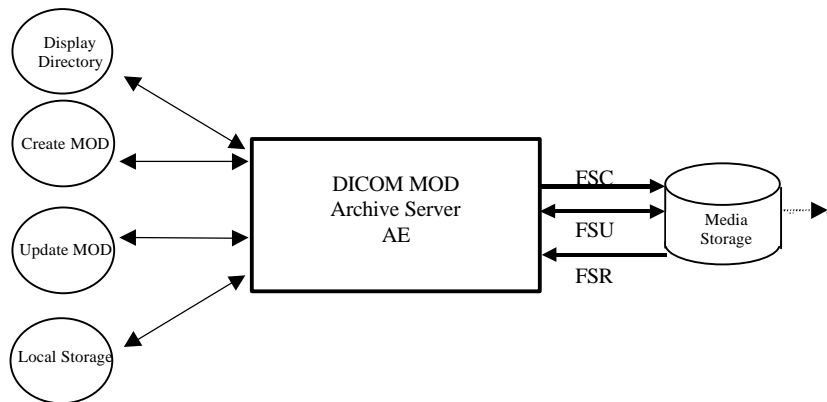
The MOD Archive Server AE has a local storage that may contain various SOP instances. These may have been obtained by original creation, network (DICOM or proprietary) or by removable media using other application entities. These instances are external to this conformance claim and the origin of SOP 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 Server has only one Application Entity: the MOD Archive Application

The MOD Archive Application 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 Requirements

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 Options (See PS3.10)

The File Meta-Information for this implementation is :

File Meta-Information Version	1
HiSpeed NX/i Implementation UID	**1.2.840.113619.6.81**
Implementation Version Name	**5.00***

*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	Create MOD	FSC	Interchange
	Update MOD	FSU	Interchange
	Display Directory	FSR	Interchange
	Copy To Local Storage	FSR	Interchange
STD-CTMR-MOD12	Create MOD	FSC	Interchange
	Update MOD	FSU	Interchange
	Display Directory	FSR	Interchange
	Copy To Local Storage	FSR	Interchange

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

Depending on the physical media type being 2.3GB or 1.2GB media, the system will apply the correct characteristics as an FSC to meet the appropriate Application Profile.

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 AE will use the appropriate Application Profile depending on the physical media type that is in the optical disk drive (be it 2.3GB or 1.2GB 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. The determination of the potentially applicable Application Profile is dependent on the type of media and the associated software on which the AE has been invoked.

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

For the list of Application Profiles that invoke this AE for the Create MOD RWA, see Table 3.3.1-1.

3.3.1.2.2   Real-World Activity: Display Directory

The MOD Archive Application 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 SOP instances in the File-set that correspond to the user selected Application Profile.

3.3.1.2.2.1   Application Profiles for the RWA: MOD Directory listing

For the list of Application Profiles that invoke this AE for the MOD directory listing RWA, see Table 3.3.1-1.

There are no extensions or specialization's.

3.3.1.2.2.2   Options:

None applicable.

3.3.1.2.3   Real-World Activity: Copy to Local Storage

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

The MOD Archive Application will copy any SOP Instance selected from an MOD Directory list from the MOD to the local storage upon request. The MOD Directory listing Real-World Application will filter out the SOP Instances that do not match the Application Profile.

3.3.1.2.3.1   Application Profiles for the RWA: Copy to Local Storage

For the list of Application Profiles that invoke this AE for the MOD Copy to Local Storage RWA, see Table 3.3.1-1.

3.3.1.2.3.2   Options:

None applicable.

3.3.1.2.4   Real-World Activity: Update MOD

The MOD Archive Application 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

For the list of Application Profiles that invoke this AE for the MOD Copy to Local Storage RWA, see Table 3.3.1-1.

3.3.1.2.4.2 Options:

None applicable.

3.4 AUGMENTED AND PRIVATE APPLICATION PROFILES

3.4.1 Class and Profile Identification

The Class of Application Profiles defined here is for Computed Tomography and Magnetic Resonance Imaging Clinical applications.

The identifier for this class is CTMR-MOD.

The specific Application Profile in this class is shown in Table 3.4.1-1.

Table 3.4.1-1: CTMR MOD Profiles

Application Profile	Identifier	Description
CT/MR Studies on 2.3GB MOD media	STD-CTMR-MOD23	Handles single 12 or 16 bit grayscale compressed / uncompressed images.
CT/MR Studies on 1.2GB MOD media	STD-CTMR-MOD12	Handles single 12 or 16 bit grayscale compressed / uncompressed images.

3.4.2 Clinical Contexts

This Application Profile facilitates the interchange of primary CT and MR images as well as processed CT and MR images as Secondary Capture Images. Typical interchanges would be between acquisition devices, archives and workstations within and between institutions.

3.4.2.1 Roles and Service Class Options

This Application Profile Class uses the Media Storage Service Class defined in PS3.4 with the Interchange Option.

The Application Entity shall support one or more roles of the File-set Creator, File-set Reader and File-set Updater defined in PS3.10.

3.4.2.1.1 File Set Creator

File Set Creator shall be able to generate the Basic Directory SOP Class in the DICOMDIR File with all types of Directory Records related to the SOP Classes stored in the File-set.

FSC for the MOD profile has no concept of finalizing the disc at the completion of most recent write session. This is a requirement of CD-R and does not apply to the MOD profiles.

3.4.2.1.2   File Set Reader

The role of File Set Reader is used by the Application Entities which receive a transferred File Set. Typical entities using this role would include display workstations and archive systems which receive a patient record transferred from another institution. File Set Readers shall be able to read all the SOP Classes defined for the specific Application Profile for which a Conformance Statement is made using all the defined Transfer Syntaxes.

3.4.2.1.3   File Set Updater

The role of File Set Updater is used by Application Entities which receive a transferred File Set and update it by the addition of information. Typical entities using this role would include analytic workstations which for instance may add to the File-set an information object containing a processed (e.g., edge-enhanced) image. File-set Updaters do not have to read the images. File-set Updaters shall be able to generate one or more of the SOP Instances defined for the specific Application Profile for which a conformance statement is made and to read and update the DICOMDIR file.

3.4.3   Standard Application Profiles

The MOD Archive Server supports the standard Application Profile: CTMR-MOD as an FSC, FSR or FSU.

3.4.3.1 STD-CTMR-MOD12 Class Profile

3.4.3.1.1   SOP Classes and Transfer Syntaxes

This class of Application Profiles is based on the Media Storage Service Class with the Interchange Option. (see PS3.4).

SOP Classes and corresponding Transfer Syntaxes supported by the STD-CTMR-MOD12 Application Profiles is also specified in the Table 3.4.3.1.1-1.

Table 3.4.3.1.1-1 : IOD's and Transfer Syntaxes for CT-MOD
Application Profiles

Information Object Definition	SOP Class UID	Transfer Syntax and UID	FSC Req.	FSR Req.	FSU Req.
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	M
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Explicit VR Big Endian Uncompressed	O	M	O

		1.2.840.10008.1.2.2			
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	JPEG Lossless Process Selection Value 14 1.2.840.10008.1.2.4.70	O	M	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	M	O
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	JPEG Lossless Process Selection Value 14 1.2.840.10008.1.2.4.70	O	M	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	M	O
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	JPEG Lossless Process Selection Value 14 1.2.840.10008.1.2.4.70	O	M	O

M : Mandatory   O : Optional

NOTE:
The MOD Archive Application chooses the JPEG Lossless compression (selection value 1) as the default transfer syntax for storing images on the media. But the transfer syntax is selectable on a per media basis at install time using a method defined by the Application.

3.4.3.1.2   Physical Media and Media Formats

The CT/MR Application Profiles in the STD-CTMR-MOD12 require the 130mm 1.2GB 512 Byte per Sector Magneto-Optical Rewriteable physical media with the PC File System as defined in PS3.12.

3.4.3.1.3   Logical Format

The STD-CTMR-MOD12 Application profile media format conforms to the Logical Format specification in PS3.12. The following tables 3.4.3.1.3-1 defines the specific values used for this profile.

Table 3.4.3.1.3-1 : Boot Sector for STD-CTMR-MOD12
conformant media

Bytes(s)	Big Endian	As Stored	Description
00 - 02		0xEB3C90	Jump instruction to loader (NOPs)
03 - 10	0x4d53444F53342E30	"MSDOS4.0" The formatting DOS (vendor specific)	
11 - 12	0x0200	0x0002	512 bytes/sector
13	32	0x20	sectors/cluster
14-15	0x0001	0x0100	1 sector in boot record
16	0x02	0x02	2 File Allocation Tables (FAT)
17 - 18	0x0200	0x0002	512 root directory entries
19 - 20	0x0000	0x0000	Flag for more than 65536 sector/disk. Use offset 32 value
21	0xF8	0xF8	Flag for disk type; F0H if not otherwise specified
22 - 23	143	0x8F00	143 sectors/FAT
24 - 25	31	0x1F00	31 sectors/track
26 - 27	1	0x0100	1 side (head) per disk
28 - 31	00000000	0x0…0	0 reserved or hidden sectors
32 - 35	1163306	0x2AC01100	1163306 Total sector/disk. Varies from disk to disk

Bytes(s)	Big Endian	As Stored	Description
36 - 37	0x0080	0x8000	Physical Drive number = 80
38	0x29	0x29	Extended boot record signature = 41
39 - 42	*Date Stamp*	Volume serial number	
43 - 53	0x47454D535F4449434F4D20	"GEMS-DICOM"	
54 - 61	0x0...0	0x0…0	The file system label
62 - 509			Don't care. Any contents acceptable
510 - 511	0xAA55	0x55AA	Signature flag

3.4.3.1.4   Directory Information in DICOMDIR

Conformant Application Entities shall include in the DICOMDIR File a Basic Directory IOD containing Directory Records at the Patient and subsidiary levels appropriate to the SOP Classes in the File-set. All DICOM files in the File-set incorporating SOP Instances defined for the specific Application Profile shall be referenced by the Directory Records.

All DICOM SOP Instance files in the File-set are stored in the MSDOS filesystem subdirectory \GEMS and are referenced from the DICOMDIR directory records.

Refer to *Appendix B* for a complete listing of all the optional modules and optional attributes used in the DICOMDIR definition. Please note that the mandatory attributes in each of the directory records as mentioned in Part 3 Addendum (Basic Directory Information Object Definition) are not listed in the appendix, but are supported by the implementation.

NOTE:
The modality attribute (0008,0060) in the DICOMDIR Series records should be CT/MR for Secondary Capture SOP Class Images. Otherwise the HiSpeed NX/i DICOM media display browser will not list-up the series for contents rendering the retrieval to local storage impossible.

3.4.3.1.4.1   Additional Keys

None.

3.4.3.2 STD-CTMR-MOD23 Class Profile

3.4.3.2.1   SOP Classes and Transfer Syntaxes

This class of Application Profiles is based on the Media Storage Service Class with the Interchange Option. (see PS3.4).

SOP Classes and corresponding Transfer Syntaxes supported by the STD-CTMR-MOD23 Application Profiles is also specified in the Table 3.4.3.2.3-1.

3.4.3.2.2   Physical Media and Media Formats

The CT/MR Application Profiles in the STD-CTMR-MOD23 require the 130mm 2.3GB 512 Byte per Sector Magneto-Optical Rewriteable physical media with the PC File System as defined in PS3.12.

3.4.3.2.3   Logical Format

The STD-CTMR-MOD23 Application profile media format conforms to the Logical Format specification in PS3.12. The following tables 3.4.3.2.3-1 defines the specific values used for this profile.

Table 3.4.3.2.3-1 : Boot Sector for STD-CTMR-MOD23 conformant media

Bytes(s)	Big Endian	As Stored	Description
00 - 02		0xEB3C90	Jump instruction to loader (NOPs)
03 - 10	0x4d53444F53342E30	"MSDOS4.0" The formatting DOS (vendor specific)	
11 - 12	0x0200	0x0002	512 bytes/sector
13	64	0x40	sectors/cluster
14-15	0x0001	0x0100	1 sector in boot record
16	0x02	0x02	2 File Allocation Tables (FAT)
17 - 18	0x0200	0x0002	512 root directory entries
19 - 20	0x0000	0x0000	Flag for more than 65536 sector/disk. Use offset 32 value
21	0xF8	0xF8	Flag for disk type; F0H if not otherwise specified
22 - 23	138	0x8A00	138 sectors/FAT
24 - 25	62	0x3E00	62 sectors/track
26 - 27	1	0x0100	1 side (head) per disk
28 - 31	00000000	0x0…0	0 reserved or hidden sectors
32 - 35	2244896	0x20412200	2244896 Total sector/disk. Varies from disk to disk
36 - 37	0x0080	0x8000	Physical Drive number = 80

38	0x29	0x29	Extended boot record signature = 41
39 - 42	*Date Stamp*	Volume serial number	
43 - 53	0x47454D535F4449434F4D20	"GEMS-DICOM"	
54 - 61	0x0...0	0x0…0	The file system label
62 - 509	-		Don't care. Any contents acceptable
510 - 511	0xAA55	0x55AA	Signature flag

3.4.3.2.4   Directory Information in DICOMDIR

Conformant Application Entities shall include in the DICOMDIR File a Basic Directory IOD containing Directory Records at the Patient and subsidiary levels appropriate to the SOP Classes in the File-set. All DICOM files in the File-set incorporating SOP Instances defined for the specific Application Profile shall be referenced by the Directory Records.

All DICOM SOP Instance files in the File-set are stored in the MSDOS filesystem subdirectory \GEMS and are referenced from the DICOMDIR directory records.

Refer to *Appendix B* for a complete listing of all the optional modules and optional attributes used in the DICOMDIR definition. Please note that the mandatory attributes in each of the directory records as mentioned in Part 3 Addendum (Basic Directory Information Object Definition) are not listed in the appendix, but are supported by the implementation.

NOTE:
The modality attribute (0008,0060) in the DICOMDIR Series records should be CT/MR for Secondary Capture SOP Class Images. Otherwise the HiSpeed NX/i DICOM media display browser will not list-up the series for contents rendering the retrieval to local storage impossible.

3.4.3.2.4.1   Additional Keys

None.

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

3.5.2   Private Transfer Syntax Specification

None

3.6   CONFIGURATION

The MOD Archive Application 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 Application 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
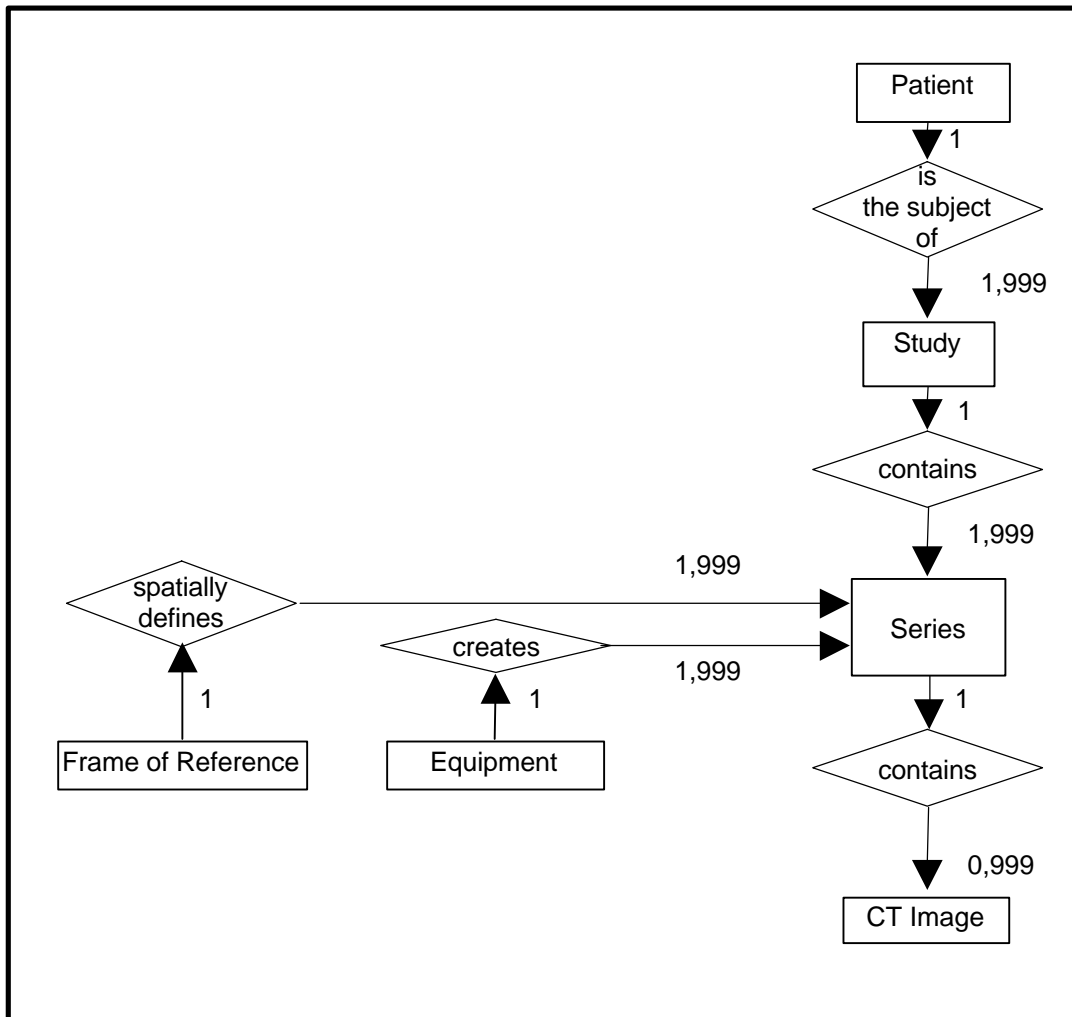
4.3.1 ENTITY DESCRIPTIONS

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 v3.0 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 v3.0 CT IOD. Modules are identified by Module Name.

See DICOM v3.0 Part 3 for a complete definition of the entities, modules, and attributes.

TABLE 4.4-1
CT IMAGE IOD MODULES

Entity Name		Reference
Patient		4.5.1.1
Study		4.5.2.1
		4.5.2.2
Series		4.5.3.1
Frame of Reference		4.5.4.1
Equipment		4.5.5.1
Image		4.5.6.1
		4.5.6.2
		4.5.6.3
		4.5.6.4
		4.5.7.1
		4.5.8.1
		4.5.9.1

4.5   INFORMATION MODULE DEFINITIONS

Please refer to DICOM v3.0 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 v3.0 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 NX/i" in this implementation.
Device Serial Number	(0018,1000)	3	Manufacturer's serial number of the equipment that produced the digital images. Sent as 0000290.XXXXXXX for HiSpeed NX/I system. XXXXXXX 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 "5.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
Image 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. "reconAlgo=n", where n is recon algorithm 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.

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 conjuction 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.

<div align="center">

TABLE 4.5.6.3
IMAGE PIXEL MODULE ATTRIBUTES
</div>

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*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","ASYNMETRIC MODE", CINE MODE","FLUORO MODE" 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.

ILLUSTRATION 4.5.9.1.1.1
CT IMAGE TYPE DECISION TREE
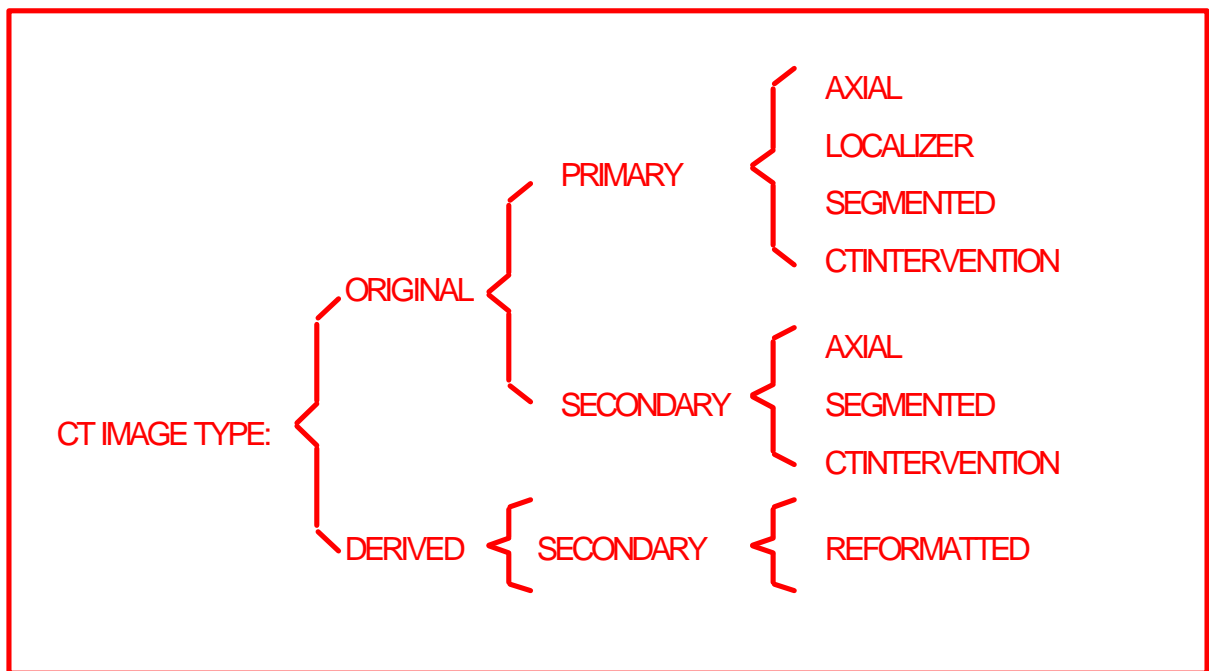
4.6   PRIVATE DATA DICTIONARY

Refer to Appendix A.

5. MODALITY WORKLIST INFORMATION MODEL DEFINITION

5.1 INTRODUCTION

This section specifies the use of the DICOM Modality Worklist Information Model used to organize data and against which a Modality Worklist Query will be performed. The contents of this section are:

> 5.2 - Information Model Description
>
> 5.3 - Information Model Entity-Relationship Model
>
> 5.4 - Information Model Module Table
>
> 5.5 - Information Model Keys

5.2 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.

5.3 MODALITY WORKLIST INFORMATION MODEL ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the Modality Worklist Information Model schema is shown in Illustration 5.3-1. 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 5.3-1
MODALITY WORKLIST INFORMATION MODEL E/R DIAGRAM
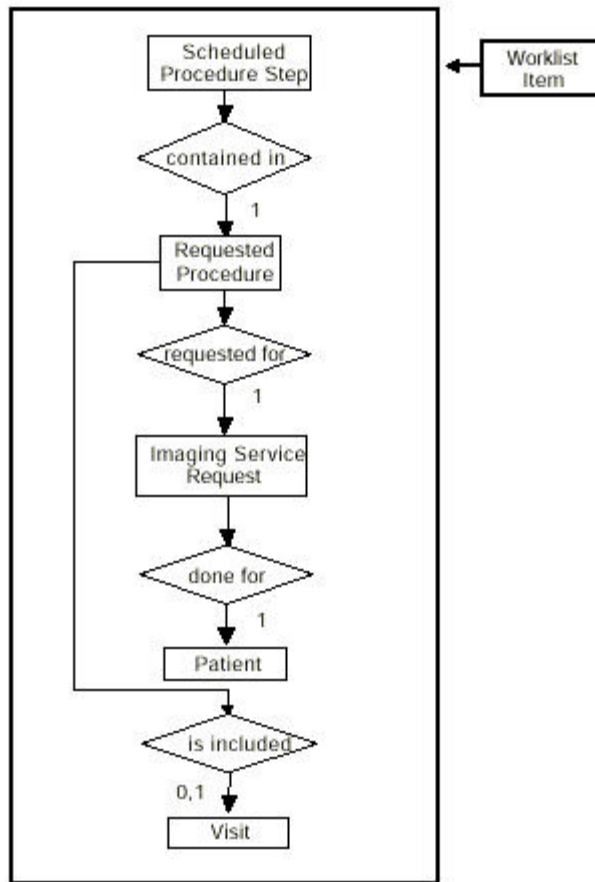
5.3.1 ENTITY DESCRIPTIONS

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.

5.3.1.1 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).

5.3.1.2 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.

5.3.1.3 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.

5.3.1.4 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.

5.3.1.5 Patient Entity Description

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

5.3.2 ConnectPro Mapping of DICOM Entities

TABLE 5.3-1
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

5.4   INFORMATION MODEL MODULE TABLE

Within an entity of the DICOM v3.0 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 5.4-1 identifies the defined modules within the entities which comprise the DICOM v3.0 Modality Worklist Information Model. Modules are identified by Module Name.

See DICOM v3.0 PS 3.3 and PS 3.4 for a complete definition of the entities, modules, and attributes.

TABLE 5.4-1
MODALITY WORKLIST INFORMATION MODEL MODULES

Entity Name	Module Name	Reference
Scheduled Procedure Step	SOP Common	5.5.2.1
	Scheduled Procedure Step	5.5.2.2
Requested Procedure	Requested Procedure	5.5.3.1
Imaging Service Request	Imaging Service Request	5.5.4.1
Visit	Visit Identification	5.5.5.2
	Visit Status	5.5.5.3
	Visit Relationship	3.5.5.4
	Visit Admission	5.5.5.1
Patient	Patient Relationship	5.5.6.1
	Patient Identification	5.5.6.2
	Patient Demographic	3.5.6.1
	Patient Medical	3.5.6.1

5.5 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 v3.0 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.

5.5.1 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

5.5.2 Scheduled Procedure Step Entity

5.5.2.1 SOP Common Module

TABLE 5.5-1
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 .

5.5.2.2 Scheduled Procedure Step Module

TABLE 5.5-2
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: • 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.

5.5.3 Requested Procedure Entity

5.5.3.1 Requested Procedure Module

TABLE 5.5-3
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	This value is not used. The Study Instance UIDs associated with all images acquired by the scanner are generated locally by the scanner itself .
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	

5.5.4 Imaging Service Request Entity

5.5.4.1 Imaging Service Request Module

TABLE 5.5-4
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	

5.5.5 Visit Entity

5.5.5.1 Visit Identification

TABLE 5.5-5
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	

5.5.5.2 Visit Status

TABLE 5.5-6
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.

5.5.5.3 Visit Relationship

TABLE 5.5-7
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	

5.5.5.4 Visit Admission

No data elements are requested from the Visit Admission Module.

5.5.6 Patient Entity

5.5.6.1 Patient Relationship

No data elements are requested from the Patient Relationship Module.

5.5.6.2 Patient Identification

TABLE 5.5-8
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.

5.5.6.3 Patient Demographic

TABLE 5.5-9
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	

5.5.6.4 Patient Medical

TABLE 5.5-10
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.

5.6   PRIVATE DATA DICTIONARY

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

6. PRINT SCU CONFORMANCE

6.1 INTRODUCTION

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

6.2 IMPLEMENTATION MODEL : PRINT SCU

The DICOM Print SCU is a DICOM print filter which provides the capability to print images to DICOM printers. The DICOM Print filter acts as an SCU of the DICOM print management SOP class.

6.2.1 Application Data Flow Diagram

DICOM print SCU Implementation model

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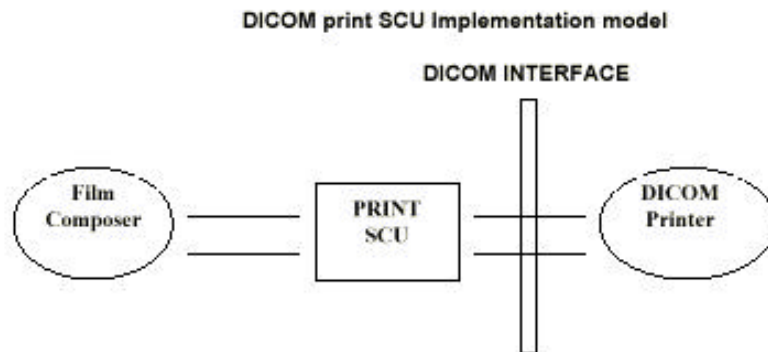
The Film Composer is the User interface and this is used to initiate the local real world activity. The user issues the print request using Film Composer. Film composer allows printer selection and it composes the pre-formatted film file. This film file is interpreted by Print SCU and it sends the appropriate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

4.2.2 Functional Definition of AE's

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

4.2.3 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 may be acquired for printing 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.

6.3 AE SPECIFICATIONS

6.3.1 DICOM Print SCU AE Specification

Print SCU provides Standard Conformance to the following DICOM 3.0 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**

6.3.1.1 Association Establishment Policy

6.3.1.1.1 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

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

6.3.1.1.2 Number of Associations

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

6.3.1.1.3 Asynchronous Nature

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

6.3.1.1.4 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 NX/i Implementation UID	1.2.840.113619.6.81

6.3.1.2 Association Establishment Policy

Print SCU initiates the association with the Printer.

6.3.1.2.1 Real World Activity

6.3.1.2.1.1 Associated Real-World Activity - "Print"

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.

6.3.1.2.1.2 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 Class	**1.2.840.10008.1.1**	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management SOP Class	**1.2.840.10008.5.1.1.18**	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
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 NX/i.

6.3.1.2.2 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.

Note: The asterisk (*) preceding some of the SOP attributes in the following sections indicates optional SCP attributes. The SCU is aware of these optional attributes and will not fail on the receipt of a response without the optional attributes; the limitation being that this information is not available for the User. Some SCP's will terminate the association with a failure upon the receipt of an optional attribute it does not support.

6.3.1.2.2.1 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. All other status "Failure" message will be sent. In all the cases the print session will be terminated.

6.3.1.2.2.2 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.

6.3.1.2.2.3 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.

6.3.1.2.2.4 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

6.3.1.2.2.5 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

6.3.1.3 Association Acceptance Policy

The Print SCU does not accept associations.

6.4 COMMUNICATION PROFILES

6.4.1 Supported Communication Stacks (parts 8,9)

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

6.4.1.1 TCP/IP Stack

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

6.4.1.1.1 API

Not Applicable

6.4.1.1.2 Physical Media Support

Ethernet v2.0, IEEE 802.3**.**

6.5 STANDARD EXTENDED/SPECIALIZED/PRIVATE SOPS

None.

6.6 CONFIGURATION

6.6.1 AE Title/Presentation Address Mapping

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

The HiSpeed NX/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.

6.6.2 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.

6.7 SUPPORT OF EXTENDED CHARACTER SET

The Print SCU does not support any Extended Character Set.

7. DICOM STORAGE COMMITMENT SCU CONFORMANCE

7.1 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.

7.2 IMPLEMENTATION MODEL

7.2.1 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
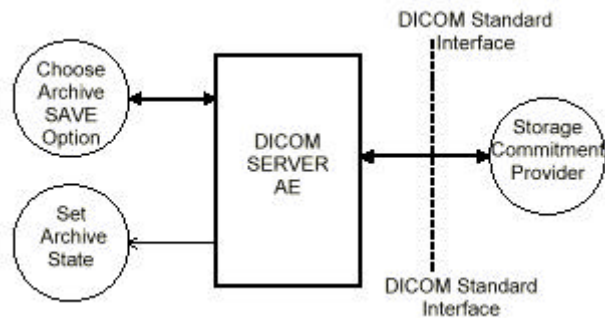
7.2.2 Functional definitions

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.

7.2.3 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.

7.3 AE SPECIFICATIONS

7.3.1 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

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 association initiated by the DICOM Storage Commitment SCU AE is:

Maximum Length PDU	10 Kbytes

7.3.1.1.2 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.

7.3.1.1.3 Asynchronous nature

Asynchronous window negotiation is not supported.

7.3.1.1.4 Implementation identifying information

The Implementation UID for this GEMS Implementation is:

HiSpeed NX/i Implementation UID	**1.2.840.113619.6.81**

7.3.1.2 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.

7.3.1.3 Real World Activity

7.3.1.3.1 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.

7.3.1.3.2 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.

7.3.1.4 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**
Name	**UID**	**Name List**	**UID List**		**Negotiation**
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

7.3.1.5 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 the response from provider on the same association for a configurable amount of time. If it does not receive the response 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.

7.3.1.6 Response Processing

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

The Archive flag information for all the successful instances will be turned on. Failed SOP instances will have

their archive flag information unaltered. Only the failure is reported and not the cause of the failure. It is left to the user's discretion whether the local sop instances (with their archive flag turned on) are to be deleted. Note that this is a shared flag with local archive.

In case of complete success the job queue entry will be removed. 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.

7.3.1.7 Association Acceptance Policy

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

7.4 COMMUNICATION PROFILES

7.4.1 Supported Communication Stacks (parts 8,9)

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

7.4.2 TCP/IP Stack

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

7.4.2.1 Physical Media Support

Ethernet v2.0, IEEE 802.3**.**

7.4.3 Point-to-Point Stack

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

7.5 EXTENSIONS/SPECIALIZATIONS/PRIVATIZATIONS

None.

7.6 CONFIGURATION

Ethernet v2.0, IEEE 802.3**.**

7.6.1 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.

7.6.2 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.

7.7 SUPPORT OF EXTENDED CHARACTER SETS

This does not support any Extended Character set.

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

TABLE A.1- 1 PRIVATE CREATOR IDENTIFICATION

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/rotation]	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 : beam thickness [mm] * pitch cine: 0 This element shall be encoded only for axial images.
Mid Scan Time [sec]	0019,xx24	3	DS	1	Mid scan time defined in **Error! Reference source not found.** 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 SFOV type value defined in **Error! Reference source not found.** shall be encoded. This element shall always be encoded.
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]
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.

Attribute Name	Tag	Type	VR	VM	Description
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 or CINE mode.
Scan Pitch Ratio	0043,xx27	3	SH	1	For helical scan, "HQ" or "HS" shall be encoded. For other scan type, nothing shall be encoded.
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.
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.
Detector Row	0043,xx6C	3	IS	1	"2" shall be encoded.
Z-smoothing Size	0043,xx6D	3	US	1	Z-smoothing size 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.

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
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. SC SPECIFIC IOD DEFINITION

Enclosed is a listing of SC IOD definition.

C.1 SC Specific IOD Definition

TABLE C.1- 1 SC IMAGE IOD MODULES

Entity Name		Reference
Patient		4.5.1.1
Study		4.5.2.1
		4.5.2.2
Series		4.5.3.1
Equipment		4.5.5.1
		C.2-1
Image		4.5.6.1
		4.5.6.3 (Only the type 1 elements are sent.)
		Not sent (consists entirely of type 3 elements).
		Only the type 1C elements are sent.
		4.5.7.1
		4.5.8.1

C.2 SC IOD COMMON MODULE DEFINITIONS

TABLE C.2-1
SC EQUIPMENT MODULE

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