

Technical Publications

**Direction 2227206
Revision 0**

**HiSpeed LX/i, FX/i, DX/i, DX/iB 2.00/2.01/2.02
CONFORMANCE STATEMENT
for DICOM v3.0**

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STATEMENT

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TABLE OF CONTENTS

1. INTRODUCTION	7
1.1 OVERVIEW	7
1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE	8
1.3 INTENDED AUDIENCE	9
1.4 SCOPE AND FIELD OF APPLICATION	9
1.5 IMPORTANT REMARKS	9
1.6 REFERENCES	10
1.7 DEFINITIONS	10
1.8 SYMBOLS AND ABBREVIATIONS	10
2. NETWORK CONFORMANCE STATEMENT	11
2.1 INTRODUCTION	11
2.2 IMPLEMENTATION MODEL	11
2.2.1 Application Data Flow Diagram	11
2.2.2 Functional Definition of AE's	12
2.2.3 Sequencing of Real-World Activities	13
2.3 AE SPECIFICATIONS	13
2.3.1 DICOM ServerAE Specification	13
2.4 COMMUNICATION PROFILES	30
2.4.1 Supported Communication Stacks (PS 3.8, PS 3.9)	30
2.4.2 OSI Stack	30
2.4.3 TCP/IP Stack	30
2.4.4 Point-to-Point Stack	31
2.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS	31
2.5.1 Private SOP Classes	31
2.5.2 Private Transfer Syntaxes	31
2.6 CONFIGURATION	32
2.6.1 AE Title/Presentation Address Mapping	32
2.6.2 Configurable Parameters	32
2.7 SUPPORT OF EXTENDED CHARACTER SETS	33
3. MEDIA STORAGE CONFORMANCE STATEMENT	34
3.1 INTRODUCTION	34
3.2 IMPLEMENTATION MODEL	34
3.2.1 Application Data Flow Diagram	34
3.2.2 Functional Definition of AE's	35
3.2.3 Sequencing Requirements	35

STATEMENT

DIR **2227206** REV 1.0

3.2.4 File Meta Information Options (See PS3.10)	35
3.3 AE SPECIFICATIONS	35
3.3.1 MOD Archive Specification	35
3.4 AUGMENTED AND PRIVATE APPLICATION PROFILES	38
3.4.1 Class and Profile Identification	38
3.4.2 Clinical Contexts	38
3.4.3 Standard Application Profiles	39
3.5 EXTENSIONS, SPECIALIZATIONS, PRIVATIZATIONS OF SOP CLASSES AND TRANSFER SYNTAXES	45
3.5.1 Extensions, Specializations, and Privatizations of SOP Classes	45
3.5.2 Private Transfer Syntax Specification	45
3.6 CONFIGURATION	46
3.7 SUPPORT OF EXTENDED CHARACTER SETS	46
4. CT INFORMATION OBJECT IMPLEMENTATION	47
4.1 INTRODUCTION	47
4.2 CT IOD IMPLEMENTATION	47
4.3 CT ENTITY-RELATIONSHIP MODEL	47
4.3.1 ENTITY DESCRIPTIONS	48
4.4 IOD MODULE TABLE	48
4.5 INFORMATION MODULE DEFINITIONS	49
4.5.1 Common Patient Entity Modules	50
4.5.2 Common Study Entity Modules	50
4.5.3 Common Series Entity Modules	52
4.5.4 Common Frame Of Reference Entity Modules	52
4.5.5 Common Equipment Entity Modules	54
4.5.6 Common Image Entity Modules	55
4.5.7 Common Lookup Table Modules	59
4.5.8 General Modules	60
4.5.9 CT Modules	60
4.6 PRIVATE DATA DICTIONARY	62
APPENDIX A. PRIVATE DATA ELEMENTS	63
APPENDIX B. DICOMDIR DIRECTORY INFORMATION	65

STATEMENT

DIR 2227206 REV 1.0

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

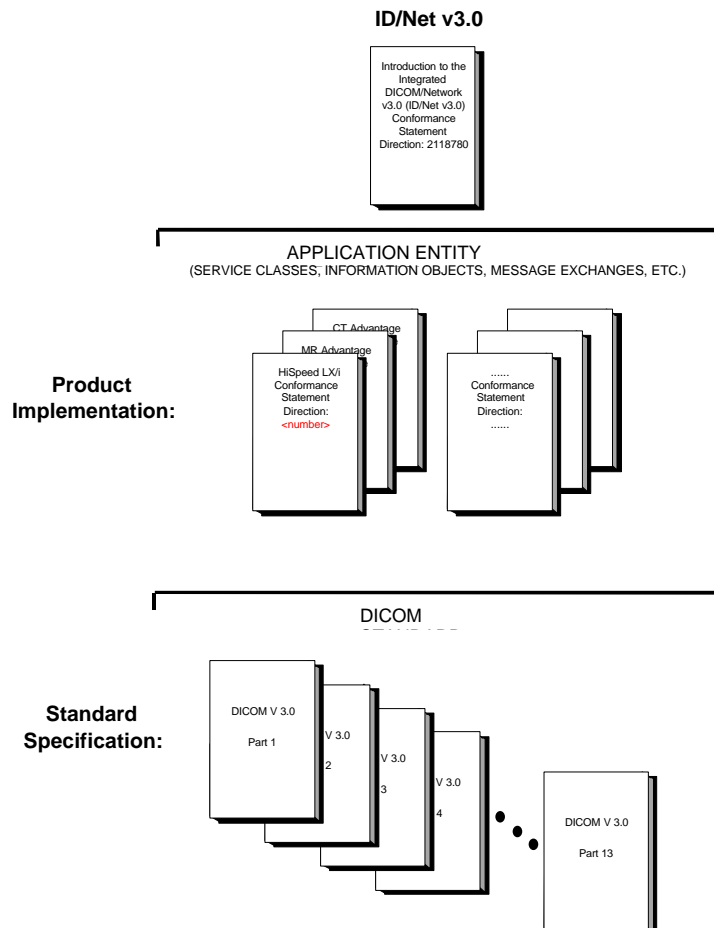
Section 2 (Network Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Networking features.

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 (HiSpeed LX/i Information Object Definition), Section 5 (Secondary Capture Image 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.

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.



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

HiSpeed LX/i, FX/i, Dx/i, DX/iB 2.00/2.01/2.02
Conformance Statement for DICOM v3.0
Direction **2227206**

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.

STATEMENT

DIR 2227206 REV 1.0

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**

STATEMENT

DIR 2227206 REV 1.0

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

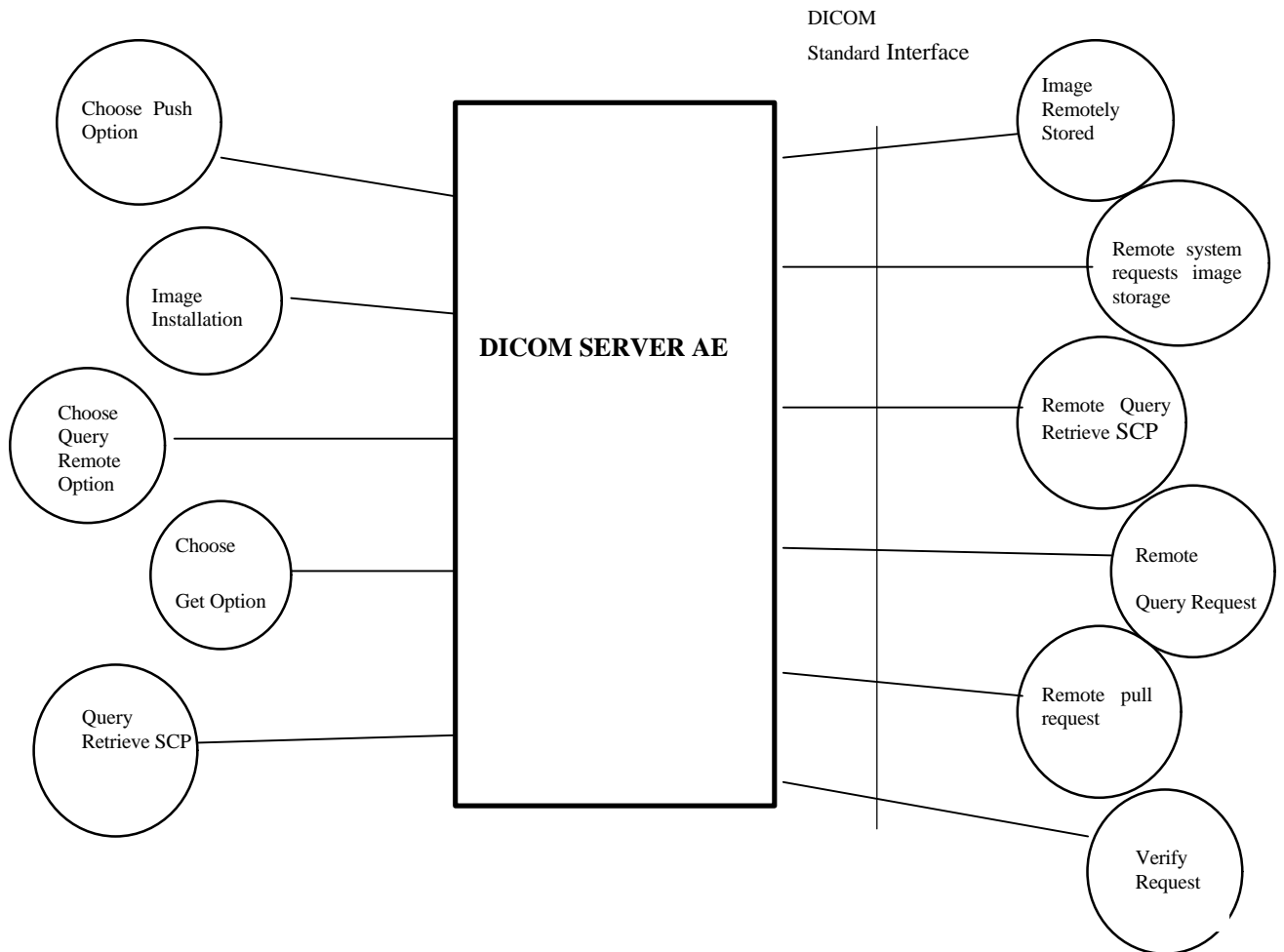
This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant **Networking** features on this GEMS product. Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that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

HiSpeed LX/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.

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:



STATEMENT

DIR 2227206 REV 1.0

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".

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 LX/i product.

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

2.2.2 Functional Definition of AE's

DICOM Server Application Entity initiates the following operations:

- 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.
- 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.
- 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:

STATEMENT

DIR 2227206 REV 1.0

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

2.2.3 Sequencing of Real-World Activities

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

2.3 AE SPECIFICATIONS

2.3.1 DICOM Server AE Specification

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

SOP Class Name	SOP Class UID
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
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8
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

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

STATEMENT

DIR 2227206 REV 1.0

SOP Class Name	SOP Class UID
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
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8
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
Verification SOP Class	1.2.840.10008.1.1

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	50Kbytes
---------------------------	-----------------

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

STATEMENT

DIR 2227206 REV 1.0

2.3.1.1.2 Number of Associations

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

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

2.3.1.1.3 Asynchronous Nature

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

2.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM v3.0 Implementation is:

HiSpeed LX/i Implementation UID	1.2.840.113619.6.22
--	----------------------------

The Implementation Version Name for this DICOM v3.0 Implementation is:

HiSpeed LX/i Implementation Version Name	NJ_1_0
---	---------------

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.

STATEMENT

DIR 2227206 REV 1.0

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 2.3.1.2.1-1 Proposed Presentation Contexts for DICOM Server AE and Real-World activity Push Image(s)

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.52		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.52		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.52		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Study Root Query/Retrieve	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

STATEMENT

DIR 2227206 REV 1.0

Information Model - FIND		Implicit VR Big Endian(GE Private)	1.2.840.113619.52		
		Explicit VR Little Endian			
		Explicit VR Big Endian	1.2.840.10008.1.2.1		
			1.2.840.10008.1.2.2		
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Implicit VR Big Endian(GE Private)	1.2.840.113619.52		
		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:

STATEMENT

DIR 2227206 REV 1.0

If the image is stored locally on the HiSpeed LX/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 LX/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.

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.

STATEMENT

DIR 2227206 REV 1.0

Table 2.3.1.2.2.1-1: Requested Study Level Keys

Description	Type	Tag	Value
Study date	R	0008,0020	Zero length
Study time	R	0008,0030	Zero length
Patient's name	R	0010,0010	Zero length
Study id	R	0020,0010	Zero length 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	GE_YMS_NJ001
Suite Id	P	0009,1002	Zero Length

Table 2.3.1.2.2.1-2: Requested Series Level Keys

Description	Type	Tag	Value
Modality	R	0008,0060	Zero length
Series number	R	0020,0011	Zero length
Series Instance UID	U	0020,000E	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

STATEMENT

DIR 2227206 REV 1.0

Table 2.3.1.2.2.1-3: 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	GE_YMS_NJ001
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

STATEMENT

DIR 2227206 REV 1.0

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.

STATEMENT

DIR 2227206 REV 1.0

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 LX/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 Endian VR Little	1.2.840.10008.1.2		SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit Endian VR Little	1.2.840.10008.1.2		SCP	None
CT Image Storage	1.2.840.10008.5.1.4.	Implicit VR Big	1.2.840.113619.5.2		SCP	None

STATEMENT

DIR 2227206 REV 1.0

	1.1.2	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
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
Standalone Overlay	1.2.840.10008.5.1.4.1.1.8	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Standalone Overlay	1.2.840.10008.5.1.4.1.1.8	Implicit VR Big Endian(GE Private)	1.2.840.113619.5.2	SCP	None
Standalone Overlay	1.2.840.10008.5.1.4.1.1.8	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
Standalone Overlay	1.2.840.10008.5.1.4.1.1.8	Explicit VR Big Endian	1.2.840.10008.1.2.2	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 one.

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 LX/i system.

STATEMENTDIR **2227206** REV 1.0

- 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 LX/i system.

Images may be deleted when instructed to do so by the user. Thus the users of the HiSpeed LX/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 (0009,1001) 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 (0009,1001) 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.

STATEMENT

DIR 2227206 REV 1.0

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					
----------------------------	--	--	--	--	--

STATEMENT

DIR 2227206 REV 1.0

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

2.3.1.3.3.2.1 SOP Specific Conformance to C-FIND SCP

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

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

Table 2.3.1.3.3.2.1-1 Supported study level keys

Description	Type	Tag	Usage
Study date	R	0008,0020	Matched
Study time	R	0008,0030	Matched
Accession number	R	0008,0050	Matched
Patient’s name	R	0010,0010	Matched
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	GE_YMS_NJ001
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

STATEMENT

DIR 2227206 REV 1.0

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

STATEMENT

DIR 2227206 REV 1.0

Private Creator Identification	P	0019,0010	GE_YMS_NJ001
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_RELTA_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.

STATEMENT

DIR 2227206 REV 1.0

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

Except sequence matching all other matchings are supported.

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:

STATEMENT

DIR 2227206 REV 1.0

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
Standalone Overlay storage	1.2.840.10008.5.1.4.1.1.8

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 than one acceptable transfer syntaxes are proposed for the same SOP class (in separate presentation contexts). It is the responsibility of the SCU to make a selection from the list of accepted presentation contexts that apply to any particular SOP class. If multiple transfer syntaxes are proposed in the same presentation context, the SCP will accept the first one.

2.4 COMMUNICATION PROFILES

2.4.1 Supported Communication Stacks (PS 3.8, PS 3.9)

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

2.4.2 OSI Stack

OSI stack not supported

2.4.3 TCP/IP Stack

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

2.4.3.1 API

Not applicable to this product.

STATEMENT

DIR 2227206 REV 1.0

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.

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.

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		

STATEMENT

DIR 2227206 REV 1.0

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

2.6.2 Configurable Parameters

The following fields are configurable for the DICOM Server AE:

- Local AE Title (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*

STATEMENT

DIR 2227206 REV 1.0

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

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

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

2.7 SUPPORT OF EXTENDED CHARACTER SETS

No extended character sets supported.

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

STATEMENT

DIR 2227206 REV 1.0

3. MEDIA STORAGE CONFORMANCE STATEMENT

3.1 INTRODUCTION

This section of the conformance statement (CS) specifies the HiSpeed LX/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 2.00

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.

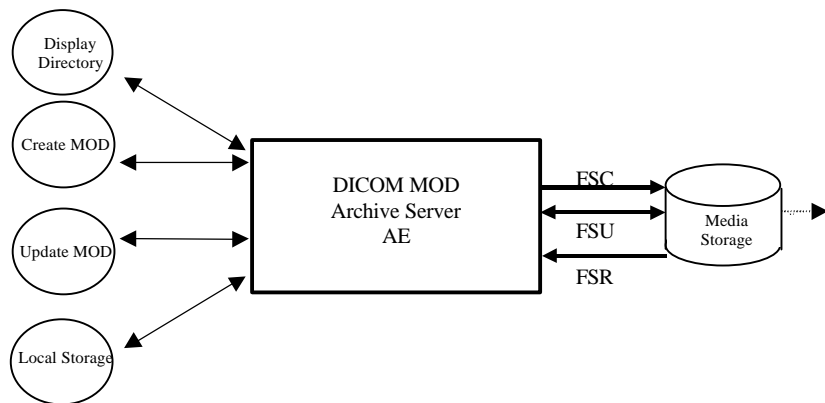
3.2 IMPLEMENTATION MODEL

All DICOM functionality on the HiSpeed LX/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.

STATEMENT

DIR 2227206 REV 1.0

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 LX/i Implementation UID	1.2.840.113619.6.22
Implementation Version Name	NJ_1_0

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

STATEMENT

DIR 2227206 REV 1.0

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

STATEMENT

DIR 2227206 REV 1.0

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.

STATEMENT

DIR 2227206 REV 1.0

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 and Standalone Overlay Images. Typical interchanges would be between acquisition devices, archives and workstations within and between institutions.

STATEMENT

DIR 2227206 REV 1.0

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.

STATEMENT

DIR 2227206 REV 1.0

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 1.2.840.10008.1.2.2	O	M	O
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
Standalone Overlay	1.2.840.10008.5.1.4.1.1.8	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	O	O
Standalone Overlay	1.2.840.10008.5.1.4.1.1.8	JPEG Lossless Process Selection Value 14 1.2.840.10008.1.2.4.70	O	O	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.

STATEMENT

DIR 227206 REV 1.0

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

36 - 37	0x0080	0x8000	Physical Drive number = 80
38	0x29	0x29	Extended boot record signature = 41
39 - 42	<i>Date Stamp</i>	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

STATEMENT

DIR 2227206 REV 1.0

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 and Standalone Overlay SOP Class Images. Otherwise the HiSpeed LX/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 Rewritable physical media with the PC File System as defined in PS3.12.

STATEMENT

DIR 2227206 REV 1.0

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

STATEMENT

DIR 2227206 REV 1.0

38	0x29	0x29	Extended boot record signature = 41
39 - 42	<i>Date Stamp</i>	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

STATEMENT

DIR 2227206 REV 1.0

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 and Standalone Overlay SOP Class Images. Otherwise the HiSpeed LX/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

STATEMENT

DIR 2227206 REV 1.0

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.

STATEMENT

DIR 2227206 REV 1.0

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

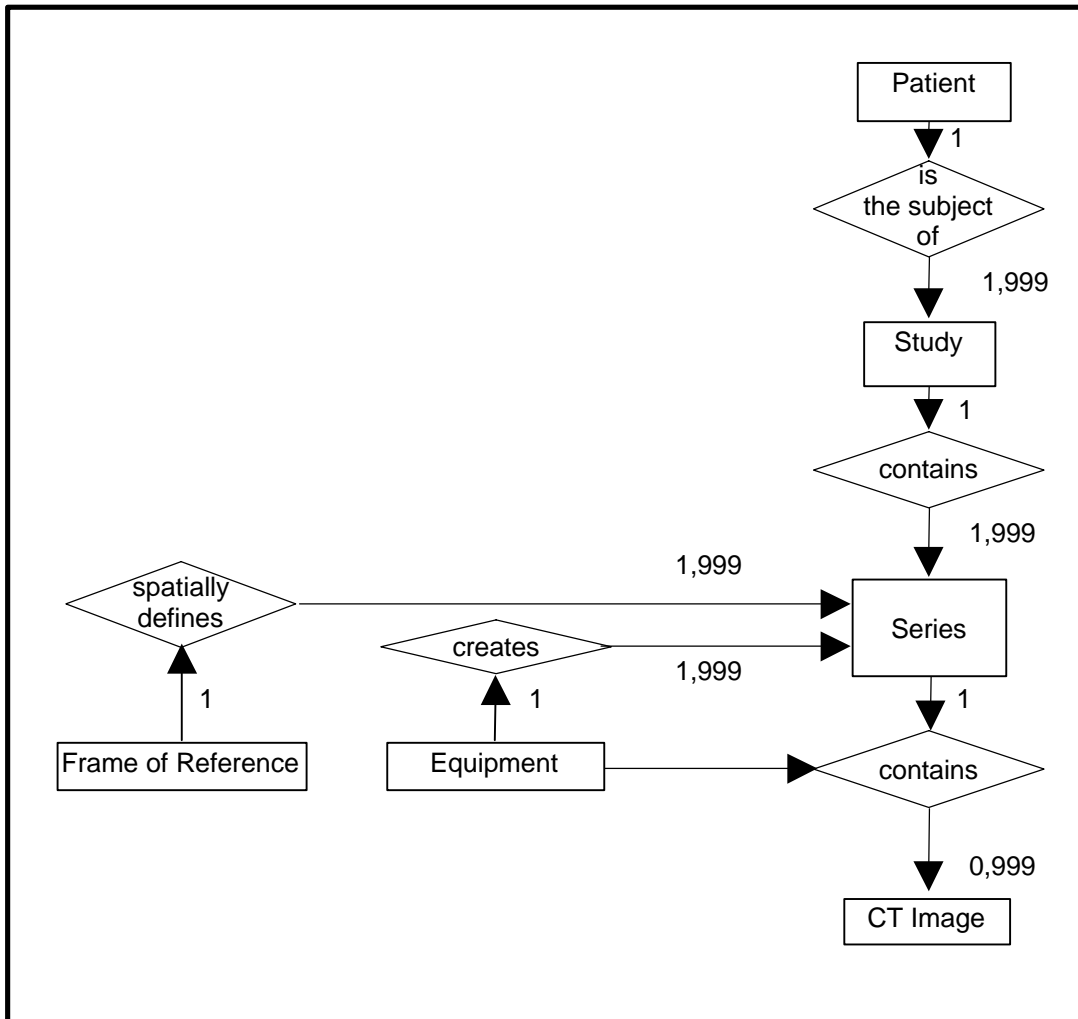
4.3 CT ENTITY-RELATIONSHIP MODEL

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.

STATEMENT

DIR 2227206 REV 1.0

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

4.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM 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).

STATEMENT

DIR 2227206 REV 1.0

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 25 characters.
Patient ID	(0010,0020)	2	Primary hospital identification number or code for the patient. Truncated to 12 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.

STATEMENT

DIR 2227206 REV 1.0

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	Always sent as 0
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.

STATEMENT

DIR 2227206 REV 1.0

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.
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

STATEMENT

DIR 2227206 REV 1.0

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.

Describe here the criteria used to group images into a Series and define multiple Series within a Study which share the same imaging space.

**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.

STATEMENT

DIR 2227206 REV 1.0

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.
Institution Address	(0008,0081)	3	Mailing address of the institution where the equipment is located that produced the digital images. Always sent as “on the earth” in this implementation.
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. Always sent as “HiSpeed” in this implementation.
Device Serial Number	(0018,1000)	3	Manufacturer's serial number of the equipment that produced the digital images. Sent as 0000287.XXXXXXX. XXXXXXXX is user defined number.
Software Versions	(0018,1020)	3	Manufacturer's designation of software version of the equipment that produced the digital images. Sent as “Series 2.0X”. X is either 0,1 or 2.
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.

STATEMENT

DIR 2227206 REV 1.0

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 Image Sequence	(0008,1140)	3	A sequence which provides reference to a set of Image SOP Class/Instance identifying other images significantly related to this image.
>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.

STATEMENT

DIR 2227206 REV 1.0

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.
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.
Slice Thickness	(0018,0050)	2	Nominal slice thickness, in mm.
Slice Location	(0020,1041)	3	Relative position of exposure expressed in mm.

STATEMENT

DIR 2227206 REV 1.0

4.5.6.3 Image Pixel Module

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

**TABLE 4.5.6.3
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data.
Rows	(0028,0010)	1	Number of rows in the image.
Columns	(0028,0011)	1	Number of columns in the image
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit.
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values: 0000H = unsigned integer. 0001H = 2's complement
Pixel Data	(7FE0,0010)	1	A data stream of the pixel samples which comprise the Image.
Planar Configuration	(0028,0006)	1C	Indicates whether the pixel data are sent color-by-plane or color-by-pixel. Required if Samples per Pixel (0028,0002) has a value greater than 1.
Pixel Aspect Ratio	(0028,0034)	1C	Ratio of the vertical size and horizontal size of the pixels in the image specified by a pair of integer values where the first value is the vertical pixel size, and the second value is the horizontal pixel size. Required if the aspect ratio is not 1\1 and the Image Plane Module is not applicable to this Image.
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Descriptor Specifies the format of the Red Palette Color Lookup Table Data (0028,1201) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB.

STATEMENT

DIR 2227206 REV 1.0

Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Specifies the format of the Green Palette Color Lookup Table Data (0028,1202) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB.
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Specifies the format of the Blue Palette Color Lookup Table Data (0028,1203) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB.
Red Palette Color Lookup Table Data	(0028,1201)	1C	Red Palette Color Lookup Table Data. Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB.
Green Palette Color Lookup Table Data	(0028,1202)	1C	Green Palette Color Lookup Table Data. Required if Photometric Interpretation(0028,0004) has a value of PALETTECOLOR or ARGB.
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Blue Palette Color Lookup Table Data. Required if Photometric Interpretation(0028,0004) has a value of PALETTECOLOR or ARGB.

STATEMENT

DIR 2227206 REV 1.0

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.
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
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.
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>>Code Value	(0008,0100)	1C	
>>Coding Scheme Designator	(0008,0102)	1C	

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.

STATEMENT

DIR 2227206 REV 1.0

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. Not sent in this implementation.
Instance Creation Date	(0008,0012)	3	Date the SOP Instance was created.
Instance Creation Time	(0008,0013)	3	Time the SOP Instance was created.
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.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data.
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored.

STATEMENT

DIR 2227206 REV 1.0

High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit.
Rescale Intercept	(0028, 1052)	1	The value b in relationship between stored values (SV) and Hounsfield (HU). $HU = m*SV+b$
Rescale Slope	(0028,1053)	1	m in the equation specified in Rescale Intercept (0028,1052).
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.
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
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. For devices with variable focal spot or multiple focalspots, small dimension followed by large dimension.

STATEMENT

DIR 2227206 REV 1.0

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"; "CHST"; or "PFRM".
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4.5.9.1.1 CT Image Attribute Descriptions

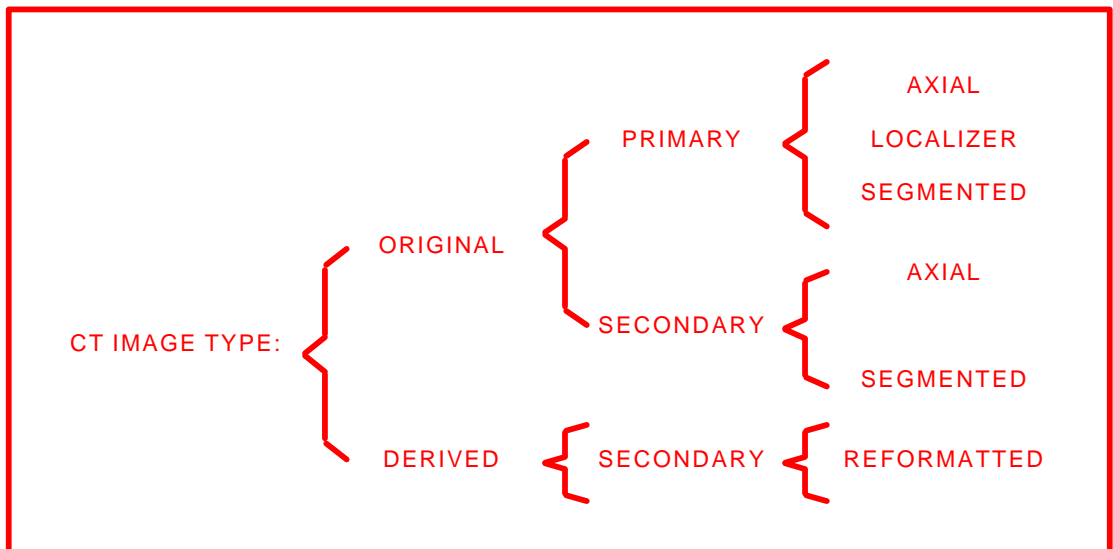
4.5.9.1.1.1 Image Type

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.

**ILLUSTRATION 4.5.9.1.1.1
CT IMAGE TYPE DECISION TREE**



4.6 PRIVATE DATA DICTIONARY

Refer to Appendix A.

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 (GE_YMS_NJ001)

Attribute Name	Tag	VR	VM
Mobile Location Code	(0009, 1031)	SH	1
Detector Channel	(0019, 1002)	SL	1
Table Speed	(0019, 1023)	DS	1
mid scan time	(0019, 1024)	DS	1
Tube Azimuth	(0019, 1026)	SL	1
Gantry Velocity	(0019, 1027)	DS	1
SFOV Type	(0019, 1039)	SS	1
Segment number	(0019, 1042)	SS	1
Total segments required	(0019, 1043)	SS	1
X-Ray Chain	(0043, 1012)	SS	3
Delta start time	(0043, 101E)	DS	1
Infant indicator	(0043, 1035)	US	1
language	(0043, 1036)	CS	1
Gantry type	(0043, 1037)	CS	1
Raw data ID	(0043, 1038)	SH	1
Reconstruction Matrix	(0043, 1039)	IS	1
Image Filter	(0043, 1040)	CS	1-n
Prospective Addition Indicator	(0043, 1041)	US	1
Motion Correction Indicator	(0043, 1043)	US	1
Helical Correction Indicator	(0043, 1044)	US	1
Cine Correction Indicator	(0043, 1045)	US	1
IBO Correction Indicator	(0043, 1046)	US	1
BBH Correction Indicator	(0043, 1047)	US	1
Advanced Noise Reduction Indicator	(0043, 1048)	US	1
Scatter Correction Indicator	(0043, 1049)	US	1
Recon Center Coordinates	(0043, 104A)	DS	3

STATEMENT

DIR 2227206 REV 1.0

Cross-Talk Correction Indicator	(0043, 1050)	US	1
Q-Cal Correction Indicator	(0043, 1051)	US	1
Afterglow Correction Indicator	(0043, 1052)	US	1
Local Decon Correction Indicator	(0043, 1053)	US	1
Scan Start Location	(0043, 1054)	DS	1
Scan End Location	(0043, 1055)	DS	1
Detector Row	(0043, 1056)	IS	1
Tube Focus	(0043, 1057)	CS	1

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

STATEMENT

DIR 2227206 REV 1.0

As indicated in table B.1.2, the PRI-CTMR-MOD12 application profile will have only the Patient, Study, Series and Image directory record types. 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	

STATEMENT

DIR 2227206 REV 1.0

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	

STATEMENT

DIR 2227206 REV 1.0

Image Orientation (Patient)	(0020,0037)	1C	
Frame of Reference UID	(0020,0052)	1C	Absent from PRI-CTMR-MOD12
Slice Location	(0020,1041)	3	
Samples Per Pixel	(0028,0002)	R	
Photometric Interpretation	(0028,0004)	R	Absent from all profiles
Rows	(0028,0010)	1	
Columns	(0028,0011)	1	
Pixel Spacing	(0028,0030)	1C	
Bits Allocated	(0028,0100)	R	
Bits Stored	(0028,0101)	R	MRI - Absent from profiles
High Bit	(0028,0102)	R	MRI - Absent from profiles