GE Healthcare

BrightSpeed* and LightSpeed RT16/Xtra Dicom Conformance Statement

for DICOM

* Refer to section 1 for a list of products in the Discovery and BrightSpeed and Optima families to which this Conformance Statement applies.

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REVISON HISTORY

REV.	DATE	REASON FOR CHANGE
1	10/26/2010	New document number and product/sw version based on DOC0793025 Rev1. Updated Overview and Instruction, removed Optima 660 and added BrightSpeed* and LightSpeed RT16/Xtra products and software version. Removed GSI Viewer and Advantage 4D in advantage applications of Instruction. Updated section 1.2 to change product name to BrightSpeed* and LightSpeed RT16/Xtra. Updated Appendix D to add implement UID of BrightSpeed* and LightSpeed RT16/Xtra with software version 10BW27.7. Removed the "Discovery CT 750 HD" line with 10MW00.00 from Appendix D. In section 3.3.1.1.1, changed “Windows2000” to “WindowsVista” since Media Viewer does not support Windows2000. Removed section A.2.2 because 10BW27.7 does not support Enhanced Dose SC feature. In section A.3.4, removed Body Part Examined tag (0018,0015) line because 10BW27.7 does not support GSI images. In section A.4.4, removed GSI* in notes of image type tag, and removed Note2 and warning messages followed. In section A.4.6, removed Creator Version UID tag (0008,9123) line because 10BW27.7 does not support GSI images. In section B.1.11, keeped (0053,1060) and (0053,1062), removed notes and all others tags lines because 10BW27.7 does not support multi-energy, shuttle mode, ASIR, shutter mode and overrapped recon. In Appendix D, removed all other products implement UID except BrightSpeed* and LightSpeed RT16/Xtra with 10BW27.7 per review comments.
2	11/17/2010	Changed DOC860682 to DOC0860282, DOC860682 is not right doc number.

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CONFORMANCE STATEMENT OVERVIEW

This DICOM Conformance Statement captures the DICOM capabilities of the GEHC CT scanners identified below. This document applies to the following software releases for each product:

BrightSpeed Elite	10BW27.7
BrightSpeed Elite Select	10BW27.7
BrightSpeed Edge Select	10BW27.7
BrightSpeed Excel Select	10BW27.7
LightSpeed RT16	10BW27.7
LightSpeed Xtra	10BW27.7

Table 0.1 provides an overview of the network services supported by GEHC CT products identified above

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Table 0.1 – NETWORK SERVICES

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
CT Image Storage	Yes	Yes
MR Image Storage	Yes	Yes
Secondary Capture Image Storage	Yes	Yes
Grayscale Softcopy Presentation State Storage	Yes	No
Enhanced SR	Yes	Yes
X-Ray Radiation Dose SR – CT Radiation Dose	Yes	Yes
RT Structure Set Storage	Yes	Yes
Positron Emission Tomography Image Storage	Yes	Yes
Query/Retrieve		
Study Root Query/Retrieve Information Model – FIND	Yes	Yes
Study Root Query/Retrieve Information Model – MOVE	Yes	Yes
Print Management		
Basic Grayscale Print Management Meta SOP Class	Yes	No
Basic Color Print Management Meta SOP Class	Yes	No
Print Job SOP Class	Yes	No
Printer SOP Class	Yes	No
Workflow Management		
Storage Commitment Push Model SOP Class	Yes	No
Modality Performed Procedure Step SOP Class	Yes	No
Basic Modality Worklist Information Model – FIND SOP Class	Yes	No

Table 0.2 provides an overview of the Media Storage Application Profiles supported by the CT products identified above.

Table 0.2 - MEDIA SERVICES

Media Storage Application Profile	Write Files (FSC or FSU)	Read Files (FSR)
Compact Disk – Recordable		
STD-GEN-CD	Yes / No	Yes
Magneto-Optical Disk		
PRI-CTMR-MOD12	Yes / Yes	Yes
STD-CTMR-MOD12	Yes / Yes	Yes
STD-CTMR-MOD23	Yes / Yes	Yes
STD-CTMR-MOD41	Yes / Yes	Yes
DVD		
STD-GEN-DVD-JPEG	Yes / N/A	No
USB		

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1 INTRODUCTION

Note: Throughout this entire document the term “GEHC CT” refers to the following products:

BrightSpeed Elite
BrightSpeed Elite Select
BrightSpeed Edge Select
BrightSpeed Excel Select
LightSpeed RT16
LightSpeed Xtra

This document applies to the following software releases for each product:

BrightSpeed Elite	10BW27.7
BrightSpeed Elite Select	10BW27.7
BrightSpeed Edge Select	10BW27.7
BrightSpeed Excel Select	10BW27.7
LightSpeed RT16	10BW27.7
LightSpeed Xtra	10BW27.7

Note: The GEHC CT product lines present an Image Works desktop, which contains advanced applications offered on the Advantage Workstation. The DICOM Conformance Statements related to these applications can be found at the following website:

http://www.gehealthcare.com/usen/interoperability/dicom/products/workstation_dicom.html

Advanced Application	DICOM Conformance Statement Reference on website
Cardiac (CardIQ Plus, CardEP)	Volume Viewer 9.x Applications 2087557 Rev 1
CT Perfusion 4 Multi-organ and Neuro	CT Perfusion V4.0 2329613-100 Rev 0
Reformat	Volume Viewer 9.x Applications 2087557 Rev 1
Volume Viewer	Volume Viewer 9.x Applications 2087557 Rev 1
Advantage CT Colonography Pro	Volume Viewer 9.x Applications 2087557 Rev 1
Advanced Vessel Analysis	Volume Viewer 9.x Applications 2087557 Rev 1

1.1 Overview

Section 1, Introduction, provides general information about the content and scope of this document.

Section 2, *Network Conformance Statement,* is the DICOM Conformance Statement related to this product Conformance Statements defines the subset of options selected from those offered by the DICOM standard.

Section 3, *Media Storage Conformance Statement*, is the DICOM Conformance Statement related to Media Storage Application Profile.

Section 4, *Print SCU Conformance Statement,* is the DICOM Conformance Statement related to DICOM Print SCU Application. This product uses DICOM Print SCU to print the images to DICOM Compliant Printers.

Section 5, *DICOM Storage Commitment SCU*, is the DICOM Conformance Statement related to DICOM Storage Commitment SCU Application. This product uses DICOM Storage Commitment Push Model to store the images using remote DICOM entity, which is Storage Commitment SCP.

Section 6, HIS/RIS (Modality Worklist) The ModalityWorklist option for GEHC CT allows a user to query for and display DICOM modality worklist information. ModalityWorklist is providing the DICOM C-FIND service as a service class user (SCU).

Section 7, Performed Procedure Step. The PPS option for GEHC CT, allows a Modality Performed Procedure Step to be communicated to the Hospital/Radiology information system. The PPS feature is providing the DICOM Modality Performed Procedure Step service as a service class user (SCU).

Section 8, Grayscale Presentation State. The Virtual Exam Split Option for GEHC CT provides the DICOM Modality GSPS service as a service class user (SCU).

Section 9, CT X-ray Radiation Dose Structured Report Object Implementation.

Appendix A specifies the CT IOD information object.

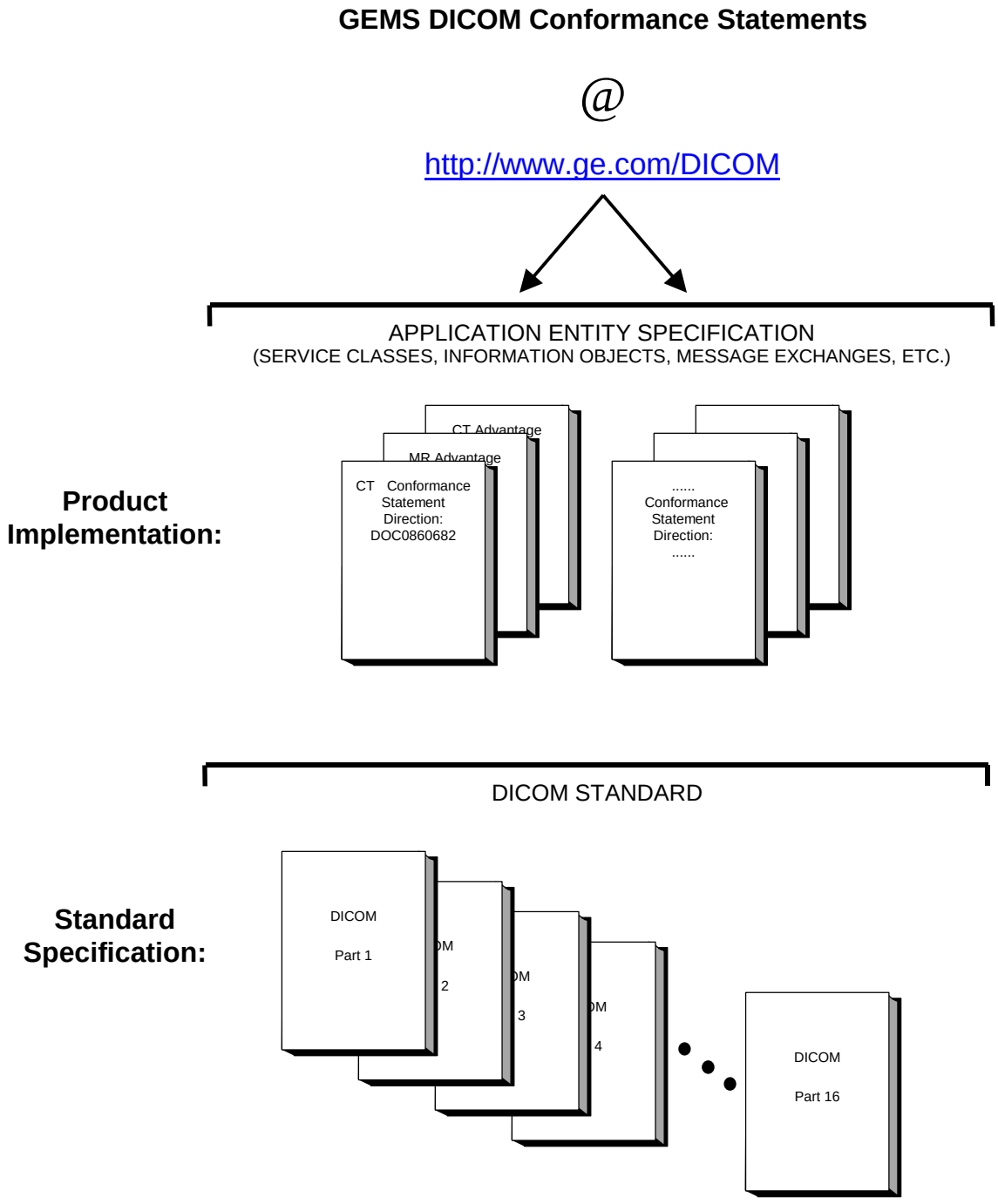
Appendix B specifies the private data element definition for CT IOD.

Appendix C specifies the DICOMDIR directory information.

Appendix D specifies Implementation UIDs for different product versions.

1.2 Overall Conformance Statement Documentation Structure

The Documentation Structure of the GEHC DICOM Conformance Statements is shown in the Illustration below.



This document specifies the DICOM implementation. It is entitled:

BrightSpeed and LightSpeed* DICOM Conformance Statement*

Conformance Statements

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This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required to interoperate with the GEHC network interface.

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

For more information regarding DICOM, copies of the Standard may be obtained on the Internet at http://medical.nema.org. Comments on the Standard may be addressed to:

DICOM Secretariat

NEMA

1300 N. 17th Street, Suite 1752

Rosslyn, VA 22209

USA

Phone : +1.703.841.320

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 Standard and with the terminology and concepts, that are used in that Standard.

1.4 Scope and Field of Application

It is the intent of this document to provide an unambiguous specification for GEHC implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GEHC medical data exchanged using DICOM. The GEHC Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEHC devices are capable of using different Information Object Definitions. For example, a GEHC 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 Definitionsused by this GEHC implementation. If the user encounters unspecified private data elements while parsing a GEHC

Data Set, the user is well advised to ignore those data elements (per the DICOM standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all of the private data elements that are sent by GEHC devices.

1.5 Important Remarks

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

- **Integration**

  The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM), and of this introduction and associated 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 integration analysis is correctly performed.

- **Validation**

  Testing the complete range of possible interactions between any GE device and non-GE devices, before the connection is declared operational, should not be overlooked. Therefore, the user should ensure that any non-GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non-GE device and the stability of the image data for the intended applications.

  Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.

- **Future Evolution**

  GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. Evolution of the Standard may require changes to devices that have implemented DICOM. In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) reflected on by these DICOM Conformance Statements. The user should ensure that any non-GE provider, which connects with GE devices, also plans future evolution of the DICOM standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE products are enhanced to support these changes.

- **Interaction**

  It is the sole responsibility of the non-GE provider to ensure that communications with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

1.6 References

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at http://medical.nema.org/

1.7 Definitions

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples : Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

Application Entity (AE) – an end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title – the externally known name of an *Application Entity*, used to identify a DICOM application to other DICOM applications on the network.

Application Context – the specification of the type of communication used between *Application Entities*. Example: DICOM network protocol.
Association – a network communication channel set up between *Application Entities*.

Attribute – – a unit of information in an object definition; a data element identified by a *tag*. The information may be a complex data structure (Sequence), itself composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD) – the specified set of *Attributes* that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The *Attributes* may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Joint Photographic Experts Group (JPEG) – a set of standardized image compression techniques, available for use by DICOM applications.

Media Application Profile – the specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)

Module – a set of *Attributes* within an *Information Object Definition* that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation – first phase of *Association* establishment that allows *Application Entities* to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context – the set of DICOM network services used over an *Association*, as negotiated between *Application Entities*; includes *Abstract Syntaxes* and *Transfer Syntaxes*.

Protocol Data Unit (PDU) – a packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

Security Profile – a set of mechanisms, such as encryption, user authentication, or digital signatures, used by an *Application Entity* to ensure confidentiality, integrity, and/or availability of exchanged DICOM data

Service Class Provider (SCP) – role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another *Application Entity* (*Service Class User*). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

Service Class User (SCU) – role of an *Application Entity* that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class – the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance – an information object; a specific occurrence of information exchanged in a *SOP Class*. Examples: a specific x-ray image.

Tag – a 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the “group” and the “element”. If the “group” number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

Transfer Syntax – the encoding used for exchange of DICOM information objects and messages. Examples: *JPEG* compressed (images), little endian explicit value representation.

Unique Identifier (UID) – a globally unique “dotted decimal” string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR) – the format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data

1.8 Symbols and Abbreviations

AE Application Entity

CD-R Compact Disk Recordable
CT Computed Tomography
DICOM Digital Imaging and Communications in Medicine
FSC File-Set Creator
FSU File-Set Updater
FSR File-Set Reader
GSPS Grayscale Softcopy Presentation State
HIS Hospital Information System
IHE Integrating the Healthcare Enterprise
IOD Information Object Definition
JPEG Joint Photographic Experts Group
MPPS Modality Performed Procedure Step
MSPS Modality Scheduled Procedure Step
MTU Maximum Transmission Unit (IP)
MWL Modality Worklist
NTP Network Time Protocol
O Optional (Key Attribute)
PACS Picture Archiving and Communication System
PET Positron Emission Tomography
R Required (Key Attribute)
RIS Radiology Information System
SC Secondary Capture
SCP Service Class Provider
SCU Service Class User
SOP Service-Object Pair
SR Structured Reporting
TCP/IP Transmission Control Protocol/Internet Protocol
U Unique (Key Attribute)
VR Value Representation

2 NETWORK CONFORMANCE STATEMENT

2.1 Introduction

This Conformance Statement (CS) specifies the GEHC CT compliance to DICOM. It details the DICOM Service Classes and roles that are supported by this product.

The GEHC CT product uses DICOM services to import images for possible further analysis and/or processing. It also uses DICOM services to export images to other DICOM-compliant machines.

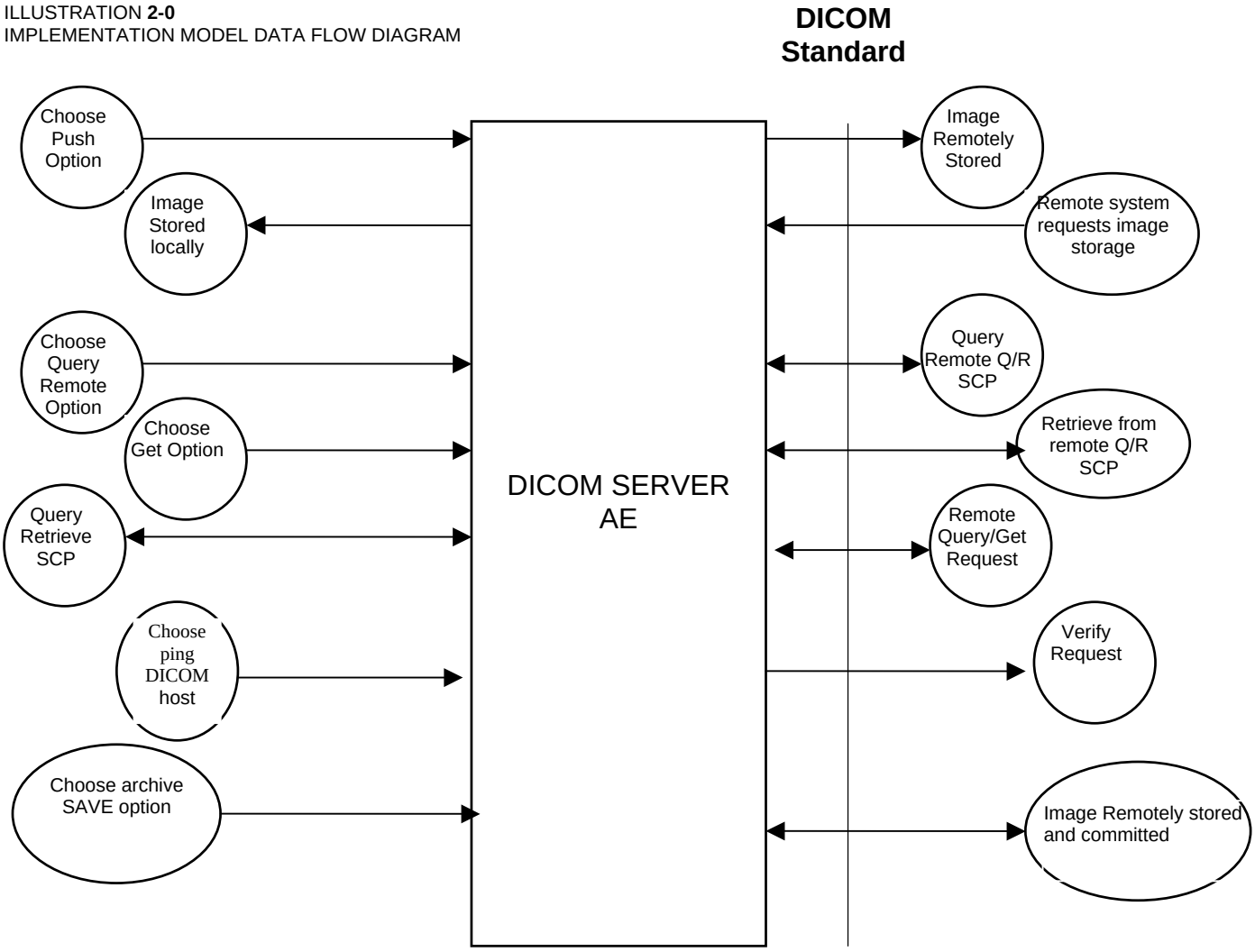
Note the format of this section follows the format of the DICOM Standard Part 2 (conformance) Annex A hence the paragraph numbering scheme. Please refer to that part of the standard while reading this section.

2.2 Implementation Model

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

2.2.1 Application Data Flow Diagram

ILLUSTRATION **2-0**
IMPLEMENTATION MODEL DATA FLOW DIAGRAM



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

(1) 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" pull-down menu on the local database manager to send the image(s) to a selected destination.

(2) 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.

(3) Real-World Activity, *Choose "Get" 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 "Get Examination", "Get Series", or "Get Images".

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

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

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

The DICOM Server AE will perform the Real-World activity Image Installation after the remote AE sends an image to the GEHC CT product.

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

2.2.2 Functional Definition of AE's

DICOM Server Application Entity initiates the following operations:

- *Ping DICOM Host (Verification):* The DICOM Server initiates an association and sends a C-ECHO-RQ message to the remote DICOM AE; the remote DICOM Server will send back a C-ECHO-RSP message with a status of "success".

- *Push:* Initiate an association to a Remote AE to send image(s). If the Remote AE accepts the presentation context applicable to the image(s) being sent, the DICOM Server AE will send the image(s) by invoking C-STORE-RQ operation for each image on the same association.

- *Query:* Initiate an association with a Remote AE to query for images on the remote host. A Study-Root Study-Level C-FIND-RQ request will be sent to the Remote AE once an association has been established. After all responses are received, DICOM Server AE will issue a Series-Level C-FIND-RQ request to get the series for a study in the list. An Image-Level C-FIND-RQ will be issued for the first series in the series list.

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

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

- *Verification*: If a C-ECHO-RQ message is received, the DICOM Server AE will send back a C-ECHO-RSP message with a status of “success”.

- *Image Storage*: If a C-STORE-RQ message is received, the DICOM Server AE will receive the image and try to update the local database. If the image is stored successfully on storage media and the database updated a status of “success” will be returned in a C-STORE-RSP message.

- *Query*: If a C-FIND-RQ message is received the DICOM Server AE will search the database for the requested attributes and send back a C-FIND-RSP message containing a match and a status of “pending”. After all matching records have been sent, a status of “success’ will be returned in a C-FIND-RSP message. The Remote AE can terminate the query by sending a C-CANCEL-FIND-RQ message.

- *Retrieve*: If a C-MOVE-RQ message is received the DICOM Server AE will lookup its list of configured Remote AEs for the Destination AE. If the Destination AE is configured, the DICOM Server AE will open a new association to the Destination AE and use C-STORE-RQ to send the image(s). The DICOM Server AE will send a C-MOVE-RSP message with a status of “pending” after every five images are sent. When all images are sent or if DICOM Server AE receives a C-CANCEL-MOVE-RQ a final C-STORE-RSP will be sent back with an appropriate status.

2.2.3 Sequencing of Real-World Activities

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

2.3 AE Specifications

2.3.1 DICOM Server AE Specification

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

SOP Class Name (SCU)	SOP Class UID
Verification (Echo)	1.2.840.10008.1.1
CT Image Information Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Information Storage	1.2.840.10008.5.1.4.1.1.4
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
X-Ray Radiation Dose SR Image Storage	1.2.840.10008.5.1.4.1.1.88.67
Enhanced SR Image Storage	1.2.840.10008.5.1.4.1.1.88.22
Study Root Query/Retrieve – FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve – MOVE	1.2.840.10008.5.1.4.1.2.2.2

Storage Commitment Push Model	1.2.840.10008.1.20.1
PET Image Information Storage	1.2.840.10008.5.1.4.1.1.128

Note: This Application Entity also supports GSPS as an SCU. Refer to section 8 for further details.

This Application Entity provides Standard Conformance to the following DICOM SOP classes as an SCP:

SOP Class Name (SCP)	SOP Class UID
Verification (Echo)	1.2.840.10008.1.1
CT Image Information Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Information Storage	1.2.840.10008.5.1.4.1.1.4
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22
Study Root Query/Retrieve – FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve – MOVE	1.2.840.10008.5.1.4.1.2.2.2
PET Image Information Storage	1.2.840.10008.5.1.4.1.1.128

2.3.1.1 Association Establishment Policy

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 association initiated by the DICOM Server AE is:

Maximum Length PDU	51 Kbytes

SOP class Extended Negotiation is not supported.

Maximum PDU Length of Zero (0) is not supported. The association request will be rejected when a request with “Maximum PDU length of zero” is received.

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

The user information items sent by this product are:

- Maximum PDU Length and,
- Implementation UID

2.3.1.1.2 Number of Associations

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

The DICOM Server AE (SCP) can have a maximum of four DICOM associations open simultaneously to receive and store image store 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 allows unique identification of a set of products that share the same implementation.

The table in Appendix D identifies the Implementation UID for this product version.

2.3.1.2 Association Initiation by Real-World Activity

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

2.3.1.2.1 Push Image(s) to Remote AE

2.3.1.2.1.1 Associated Real-World Activity

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

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

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

2.3.1.2.1.2 Proposed Presentation Contexts

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

Table 2.2.1.2.1.2-1 Proposed Presentation Contexts for DICOM Server AE and Real-World activities Push, Query, Pull (Get Images) and Verification (Dicom Ping) SCUs

Presentation Context Table – Proposal

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 Implicit VR Big Endian (GE Private) Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.113619.5.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian Implicit VR Big Endian (GE Private) Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.113619.5.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Implicit VR Big Endian (GE Private) Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.113619.5.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Study Root 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
Study Root 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
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

2.3.1.2.1.2.1 SOP Specific Conformance Statement C_STORE SCU

This implementation can perform multiple C-STORE operations over a single association.

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 or received and stops when the association is established. The time-out is 60 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.

Note: The time-outs are configurable.

When DICOM Server AE initiates an association to issue a C-STORE, the following will occur:

1. 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).

2.3.1.2.2 Query Remote AE

2.3.1.2.2.1 Associated Real-World Activity

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

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

To initiate a Query select “***Receive***” from “***Network***” pull-down menu.

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

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

2.3.1.2.2.2 Proposed Presentation Contexts

When the Real-World activity *“Query”* or *“Get”* is initiated all presentation contexts shown in table 2.2.1.2.1.2-1 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. Relational Queries are not supported. C-CANCEL-FIND-RQ is not supported.

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

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 it fails to parse. Tables 2.2.1.2.2.2.1-1 - 2.2.1.2.2.2.1-3 shows the various fields that are requested at the Study, Series, and Image levels of the C-FIND request.

Query results are filtered based on the Modality field. Only CT/MR Screen Save images are supported.

Table 2.2.1.2.2.2.1-1: Requested Study Level Keys

Description	Type	Tag	Value
Study date	R	0008,0020	Zero length
Study time	R	0008,0030	Zero length
Patient’s name	R	0010,0010	Zero length
Patient ID	R	0010,0020	Zero length
Study id	R	0020,0010	Zero length
Study Instance UID	U	0020,000D	Zero length
Study description	O	0008,1030	Zero length
Private Creator Identification	P	0009,00xx	GEMS_IDEN_01
Suite Id	P	0009,xx02	Zero Length

Table 2.2.1.2.2.2.1-2: Requested Series Level Keys

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

Table 2.2.1.2.2.2.1-3: Requested Image Level Keys

Description	Type	Tag	Value
Image number	R	0020,0013	Zero length
Image Instance UID	U	0008,0018	Image UID
Image type	O	0008,0008	Zero length
Rows	O	0028,0010	Zero length
Columns	O	0028,0011	Zero length
Image position	O	0020,0032	Zero length
Image orientation	O	0020,0037	Zero length
Slice thickness	O	0018,0050	Zero length

Description	Type	Tag	Value
Slice spacing	O	0018,0088	Zero length
Gantry tilt	O	0018,1120	Zero length
Convolution kernel	O	0018,1210	Zero length
Reconstruction diameter	O	0018,1100	Zero length
Data collection diameter	O	0018,0090	Zero length
Flip angle	O	0018,1314	Zero length
Echo number	O	0018,0086	Zero length
Echo time	O	0018,0081	Zero length
Inversion time	O	0018,0082	Zero length
Repetition time	O	0018,0080	Zero length
Private Creator Identification	P	0019,00xx	GEMS_ACQU_01
Dfov Rect	P	0019,001E	Zero Length
Dfov Rect	P	0019,xx1E	Zero Length
Midscan Time	P	0019,xx24	Zero Length
Azimuth	P	0019,xx26	Zero Length
Number of Echo	P	0019,xx7E	Zero Length
Private Creator Identification	P	0021,00xx	GEMS_RELA_01
Scout Anref	P	0021,xx4A	Zero Length
Private Creator Identification	P	0027,00xx	GEMS_IMAG_01
Location RAS	P	0027,xx40	Zero Length
Location	P	0027,xx41	Zero Length
Center R Coordinate	P	0027,xx42	Zero Length
Center A Coordinate	P	0027,xx43	Zero Length
Table Start Location	P	0027,xx50	Zero Length
Table End Location	P	0027,xx51	Zero Length
RAS Letter for Side of Image	P	0027,xx52	Zero Length
RAS Letter for Anterior/Posterior	P	0027,xx53	Zero Length
RAS Letter for Scout Start Location	P	0027,xx54	Zero Length
RAS Letter for Scout End Location	P	0027,xx55	Zero Length
Image Dimension X	P	0027,xx60	Zero Length
Image Dimension Y	P	0027,xx61	Zero Length

Note1: Refer to section 2.3.1.2.2.1 for Custom Search/Query option.

Note2: Type P refers to a private DICOM element.

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 2.2.1.2.1.2-1 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. A user attention pop-up will be posted if a failure status is received. The specific error message for the failure will be logged.

Each C-MOVE SCU operation supports an "Association Timer", "Operation Inactivity Timer" and "Session Timer" with time out values of 60 seconds, 300 seconds and 60 minutes respectively.

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

2.3.1.2.4 Real-World Activity: Verify (DICOM Ping)

2.3.1.2.4.1 Associated Real-World Activity

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

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

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

2.3.1.2.4.2 Proposed Presentation Context Table

Refer to the Table 2.2.1.2.1.2-1 for the Proposed Presentation Contexts for DICOM Server AE and Real-World activity Verification

2.3.1.2.4.2.1 SOP Specific DICOM Conformance C_ECHO SCU

The GEHC CT 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 60 seconds, 15 seconds and 60 minutes respectively

2.3.1.2.5 Real-World Activity: Storage Commitment

2.3.1.2.5.1 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. Select the

"*Update*" option, if the hostname is already present. Set the "*Archive Node*" option to "*Yes*". If the remote host is not present add the remote host in the local database with "*Archive Node*" option set to "*Yes*".

Note: The remote node should be a Storage Commitment SCP.

The operator must then select " Archive " pull-down menu on the local database manager. Select "*Select Media*" option menu. Select "*Remote Node*" in the menu.

Note: Only if you configure the remote node as a "*archive node"* will you see the remote node option in the archive menu.

The operator then selects one or more study, series, or images in the local database manager and then chooses "Save Examination", "Save Series", or "Save Image" from the "Archive" pull-down menu on the local database manager.

Note: Also refer to section 5.3.1.3

2.3.1.2.5.2 Proposed Presentation Context Table

Refer to section 5.3.1.4

2.3.1.2.5.3 SOP Specific Conformance Statement Storage Commitment SCU

Refer to section 5.3.1.4

2.3.1.3 Association Acceptance Policy

The DICOM Server AE places limitations on who may connect to it.

If the Remote AE needs to "Push Images" or "Query/Retrieve Images", to the local system then it has to be configured in the Local system to do the same.

To configure a remote AE choose "Select Remote Host" in the "network" pull down menu. Select the Remote Host and choose "Update" option, if the Remote AE is already present. If the Remote AE is not present choose "Add" option to add the Remote AE.

Set "Push Images" option to "Yes", if the Remote AE needs to push images to the Local system

Set "Query/Retrieve" option to "Yes", if the Remote AE needs to "Query/Retrieve" the local system.

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 GEHC CT.

2.3.1.3.1.2 Presentation Context Table

Table 2.2.1.3.1.2-1: Accepted Presentation Contexts for DICOM Server AE and Real-World Activity Receive Image(s)

Presentation Context Table - Accepted					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian Implicit VR Big Endian (GE Private) Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.113619.5.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian Implicit VR Big Endian (GE Private) Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.113619.5.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Implicit VR Big Endian (GE Private) Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.113619.5.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
X-ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.68	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

Note: Sequence of the transfer syntax depends on the dcs.cfg file present on the host machine.

By default, sequence is:

"1.2.840.10008.1.2.1" - ELE
"1.2.840.10008.1.2.2" - EBE
"1.2.840.10008.1.2" - ILE
"1.2.840.113619.5.2" – GEIBE

Based on the above sequence an transfer syntax table is created.
The transfer syntax table is iterated until it gets a match after getting the response from the remote host in the Association,

2.3.1.3.1.2.1 SOP Specific Conformance to C_STORE SCP

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. All of the **standard** type elements (1,1c,2,2c,3) will be retained.

Each C-STORE SCP operation supports an "Association Timer", "Operation Inactivity Timer" and "Session Timer" with time out values of 60 seconds, 900 seconds and 60 minutes respectively.

Association Timer – duration for SCP to respond to an association request.

Session Timer – duration from association to first command sent by SCU.

Inactivity Timer – duration between two commands after the association.

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 GEHC CT system.
- A712 (Out of Resources) Indicates that there was not enough resource (such as memory) to store the image.
- A800 (SOP Class not supported)

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

Images may be deleted when instructed to do so by the user. Thus the duration of the storage of the image is determined by the users of the GEHC CT system.

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 non-GE Created MR or CT Images

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

2.3.1.3.2 Verification Request from Remote AE

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

2.3.1.3.2.1 Associated Real-World Activity

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

2.3.1.3.2.2 Presentation Context Table

Table 2.2.1.3.2.2-1: 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 C_ECHO SCP

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

Each ECHO operation supports an “Operation Inactivity Timer” with time out value of 15 seconds.

2.3.1.3.3 Query Request from Remote AE

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

2.3.1.3.3.1 Associated Real-World Activity

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

2.3.1.3.3.2 Presentation Context Table

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

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		

Study Root Query/Retrieve FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

2.3.1.3.3.2.1 SOP Specific Conformance to C-FIND SCP

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
Suite Id	P	0009,0002	Returned

Table 2.3.1.3.3.2.1-2 Supported series level keys

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

Table 2.3.1.3.3.2.1-3 Supported image level keys

Description	Type	Tag	Usage
Image number	R	0020,0013	Matched
Image Instance UID	U	0008,0018	Matched
Image type	O	0008,0008	Returned
Rows	O	0028,0010	Returned
Columns	O	0028,0011	Returned
Image position	O	0020,0032	Returned
Image orientation	O	0020,0037	Returned
Slice thickness	O	0018,0050	Returned
Slice spacing	O	0018,0088	Returned
Gantry tilt	O	0018,1120	Returned
Convolution kernel	O	0018,1210	Returned

Description	Type	Tag	Usage
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
Dfov Rect	P	0019,001E	Returned
Midscan Time	P	0019,0024	Returned
Azimuth	P	0019,0026	Returned
Number of Echo	P	0019,007E	Returned
Scout Anref	P	0021,004A	Returned
Location RAS	P	0027,0040	Returned
Location	P	0027,0041	Returned
Center R Coordinate	P	0027,0042	Returned
Center A Coordinate	P	0027,0043	Returned
Table Start Location	P	0027,0050	Returned
Table End Location	P	0027,0051	Returned
RAS Letter for Side of Image	P	0027,0052	Returned
RAS Letter for Anterior/Posterior	P	0027,0053	Returned
RAS Letter for Scout Start Location	P	0027,0054	Returned
RAS Letter for Scout End Location	P	0027,0055	Returned
Image Dimension X	P	0027,0060	Returned
Image Dimension Y	P	0027,0061	Returned

Note: In the above tables the type field has the following meaning:
R = Required **U** = Unique **O** = Optional **P** = Private

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

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

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

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

Sequence matching is not supported.

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

Only hierarchical query is supported.

Special character ? can be used to match any single character and special character * can be used to match any character or set of characters for (0008, 0050) Accession Number, (0010, 0010) Patient's Name, (0010, 0020) Patient ID and (0020, 0010) Study ID.

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		
Study Root Query/Retrieve MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	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 60 seconds, 300 seconds and 60 minutes respectively. These time-outs are configurable in dcs.cfg as *bi_assoc_tio*, *bi_move_tio* and *bi_session_*tio respectively

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

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

SOP Class Name	SOP Class UID
CT Image Information Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Information Storage	1.2.840.10008.5.1.4.1.1.4
Secondary Capture image storage	1.2.840.10008.5.1.4.1.1.7
Standalone Overlay storage	1.2.840.10008.5.1.4.1.1.8
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22

PET Image Information Storage	1.2.840.10008.5.1.4.1.1.128

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

- C000 Indicates that an error occurred while retrieving records from the local database.
- C001 Indicates all other processing error.
- C011 If the Destination AE returns a *"Storage Full"* condition this status will be returned. This status will only be sent if the Destination AE returns a status of A711 and is only applicable if the Destination AE is another GE Medical Systems product.

2.3.1.3.4.3 Presentation Context Acceptance Criteria

No criterion.

2.3.1.3.4.4 Transfer Syntax Selection Policy

All protocols detailed above in the tables are supported; no priority selection is given.

2.4 Configuration

2.4.1 AE Title/Presentation Address Mapping

The GEHC CT 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.

2.4.2 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:
  *Association time-out - *bi_assoc_tio*
  *Session timeout - *bi_session_tio*
  *Create timeout - *bi_ncreate_tio*

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

Note: The local port on which the GEHC CT system receives DICOM incoming TCP connections is port 4006.

2.5 Support of Extended Character Sets

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

2.6 Codes and Controlled Terminology

The product uses coded terminology as defined below.

2.6.1 Mapped Coded Terminology

The product maps, without change, coded terminology values supplied in Modality Worklist Scheduled Procedure Steps into Image SOP Instance and Modality Performed Procedure Step attributes, as described in Sections 6 and 7.

2.7 Security Profiles

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

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

1. Firewall or router protections to ensure that only approved external hosts have network access to the product.
2. Firewall or router protections to ensure that the product only has network access to approved external hosts and services.
3. Any communications with external hosts and services outside the locally secured environment use appropriate secure network channels (such as a Virtual Private Network (VPN))

3 MEDIA STORAGE CONFORMANCE STATEMENT

3.1 Introduction

This conformance statement specifies the GEHC CT conformance to the DICOM Media Interchange. It details the DICOM Media Storage Application Profiles and roles that are supported by this product.

GEHC CT system provides capabilities to DICOM interchange on MODs, CD-R (Compact Disc-Recordable) and DVD-R(Digital Video Disc–Recordable).

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

3.2 Implementation Model

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

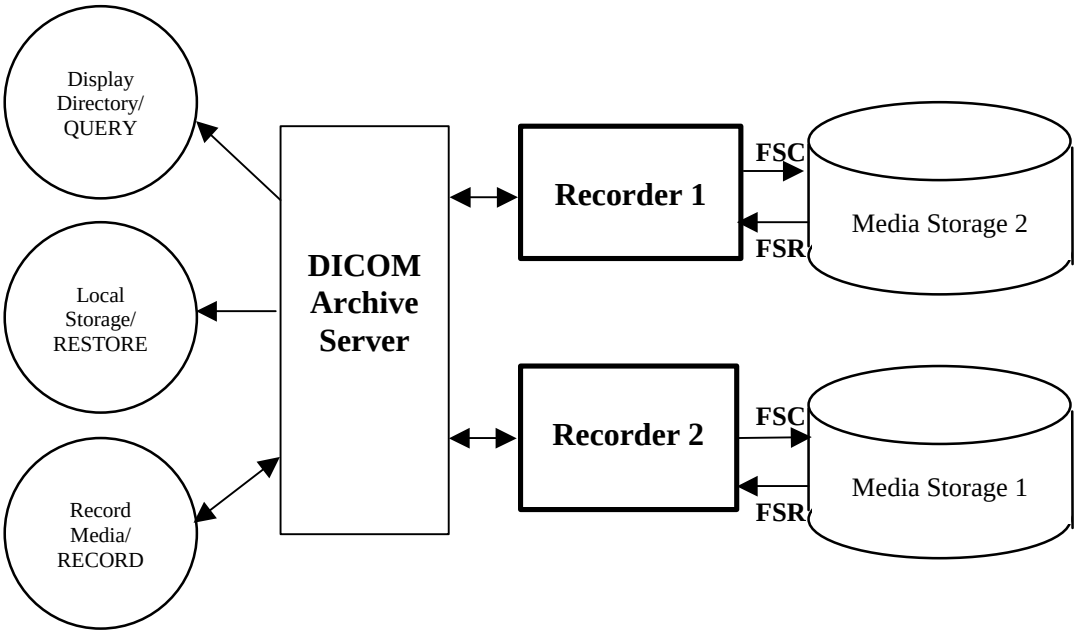
3.2.1 Application Data Flow Diagram

The Basic and Specific Application models for the MOD/CD-R/DVD-R devices are shown in the following Illustrations.

The DICOM Interchange Archive Server Application Entity (AE) handles the DICOM CREATE CD (/DVD) / RESTORE CD (/DVD) functionality for the CD-R/DVD-R media. The DICOM Interchange Archive Server Application Entity (AE) is commanded by the user to perform DICOM services operating on the DICOM media through the use of buttons and menu selections on the graphical user interface of the platform.

The user requests the creation of a DICOM File Set and the writing of this DICOM File Set on blank Interchange Media by selecting images in the local Browser and selecting the Interchange Media as being the selected device. Then, the iso9660 image of the CD/DVD to burn will be generated. Once the generation has been done, it burns the complete set of data on the selected Interchange Media.

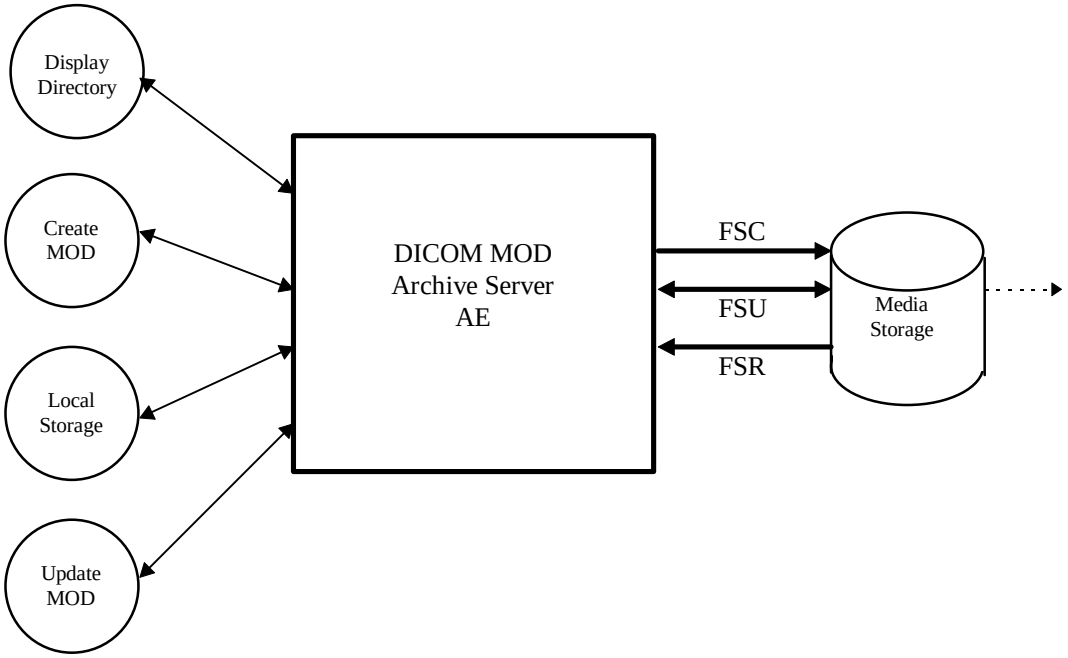
Illustration 3-1: Specific AE Application Model for the CD-R/DVD-R device



The DICOM Interchange 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 DICOM Interchange Archive Server AE can initialize Media by acting as an FSC to create a new DICOM File-set on a 700MB/4.7GB blank Interchange Media. It initializes the DICOM File-set and writes all the specified SOP instances onto the Interchange Media at once. The SOP instances written will be limited to instances that match the criteria of one of the Application Profiles that is supported. Updating the media is not supported.

Illustration 3-2: Specific AE Application Model for the MOD device



The MOD Archive Server AE has a local storage that may contain various SOP instances. These may have been obtained by original creation, network (DICOM or proprietary) or by removable media using other application entities. These instances are external to this conformance claim and the origin of SOP instances is outside the scope of this claim.

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

3.2.2 Functional Definitions of AE's

3.2.2.1 Functional Definition of the CD-R/DVD-R DICOM Media Server AE

The CD-R/DVD-R DICOM Interchange Archive Server Application Entity supports the following functions:

- Generate and write a DICOM File Set (FSC) in a one shot activity. (SAVE).
- Read a DICOM File Set (FSR) on a Interchange Media (QUERY).
- It can copy SOP instances from the media onto local storage. (RESTORE).

3.2.2.2 Functional Definition of the MOD DICOM Media Server AE

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 of Real World Activities

3.2.3.1 Sequencing of CD-R/DVD-R Real World Activities

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

The save function can only be performed on a blank (unused) Interchange Media. Updates to an already recorded Interchange Medium are not supported.

There are no other sequencing requirements.

3.2.3.2 Sequencing of MOD Real World Activities

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

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

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

There are no other sequencing requirements.

3.2.4 File Meta Information for Implementation Class and Version

The File Meta-Information for this implementation is:

- File Meta-Information Version 1
- Implementation Version Name ..... Helios Ver1

The table in Appendix D identifies the Implementation UID for this product version.

3.3 AE Specifications

3.3.1 DICOM CD-R/DVD-R Archive Specification

The DICOM CD-R/DVD-R Interchange Archive Server AE provides standard conformance to DICOM Interchange Option of the Media Storage Service Class. The supported Application Profiles and roles are listed in Table 3.1-1.

Table 3.1-1: Application Profile, Activities and Roles for MOD Update

Application Profiles Supported	Real World Activity	Role	SC Option
STD-GEN-CD	CREATE CD	FSC	Interchange
STD-GEN-CD	QUERY CD	FSR	Interchange
STD-GEN-CD	RESTORE CD	FSR	Interchange
STD-GEN-DVD	CREATE DVD	FSC	Interchange
STD-GEN-DVD	QUERY DVD	FSR	Interchange
STD-GEN-DVD	RESTORE DVD	FSR	Interchange

Note: JPEG compressed images are not supported in this implementation for both CD/DVD CREATE/RESTORE.

3.3.1.1 Real-World Activities for the CD-R/DVD-R DICOM Interchange Archive Server Application Entity

3.3.1.1.1 Real-World Activity (RWA) Create (Generate and Write) CD/DVD

The DICOM Media Server acts as an FSC using the interchange option when requested to copy SOP Instances from the local database to a CD-R/DVD-R.

The user selects the entries in the local database that he/she wants the DICOM Media Server to copy onto Interchange Media.

The graphic interface allows the user to select the entries (patients, studies, series or images) in the local database to be copied onto to the selected Interchange Media.

The DICOM Media Server creates one File Set per generated Interchange Media.

- A user can only create one copy of CD/DVD image for a drive at a time; any other attempt of creation will wait until the first one is complete.
- A user cannot create CD/DVD while restore CD/DVD is in process.

- A DICOM CD-Viewer is provided along with the selected object instances on the interchange media. This viewer can be loaded on a standard PC running WindowsXP or Windows Vista.

Before writing on the Interchange Medium, the DICOM Media Server checks for the following condition:

- The inserted media is blank and write-able. If the condition is not met, an error is displayed and the user needs to replace it with a blank media.

Note:

Since JPEG compression is not enabled, the transfer syntax for SOP Instances will always be Explicit VR Little Endian (ELE) Uncompressed Transfer Syntax, UID 1.2.840.10008.1.2.1. For any other IODs with Transfer syntax **other than** ELE, the corresponding SOP instance data are converted to ELE and then copied to CD/DVD. During the conversion to ELE, the private tags are stored with VR as UN if the syntax is implicit to facilitate fidelity.

The Object SOP instances have to be encoded with the ISO_IR 100 Specific Character set or DICOM Default Character Set.

3.3.1.1.1.1 Application Profiles for the RWA: Create CD/DVD

For the list of Application Profiles that invoke this AE for the Create CD /DVD RWA, see the Table in Section 3.3.1.2.3.1.1.

3.3.1.1.1.1.1 Options for STD-GEN-CD and STD-GEN-DVD-JPEG Application Profile:

Following are the SOP Classes supported by the RWA “Create CD/DVD”. All SOP Instances use the Explicit VR Little Endian Uncompressed Transfer Syntax, UID 1.2.840.10008.1.2.1. for creating CD/DVD.

SOP Class	SOP Class UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
PET Image Information Storage	1.2.840.10008.5.1.4.1.1.128
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
GEMS PET Raw Information Storage	1.2.840.113619.4.30
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
Enhanced Structured Report	1.2.840.10008.5.1.4.1.1.88.22

3.3.2 DICOM MOD Interchange Archive Server AE Specification

The MOD Archive provides standard conformance to DICOM Media Storage Service Class. The Application Profiles and roles are listed in Table 3.1-2.

Table 3.1-2: Application Profile, Activities and Roles for MOD Update

Application Profiles Supported	Real World Activity	Role	SC Option
STD-CTMR-MOD23	Create MOD	FSC	
	Update MOD	FSU	
	Display Directory	FSR	
	Copy To Local Storage	FSR	
STD-CTMR-MOD12	Create MOD	FSC	
	Update MOD	FSU	
	Display Directory	FSR	
	Copy To Local Storage	FSR	
PRI-CTMR-MOD12	Create MOD	FSC	
	Update MOD	FSU	
	Display Directory	FSR	
	Copy To Local Storage	FSR	
STD-CTMR-MOD41	Create MOD	FSC	
	Update MOD	FSU	
	Display Directory	FSR	
	Copy To Local Storage	FSR	

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 4.1GB, 2.3GB or 1.2GB media, the system will apply the correct characteristics as an FSC to meet the appropriate Application Profile.

As an FSU role, the system will produce directory sequences for each SOP instance that is added to the File-set consistent with the STD-CTMR-MOD {12,23,41} profile and it will make the File-set directory so that an early installed base system that only understands the PRI-CTMR-MOD12 profile will not be able to use the media. An upgrade to the installed base system will be required to learn how to be a FSU or FSR of the STD-CTMR-MOD {12,23,41} profile directory sequences.

3.3.2.1 File Meta Information for the Application Entity

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

- 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

3.3.2.2 Real World Activities

3.3.2.2.1 Real World Activity: Create MOD Request

The MOD Archive Application acts as an FSC 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 4.1 GB, 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 3.1-1. These SOP instances are written to the media and a corresponding DICOMDIR sequence record is created. The determination of the potentially applicable Application Profile is dependent on the type of media and the associated software on which the AE has been invoked.

3.3.2.2.1.1 Application Profiles for the RWA: Create MOD

For the list of Application Profiles that invoke this AE for the Create MOD RWA, see Table 3.1-1.

For extensions and specialization’s see section 3.4.

3.3.2.2.2 Real World Activity: Display Directory

The MOD Archive Application acts as an FSR 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.

3.3.2.2.2.1 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 3.1-1.

There are no extensions or specializations.

3.3.2.2.2.2 Options:

None applicable.

3.3.2.2.3 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.

3.3.2.2.3.1 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 3.1-1. For extensions and specialization's see section 3.4.

3.3.2.2.3.2 Options:

None applicable.

3.3.2.2.4 Real World Activity: Update MOD

The MOD Archive Application acts as an FSU when requested to update an MOD.

The MOD Archive Application will take the selected list of SOP instances and eliminate any SOP instance that does not correspond to permissible SOP instances listed in the Application Profiles Table 3.1-1. 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.

3.3.2.2.4.1 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 3.1-1. For extensions and specialization's see section 3.4.

3.3.2.2.4.2 Options:

None applicable.

3.4 Standard, 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 3.3.1-1.

Table 3.3.1-1: 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.
CT/MR Studies on 1.2 GB MOD media	PRI-CTMR-MOD12	Handles single 12 or 16 bit grayscale compressed / uncompressed images.

Application Profile	Identifier	Description
CT/MR Studies on 4.1 GB MOD media	STD-CTMR-MOD41	Handles single frame 8, 12 or 16 bit grayscale and 8 bit palette color, uncompressed and lossless compressed 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 with certain defined attributes. CT, MR, SC and OV images may coexist within the same File-set.

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

3.4.2.1 Roles and Service Class Options

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

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

The Application Entity acting as a File-set Creator generates a File Set under the STD-CTMR-MOD / PRI-CTMR-MOD12 Application Profile Class. Typical entities using this role would include CT or MR equipment and archive systems that generate a patient record to transfer to another institution. 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 that receive a transferred File Set. Typical entities using this role would include display workstations and archive systems that 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 Syntax.

3.4.2.1.3 File Set Updater

The role of File Set Updater is used by Application Entities that receive a transferred File Set and update it by the addition of information. Typical entities using this role would include analytic workstations that for instance may add to the File-set an information object containing a processed (e.g., edge-enhanced) image. Stations that update patient information objects would also use this role. 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.

FSU shall offer the ability to allow multi-session writes (additional information may be subsequently added to the volume).

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 Syntax's

This class of Application Profiles is based on the Media Storage Service Class (See PS3.4).

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

Table 3.4.3.1.1-1: IOD's and Transfer Syntax's for CTMR-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 Little Endian Uncompressed 1.2.840.10008.1.2.1	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 Little Endian Uncompressed 1.2.840.10008.1.2.1	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 (Grayscale and color)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	M	O
SC Image Storage (Grayscale and color)	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

Information Object Definition	SOP Class UID	Transfer Syntax and UID	FSC Req.	FSR Req.	FSU Req.
Standalone Overlay	1.2.840.10008.5.1.4.1.1.8	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	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.

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 table 3.3.3.1.3-1 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	*Date Stamp*		Volume serial number
43 - 53	0x47454D535F4449434F4D20		"GEMS-DICOM"
54 - 61	0x0...0	0x0…0	The file system label
62 - 509	-		Don't care. Any contents acceptable
510 - 511	0xAA55	0x55AA	Signature flag

3.4.3.1.4 Directory Information in DICOMDIR

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

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

Refer to *Appendix C* 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 GEHC CT 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.

3.4.3.1.5 Other Parameters

This section defines other parameters common to all specific Application Profiles in the PRI-CTMR-MOD12 class that need to be specified in order to ensure interoperable information interchange.

3.4.3.1.6 Image Attribute Values

The attributes listed in Table 3.4.3.1.6.1-1 used within the CT/MR/SC/Standalone Overlay Image files, shall take the values specified.

Table 3.4.3.1.6.1-1: CTMR-MOD Profiles Required Image Attribute Values for CT and MR, SC and OV Images

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

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

3.4.3.1.6.1 Attribute Value Precedence

None.

3.4.3.2 STD-CTMR-MOD23 Class Profile

3.4.3.2.1 SOP Classes and Transfer Syntax's

This class of Application Profiles is based on the Media Storage Service Class (See PS3.4).

SOP Classes and corresponding Transfer Syntax's supported by the STD-CTMR-MOD23 Application Profiles is also specified in the Table 3.3.3.1.1-1.

3.4.3.2.2 Physical Media and Media Formats

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

3.4.3.2.3 Logical Format

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

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

Bytes(s)	Big Endian	As Stored	Description
00 – 02		0xEB3C90	Jump instruction to loader (NOPs)
03 – 10	0x4d53444F53342E30		"MSDOS4.0" The formatting DOS (vendor specific)
11 – 12	0x0200	0x0002	512 bytes/sector
13	64	0x40	sectors/cluster
14-15	0x0001	0x0100	1 sector in boot record
16	0x02	0x02	2 File Allocation Tables (FAT)
17 – 18	0x0200	0x0002	512 root directory entries
19 – 20	0x0000	0x0000	Flag for more than 65536 sector/disk. Use offset 32 value
21	0xF8	0xF8	Flag for disk type; F0H if not otherwise specified
22 – 23	138	0x8A00	138 sectors/FAT
24 – 25	62	0x3E00	62 sectors/track
26 – 27	1	0x0100	1 side (head) per disk
28 – 31	00000000	0x0…0	0 reserved or hidden sectors
32 – 35	2244896	0x20412200	2244896 Total sector/disk. Varies from disk to disk
36 – 37	0x0080	0x8000	Physical Drive number = 80
38	0x29	0x29	Extended boot record signature = 41
39 – 42	*Date Stamp*		Volume serial number
43 – 53	0x47454D535F4449434F4D20		"GEMS-DICOM"
54 – 61	0x0...0	0x0…0	The file system label
62 – 509	-		Don't care. Any contents acceptable
510 – 511	0xAA55	0x55AA	Signature flag

3.4.3.2.4 Directory Information in DICOMDIR

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

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

Refer to *Appendix C* 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 GEHC CT 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.

3.4.3.2.5 Other Parameters

This section defines other parameters common to all specific Application Profiles in the PRI-CTMR-MOD12 class that need to be specified in order to ensure interoperable information interchange.

3.4.3.2.5.1 Image Attribute Values

The attributes listed in Table 3.3.3.1.5.1-1 used within the CT/MR/SC/Standalone Overlay Image files, shall take the values specified.

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

3.4.3.2.5.2 Attribute Value Precedence

None.

3.4.3.3 STD-CTMR-MOD41 Class Profile

3.4.3.3.1 SOP Classes and Transfer Syntax's

This class of Application Profiles is based on the Media Storage Service Class (See PS3.4).

SOP Classes and corresponding Transfer Syntax's supported by the STD-CTMR-MOD41 Application Profiles is also specified in the Table 3.4.3.1.1-1.

Table 3.4.3.3.1-1: IOD's and Transfer Syntax's for CTMR-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 Little Endian Uncompressed 1.2.840.10008.1.2.1	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 Little Endian Uncompressed 1.2.840.10008.1.2.1	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 Little Endian Uncompressed 1.2.840.10008.1.2.1	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 Little Endian Uncompressed 1.2.840.10008.1.2.1	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.

3.4.3.3.2 Physical Media and Media Formats

The STD-CTMR-MOD41 application profile requires the 130 mm 4.1GB R/W MOD physical medium with the PCDOS Media Format, as defined in PS 3.12.

3.4.3.3.3 Logical Format

The STD-CTMR-MOD41 Application profile media format conforms to the Logical Format specification in PS3.12. The following table 3.4.3.3.3-1 defines the specific values used for this profile.

Table 3.4.3.3.3-1: Boot Sector for STD-CTMR-MOD41 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	*Date Stamp*		Volume serial number
43 - 53	0x47454D535F4449434F4D20		"GEMS-DICOM"
54 - 61	0x0...0	0x0…0	The file system label
62 - 509	-		Don't care. Any contents acceptable
510 - 511	0xAA55	0x55AA	Signature flag

3.4.3.3.4 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 C* 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 GEHC CT DICOM media display browser will not list-up the series for contents rendering the retrieval to local storage impossible.

3.4.3.3.4.1 Additional Keys

None.

3.4.3.3.5 Other Parameters

This section defines other parameters common to all specific Application Profiles in the STD-CTMR-MOD41 class that need to be specified in order to ensure interoperable information interchange.

3.4.3.3.6 Image Attribute Values

The attributes listed in Table 3.4.3.3.6.1-1 used within the CT/MR/SC/Standalone Overlay Image files, shall take the values specified.

Table 3.4.3.3.6.1-1: CTMR-MOD Profiles Required Image Attribute Values for CT and MR, SC and OV Images

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

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

3.4.3.3.6.1 Attribute Value Precedence

None.

3.4.3.4 STD-GEN Class Profile

3.4.3.4.1 SOP Classes and Transfer Syntaxes

The class of Application Profile is based on the Media Storage Service Class with the Interchange Option.

SOP Classes and corresponding Transfer Syntaxes supported by the STD-GEN-CD and STD-GEN-DVD-JPEG Application Profiles are specified in Table 3.4.3.4.1-1.

Table 3.4.3.4.1-1 IOD's and Transfer Syntaxes for STD-GEN-CD and STD-GEN-DVD-JPEG 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
PET Image Information Storage	1.2.840.10008.5.1.4.1.1.128	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
PET Image Information Storage	1.2.840.10008.5.1.4.1.1.128	JPEG Lossless Process Selection Value 14 1.2.840.10008.1.2.4.70	O	M	O
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	JPEG Lossless Process Selection Value 14 1.2.840.10008.1.2.4.70	O	M	O
GEMS PET Raw Information Storage	1.2.840.113619.4.30	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
GEMS PET Raw Information Storage	1.2.840.113619.4.30	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
GSPS Storage	1.2.840.10008.5.1.4.1.1.11.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
GSPS Storage	1.2.840.10008.5.1.4.1.1.11.1	JPEG Lossless Process Selection Value 14 1.2.840.10008.1.2.4.70	O	M	O
Enhanced Structured Report	1.2.840.10008.5.1.4.1.1.88.22	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
Enhanced	1.2.840.10008.5.1.4.1.1.88.22	JPEG Lossless Process	O	M	O

Structured Report		Selection Value 14 1.2.840.10008.1.2.4.70			

M : Mandatory O : Optional

3.4.3.4.2 Physical Media and Media Formats

The STD-GEN-CD application profile requires the 120 mm CD-R physical medium with the ISO/IEC 9660 Media Format, as defined in PS3.12. The physical format of DICOM CD-R discs shall comply with the applicable definitions within ISO/IEC 10149, Part II: CD-WO and CD-ROM-XA (extended Architecture) with the additional modifications described below.

The STD-GEN-DVD-JPEG application profile requires any of the 120 mm DVD media other than DVD-RAM, as defined in PS 3.12.

3.4.3.4.2.1 STD-GEN-CD Media Details

Only one File-set shall be stored onto a single CD-R.

The ISO 9660 Standard provides a Volume Identifier in byte position 41 to 72 of the Primary Volume Descriptor. A DICOM File-Set is defined to be one volume, and the File-Set ID shall be placed in the Volume Identifier, starting with byte position 41. Extra bytes within the Volume Identifier shall be spaces (20H). The Volume Identifier for a File-Set ID consisting of zero characters shall consist of all spaces (20H).

Notes: 1. The character set for File IDs and File-set IDs (see PS 3.10) is a subset of the ISO 9660 character set, therefore no further restrictions need to be imposed.
2. Multiple ISO 9660 File-Sets on a single volume are achievable, but this profile does not support multiple file-sets.

The ISO 9660 standard provides a hierarchical structure for directories and files within directories. Each volume has a root directory that may contain references to both files and subdirectories. Subdirectories may contain reference to both files and other subdirectories.

A volume may have at most 8 levels of directories, where the root directory is defined as level 1. The nomenclature for referring to a file in the ISO 9660 standard is dependent upon the receiving system. For the purposes of this document, the following notation will be used:

a) / – For the root directory
b) /FILENAME.;1 – For a file in the root directory
c) /SUBDIR – For a subdirectory in the root directory
d) /SUBDIR/FILENAME.;1 – For a file in the subdirectory

Given a File ID consisting of N components, referred to as Comp1 through CompN, then the corresponding ISO 9660 file shall be named /Comp1/.../CompN.;1

The ISO 9660 File Name Extension shall not be used.

The ISO 9660 standard requires the two separators "." and ";" to demarcate a "File Name Extension" and a "Version Number". To remain compatible with the ISO standard, the version number shall be 1.

Notes: 1. The above specified file ID mapping corresponds to ISO 9660 Level 1 compliance. it ensures the greatest level of compatibility across receiving systems.
The following is an example of the DICOM to ISO 9660 file mapping:

DICOM File ID ISO 9660 File Name

DICOMDIR /DICOMDIR.;1
SUBDIRA\IMAGE1 /SUBDIRA/IMAGE1.;1

A DICOMDIR file in a DICOM File-set shall reside in the root directory of the directory hierarchy, and shall be named /DICOMDIR.;1.

Multiple DICOMDIR files shall not be stored on a single volume.

A Directory record in ISO 9660 provides for a Recording Data and Time field which shall be set to the creation date of the file. File modification data, file owner identification, and permissions are part of the ISO 9660 – Extended Attribute Record. The Extended Attribute Record is not required by this annex and shall be ignored at this time. To ensure future backwards compatibility and file accessibility, the Extended Attribute Record Length and File Flag of the Directory record shall be set as follows for each file. The Extended Attribute Record Length (byte position 2) shall be zero. The File Flags (byte position 26) shall have bit positions 3 and 4 set to zero.

3.4.3.4.2.1.1 CD-R Sector Format

All DICOM files and all data that comprise the ISO 9660 file system of the DICOM CD-R disc shall be

stored either:

- within Mode 1 sectors, or
- within Mode 2, Form 1 sectors with CD-ROM-XA File Number = 0, Channel Number = 0 and Coding Information Byte = 0.

3.4.3.4.2.2 DVD-R Media Format Details

The reader shall be able to read a logical format conforming to UDF and ISO 9660 filesystems. The creator shall be able to create a logical format conforming to UDF or ISO 9660 filesystems or both, as defined below. No requirements are defined for an updater.

Note: The intent of these requirements is to insist that a reader be able to read media created by any creator, but not to require that media created by a particular creator can necessarily be updated by a different updater.

For more information on DICOM UDF requirements, refer to PS3.12.

3.4.3.4.3 Logical Format

The logical format of CD-R/DVD-R shall conform to ISO 9660 level 1, with the following extensions:

The ISO 9660 System Identifier Field of the PVD (Primary Volume Descriptor) shall contain "CD-RTOS CD-BRIDGE" if a CD-I (Compact Disc-Interactive) application is present. If a CD-I application is not present, then this field shall be padded with space characters.

The ISO 9660 System and Volume Descriptor Area (SVD) from the last session points to the set of ISO 9660 Path Tables and Directory Records that describes the file system of the DICOM CD-R disc. The SVD area starts at the first logical sector of each session and continues through to the first instance of the Volume Descriptor Set Terminator. Adding, replacing or deleting files from the disc is accomplished by opening a new session and writing within the new session new data (if any), a new set of Path Tables, and Directory Records that reflect the changes, and an SVD area that points to the new set of Path Tables and Directory records.

3.4.3.4.4 Directory Information in DICOMDIR

Conformant Application Entities shall include in the DICOMDIR File the Basic Directory IOD containing Directory Records at the Patient and the subsidiary Study and Series levels, appropriate to the SOP Classes in the File Set. Directory Records shall reference all DICOM files in the File Set incorporating SOP Instances defined for the specific Application Profile.

Note: this Application Profile does not allow DICOMDIRs with no directory information.

All implementations shall include the DICOM Media Storage Directory in the DICOMDIR file. There shall only be one DICOMDIR file per File Set. The DICOMDIR file shall be in the root directory of the medium.

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

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

3.4.3.4.4.1 Additional Keys

None.

3.4.3.4.5 Other Parameters

3.4.3.4.5.1 DVD MultiFrame JPEG Format

The JPEG encoding of pixel data shall use Interchange Format (with table specification) for all frames.

3.4.3.4.5.2 Image Attribute Values

None.

3.4.3.4.5.2.1 Attribute Value Precedence

None.

3.4.4 Private Application Profiles

The MOD Archive Server supports a private Application Profile: PRI-CTMR-MOD12 as an FSR or FSU.

3.4.4.1 PRI-CTMR-MOD12 Class Profile

3.4.4.1.1 SOP Classes and Transfer Syntax

This class of Application Profiles is based on the Media Storage Service Class (See PS3.4).

SOP Classes and corresponding Transfer Syntax supported by the PRI-CTMR-MOD12 Application Profiles is specified in the Table 3.3.3.1.1-1.

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.

The SOP instance files in the Media File-set in the PRI-CTMR-MOD12 profile uses a non-standard JPEG compression process resulting in interoperability problems when decoded using readily available industry decompression routines. See section 3.4.2 for details of the encoding problem unique to the PRI-CTMR-MOD12 profile.

3.4.4.1.2 Physical Media and Media Formats

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

3.4.4.1.3 Logical Format

The PRI-CTMR-MOD12 Application profile media format conforms to the Logical Format specification in PS3.12. The table 3.3.3.1.3-1 defines the specific values used for this profile.

3.4.4.1.4 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 C* 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.

Directory records found in the PRI-CTMR-MOD12 profile do not contain the Attribute "Frame of Reference" (0020,0052). This Attribute was specified as Required after the first release of this Application Profile.

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 GEHC CT DICOM media display browser will not list-up the series for contents rendering the retrieval to local storage impossible.

3.4.4.1.4.1 Additional Keys

None.

3.4.4.1.5 Other Parameters

This section defines other parameters common to all specific Application Profiles in the PRI-CTMR-MOD12 class that need to be specified in order to ensure interoperable information interchange.

See 3.4.2 for JPEG encoding problem in the PRI-CTMR-MOD12 profile.

3.4.4.1.5.1 Image Attribute Values

The attributes listed in Table 3.3.3.1.5.1-1 used within the CT/MR/SC/Standalone Overlay Image files, shall take the values specified.

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

3.4.4.1.5.2 Attribute Value Precedence

None.

3.5 Extensions, Specializations and Privatization of SOP Classes and Transfer Syntax

3.5.1 Extensions, Specialization's and Privatization's 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 B*** for private data elements.

3.5.1.2 SOP Specific Conformance Statement for MR SOP Class

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

3.5.2 Private Transfer Syntax Specification

The SOP instance files in the Media File-set in the PRI-CTMR-MOD12 profile uses a non-standard JPEG compression process resulting in interoperability problems when decoded using readily available industry standard JPEG decompression routines.

GEMS "PRI-CTMR-MOD12" DICOM MOD "JPEG" Encoding Information

Note: ***Some earlier versions of that were intended to write JPEG Lossless Process Selection Value 14 1.2.840.10008.1.2.4.70 actually contained errors in byte ordering of encapsulation of fragment item tags, selection of entropy coding tables, and calculation of difference values from predictors. These errors cause the compressed images to be unreadable by non-GEHC software. All future GEHC GEHC CT software will read (but not write) archive media written with these errors.***

The early release product software had a JPEG encode routine that is called the BAD_ENCODER for the following explanation.

In the BAD_ENCODER produced 'SOS' (0xFFDA) header, the entropy coding table selector codes are 0x11. They should be 0x00. This mistake is the key that specifies the BAD_ENCODER processing problems

The BAD_ENCODER computation of the pixel value difference to be entropy encoded is computed as (Predictor - value) when it should be calculated as (value - Predictor)1. The result is that the decompression via industry standard packages result in a negative of the original image pixel value.

1 No specific direct confirmation of the (value - Predictor) policy was found, but the graphic on page 185 of the book "JPEG still image data compression standard" by Pennebaker shows the predictor entering the adder as a negative element and the value entering as positive element. Like wise, both Cornell and Stanford packages perform the computation as (value - Predictor).

The BAD_ENCODER predictor value used at the beginning of each line uses the last value of the previous line in the image. The JPEG standard says the predictor for the first line element of each line should be the first element of the line immediately above the current line. The first line, first element predictor should be the unsigned value that is half the full-scale range for the "sample precision". The first line, first element predictor is correctly determined in the BAD_ENCODER.

Explanation

This section is provided to explain what was done during Image encoding so that people who wish and need to decode the images can modify the available JPEG codec software. These packages are available from the WEB and were originally developed at Stanford and Cornell as well as others in the industry.

What was done in Generation 1 DICOM MOD encoding by GEHC:

In the JPEG codec output, the JPEG 'SOS' header defines the Huffman table selector codes to find the appropriate Huffman table (FF DA 00 08 01 00 11 01 00 00 ...). The GEHC DICOM Access Kit coded these as 0x11. They should have been 0x00. Zero was the number assigned in the "DHT" header. This error is a primary key that is used in the GEHC Generation 2 system to determine that the JPEG data was encoded using the GEHC Generation 1 coding technique.

In Generation 1 images, the predictor value used at the beginning of each line is the last pixel value from the previous line in the image (Assumes Left to Right, Top to Bottom scanning of the pixels).

The Generation 2 and industry compliant predictor for the first line element of each line should be the first element of the line above the current line. For the first line, first element predictor should be the unsigned value that is half the full-scale range for the "sample precision" (GEHC uses (1 << 15) = 32768).

The GEHC Generation 1 JPEG computation of the difference to be Huffman encoded was computed as (Predictor - value) when it should have been calculated as (value - Predictor) . The result is that the decompression via industry standard packages results in a negative of the original image and a breakdown of the pixel basis when the last pixel on a line is different from the first pixel on the next line.

The JPEG software distributed by the Independent JPEG Group does not include an important feature found in the GEHC, the Stanford, and the Cornell JPEG packages with respect to handling 16 bit deep images. In the case where the "huffDECODE" would return a category 16 value indicating that 16 bits should be acquired from the bit stream, the correct action is to add 32768 to the current value and to NOT get the number from the bit stream. Without this test [if (s == 16) dx += 32768; else ...], the image will exhibit a spatial offset resulting from the incorrect synchronization of the input bit stream.

This version and all future GEHC CT software will read (but not write) the Installed Base Generation 1 media. In addition, the creation of Generation 2 media as has been initiated and the new format media will be Industry compatible JPEG and will NOT use the Multi-Fragment segmentation. The ability to handle Multi-Segment data sets is also being deployed to handle the small number of Multi-Fragment images that have reached media.

3.6 Configuration

The MOD Archive Application may have either a 1.2GB, 2.3GB or 4.1GB drive installed.

Table 3.6-1: Supported Profiles for various Drive Configurations

Disk Drive Installed	Profiles Supported
1.2GB Optical Disk Drive	PRI-CTMR-MOD12
	STD-CTMR-MOD12
2.3GB-Optical Disk Drive	PRI-CTMR-MOD12
	STD-CTMR-MOD12
	STD-CTMR-MOD23

3.7 Support of Extended Character Sets

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

4 PRINT SCU CONFORMANCE

4.1 Introduction

This conformance statement specifies the GEHC CT conformance to the DICOM Print SCU Application Profile. The GEHC CT product uses DICOM Print SCU to print images on DICOM Compliant Printers.

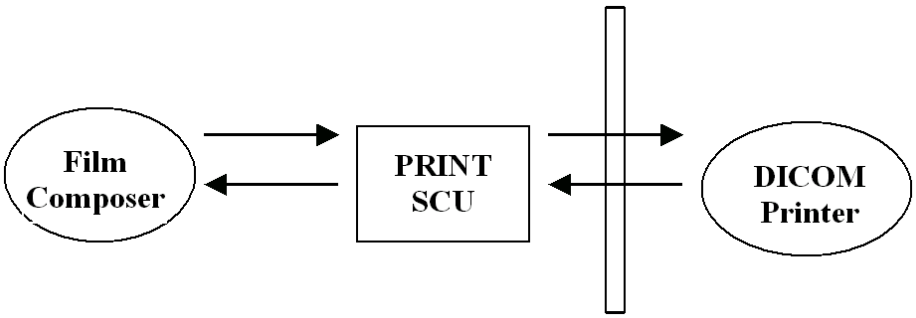
4.2 Implementation Model: PRINT SCU

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

4.2.1 Application Data Flow Diagram

DICOM print SCU Implementation model

DICOM INTERFACE



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

4.2.2 Functional Definition of AE's

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

4.2.3 Sequencing of Real-World Activities

- The DICOM printer is installed through a camera installation process. The DICOM printer is selected from the Film Composer Interface for Manual Filming. Autofilming is enabled using the camera setup via the camera installation process.

- Images may be acquired for printing in the following manner:
  – Images to be printed may be manually dropped from Viewing applications into the manual film composer slots.
  – Images to be printed may be automatically dropped from Viewing applications into the manual film composer slots.
  – Images to be printed may be manually dropped from Viewing applications into the auto film composer slots.
  – Image series to be printed may be automatically dropped from the PrintSeries application into the manual film composer slots.
  – Images to be printed may be automatically dropped from the Scanning Application into the auto film composer slots.

- Based upon the filming mode (and the attributes) used to acquire images into the film composer, films will be automatically printed when the film session is full, or the user must press the Print Button to print the images.

- The Print SCU retrieves the Print SCP status by using the N-GET service of Printer SOP Class. If the printer returns a FAILURE status the print session will be terminated. The printer status is not read.

- The film session is created using the N-CREATE service. The print session will be terminated if the printer fails to create the film session.

- The film box is created using the N-CREATE service. The print session will be terminated if the printer fails to create the film box.

- The images are placed on the film box by using the N-SET. If the printer fails to place the image on the film box, the print session will be terminated.

- The film will be printed using the N-ACTION. Only film box printing is supported. If the printer fails to print the film, the print session will be terminated.

- After the successful N-ACTION, the film box will be deleted using the N-DELETE. Any N-EVENT-REPORTS given to the PRINT SCU will be received but the data is ignored. After the film box is deleted, the association will be closed.

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

4.3 AE Specifications

4.3.1 DICOM Print SCU AE Specification

Print SCU provides Standard Conformance to the following DICOM 3.0 SOP classes as an SCU:

SOP CLASS Name	SOP CLASS UID
Basic grayscale print management meta SOP class	**1.2.840.10008.5.1.1.9**
Basic color print management meta SOP class	**1.2.840.10008.5.1.1.18**
Print Job SOP class	**1.2.840.10008.5.1.1.14**

4.3.1.1 Association Establishment Policy

4.3.1.1.1 General

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

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

Application Context Name	**1.2.840.10008.3.1.1.1**

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

Maximum Length PDU	**16 Kbytes**

4.3.1.1.2 Number of Associations

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

4.3.1.1.3 Asynchronous Nature

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

4.3.1.1.4 Implementation identifying information

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

The table in Appendix D identifies the Implementation UID for this product version.

4.3.1.2 Association Establishment Policy

Print SCU initiates the association with the Printer.

4.3.1.2.1 Real World Activity

4.3.1.2.1.1 Associated Real-World Activity – "Print"

The Film Composer allows the user to select printers and it also allows the user to drag and drop the images (from the viewer application) into the film. It also allows the user to manipulate some print parameters like film format and number of copies to print. When the user presses the "Print" Button, the Film composer communicates this request to Print SCU, which then tries to establish the association with the requested printer and transmits the images for printing.

4.3.1.2.1.2 Proposed Presentation Contexts

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

Presentation Context Table – Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
Verification SOP Class	1.2.840.10008.1.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
Printer SOP Class	1.2.840.10008.5.1.1.16	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
Print Job SOP Class	1.2.840.10008.5.1.1.14	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None

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

4.3.1.2.2 SOP Specific Conformance Statement

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

The Print SOP Classes supported by Print SCU:

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

The Print SCU does not support any optional SOP Classes.

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

4.3.1.2.2.1 Basic Film Session SOP Class

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

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

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

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

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

If Failure status is returned during N-CREATE operation of Film session the following action will be taken by Print SCU:

0x213 "Resource Limitation" message will be logged.

All other status "Failure" message will be logged.

In all the cases the print session will be terminated.

4.3.1.2.2.2 Basic Film box SOP Class

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

- N-CREATE – Requests the Print SCP to create an instance of Film Box.
- N-ACTION – Requests the Print SCP to print the Film Box onto Printer.
- N-DELETE – Requests the Print SCP to delete the Film Box Instance.

The Following Attribute values are supported:

Attribute	DICOM Tag	Valid Range	Default Value
Image Display Format	(2010, 0010)	STANDARD/C,R Printer Dependent	Set in User Interface
Reference Film Session Sequence	(2010, 0500)		
Referenced Image Box Sequence	(2010,0510)	NA	NA
*Film Orientation	(2010, 0040)	PORTRAIT	Set in Configuration File
Film Size ID	(2010, 0050)	Sent zero length	Sent zero length
*Magnification type	(2010, 0060)	BILINEAR CUBIC REPLICATE NONE	Set in Configuration File
*Max Density	(2010, 0130)	0-4095	Set in Configuration File
Configuration Information	(2010, 0150)	Printer Dependent	Set in Configuration File
*Smoothing type	(2010, 0080)	Printer Dependent	Set in Configuration File
*Border density	(2010, 0100)	BLACK WHITE	Set in Configuration File
*Empty image density	(2010, 0110)	BLACK WHITE	Set in Configuration File
*Min density	(2010, 0120)	0-4094	Set in Configuration File
*Trim	(2010, 0140)	NO	NO

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

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

If Failure status is returned during N-CREATE operation of Film box following action will be taken by Print SCU.

0x213: “Resource Limitation” message will be sent.

0x106: “Unsupported Film Format” message will be sent.

All other status: “Failure” message will be sent

In all the cases the print session will be terminated.

If Failure status is returned during N-ACTION operation of Film box following action will be taken by Print SCU.

0xC602: “Unable to Create Print Job” message will be sent.

All other status: “Failure” message will be sent.

In all the cases the print session will be terminated.

If Failure status is returned during N-DELETE operation of Film box following action will be taken by Print SCU.

All the return status: “Failure” message will be sent and the print session will be terminated.

4.3.1.2.2.3 Basic Grayscale Image Box SOP Class

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

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

The Following Attribute values are supported:

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

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

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

0xC605: “Resources temporarily not available” message will be sent.

All other status: “Failure” message will be sent.

In all the cases the print session will be terminated.

4.3.1.2.2.4 Printer SOP Class

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

Print SCU issues the request to retrieve the following attributes:

Optional Attribute	DICOM Tag	Default Value
Printer Status	(2110, 0010)	Printer shall return Value
Printer Status Info	(2110, 0020)	Printer may return Value
Printer Name	(2110, 0030)	Printer may return Value
Manufacturer	(0008, 0070)	Printer may return Value
Manufacturer Model Name	(0008, 1090)	Printer may return Value
Device Serial No.	(0018, 1000)	Printer may return Value
Software Versions	(0018, 1020)	Printer may return Value
Date Last Calibrated	(0018, 1200)	Printer may return Value
Time Last Calibrated	(0018, 1201)	Printer may return Value

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

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

For all other Printer Status Info (2110, 0020) values, the status is ignored and the print job continues.

4.3.1.2.2.5 Print Job SOP Class

Print SCU looks for following attributes in N-EVENT REPORT data received from Print SCP. If Print SCU does not receive N-EVENT_REPORT it requests the Print SCP to retrieve the following set of attributes using N-GET.

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

4.3.1.2.2.6 Basic Color Image Box SOP Class

The Basic Color Image Box SOP Instance is created by the SCP at the time the Basic Film Box SOP Instance is created, based on the value of the Basic Film Box Attribute Image Display Format (2010,0010).

The following DIMSE Services are applicable to the IOD:

N-SET - The N-SET may be used to update an instance of the Basic Color Image Box SOP Class.

Note: There is no N-CREATE because Instances of the Basic Color Image Box SOP Class are created by the SCP as a result of the N-CREATE of the Film Box SOP Instance.

Attribute Name	DICOM Tag	Default Value
Image Box Position	(2020,0010)	SCU shall send Value to printer
Basic Color Image Sequence	(2020,0111)	SCU shall send Value to printer
>Samples Per Pixel	(0028,0002)	SCU shall send Value to printer
>Photometric Interpretation	(0028,0004)	SCU shall send Value to printer
>Planar Configuration	(0028,0006)	SCU shall send Value to printer
>Rows	(0028,0010)	SCU shall send Value to printer
>Columns	(0028,0011)	SCU shall send Value to printer
>Pixel Aspect Ratio	(0028,0034)	SCU shall send Value to printer
>Bits Allocated	(0028,0100)	SCU shall send Value to printer
>Bits Stored	(0028,0101)	SCU shall send Value to printer
>High Bit	(0028,0102)	SCU shall send Value to printer

>Pixel Representation	(0028,0103)	SCU shall send Value to printer
>Pixel Data	(7FE0,0010)	SCU shall send Value to printer
Polarity	(2020,0020)	SCU shall send Value to printer
Magnification Type	(2010,0060)	SCU shall send Value to printer
Smoothing Type	(2010,0080)	SCU shall send Value to printer
Requested Image Size	(2020,0030)	SCU shall send Value to printer
Requested Decimate/Crop Behavior	(2020,0040)	SCU shall send Value to printer

The status values which are specific for this SOP Class are defined as follows.

Status	Meaning	
Warning	Image size larger than image box size, the imagehas been demagnified.	B604
	Image size is larger than the Image Box size. The Image has been cropped to fit.	B609
	Image size or Combined Print Image size is larger than the Image Box size. The Image or combined Print Image has been decimated to fit.	B60A
Failure	Image size is larger than image box size	C603
	Insufficient memory in printer to store the image	C605
	Combined Print Image size is larger than the Image Box size.	C613

4.3.1.3 Association Acceptance Policy

The Print SCU does not accept associations.

4.4 Communication Profiles

4.4.1 Supported Communication Stacks (parts 8,9)

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

4.4.1.1 TCP/IP Stack

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

4.4.1.1.1 API

Not Applicable

4.4.1.1.2 Physical Media Support

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

4.5 Standard Extended / Specialized / Private SOPs

None.

4.6 Configuration

4.6.1 AE Title/Presentation Address Mapping

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

The GEHC CT system allows the user to “add”, “Remove”, or “Update” the mapping of remote DICOM Printer AE Titles to IP Addresses and Ports. These options can be selected from the Service Desktop camera installation utility.

Note: If “hostname_DCP” is greater than 16 characters then the name of the local AE title is limited to first 16 characters.

4.6.2 Configurable Parameters

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

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

- Local IP Address
- Local IP Netmask
- Max PDU length
- The following DICOM print parameters are configurable. The valid ranges are shown in earlier sections of this conformance statement.
    - Medium Type (2000, 0030)
    - Film Destination (2000, 0040)

- Magnification Type (2010, 0060)
- Min Density (2010, 0120)
- Max Density (2010, 0130)
- Empty Image Density (2010, 0110)
- Border Density (2010, 0100)
- Configuration Information (2010, 0150)
- Smoothing Type (2010, 0080)

- The following network timers are supported and are configurable. When these timers expire the association is terminated. The default values are:
  - Association Time out = 120 seconds
  - Session Time out = 1200 seconds (total time for open association)
  - N-SET Time out = 300 seconds
  - N-ACTION Time out = 300 seconds
  - N-CREATE Time out = 300 seconds
  - N-DELETE Time out = 300 seconds
  - N-GET Time out = 100 seconds
- Time-outs, which are set for all hosts, are configurable in dprint.cfg:
  *Association time-out - *bi_assoc_tio*
  *Session timeout - *bi_session_tio*
  *Create timeout - *bi_ncreate_tio*

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

4.7 Support of Extended Character Set

The Print SCU does not support any Extended Character Set.

5 DICOM Storage Commitment SCU Conformance

5.1 Introduction

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

5.2 Implementation Model

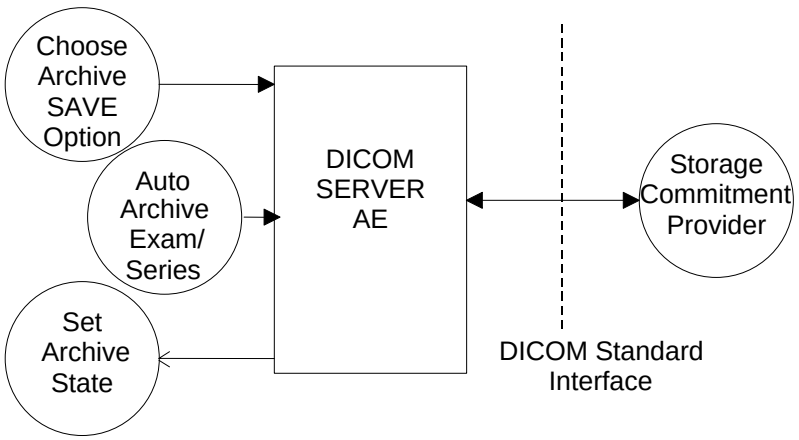
5.2.1 Application data flow diagram

Illustration 5.1.1 shows the data flow diagram of Storage Commitment SCU. There is only one Real-World activity that will cause the DICOM Server Application Entity (DICOM Server AE) to initiate an association to a remote DICOM entity that is a Service Class Provider (SCP) of the Storage Commitment SOP class.

The *Choose Archive save Option* Real-World activity consists of an operator choosing a remote DICOM AE that supports Storage Commitment as provider as the archive device and selecting one or more exam or series from the local database and choosing either *Save Exam* or *Save Series* from the archive menu. The images to be committed are sent to the remote provider entity first. The Commitment request for the transferred image instances is sent after the complete image transfer. The Commitment response must come on a different association.

The DICOM Server AE to respond to an incoming Storage Commitment response from the remote DICOM AE with the Real World Activity *Set Archive State*. This marks the successfully committed images as archived and permitted for deletion from the local storage.

Illustration 5.2.1 **Application Data Flow Diagram**



5.2.2 Functional definitions

DICOM Server AE initiates the following operations:

- Negotiates and establishes association with remote Storage Commitment Provider
- Sends the selected images to the remote DICOM AE.
- Closes the association.
- If all the images are transferred without failures the following steps will be executed. If there are any failures the job will be marked as failed and the Storage Commitment request will not be sent.
- Establishes a new association for sending the commitment request. Here note that a storage commitment request does not imply that the acquisition of images is complete.
- Closes the association for sending the commitment request. Receives the response on a different association.
- Updates the archive flag information for successful instances. The archive flag is shared with the local archive and the two cannot be distinguished.

5.2.3 Sequencing of real-world activities

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

5.3 AE Specifications

5.3.1 DICOM Storage Commitment SCU specifications

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

SOP class name	SOP class UID
Storage Commitment Push model SOP class	1.2.840.10008.1.20.1

5.3.1.1 Association establishment policies

5.3.1.1.1 General

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

Application Context Name	1.2.840.10008.3.1.1.1

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

Maximum Length PDU	10 Kbytes

5.3.1.1.2 Number of associations

A single association is used to send the commitment request. This commitment request association is closed after the request is successfully acknowledged. It accepts an association for receiving the response from commitment provider at any time.

5.3.1.1.3 Asynchronous nature

Asynchronous window negotiation is not supported.

5.3.1.1.4 Implementation identifying information

The table in Appendix D identifies the Implementation UID for this product version.

5.3.1.2 Association initiation policy

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

5.3.1.2.1 Real World Activity

5.3.1.2.1.1 Associated Real World Activity - ”Choose Archive Save option”

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

5.3.1.2.1.2 Associated Real World Activity - ”Auto Archive exam/series”

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

5.3.1.2.2 Proposed Presentation Contexts

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

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name	UID		Negotiation

Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None

The Storage Commitment SCU can send the commitment request for following SOP classes.

NAME	UID
CT Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.2
Secondary Capture Storage SOP Class	1.2.840.10008.5.1.4.1.1.7
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1

5.3.1.2.3 Storage Commitment Push Model SOP Class Request Processing

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

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

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

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

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

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

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

The following attributes are sent as part of the **DATA Set** for the **N-Action request**.

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

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

5.3.1.3 Association Acceptance Policy

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

5.3.1.3.1 Real World Activity "Storage Commitment Response" and "Set Archive State"

The remote storage provider will respond with a commitment success or failure. The Set Archive State activity processes that response, as described below.

5.3.1.3.1.1 Accepted Presentation Context Table

The Accepted Presentation Context table for the DICOM Storage Commitment SCU is shown in the following table.

Accepted Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

5.3.1.3.2 Storage Commitment Push Model SOP Class Response Processing

The following DIMSE Service Elements are supported for the Storage Commitment response processing

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

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

5.3.1.3.2.1 Commit response with SUCCESS status

The Archive flag information in the browser for all the successful instances will be updated. The status will be changed to “Y”.

The job queue entry will be removed

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

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

N-EVENT-REPORT-RSP will be sent on the same association itself. No DATA Set will be sent along with the response.

5.3.1.3.3 Commit response with FAILURE status

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

Attribute	Tag	Value
Transaction UID	(0008,1195)	Value received from SCP
Failed SOP Sequence	(0008,1198)	Value received from SCP
SOP Class UID	(0008,1150)	Value received from SCP
SOP Instance UID	(0008,1155)	Value received from SCP
Failure Reason	(0008,1197)	Value received from SCP

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

The failure reason is ignored.

Failed SOP instances will have their archive flag information unaltered.

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

N-EVENT-REPORT-RSP will be sent on the same association itself. No DATA Set will be sent along with the response.

Note: (0008, 1199) Reference SOP Sequence is not handled.

5.4 Communication Profiles

5.4.1 Supported Communication Stacks (parts 8,9)

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

5.4.2 TCP/IP Stack

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

5.4.2.1 Physical Media Support

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

5.4.3 Point-to-Point Stack

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

5.5 Extensions/Specialization/Privatizations

None.

5.6 Configuration

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

5.6.1 AE Title/Presentation Address Mapping

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

5.6.2 Configurable Parameters

The following fields are configurable for the DICOM Server AE:

- Local AE Title (the machine hostname)
- Local IP Address
- Local IP Netmask
- Max PDU length

- Time-outs, which are set for all hosts, are configurable in dcs.cfg:

Note: * denotes any SOP class (time in sec)
*Association time-out - *bi_assoc_tio*
* Inactivity time-out - *bi_store_tio*
*Session time-out - *bi_session_tio*

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

5.7 Support of Extended Character Sets

This does not support any Extended Character set.

6 Modality Worklist Information Model Definition

6.1 Introduction

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

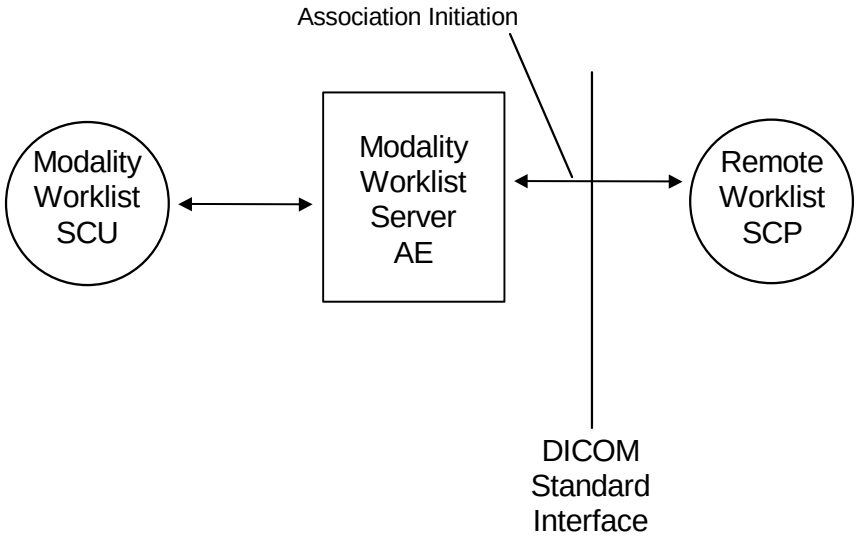
The ModalityWorklist option for GEHC CT allows a user to query for and display DICOM modality worklist information from a remote hospital or radiology department information system computer. For example, a user may wish to query for all procedures scheduled to be performed on the scanner. In this situation,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

6.2 Implementation Model

All DICOM functionality provided by the ModalityWorklist feature is logically provided by the Modality Server DICOM AE. The Modality Worklist Server DICOM AE is commanded to perform DICOM modality worklist query services through the use of the GEHC CT user interface.

6.2.1 Application Data Flow Diagram

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



6.2.2 Functional definitions

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

The Modality Worklist Server AE initiates the following functions:

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

6.2.3 Sequencing of Real-World Activities

1. The user or the system initiates a modality worklist query (as a modality worklist SCU) to the modality worklist SCP with a given set of query parameters.

2. The modality worklist SCP returns responses that match the query parameters.

3. Items from the returned worklist responses are presented to the user.

4. The user selects the worklist entry (or entries) that corresponds to the patient to be imaged from the scanner Patient Schedule.

5. The user performs the patient scan required to meet the worklist entry requested. A subset of the returned worklist responses is included in acquired DICOM images related to the responses.

6. The patient study/images generated are sent to the image archive via the Image Push activity described in Section 2

7. Further image analysis via the advanced console applications may be performed on the scanner. Refer to section 1 for a table of Advance Applications and references to their DICOM conformance Statements.

6.3 AE Specifications

6.3.1 Modality Worklist Server AE Specification

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

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

6.3.1.1 Association Establishment Policies

6.3.1.1.1 General

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

Application Context Name	1.2.840.10008.3.1.1.1

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

Maximum Length PDU	50 Kbytes

The SOP Class Extended Negotiation is not supported.

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

The user information Items sent by this product are:

- Maximum PDU Length
- Implementation UID

6.3.1.1.2 Number of Associations

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

6.3.1.1.3 Asynchronous Nature

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

6.3.1.1.4 Implementation Identifying Information

The table in Appendix D identifies the Implementation UID for this product version.

6.3.1.2 Association Initiation Policy

The Modality Worklist Server AE initiates a new association due to an update operation being initiated from the GEHC CT user interface.

6.3.1.2.1 Real-World Activity: Worklist Query

6.3.1.2.1.1 Associated Real-World Activity

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

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

This Scanner:	• Modality, (0008,0060) - set to CT • Scheduled Station AE Title, (0040,0001) - set to local AE title
This Modality:	• Modality, (0008,0060) - set to CT • Scheduled Station AE Title, (0040,0001) - zero-length (universal matching)
All Scanners	• Modality, (0008,0060) - zero-length (universal matching) • Scheduled Station AE Title, (0040,0001) - zero-length (universal matching)

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

Today:	Scheduled Procedure Step Start Date (0040,0002) - set to YYYYMMDD, where this date is the current date.
Days Before Today and Days After Today:	Scheduled Procedure Step Start Date (0040,0002) - set to YYYYMMDD-YYYYMMDD, where this date range represents the specified number of days before today and/or after today. Note that number of days both before and after can be specified in the same query and that each always includes today.
All Days:	Scheduled Procedure Step Start Date (0040,0002) - zero-length (universal matching)

6.3.1.2.1.2 Proposed Presentation Context Table

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

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

6.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for the Worklist SOP Class

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

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

Each C-FIND response received from the remote AE is parsed to verify the length/type of the items in the response). Upon detecting any error in the response data, the Modality Modality Server AE will save worklist entry in binary format for investigative purposes and the Modality Worklist Server AE will continue receiving worklist entries. Note: All worklist entries, valid and invalid, can be configured to be saved in binary format.

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

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

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

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

6.3.1.2.1.2.2 Record Acceptance Policy

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

Any inconsistencies in the response data, with respect to the categories described above, are considered errors. Upon detecting any such errors in the response data, the Worklist Server AE will issue a C-FIND-CANCEL and, upon receipt of a C-FIND-RSP (or if an applicable timer expires), will abort the association. All previously received worklist items are retained. Note that the absence of requested Type 3 attributes is not considered an error.

Fields considered Type 1 by the Modality Worklist Server include:

- (0010,0010), Patient Name
- (0010,0020), Patient ID
- (0020,000D), Study Instance UID
- (0040,0001), Scheduled Station AE Title
- (0040,0002), Scheduled Procedure Step Start Date [1]
- (0040,0003), Scheduled Procedure Step Start Time [1]
- (0040,0009), Scheduled Procedure Step ID
- (0040,1001), Requested Procedure ID

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

Fields considered Type 2 by Modality Worklist Server include:

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

6.3.1.3 Association Acceptance Policy

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

6.4 Communication Profiles

6.4.1 Supported Communication Stacks (PS 3.8, PS 3.9)

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

6.4.2 OSI Stack

The OSI Communication Stack is not supported by this implementation.

6.4.3 TCP/IP Stack

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

6.4.3.1 API

Not applicable to this product.

6.4.3.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

6.4.4 Point-to-Point Stack

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

6.5 Extensions / Specializations / Privatizations

6.5.1 Standard Extended /Specialized/Private SOPs

Modality Worklist for GEHC CT does not implement any private transfer SOP classes.

6.5.2 Private Transfer Syntaxes

Modality Worklist for GEHC CT does not implement any private transfer syntaxes.

6.6 Configuration

The Modality Worklist feature is configured by GEHC Field Service engineers. The DICOM configuration items below are configurable or re-configurable by a Field Service Engineer and are not accessible by users through the GEHC CT user interface.

6.6.1 AE Title/Presentation Address Mapping

Modality Worklist allows for the configuration of the following parameters that pertain to the remote AE.

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

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

6.6.2 Configurable Parameters

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

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

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

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

6.7 Support of Extended Character Sets

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

6.8 Modality Worklist Information Model Definition

6.8.1 Introduction

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

6.8.2 - Information Model Description

6.8.3 - Information Model Entity-Relationship Model

6.8.4 - Information Model Module Table

6.8.5 - Information Model Keys

6.8.2 Modality Worklist Information Model Description

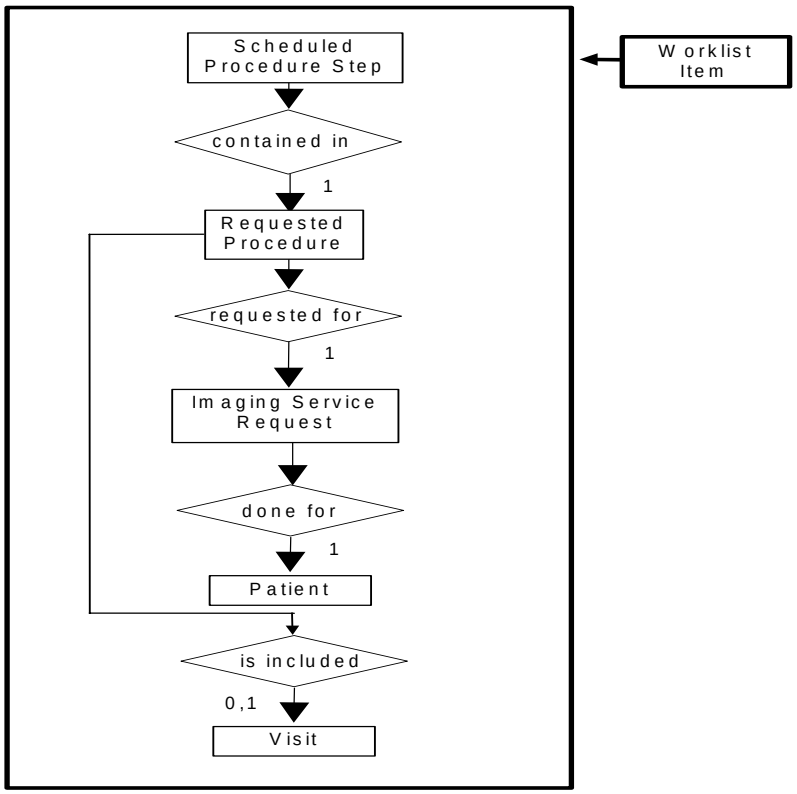
In order to serve as a Service Class Provider (SCP) of the Modality Worklist Service Class, a DICOM Application Entity (AE) possesses information about the attributes of a number of managed worklist items. These items are organized into Modality Worklist Information Modules. In this Service Class, the Information Model plays a role similar to an Information Object Definition of most other DICOM Service Classes.

6.8.3 Modality Worklist Information Model Entity-Relationship Model

The Entity-Relationship diagram for the Modality Worklist Information Model schema is shown in Illustration 6.8.3-1. It represents the information that composes a Worklist Item. In this figure, the following diagrammatic convention is established to represent the information organization:

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

Illustration 6.8.3-1 – Modality Worklist Information Model E/R DIAGRAM



6.8.4 Entity Descriptions

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

6.8.4.1 Scheduled Procedure Step

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

6.8.4.2 Requested Procedure Entity Description

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

6.8.4.3 Imaging Service Request Entity Description

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

6.8.4.4 Visit Entity Description

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

6.8.4.5 Patient Entity Description

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

6.8.5 Modality Worklist Mapping of DICOM Entities

Table 6.8.5-1 —Mapping of DICOM Entities to Modality Worklist Entities

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

6.8.6 Information Model Module Table

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

Table 6.8.6-1 identifies the defined modules within the entities that comprise the DICOM Modality Worklist Information Model. Modules are identified by Module Name.

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

Table 6.8.6-1 – Modality Worklist Information Model Modules

Entity Name	Module Name	Reference
Scheduled Procedure Step	SOP Common	6.8.9.1
	Scheduled Procedure Step	6.8.9.2
Requested Procedure	Requested Procedure	6.8.10.1
Imaging Service Request	Imaging Service Request	6.8.11.1
Visit	Visit Identification	6.8.12.1
	Visit Status	6.8.12.2
	Visit Relationship	6.8.12.3
	Visit Admission	6.8.12.4
Patient	Patient Relationship	6.8.13.1
	Patient Identification	6.8.13.2
	Patient Demographic	6.8.13.3
	Patient Medical	6.8.13.4

6.8.7 Information Model Keys

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

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

- Name
- Tag group and element numbers
- Expected Matching Key Type: R-required, O-optional

- Expected Return Key Type:
  - 1 - non-zero value required
  - 1C - conditionally of type 1
  - 2 - required to be present, possibly with zero-length value

  - 3 - optional
- Mapped into The Image - whether this data is mapped into subsequently acquired images
- Notes - clarification of this implementation's use/treatment of this attribute

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

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

6.8.8 Supported Matching

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

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

6.8.9 Scheduled Procedure Step Entity

6.8.9.1 SOP Common Module

Table 6.8.9-1 – SOP Common Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Specific Character Set	(0008,0005)	O	1C	No	Matching for this item is supported only for the character set ISO_IR 100. This value is always sent . Product expects this to always be returned.

6.8.9.2 Scheduled Procedure Step Module

Table 6.8.9-2 – Scheduled Procedure Step Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Scheduled Procedure Step Sequence	(0040,0100)	R	1	No	
Scheduled Station AE Title	(0040,0001)	R	1	No	Matching is supported as follows: either no AE title is supplied (universal matching), or the scanner's Worklist Server AE title is supplied for matching; this is user selectable.

Scheduled Procedure Step Start Date	(0040,0002)	R	1	No	Matching is supported as one of the following; this is user selectable: • all days, • today only, • today and a number of days before today, • today and a number of days after today, • today and a number of days before today and a number of days after today. Number of days before/after is specified by the user. Returned values must be exactly 8 numeric characters in YYYYMMDD format.
Scheduled Procedure Step Start Time	(0040,0003)	R	1	No	This attribute is sent with zero-length. Returned values must be exactly 6 numeric characters in HHMMSS format.
Modality	(0008,0060)	R	1	Yes	Matching is supported as follows: either no Modality is supplied (universal matching), or the scanner's Modality is supplied for matching; this is user selectable.
Scheduled Performing Physician's Name	(0040,0006)	R	2	Yes	This attribute is sent with zero-length. This value is mapped into (0008, 1050) in the image header.
Scheduled Procedure Step Description	(0040,0007)	O	1C	Yes	
Scheduled Station Name	(0040,0010)	O	2	No	
Scheduled Procedure Step Location	(0040,0011)	O	2	No	
Scheduled Protocol Code Sequence	(0040,0008)	O	1C	Yes	Up to 5 Scheduled Action Item Code Sequence Items are mapped into the image if they system is configured to support GSPS.
Code Value	(0008,0100)	O	1C	Yes	
Coding Scheme Designator	(0008,0102)	O	1C	Yes	
Code Meaning	(0008,0104)	O	3	Yes	NOTE: though type 3, the scanner expects Code Meaning to be sent if (0040,0008) is sent.
Pre-Medication	(0040,0012)	O	2C	No	
Scheduled Procedure Step ID	(0040,0009)	O	1	Yes	
Requested Contrast Agent	(0032,1070)	O	2C	No	Displayed on "More Info..." screen.

6.8.10 Requested Procedure Entity

6.8.10.1 Requested Procedure Module

Table 6.8.10.1-1 Requested Procedure Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Requested Procedure ID	(0040,1001)	O	1	Yes	User can enter the value for Requested Procedure Id prior to query. If user has entered the value then that value will be sent as part of the query. The value returned in the response shall be mapped to the image.
Requested Procedure Description	(0032,1060)	O	1C	Yes	Truncated to 22 characters by default however this is configurable to allow 64 characters.
Requested Procedure Code Sequence	(0032,1064)	O	1C	Yes	
Code Value	(0008,0100)	O	1C	Yes	
Coding Scheme Designator	(0008,0102)	O	1C	Yes	
Code Meaning	(0008,0104)	O	3	Yes	NOTE: thought type 3, the scanner expects Code Meaning to be sent if (0032,1064) is sent.
Study Instance UID	(0020,000D)	O	1	Yes (Based on User option)	User (Modality) will be able to configure the following. If the user has set the option to “Use MWL Study UID”, then study Instance UID will be copied into the final DICOM image header. If this option is not set then a new Study instance UID is generated locally on the scanner. The default setting is to generate a new study instance uid if a worklist entry is re-used however it can be configured to reuse the same study instance uid.
Referenced Study Sequence	(0008,1110)	O	2	Yes	Only 1 Referenced Study Sequence is mapped into the image.
Referenced SOP Class UID	(0008,1150)	O	1C	Yes	
Referenced SOP Instance UID	(0008,1155)	O	1C	Yes	
Requested Procedure Priority	(0040,1003)	O	2	No	
Patient Transport Arrangements	(0040,1004)	O	2	No	
Requested Procedure Location	(0040,1005)	O	3	No	

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Confidentiality Code	(0040,1008)	O	3	No	

6.8.11 Imaging Service Request Entity

6.8.11.1 Imaging Service Request Module

Table 6.8.11.1-1 – Imaging Service Request Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Accession Number	(0008,0050)	O	2	Yes	User will be able to enter value for Accession Number prior to query to be sent as part of C-FIND request. Supports maximum of 16 characters.
Requesting Physician	(0032,1032)	O	2	No	
Referring Physician's Name	(0008,0090)	O	2	Yes	Truncated to 32 characters by default however this is configurable to allow 64 characters.
Requesting Service	(0032,1033)	O	3	No	

6.8.12 Visit Entity

6.8.12.1 Visit Identification

Table 6.8.12.1-1 – Visit Identification Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Admission ID	(0038,0010)	O	2	No	
Institution Name	(0008.0080)	O	3	No	

6.8.12.2 Visit Status

Table 6.8.1.12.2-1 – Visit Status Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Current Patient Location	(0038,0300)	O	2	No	Displayed on “More Info...” screen.

6.8.12.3 Visit Relationship

Table 6.8.12.3-1 – Relationship Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Referenced Patient Sequence	(0008,1120)	O	2	No	
Referenced SOP Class UID	(0008,1150)	O	2	No	
Referenced SOP Instance UID	(0008,1155)	O	2	No	

6.8.12.4 Visit Admission

No data elements are requested from the Visit Admission Module.

6.8.13 Patient Entity

6.8.13.1 Patient Relationship

No data elements are requested from the Patient Relationship Module.

6.8.13.2 Patient Identification

Table 6.8.13.2-1 – Patient Identification Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patient's Name	(0010,0010)	R	1	Yes	Supports up to 32 characters by default however this is configurable to allow 64 characters. See also **Note1**.
Patient ID	(0010,0020)	R	1	Yes	Supports up to 16 characters by default however this is configurable to 64 characters.
Other Patient ID	(0010, 1000)	O	3	Yes	Supports 64 characters.

Note 1 :

- *Modality Worklist server supports 32 characters for patient Name*
- *Supports DICOM format for patient Name (with "^" as delimiters)*
- *If patient name in worklist response (schedule procedure step) has more than 32 characters then*
  - *Worklist will be accepted by the server*
  - *Worklist Browser will display only the first 32 characters*
  - *"More Info" screen will display the full patient name*
  - ***Only the FIRST 32** characters is copied into the final DICOM image header by default however this is configurable to allow 64 characters.*

6.8.13.3 Patient Demographic

Table 6.8.13.3-1 – Patient Demographic Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patient's Birth Date	(0010,0030)	O	2	Yes	This value is also used to calculate the Patient's Age.
Patient's Sex	(0010,0040)	O	2	Yes	
Patient's Weight	(0010,1030)	O	2	Yes	Limited to maximum value of 999 kg.
Confidentiality constraint on patient data	(0040,3001)	O	2	No	
Patient's Size	(0010,1020)	O	3	No	
Patient's Address	(0010,1040)	O	3	No	
Patient's Telephone Numbers	(0010,2154)	O	3	No	

6.8.13.4 Patient Medical

Table 6.8.13.4-1 – Patient Medical Module Attributes

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

6.9 Private Data Dictionary

The Modality Worklist implementation does not define any Private Attributes within the Modality Worklist Information Model.

6.10 C-FIND Request Message

This section provides a detailed description of the C-FIND request message data that is provided to the remote AE during a worklist query operation. The dump in Table 6.10-1 below lists, in exact message order, the fields transferred as part of the C-FIND request message for a typical query.

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

Table 6.10-1 – C-FIND Request Message Dump

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

```
(0038,0300) LO    (no value available)  #     0,  0  CurrentPatientLocation
(0038,0500) LO    (no value available)  #     0,  0  PatientState
(0040,0000) UL    192                   #     4,  1  ModalityWorklistGroupLength
(0040,0100) SQ    (Sequence with explicit Length #=1) #   136,  1  ScheduledProcedureStepSequence
 (fffe,e000) na    (Item with explicit Length  #=12)  #   128,  1  Item
  (0008,0060) CS    (no value available)  #     0,  0  Modality
  (0032,1070) LO    (no value available)  #     0,  0  RequestedContrastAgent
  (0040,0001) AE    (no value available)  #     0,  0  ScheduledStationAETitle
  (0040,0002) DA    (no value available)  #     0,  0  ScheduledProcedureStepStartDate
  (0040,0003) TM    (no value available)  #     0,  0  ScheduledProcedureStepStartTime
  (0040,0006) PN    (no value available)  #     0,  0  ScheduledPerformingPhysiciansName
  (0040,0007) LO    (no value available)  #     0,  0  ScheduledProcedureStepDescription
  (0040,0008) SQ    (Seq with explicit Length #=1) #    32,  1  ScheduledActionItemCodeSequence
   (fffe,e000) na    (Item with explicit Length  #=3) #    24,  1  Item
    (0008,0100) SH    (no value available)  #     0,  0  CodeValue
    (0008,0102) SH    (no value available)  #     0,  0  CodingSchemeDesignator
    (0008,0104) LO    (no value available)  #     0,  0  CodeMeaning
   (fffe,e00d) na    (ItemDelimitationItem for re-encoding) #     0,  1  ItemDelimitationItem
  (fffe,e0dd) na    (SequenceDelimitationItem for re-enc.) #     0,  1  SequenceDelimitationItem
  (0040,0009) SH    (no value available)  #     0,  0  ScheduledProcedureStepID
  (0040,0010) SH    (no value available)  #     0,  0  ScheduledStationName
  (0040,0011) SH    (no value available)  #     0,  0  ScheduledProcedureStepLocation
  (0040,0012) LO    (no value available)  #     0,  0  PreMedication
 (fffe,e00d) na    (ItemDelimitationItem for re-encoding) #     0,  1  ItemDelimitationItem
(fffe,e0dd) na    (SequenceDelimitationItem for re-enc.) #     0,  1  SequenceDelimitationItem
(0040,1001) SH    (no value available)  #     0,  0  RequestedProcedureID
(0040,1003) SH    (no value available)  #     0,  0  RequestedProcedurePriority
(0040,1004) LO    (no value available)  #     0,  0  PatientTransportArrangements
(0040,1005) LO    (no value available)  #     0,  0  RequestedProcedureLocation
(0040,1008) LO    (no value available)  #     0,  0  ConfidentialityCode
(0040,1010) PN    (no value available)  #     0,  0  Names of Intended Recipients
(0040,1400) LT    (no value available)  #     0,  0  Requested Procedure Comments
(0040,2400) LT    (no value available)  #     0,  0  Imaging Service Request Comm.
(0040,3001) LO    (no value available)  #     0,  0  ConfidentialityConstraintOnPatientData
```

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

User will be able to enter the values for “Patient Id” prior to the query. If value is entered then that value will be sent as part of the query. For example, if “6789” is entered then

```
(0010,0020) LO    [6789]  #    4, 1  PatientID
```

User will be able to enter the values for “Patient Name” prior to the query. If value is entered then that value will be sent as part of the query. For example, if “Lastname^Firstname” is entered then

```
(0010,0010) PN    [Lastname^Firstname]  #    18, 1  PatientName
```

6.11 Use of Specific DICOM Data

This section details the use of the DICOM data returned by remote AEs during worklist queries. The GEHC CT user interface fields that display the data, along with the data’s mapping into resulting acquired and transferred DICOM images, are presented in following table 6.11-1.

Table 6.11-1 – Specific Data Usage

DICOM Worklist Data Element	Patient Schedule Screen Field	GEHC CT DICOM Image Data Element
Accession Number (0008,0050)	Req Number	Accession Number Supports maximum of 16 characters. Can be configured so the top level accession number tag in the image header will be empty if worklists are grouped and have different accession numbers. Default behavior is to fill in the top level accession number in the grouped case.
Patient ID (0010,0020)	Patient ID	Patient ID Supports maximum of 16 characters. Can be configured to allow 64 characters.
Other Patient ID (0010,1000)	Other Patient Ids (only displayed on the More Info screen)	Patient ID Supports maximum of 64 characters.
Patient Name (0010,0010)	Patient Name	Patient Name Supports maximum of 32 characters. Can be configured to allow 64 characters.
Patient’s Birth Date (0010,0030)	Patient Age (Patient Birth Date user to calculate age)	Patient Birth Date
Patient's Sex (0010,0040)	Sex	Patient’s Sex
Patient's Weight (0010,1030)	Weight in Kg	Patient's Weight

Referring Physician's Name (0008,0090)	Referring Physician	Referring Physician's Name
Requested Procedure Description (0032,1060)	Exam Description	Study Description.
Scheduled Procedure Step Start Date (0040,0002)	Date	Not available.
Scheduled Procedure Step Start Time (0040,0003)	Time	Not available.
Scheduled Performing Physician's Name (0040,0006)	Performing Physician (only displayed on the "More Info.." screen)	This value is mapped into (0008, 1050) in the image header.
Study Instance UID (0020,000d)	Study instance UID (only displayed on the "More Info..." screen)	Study Instance UID, **if User has set the preference to "Use MWL Study UID".**
Requested Procedure Id (0040,1001)	Requested Proc ID	Requested Procedure Id.
Pregnancy Status (0010,21C0)	Pregnancy Status (only displayed on the "More Info..." screen)	Not available.
Medical Alerts (0010,2000)	Medical Alerts (only displayed on the "More Info..." screen)	Not available.
Contrast Allergies (0010,2110)	Contrast Allergies (only displayed on the "More Info..." screen)	Not available.
Special Needs (0038,0050)	Special Needs (only displayed on the "More Info..." screen)	Not available.
Requested Contrast Agent (0032,1070)	Requested Contrast Agent (only displayed on the "More Info..." screen)	Not available.
Current Patient Location (0038,0300)	Current Patient Location (only displayed on the "More Info..." screen)	Not available.
Additional Patient History (0010,21B0)	Additional Patient History (only displayed on the "More Info..." screen)	Patient History.

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

6.12 Setting User Preferences

6.12.1 Setting "Use MWL Study UID " Option

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

1. Click on "Patient Schedule"
2. Click on "Preferences" button
3. Set the option "Use Study Instance UID", to either "Yes" or "No"

6.12.2 Setting Custom Query Option

This option allows the user to enter values for “Accession Number” and / or “ Requested Procedure Id” , which are used for Custom Query.

1. Click on “Patient Schedule”
2. Click on “Preferences” button
3. Set the option “**Show Update Parameters** ”, to “**Yes”**
4. To do a query click on “Update” button.
   A User Interface appears, with provision to enter values for:
   a) Accession Number
   b) Requested Procedure Id

7 PERFORMED PROCEDURE STEP CONFORMANCE STATEMENT

7.1 Introduction

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

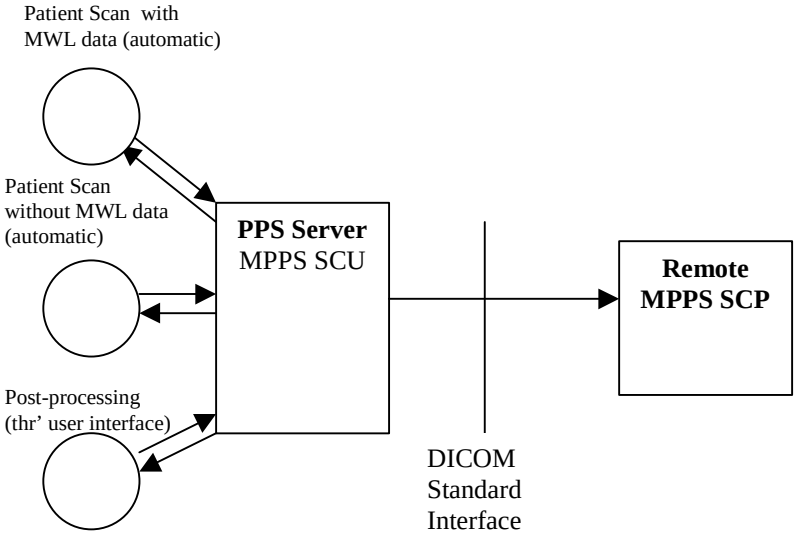
This feature works in conjunction with DICOM Modality Worklist feature, if installed. However the conformance of this feature is independent of Modality Worklist feature. For information on conformance of Modality Worklist feature to DICOM standard please refer to the appropriate section or document.

7.2 Implementation Model

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

7.2.1 Application Data Flow Diagram

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



7.2.2 Functional Definition of AEs

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

The PPS Server AE initiates the following functions.

- *Start PPS*: Initiates a DICOM association in order to create a DICOM Modality Performed Procedure Step SOP instance in the remote AE. If the remote AE accepts a presentation context applicable to Modality performed Procedure Step, the PPS Server AE will issue a request to create the SOP instance in the remote AE via the N-CREATE service.

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

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

7.2.3 Sequencing of Real-World Activities

7.2.3.1 PPS from Acquisition System with MWL data

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

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

- The MPPS SCP returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user. ***The DICOM association is closed.***

- System includes the necessary information related to Scheduled Procedure Steps and the Performed procedure Step in the image instances created.

- At the end of image acquisition, system initiates a 'Complete PPS' or 'Discontinue PPS' based on the choice selected by the user using the user interface provided. The user is also given a choice 'Defer PPS' which is described below. PPS Server AE initiates a MPPS N-SET request to the remote AE, in-order to update the MPPS SOP instance that is already created**. The N-SET is sent over a new DICOM association**

- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

- At the end of image acquisition, if the user has chosen 'Defer PPS', the user is provided with an interface to 'Complete PPS' or 'Discontinue PPS' at any later time. The user might wish to alter the image set generated through acquisition, before invoking these operations. Note that the user explicitly uses the user interface provided to invoke this operation, as in the case of PPS generated for post-processing, which is described in the following section. **PPS messages N-CREATE (if applicable) and N-SET will be sent over the same DICOM association**

- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

7.2.3.2 PPS from acquisition system without MWL data

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

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

- The MPPS SCP returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

- System includes the necessary information related to Scheduled Procedure Steps and the Performed procedure Step in the image instances created.

- At the end of image acquisition, system initiates a 'Complete PPS' or 'Discontinue PPS' based on the choice selected by the user using the user interface provided. The user is also given a choice 'Defer PPS' which is described below. PPS Server AE initiates a MPPS N-SET request to the remote AE, in-order to update the MPPS SOP instance that is already created.

- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

- At the end of image acquisition, if the user has chosen 'Defer PPS', the user is provided with an interface to 'Complete PPS' or 'Discontinue PPS' at any later time. The user might wish to alter the image set generated through acquisition, before invoking these operations. Note that the user explicitly uses the user interface provided to invoke this operation, as in the case of PPS generated for post-processing, which is described in the following section.

- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

7.2.3.3 PPS from post-processing system

- The user initiates post-processing on the images generated through acquisition.

- The system creates a Modality performed Procedure Step instance locally in the system. If the source image instance has the Scheduled Procedure Step information, it is copied into the image instances created. Also the system includes the necessary information related to the Modality Performed Procedure Step into the image instance.

- At the end of (one or more) post-processing, the user initiates 'Complete PPS' or 'Discontinue PPS' through the user interface provided. PPS Server AE initiates a MPPS (Modality Performed Procedure Step) N-CREATE request to the remote AE (MPPS SCP), in-order to create a MPPS SOP instance at the remote AE (which is actually a replica of the locally created MPPS SOP instance).

- The remote AE returns response indicating the success/failure of the request execution. If the response indicates success, PPS Server AE initiates a MPPS N-SET request to the remote AE, in-order to update the MPPS SOP instance that is already created, with the additional information.

- The remote AE returns response indicating the success/failure of the request execution. The PPS state information is updated in the system based on the response data, and is presented to the user.

7.3 AE Specification

7.3.1 PPS Server AE Specification

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

SOP Class Name	SOP Class UID
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3

7.3.1.1 Association Establishment Policies

7.3.1.1.1 General

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

Application Context Name	1.2.840.10008.3.1.1.1

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

Maximum Length PDU	128 Kbytes

The SOP Class Extended negotiation is not supported.

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

The user information items sent by this AE are

- Maximum PDU Length
- Implementation UID

7.3.1.1.2 Number of Associations

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

7.3.1.1.3 Asynchronous Nature

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

7.3.1.1.4 Implementation Identifying information

The table in Appendix D identifies the Implementation UID for this product version.

7.3.1.2 Association Initiation Policy

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

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

7.3.1.2.1.1 Associated Real-World Activity

The real-world activities are mentioned in section 7*.2.3 Sequencing of Real-World Activities*. Each of the real world activity results in either creating a new Performed procedure Step SOP instance at the remote SCP or updating an already created Performed Procedure Step SOP instance as per the DICOM standard.

7.3.1.2.1.2 Proposed Presentation Context Table

The following table shows the proposed presentation contexts for the PPS Server AE after any of the real-world activity listed in section 7*.2.3 Sequencing of Real-World Activities*, is initiated.

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

7.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for MPPS SOP class

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

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

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

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

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

7.3.1.3 Association Acceptance Policy

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

7.4 Communication Profiles

7.4.1 Supported Communication Stacks (PS 3.8)

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

7.4.2 OSI Stack

The OSI Communication stack is not supported by this implementation.

7.4.3 TCP/IP Stack

The TCP/IP stack is inherited from the operating system

7.4.3.1 API

Not Applicable to this product.

7.4.3.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

7.4.4 Point-to-Point Stack

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

7.5 Extensions/Specialization/Privatization

7.5.1 Standard Extended/Specialized/Private SOPs

PPS for GEHC CT does not implement any private SOP classes.

7.5.2 Private Transfer Syntaxes

PPS for GEHC CT does not implement any private Transfer Syntaxes.

7.6 Configuration

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

7.6.1 AE Title/Presentation address Mapping

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

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

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

7.6.2 Configurable Parameters

The following are configurable for the PPS Server AE:

- Local (PPS Server AE) AE Title (The default is host name of the scanner appended with string "_PPS". If the length exceeds 16 characters the AE Title is truncated to a length of 16.)
- Local IP Address
- Local IP net-mask
- Local IP gateway
- The following parameters are configurable, but need change only in case of a system software upgrade:
- Implementation UID
- PDU size
- Association time-out period
- Session time-out period

7.6.3 Configurable DICOM Data

The following DICOM sequences are currently defaulted to be automatically sent in the PPS N-CREATE and PPS N-SET however PPS can be configured to not send them:

- (0008, 1032) Procedure Code Sequence – sent in the PPS N-CREATE. If not sent, the PPS N-CREATE will contain an empty Procedure Code Sequence.

- (0040, 0260) Performed Protocol Code Sequence – sent in the PPS N_SET. If not sent, the PPS N-SET will not contain a Performed Protocol Code Sequence.

The configuration is performed by GEHC Field Service Engineers using software environment variables.

7.7 Support of Extended Character Sets

PPS supports ISO_IR 100 character set.

7.8 N-create & N-set Request Message

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

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

GEHC CT supports the selection of single or multiple SPS for a scan. The following are applicable.

- Single SPS selection results in single PPS message
- Multiple SPS selection results in single PPS message
- Multiple SPS selection is allowed **only if they all correspond to same patient id**
- A maximum of 15 SPS’s can be selected
- Referenced Study Sequence - a maximum of ten Item’s is supported. *This attribute will be present only if SPS information is available from Modality Worklist SCU.*
- At the end of acquisition the user might choose to ‘Defer PPS’ and later choose to ‘Complete PPS’ or ‘Discontinue PPS’ from the user interface provided in the system. In this case, the date and time when user chooses to ‘Complete PPS’ or ‘Discontinue PPS’ is taken as the Performed Procedure Step End Date and Performed Procedure Step End Time respectively (Not the actual end date and end time of acquisition)
- Mapping of SPS data to **MPPS SOP instance** is explained in section 7.10
- Mapping of specific SPS data to **CT DICOM IMAGE HEADER** , for PPS is explained in section 7.11

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

- Referenced Study Sequence – The sequence is not sent in the MPPS message

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

7.9 Error Handling and Recovery

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

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

7.10 Use of Specific DICOM Data

The following table gives specific usage of some of attributes in the MPPS SOP instance created, with reference to each of the real-world scenarios mentioned in 7*.2.3* of this document.

Attribute Name	Tag	Usage in MPPS Instance		
		Acquisition with MWL data	Acquisition without MWL data	Post-Processing
Specific Character Set	(0008,0005)	Not used, but copied into image header	Not used	Not used, but copied into image header
Scheduled Step Attribute Sequence	(0040,0270)	Up to 15 items		Up to 15 items
>Study Instance UID	(0020,000D)	Copied from SPS, if option to copy is selected or else created at the scanner	Created at the scanner	Copied from source image
>Referenced Study Sequence	(0008,1110)	Copied from SPS, if selected	Not sent as part of image header	Not sent as part of image header
>Accession Number	(0008,0050)	Copied from SPS, if selected	User input on the scanner	Copied from source image
>Placer Order Number/Imaging Service Request	(0040,2016)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
>Filler Order Number/Imaging Service Request	(0040,2017)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
>Requested Procedure ID	(0040,1001)	Copied from SPS, if selected	User input on the scanner	Copied from source image
>Requested Procedure Description	(0032,1060)	Copied from SPS, if selected	Not used	Not sent as part of image header
>Placer Order Number/Procedure	(0040,1006)	Not sent as part of image header	Not used	Not sent as part of image header
>Filler Order Number/Procedure	(0040,1007)	Not sent as part of image header	Not used	Not sent as part of image header
>Scheduled Procedure ID	(0040,0009)	Copied from SPS, if selected	Not used	Copied from source image
> Scheduled Performing Physician's Name	(0040,0006)	Copied from SPS, if selected	Not used	Copied from source image
>Scheduled Procedure Step Description	(0040,0007)	Copied from SPS, if selected	Not used	Copied from source image
>Scheduled Protocol Code Sequence	(0040,0008)	Copied from SPS, if selected	Not used	Not sent as part of image header
Patient's Name	(0010,0010)	Copied from SPS, if selected	User input on the scanner	Copied from source image
Patient ID	(0010,0020)	Copied from SPS, if selected	User input on the scanner	Copied from source image
Patient's Birth Date	(0010,0030)	Copied from SPS, if selected	User input on the scanner	Copied from source image
Patient's Sex	(0010,0040)	Copied from SPS, if selected	User input on the scanner	Copied from source image
Referenced Patient Sequence	(0008,1120)	Copied from SPS, if selected	Not used	No item
Performed Procedure Step	(0040,0253)	Created at the	Created at the	New generated, may

Attribute Name	Tag	Usage in MPPS Instance		
		Acquisition with MWL data	Acquisition without MWL data	Post-Processing
ID		scanner. Will have the following ***"PPS_ID_<exam number"***	scanner. Will have the following ***"PPS_ID_<exam number"***	not be unique
Performed Station AE Title	(0040,0241)	Local system host-name	Local system host-name	Local system host-name
Performed Station Name	(0040,0242)	Local system suite id	Local system suite id	Local system host-name
Performed Location	(0040,0243)	Local system suite id	Local system suite id	Not used
Performed Procedure Step Start Date	(0040,0244)	Same as exam start date	Same as exam date	Same as exam date
Performed Procedure Step Start Time	(0040,0245)	Same as exam start time	Same as exam time	Same as exam time
Performed Procedure Step Description	(0040,0254)	Copied from SPS, if selected	Not sent as part of image header	Not sent as part of image header
Performed Procedure Step status	(0040,0252)	See Note 1.	See Note 1.	See Note 1.
Performed Procedure Type Description	(0040,0255)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
Procedure Code Sequence	(0008,1032)	Not sent as part of image header. Not sent in MPPS N-Create.	Not sent as part of image header. Not sent in MPPS N-Create.	Not sent as part of image header. Not sent in MPPS N-Create.
Performed Procedure Step End Date	(0040,0250)	Date when all images got installed	Date when all images got installed	The date "Complete PPS" or "Discontinue PPS" is invoked, not the actual end of post-processing
Performed Procedure Step End Time	(0040,0251)	Time when all images got installed	Time when all images got installed	The time "Complete PPS" or "Discontinue PPS" is invoked, not the actual end of post-processing
Modality	(0008,0060)	Value "CT" is stored in image header	Value "CT" is stored in image header	Value "CT" is stored in image header
Study ID	(0020,0010)	Same as exam number	Same as exam number	Copied from source image
Performed Action Item Code Sequence	(0040,0260)	Derived from (0040, 0008)	Not used	Not used
Performed Series Sequence	(0040,0340)	One item for each series created	One item for each series created	One item for each series created with post-processing
>Performing Physician's Name	(0008,1050)	Copied from SPS, if selected	User input on the scanner	Not sent as part of image header
>Protocol Name	(0018,1030)	The name of the protocol selected on the scanner	The name of the protocol selected on the scanner	Copied from source image
>Operator's Name	(0008,1070)	Copied from SPS if selected and	User input on the scanner	Not sent as part of image header

Attribute Name	Tag	Usage in MPPS Instance		
		Acquisition with MWL data	Acquisition without MWL data	Post-Processing
		present otherwise from user input on the scanner		
>Retrieve AE Title	(0008,0054)	Local system host-name	Local system host-name	host-name of the system
>Referenced Image Sequence	(0008,1140)	One item for each image created within the series	One item for each image created within the series	One item for each image generated by post-processing
>Referenced Standalone SOP Instance Sequence	(0040,0220)	Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
>All other attributes from Performed Series Sequence (which Table F.7.2.1 of DICOM standard PS3.4 does not explicitly list)		Not sent as part of image header	Not sent as part of image header	Not sent as part of image header
All other attributes from Radiation Dose Module and Billing and Material Code Module (which Table F.7.2.1 of DICOM standard PS3.4 does not explicitly list)		Not sent as part of image header	Not sent as part of image header	Not sent as part of image header

Note 1:
- When PPS start (N-CREATE) message is sent, this element will have the value “IN PROGRESS”
- When PPS end (N-SET) message is sent, this element will have either “COMPLETED” or “DISCONTINUED” based on user selection

7.11 Use of Specific DICOM Data

7.11.1 Patient Level

Attribute Name	Tag	Usage in CT DICOM Image Header
Patient Name	(0010,0010)	Copied from SPS, if selected
Patient ID	(0010,0020)	Copied from SPS, if selected
Patient Birthdate	(0010,0030)	Copied from SPS, if selected
Patient Sex	(0010,0040)	Copied from SPS, if selected
Referenced Patient Sequence	(0008,1120)	Copied from SPS, if selected
Ref. SOP class uid	(0008,1150)	
Ref. SOP Instance uid	(0008,1155)	

7.11.2 Study Level

Attribute Name	Tag	Usage in CT DICOM Image Header
Study Instance UID	(0020,000D)	Copied from SPS, if selected
Study ID	(0020,0010)	Scanner generated study ID
Referring Physicians name	(0008,0090)	Copied from SPS, if selected
Accession Number	(0008,0050)	If multiple SPS's are selected, then accession number from the first selection (determined by the user) is used, however, it is configurable to be set to zero length. Default is to use the accession number from the first selection.
Referenced Study Sequence	(0008,1110)	Copied from SPS, if selected
Ref. SOP class uid	(0008,1150)	
Ref. SOP Instance uid	(0008,1155)	

7.11.3 Series Level

Attribute Name	Tag	Usage in CT DICOM Image Header
Modality	(0008,0060)	Value "CT" is copied
Protocol Name	(0018,1030)	Name of the selected protocol is copied
Operator Name	(0008,1070)	Copied from SPS if selected and present otherwise generated from user input on scanner
Referenced Performed Procedure Step Sequence	(0008,1111)	Will be present only if SPS , obtained form HIS/RIS is selected for scanning
Ref. SOP class uid	(0008,1150)	Value of MPPS SOP class UID
Ref. SOP Instance uid	(0008,1155)	Scanner generated unique UID
Requested Attribute Sequence	(0040,0275)	Will be present only if SPS obtained from HIS/RIS is selected for scanning. If multiple SPS's are selected then this will contain multiple items one for each SPS. For all other cases this element will not be present
Requested Procedure Id	(0040,1001)	Copied from SPS, if selected
Scheduled Procedure Step Id	(0040,0009)	Copied from SPS, if selected
Scheduled Procedure Step description	(0040,0007)	Copied from SPS, if selected
Scheduled Protocol Code Sequence	(0040,0008)	Copied from SPS, if selected
Performed Procedure Step Id	(0040,0253)	Created at the scanner. The string "***PPS_ID_<examnumber>"*** is used.
Performed Procedure Step start date	(0040,0244)	Same as exam start date
Performed Procedure Step start time	(0040,0245)	Same as exam start time

Attribute Name	Tag	Usage in CT DICOM Image Header
Performed Procedure Step description	(0040,0254)	Exam description is used

8 Grayscale Presentation State in Virtual Exam Split application

8.1 Introduction

The Exam Split feature supports two configuration modes of operation. If the other hospital systems support the IHE Radiology Presentation of Grouped Procedures (PGP) Profile, the Exam Split feature should be configured as Virtual Exam Split. If the other hospital systems do not support the PGP profile, the Exam Split feature can be configured as Hard Exam Split. Both modes provide the user with the same user interface. The Hard Exam Split mode will create new image series with the images, which should be associated with a selected requested procedure.

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the Grayscale Presentation State (GSPS), used in the Virtual Exam Split mode on this GEHC product. The Virtual Exam Split feature provides the DICOM Modality GSPS service as a service class user (SCU).

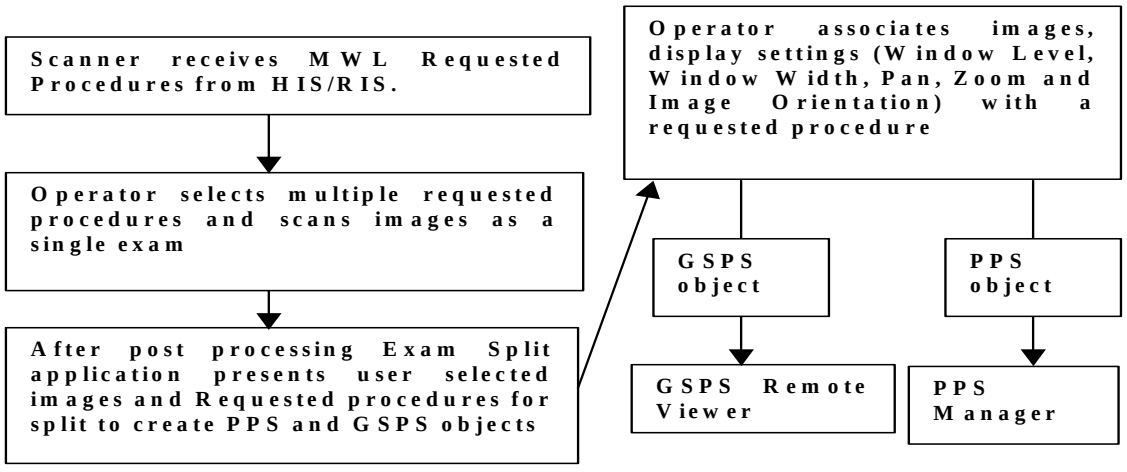
The Virtual Exam Split feature works in conjunction with the DICOM Modality Worklist feature and the Modality Performed Procedure Step feature to support the IHE PGP profile as an acquisition modality.

8.2 Implementation Model

Virtual Exam Split will create Grayscale Presentation State (GSPS) and Performed Presentation State as defined for the Modality actor in the IHE Radiology Presentation of Grouped Procedures (PGP) Profile.

8.2.1 Application Data Flow Diagram

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



8.2.2 Sequencing of Real-World Activities

8.2.2.1 GSPS Acquisition System with MWL data

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

- After Post processing Exam Split application presents associated requested Procedure(s) along with selected acquired Images.
- Exam Split application includes the necessary information related to Requested Procedure, scheduled Procedure Steps and the Performed Procedure Step of the images acquired during acquisition.
- After User modifications on Image(s), user has to click on Send button to create Grayscale Presentation State and Performed Procedure Step objects to transmit to remote host. If there is any Image Orientation, user will be notified about the orientation before sending to Remote Host.
- Exam Split will provide Host Selection user interface to select remote host to transmit of Grayscale Presentation State object. Performed Procedure Step object will be sent to default Performed Procedure Step host.
- After successful transmission of Grayscale Presentation State and Performed Procedure Step objects to remote host, user will be notified with success.

8.2.3 GSPS Server AE Specification

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

SOP Class Name	SOP Class UID
Grayscale Softcopy Presentation State	1.2.840.10008.5.1.4.1.1.11.1

8.2.3.1 Association Establishment Policies

8.2.3.1.1 General

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

Application Context Name	1.2.840.10008.3.1.1.1

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

Maximum Length PDU	128 Kbytes

The SOP Class Extended negotiation is not supported.

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

The user information items sent by this AE are

- Maximum PDU Length
- Implementation UID

8.2.3.1.2 Number of Associations

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

8.2.3.1.3 Asynchronous Nature

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

8.2.3.1.4 Implementation Identifying information

The table in Appendix D identifies the Implementation UID for this product version.

8.2.3.2 Association Initiation Policy

The GSPS AE initiates a new association for every GSPS operation initiated.

8.2.3.2.1 Real-World Activity: GSPS

8.2.3.2.1.1 Associated Real-World Activity

The real-world activities are mentioned in section 8*.2.3 Sequencing of Real-World Activities*. Each of the real world activity results in either creating a new GSPS SOP instance at the remote SCP.

8.2.3.2.1.2 Proposed Presentation Context Table

The following table shows the proposed presentation contexts for the GSPS AE after any of the real-world activity listed in section 8*.2.3 Sequencing of Real-World Activities*, is initiated.

Presentation Context Table – Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Grayscale Presentation State	1.2.840.10008.5.1.4.1.1.11.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Grayscale Presentation State	1.2.840.10008.5.1.4.1.1.11.1	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
Grayscale Presentation State	1.2.840.10008.5.1.4.1.1.11.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

8.2.3.2.1.2.1 SOP Specific DICOM Conformance Statement for GSPS SOP class

If the remote AE does not support the proposed Presentation context, an appropriate error message logged. Refer to section 8.7 for additional information on error messages. Only one association is opened at a time.

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

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

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

8.2.3.3 Association Acceptance Policy

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

8.3 Communication Profiles

8.3.1 Supported Communication Stacks (PS 3.8)

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

8.3.2 OSI Stack

The OSI Communication stack is not supported by this implementation.

8.3.3 TCP/IP Stack

The TCP/IP stack is inherited from the operating system

8.3.3.1 API

Not Applicable to this product.

8.3.3.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

8.3.4 Point-to-Point Stack

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

8.4 Extensions/Specialization/Privatization

8.4.1 Standard Extended/Specialized/Private SOPs

GSPS for GEHC CT does not implement any private SOP classes.

8.4.2 Private Transfer Syntaxes

GSPS for GEHC CT does not implement any private Transfer Syntaxes.

8.5 Configuration

The Exam Split feature is an option with two modes described earlier. The DICOM configuration items below are configurable or re-configurable by the Field Service Engineer and are not accessible by users through the GEHC CT's user interface.

8.5.1 AE Title/Presentation address Mapping

Exam Split allows for the configuration of the following parameters that pertain to the remote AE.

- Remote GSPS AE IP Address — IP Address used to contact the remote GSPS AE
- Remote GSPS IP Port: — IP Port used to contact the remote GSPS AE
- Remote GSPS AE Title — Application Entity Title used to contact the remote GSPS AE

- Remote HES AE IP Address — IP Address used to contact the remote HES AE
- Remote HES IP Port: — IP Port used to contact the remote HES AE
- Remote HES AE Title — Application Entity Title used to contact the remote HES AE

8.5.2 Configurable Parameters

The following are configurable for the GSPS. This section

- Remote Host IP address
- Remote Host port
- Remote AE Title
- Changesplit_mode <HES/VES>

8.6 Support of Extended Character Sets

GSPS feature supports ISO_IR 100 character set.

8.7 Error Handling and Recovery

Exam Application has an extended error codes and the standard error codes are also handled. If the sending GSPS/PPS objects request has failed or response is not received before the association timeout, the operation is deemed ‘Failed’ and the system updates the state and indicates the same on the user interface.

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

8.8 Grayscale Softcopy Presentation State (GSPS) IOD for PGP Profile

8.8.1 Grayscale Softcopy Presentation State (GSPS) IOD Modules

Entity Name	Module Name	Référence	Usage
Patient	Patient	8.8.2	M
Study	General Study	8.8.3	M
	Patient Study	8.8.4	U
Series	General Series	8.8.5	M
	Presentation Series	8.8.6	M
Equipment	General Equipment	8.8.7	M
Presentation State	Presentation State Identification	8.8.8	M
	Presentation State Relationship	8.8.9	M
	Presentation State Shutter	Not sent (attribute condition not met)	M
	Presentation State Mask	Not sent (attribute condition not met)	M
	Mask	Not sent (no multi-frame present)	C
	Display Shutter	Not sent (no display shutter)	C
	Bitmap Display Shutter	Not sent (no bitmap data present)	C
	Overlay Plane	Not sent (no overlay data present)	C
	Overlay Activation	Not sent (no overlay data present)	C
	Displayed Area	8.8.10	M
	Graphic Annotation	Not sent (no annotation data present)	C
	Spatial Transformation	Not sent (no flip/rotate being applied)	C
	Graphic Layer	Not sent (no graphics layers are added)	C
	Modality LUT	8.8.11	C
	Softcopy VOI LUT	8.8.12	C
	Softcopy Presentation LUT	8.8.13	M
	SOP Common	8.8.14	M

8.8.2 Patient Module

Attribute Name	Tag	Type	Notes
Patient's Name	(0010,0010)	2	Copied from original images
Patient ID	(0010,0020)	2	Copied from original images

Patient's Birth Date	(0010,0030)	2	Copied from original images
Patient's Sex	(0010,0040)	2	Copied from original images

8.8.3 General Study Module

Attribute Name	Tag	Type	Notes
Study Instance UID	(0020,000D)	1	Copied from original images
Study Date	(0008,0020)	2	Copied from original images
Study Time	(0008,0030)	2	Copied from original images
Accession Number	(0008,0050)	2	Copied from original images
Referring Physician's Name	(0008,0090)	2	Copied from original images
Referenced Study Sequence	(0008,1110)	3	Copied from original images
> Referenced SOP Class UID	(0008,1150)	1	Value copied from original Images corresponding to the Requested Procedure this GSPS is responding to.
> Referrenced SOP Instance UID	(0008,1155)	1	Value copied from original Images corresponding to the Requested Procedure this GSPS is responding to
Study ID	(0020,0010)	2	Copied from original images
Study Description	(0008,1030)	3	Copied from original images

Note: If two or more of the accession numbers in the grouped case are different, the top level Accession Number (0008, 0050) shall contain 1 of the accession numbers if the relevant CT Image Objects contain a value in the top level Accession Number (0008, 0050) otherwise the top level Accession Number shall be zero length.

8.8.4 Patient Study Module

Attribute Name	Tag	Type	Notes
Patient's Age	(0010,1010)	3	Copied from original images
Patient's Size	(0010,1020)	3	Copied from original images
Patient's Weight	(0010,1030)	3	Copied from original images
Additional Patient's History	(0010,21b0)	3	Copied from original images

8.8.5 General Series Module

Attribute Name	Tag	Type	Notes
Series Number	(0020,0011)	2	Set to 1004.
Laterality	(0020,0060)	2C	Always sent zero-length.
Series Date	(0008,0021)	3	Generated for each series and always

			sent.
Series Time	(0008,0031)	3	Generated for each series and always sent.
Modality	(0008,0060)	1	PR
Performing Physician's Name	(0008,1050)	3	Copied from original images
Protocol Name	(0018,1030)	3	Copied from original images
Series Description	(0008,103E)	3	This will be set as Requested Procedure Code Meaning. If Code Meaning absent, it will be Requested Procedure Description
Operators Name	(0008,1070)	3	Copied from original images
Series Instance UID	(0020,000E)	1	Generated for each series and always sent.
Performed Procedure Step Start Date	(0040,0244)	3	Calculated and sent.
Performed Procedure Step Start Time	(0040,0245)	3	Calculated and sent.
Performed Procedure Step ID	(0040,0253)	3	Will be set as Requested Procedure ID (0040,1001) from (0040,0275)
Performed Procedure Step Description	(0040,0254)	3	This will be set as Requested Procedure Code Meaning with a "PGP-" prefix. If Code Meaning absent, it will be Requested Procedure Description. The length will be truncated to 64 if necessary.
Requested Attributes Sequence	(0040,0275)	3	Sent when MPPS option is enabled and filled in based on what RIS provides to scanner. Number of items relates to number of items selected from Patient Schedule.
> Requested Procedure ID	(0040,1001)	1C	Always sent, copied from RIS
> Accession Number	(0008,0050)	3	Value from worklist sent
> Referenced Study Sequence	(0008,1110)	3	Value from worklist sent
> Study Instance UID	(0020,000D)	3	Value from worklist sent
> Requested Procedure Desc	(0032,1060)	3	Value from worklist sent
> Requested Procedure Code Sequence	(0032,1064)	3	Value from worklist sent.
> Scheduled Procedure Step Desc	(0040,0007)	3	Value from worklist sent
> Scheduled Protocol Code Sequence	(0040,0008)	3	Value from worklist sent
> Scheduled Procedure Step ID	(0040,0009)	3	Value from worklist sent
> Reason for	(0040,1002)	3	Value from worklist sent

Requested Procedure			
> Reason for Requested Procedure Code sequence	(0040,1004)	3	Value from worklist sent

Note: If scheduled procedures are grouped, the accession number for each procedure is stored in the Request Attributes Sequence (0040, 0275) in the image header.

8.8.6 Presentation Series Module

Attribute Name	Tag	Type	Notes
Modality	(0008,0060)	1	PR

8.8.7 General Equipment

Attribute Name	Tag	Type	Notes
Manufacturer	(0008,0070)	2	Always sent as “GE MEDICAL SYSTEMS”
Institution Name	(0008,0080)	3	Copied from original images
Station Name	(0008,1010)	3	Copied from original images
Manufacturers Model Name	(0008,1090)	3	Copied from original images
Software Versions	(0018,1020)	3	Copied from original images

8.8.8 Presentation State Identification Module

Attribute Name	Tag	Type	Notes
Presentation Creation Date	(0070,0082)	1	Calculated and sent.
Presentation Creation Time	(0070,0083)	1	Calculated and sent.
Instance Number	(0020,0013)	1	Set to 24 and sent.
Content Label	(0070,0080)	1	This will be set as “PGP” plus Requested Procedure Code Meaning or Requested Procedure Description converted to all capital letters and truncated to 16 characters.
Content Description	(0070,0081)	2	This will be set to “Exam Split”.
Content Creator’s Name	(0070,0084)	2	Set to “” and sent.

8.8.9 Presentation State Relationship

Attribute Name	Tag	Type	Notes
Referenced Series Sequence	(0008,1115)	1	Copied from original images
> Referenced Image Sequence	(00008,1140)	1	Always sent, references images selected.
>> Reference SOP Class UID	(0008,1150)	1	Always sent
>> Reference SOP Instance UID	(0008,1155)	1	Always sent
> Series Instance UID	(0020,000E)	1	Always sent, references series selected

8.8.10 Displayed Area

Attribute Name	Tag	Type	Notes
Displayed Area Selection Sequence	(0070,005A)	1	Exam Split Application will calculate values for pan and zoom being displayed.
>Referenced Image Sequence	(0008,1140)	1C	Always sent.
>Displayed Area Top Left Hand Corner	(0070,0052)	1	Always sent.
>Displayed Area Bottom Right Hand Corner	(0070,0053)	1	Always sent.
>Presentation Size Mode	(0070,0100)	1	Always sent.
>Presentation Pixel Spacing	(0070,0101)	1C	Always sent.
>Presentation Pixel Aspect Ratio	(0070,0102)	1C	Always sent.
>Presentation Pixel Magnification Ratio	(0070,0103)	1C	Always sent.

8.8.11 Modality LUT Module

Attribute Name	Tag	Type	Notes
Rescale slope intercept	(0028,1052)	1C	Always sent
Rescale slope	(0028,1053)	1C	Always sent
Rescale type	(0028,1054)	1C	Always sent as “HU”

8.8.12 Softcopy VOI LUT Module

Attribute Name	Tag	Type	Notes

Softcopy VOI LUT Sequence	(0028,3110)	1	Always sent
> Reference Image Sequence	(0008,1140)	1C	Always sent
> Window Center	(0028,1050)	1C	Always sent
> Window Width	(0028,1051)	1C	Always sent
> Window Center & Width Explanation	(0038,1055)	3	Always sent

8.8.13 Softcopy Presentation LUT Module

Attribute Name	Tag	Type	Notes
Presentation LUT sequence	(2050,0010)	1C	Not sent, condition not met.
Presentation LUT shape	(2050,0020)	1C	Always sent as IDENTITY

8.8.14 SOP Common Module

Attribute Name	Tag	Type	Notes
SOP Class UID	(008,0016	1	Always sent.
SOP Instance UID	(008,0018)	1	Always sent.
Specific Character Set	(0008,0005)	1C	ISO_IR 100

8.9 Image Header Changes Supporting GSPS

8.9.1 Request Attributes Sequence

The (0040, 0275) Request Attributes Sequence has been expanded to include dicom tags that the Virtual Exam Split (VES) application requires to complete the VES GSPS and PPS. Refer to section 8.8.5 for the details.

The Requested Attributes Sequence may contain a maximum of 15 sequence items. This sequence will only appear in the image header if the VES/HES option is installed or PPS is enabled.

9 CT X-ray Radiation Dose Structured Report Object Implementation

9.1 IOD Module Table

Entity Name	Module Name	Référence	Usage
Patient	Patient	A.3.1	M
Study	General Study	A.3.2	M
	Patient Study	A.3.3	U
Series	SR Document Series	9.2	M

Equipment	General Equipment	A.3.5	M
Document	SR Document General	9.3	M
	SR Document Content	9.4	M
	SOP Common	A.3.9	M

9.2 SR Document Series Module

Attribute Name	Tag	Type	Notes
Modality	(0008,0060)	1	SR sent
Series Instance UID	(0020,000E)	1	Sent.
Series Number	(0020,0011)	1	997 sent
Referenced Performed Procedure Step Sequence	(0008,1111)	2	Sent as null

9.3 SR Document General Module

Attribute Name	Tag	Type	Notes
Instance Number	(0020,0013)	1	Sent
Completion Flag	(0040,A491)	1	COMPLETE sent
Completion Flag Description	(0040,A492)	3	Sent empty
Verification Flag	(0040,A493)	1	UNVERIFIED sent
Content Date	(0008,0023)	1	Sent
Content Time	(0008,0033)	1	Sent
Verifying Observer Sequence	(0040,A073)	1C	Not sent per conditional
>Verifying Observer Name	(0040,A075)	1	Not sent
>Verifying Observer Identification Code Sequence	(0040,A088)	2	Not sent
>>Include 'Code Sequence Macro' Table 8.8-1			Not sent
>Verifying Organization	(0040,A027)	1	Not sent
>Verification DateTime	(0040,A030)	1	Not sent
Author Observer Sequence	(0040,A078)	3	Not sent
>Include 'Identified Person or Device Macro' Table C.17-3b			
Participant Sequence	(0040,A07A)	3	Not sent
>Participation Type	(0040,A080)	1	Not sent
>Participation DateTime	(0040,A082)	2	Not sent
>Include 'Identified Person or Device Macro' Table C.17-3b			

Custodial Organization Sequence	(0040,A07C)	3	Not sent
>Institution Name	(0008,0080)	2	Not sent
>Institution Code Sequence	(0008,0082)	2	Not sent
>>Include 'Code Sequence Macro' Table 8.8-1			
Predecessor Documents Sequence	(0040,A360)	1C	Not sent per condition
>Include ' Hierarchical SOP Instance Reference Macro' Table C.17-3			
Identical Documents Sequence	(0040,A525)	1C	Not sent per condition
>Include ' Hierarchical SOP Instance Reference Macro' Table C.17-3			
Referenced Request Sequence	(0040,A370)	1C	Not sent per condition
>Study Instance UID	(0020,000D)	1	Not Sent
>Referenced Study Sequence	(0008,1110)	2	Not Sent
>> Include 'SOP Instance Reference Macro' Table 10-11			
>Accession Number	(0008,0050)	2	Not Sent
>Placer Order Number/Imaging Service Request	(0040,2016)	2	Not Sent
>Filler Order Number/Imaging Service Request	(0040,2017)	2	Not Sent
>Requested Procedure ID	(0040,1001)	2	Not Sent
>Requested Procedure Description	(0032,1060)	2	Not Sent
>Requested Procedure Code Sequence	(0032,1064)	2	Not Sent
>>Include 'Code Sequence Macro' Table 8.8-1		*No Baseline Context ID Number is specified.*	
>Reason for the Requested Procedure	(0040,1002)	3	Not Sent
>Reason for Requested Procedure Code Sequence	(0040,100A)	3	Not Sent
>>Include 'Code Sequence Macro' Table 8.8-1		*No Baseline Context ID Number is specified.*	
Performed Procedure Code Sequence	(0040,A372)	2	Sent empty
>Include 'Code Sequence Macro' Table 8.8-1		*No Baseline Context ID Number is specified.*	
Current Requested Procedure Evidence Sequence	(0040,A375)	1C	Not Sent
>Include ' Hierarchical SOP Instance Reference Macro' Table C.17-3			

Pertinent Other Evidence Sequence	(0040,A385)	1C	Not sent
>Include ' Hierarchical SOP Instance Reference Macro' Table C.17-3			
Referenced Instance Sequence	(0008,114A)	1C	Not sent
>Include 'SOP Instance Reference Macro' Table 10-11			
>Purpose of Reference Code Sequence	(0040,A170)	1	Not sent
>>Include 'Code Sequence Macro' Table 8.8-1			

9.4 SR Document Content Module

The tables below capture notes concerning the values stored.

9.4.1 TID 10011 – CT Radiation Dose

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Notes
1			CONTAINER	EV (113701, DCM, "X-ray Radiation Dose Report")	1	M	Sent
2	>	HAS CONCEPT MOD	CODE	EV (121058, DCM, "Procedure reported")	1	M	Code sequence (P5-08000, SRT, Computed Tomography X-ray) sent
3	>>	HAS CONCEPT MOD	CODE	EV (G-C0E8, SRT, "Has Intent")	1	M	Not sent. Added in 2009 DICOM standard. Not implemented in product yet.
4	>		INCLUDE	DTID (1002) Observer Context	1-n	M	Observer context sent with Device context values equal to Implementation UID. Single item sent.
5	>	HAS OBS CONTEXT	DATETIME	EV (113809, DCM, "Start of X-ray Irradiation")	1	M	Sent
6	>	HAS OBS CONTEXT	DATETIME	EV (113810, DCM, "End of X-ray Irradiation")	1	M	Sent
7	>	HAS OBS CONTEXT	CODE	EV (113705, DCM, "Scope of Accumulation")	1	M	Code sequence (113014, DCM, Study) sent
8	>>	HAS PROPERTI	UIDREF	DCID (10001) UID Types	1	M	Study Instance UID sent

		ES					
9	>	CONTAINS	INCLUDE	DTID (10012) CT Accumulated Dose Data	1	M	See CT Accumulated Dose Data table below for details
10	>	CONTAINS	INCLUDE	DTID (10013) CT Irradiation Event Data	1-n	M	See CT Irradiation Event Data table below for details
11	>	CONTAINS	TEXT	EV (121106, DCM, "Comment")	1	U	Not sent
12	>	CONTAINS	CODE	EV (113854, DCM, "Source of Dose Information")	1-n	M	Not sent. Added in 2009 DICOM standard. Not implemented in product yet.
13	>	CONTAINS	INCLUDE	DTID (1020) Person Participant	1	U	Not sent.

9.4.2 TID 10012 – CT Accumulated Dose Data

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Notes
1			CONTAINER	EV (113811, DCM, "CT Accumulated Dose Data")	1	M	Sent
2	>	CONTAINS	NUM	EV (113812, DCM, "Total Number of Irradiation Events")	1	M	Sent
3	>	CONTAINS	NUM	EV (113813, DCM, "CT Dose Length Product Total")	1	M	Sent
4	>	CONTAINS	NUM	EV (113814, DCM, "CT Effective Dose Total")	1	U	Not sent
5	>>	HAS PROPERTIES	TEXT	EV (121406,DCM, "Reference Authority")	1	MC	Not sent
6	>>	HAS PROPERTIES	CODE	EV (121406,DCM, "Reference	1	MC	Not sent

				Authority")			
7	>>	HAS CONCEPT MOD	CODE	EV (G-C036,SRT, "Measurement Method")	1	M	Not sent
8	>>	HAS PROPERTIES	TEXT	EV (113815,DCM, "Patient Model")	1	MC	Not sent
9	>>	HAS PROPERTIES	CONTAINER	EV (113816, DCM, "Condition Effective Dose measured")	1	MC	Not sent
10	>>>	CONTAINS	TEXT	EV (113817,DCM, "Effective Dose Phantom Type")	1	M	Not sent
11	>>>	CONTAINS	TEXT	EV (113818, DCM, "Dosimeter Type")	1	M	Not sent
12	>	CONTAINS	TEXT	EV (121106, DCM, "Comment")	1	U	Not sent

9.4.3 TID 10013 – CT Irradiation Event Data

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Notes
1			CONTAINER	EV (113819, DCM, "CT Acquisition")	1	M	Sent
2	>	CONTAINS	TEXT	EV (125203, DCM, "Acquisition Protocol")	1	U	Not sent
3	>	CONTAINS	CODE	EV (123014 , DCM, "Target Region")	1	M	Sent. See note below for specifics.
4	>	CONTAINS	CODE	EV (113820, DCM, "CT Acquisition Type")	1	M	Sent
5	>	CONTAINS	CODE	(G-C232, SRT, "Procedure	1	U	Not sent

				Context")			
6	>	CONTAINS	UIDREF	EV (113769, DCM, "Irradiation Event UID")	1	M	Sent
7	>	CONTAINS	CONTAINER	EV (113822, DCM, "CT Acquisition Parameters")	1	M	Sent
8	>>	CONTAINS	NUM	EV (113824, DCM, "Exposure Time")	1	M	Sent
9	>>	CONTAINS	NUM	EV (113825, DCM, "Scanning Length")	1	M	Sent
10	>>	CONTAINS	NUM	EV (113826, DCM, "Nominal Single Collimation Width")	1	M	Sent
11	>>	CONTAINS	NUM	EV (113827, DCM, "Nominal Total Collimation Width")	1	M	Sent
12	>>	CONTAINS	NUM	EV (113828, DCM, "Pitch Factor")	1	MC	Sent per conditional
13	>>	CONTAINS	NUM	EV (113823, DCM, "Number of X-ray Sources")	1	M	Sent
14	>>	CONTAINS	CONTAINER	EV (113831, DCM, "CT X-ray Source Parameters")	1-n	M	Single item sent.
15	>>>	CONTAINS	TEXT	EV (113832, DCM, "Identification Number of the X-ray Source")	1	M	Sent
16	>>>	CONTAINS	NUM	EV (113733, DCM, "KVP")	1	M	Sent
17	>>>	CONTAINS	NUM	EV (113833, DCM, "Maximum X-ray Tube Current")	1	M	Sent
18	>>>	CONTAINS	NUM	EV (113734, DCM, "Mean X-	1	M	Sent

				ray Tube Current"			
19	>>>	CONTAINS	NUM	EV (113834, DCM, "Exposure Time per Rotation")	1	MC	Sent per conditional
20	>>>	CONTAINS	NUM	EV (113821, DCM, "X-Ray Filter Aluminum Equivalent")	1	U	Not sent
21	>	CONTAINS	CONTAINER	EV (113829, DCM, "CT Dose")	1	MC	Sent per conditional
22	>>	CONTAINS	NUM	EV (113830, DCM, "Mean CTDIvol ")	1	M	Sent
23	>>	CONTAINS	CODE	EV (113835, DCM, "CTDIw Phantom Type")	1	M	Sent (IEC Head Dosimetry Phantom or IEC Body Dosimetry Phantom)
24	>>	CONTAINS	NUM	EV (113836, DCM, "CTDIfreeair Calculation Factor")	1	U	Not sent
25	>>	CONTAINS	NUM	EV (113837, DCM, "Mean CTDIfreeair")	1	U	Not sent
26	>>	CONTAINS	NUM	EV (113838, DCM, "DLP")	1	M	Sent
27	>>	CONTAINS	NUM	EV (113839, DCM, "Effective Dose")	1	U	Not sent
28	>>>	HAS CONCEPT MOD	CODE	EV (G-C036, SRT, "Measurement Method")	1	MC	Not sent
29	>>>>	HAS PROPERTIES	NUM	EV (113840, DCM, "Effective Dose Conversion Factor")	1	MC	Not sent
30	>	CONTAINS	TEXT	EV (113842, DCM, "Xray Modulation Type")	1	U	Not sent
31	>	CONTAINS	TEXT	EV (121106, DCM, "Comment")	1	U	Not sent

32	>	CONTAINS	INCLUDE	DTID (1020) Person Participant	1-n	U	Not sent
33	>	CONTAINS	INCLUDE	DTID (1021) Device Participant	1	M	Not sent. Added in 2009 DICOM standard. Not implemented in product yet.

Note: Target region is filled in per the following table:

Protocol Category	Value stored in Target Region
Head	SRT T-D1100 Head
Orbit	SRT T-D0801 Orbital region
Neck	SRT T-D1600 Neck
Upper Extremity	SRT T-02220 Shoulder
Chest	SRT T-D3000 Chest
Abdomen	SRT T-D4000 Abdomen
Spine	SRT T-11503 Lumbar spine
Pelvis	SRT T-D6000 Pelvis
Lower Extremity	SRT T-D0300 Extremity

Note 2: CT X-Ray Radiation Dose SR Record adheres to the DICOM 2008 edition prior to recent CPs

9.5 Configuration

The product is configured by default to not generate the CT X-Ray Radiation Dose SR Record. Creation of the CT Dose Record can be enabled via reconfig.

The product implements the CT Radiation Dose Report template (TID 10011) per DICOM Supplement 127. The DICOM standard says that the SOP class shall be the “X-Ray Radiation Dose SR” SOP Class (1.2.840.10008.5.1.4.1.1.88.67). However, since many products may not support this SOP class, the product supports the option via reconfig to create the CT Radiation Dose Report as an “Enhanced SR” SOP Class (1.2.840.10008.5.1.4.1.1.88.22). reconfig “Dose Report:” set to “Full” will produce the X-Ray Radiation Dose SR SOP class and “Yes” will produce the Enhanced SR SOP class

APPENDIX A: CT Image and Secondary Capture Modules/Attributes

The tables below specify the attributes of the CT Image and Secondary Capture Image transmitted by the Storage SCU AE.

A.1 CT Image IOD

A.1.1 CT Image IOD Modules

Entity Name	Module Name	Référence	Usage
Patient	Patient	A.3.1	M
Study	General Study	A.3.2	M
	Patient Study	A.3.3	U
Series	General Series	A.3.4	M
Frame of Reference	Frame of Reference	A.4.5	M

Equipment	General Equipment	A.3.5	M
Image	General Image	A.3.6	M
	Image Plane	A.4.1	M
	Image Pixel	A.4.2	M
	Contrast/Bolus	A.4.3	C
	CT Image	A.4.4	M
	VOI LUT	A.3.7	U
	SOP Common	A.3.8	M

A.1.1.1 Implementation Specific details

- For all CT Images created by GEHC CT patient birth date element (0010,0030) is sent, if the operator has entered the details. If the operator has not entered the details it will be sent as a "Zero length element"
- The length of Accession number element (0008,0050) is a maximum of 16 characters
- Window Center (0028,1050) and Window Width (0028,1051) are sent for all CT Images created by GEHC CT
- Based on whether contrast was used or not the following applies for CT Images created by GEHC CT

Mode	(0018,0010)	(0018,1040)
No Contrast	Not sent	Not sent
Oral Contrast	Oral Contrast Agent name	The string "Oral"
IV Contrast	IV Contrast agent name	The String "IV"
Oral and IV contrast	Oral contrast agent " & " IV Contrast agent	The string "Oral & IV"

- Supported field length for DICOM fields

DICOM Tag	Field Name	Field Length
(0008, 0050)	Accession Number	16 characters
(0010, 0010)	Patient Name	32 characters (configurable to 64)
(0010, 0020)	Patient Id	16 characters (configurable to 64)

A.2 SC Image IOD

A.2.1 SC Image IOD Modules

Entity Name	Module Name	Reference	Usage
Patient	Patient	A.3.1	M
Study	General Study	A.3.2	M
	Patient Study	A.3.3	U
Series	General Series	A.3.4	M
Equipment	General Equipment	A.3.5	U
	SC Equipment	A.5.1	M

Image	General Image	A.3.6	M
	Image Pixel	A.5.2	M
	SC Image	Not sent (consists entirely of type 3 element).	M
	Modality LUT	A.5.3	U
	VOI LUT	A.3.7	U
	SOP Common	A.3.8	M

A.3 Common Modules

A.3.1 Patient Module

Attribute Name	Tag	Type	Notes
Patient's Name	(0010,0010)	2	As entered at user interface or from worklist*. Supports 5 different components delimited by "^". Supports a maximum length of 32 characters including the delimiter* . Can be configured to allow 64 characters.
Patient ID	(0010,0020)	2	As entered at user interface or from worklist. Supports maximum of 16 characters. Can be configured to allow 64 characters.
Patient's Birth Date	(0010,0030)	2	As entered at user interface or from worklist.
Patient's Sex	(0010,0040)	2	As entered at user interface or from worklist.
Other Patient ID	(0010, 1000)	3	From worklist.

A.3.2 General Study Module

Attribute Name	Tag	Type	Notes
Study Instance UID	(0020,000D)	1	Value from worklist, if present, is used. Otherwise, the scanner creates a unique value for each exam. If worklist is reused, system can be configured to reuse the study instance uid. Default behavior is to generate a new study instance uid if the worklist is reused.
Study Date	(0008,0020)	2	Generated for each exam and always sent.
Study Time	(0008,0030)	2	Generated for each exam and always sent.
Accession Number	(0008,0050)	2	Value from user interface or worklist sent. If worklists with different accession numbers are grouped, the default behavior is to fill in the top level accession number in the image header. The accession number can be configured to be empty in the grouped case.
Referring Physician's Name	(0008,0090)	2	Value from user interface sent. Accepts 32 characters by default but is configurable to accept 64 characters.

Attribute Name	Tag	Type	Notes
Study ID	(0020,0010)	2	Generated for each exam on the scanner and always sent..
Study Description	(0008,1030)	3	Value from user interface or worklist sent. Accepts 22 characters by default but is configurable to accept 64 characters.
Name of Physician(s) Reading Study	(0008,1060)	3	Sent if entered at the user interface.

A.3.3 Patient Study Module

Attribute Name	Tag	Type	Notes
Patient's Age	(0010,1010)	3	Calculated from Date of Birth entered at user interface.
Patient's Size	(0010,1020)	3	Value from user interface or worklist sent
Patient's Weight	(0010,1030)	3	Value from user interface or worklist sent.
Additional Patient's History	(0010,21b0)	3	Value from user interface or worklist sent

A.3.4 General Series Module

Attribute Name	Tag	Type	Notes
Series Number	(0020,0011)	2	Generated sequentially, always sent.
Laterality	(0020,0060)	2C	Always sent zero-length.
Series Date	(0008,0021)	3	Generated for each series and always sent.
Series Time	(0008,0031)	3	Generated for each series and always sent.
Modality	(0008,0060)	1	Always sent
Performing Physician's Name	(0008,1050)	3	Mapped from (0040, 0006) in the worklist.
Protocol Name	(0018,1030)	3	Sent if entered at user interface.
Series Description	(0008,103E)	3	Value from user interface is sent.
Operators Name	(0008,1070)	3	Value from user interface is sent.
Patient Position	(0018,5100)	2C	Sent. As selected by operator when patient is positioned. Defined terms are: HFP = Head-First Prone HFS = Head-First Supine HFDR = Head-First Decubitus Right HFDL = Head-First Decubitus Left FFDR = Feet-First Decubitus Right FFDL = Feet-First Decubitus Left FFP = Feet-First Prone FFS = Feet-First Supine
Series Instance UID	(0020,000E)	1	Always sent

Performed Procedure Step Start Date	(0040,0244)	3	Sent when MPPS option is enabled
Performed Procedure Step Start Time	(0040,0245)	3	Sent when MPPS option is enabled
Performed Procedure Step ID	(0040,0253)	3	Sent when MPPS option is enabled
Performed Procedure Step Description	(0040,0254)	3	Sent when MPPS option is enabled
Requested Attributes Sequence	(0040,0275)	3	Sent when MPPS option is enabled and filled in based on what RIS provides to scanner. Number of items relates to number of items selected from Patient Schedule.
> Requested Procedure ID	(0040,1001)	1C	Always sent, copied from RIS
> Accession Number	(0008,0050)	3	Value from worklist sent
> Referenced Study Sequence	(0008,1110)	3	Value from worklist sent
> Study Instance UID	(0020,000D)	3	Value from worklist sent
> Requested Procedure Desc	(0032,1060)	3	Value from worklist sent
> Requested Procedure Code Sequence	(0032,1064)	3	Value from worklist sent
> Scheduled Procedure Step Desc	(0040,0007)	3	Value from worklist sent
> Scheduled Protocol Code Sequence	(0040,0008)	3	Value from worklist sent
> Scheduled Procedure Step ID	(0040,0009)	3	Value from worklist sent
> Reason for Requested Procedure	(0040,1002)	3	Value from worklist sent
> Reason for Requested Procedure Code sequence	(0040,1004)	3	Value from worklist sent

A.3.5 General Equipment Module

Attribute Name	Tag	Type	Notes
Manufacturer	(0008,0070)	2	Always sent as “GE MEDICAL SYSTEMS”
Institution Name	(0008,0080)	3	Sent. Value is configurable.
Station Name	(0008,1010)	3	Sent. Value is configurable.
Manufacturers Model Name	(0008,1090)	3	Sent.
Device Serial Number	(0018,1000)	3	Not sent

Attribute Name	Tag	Type	Notes
Software Versions	(0018,1020)	3	Sent.
Spatial Resolution	(0018,1050)	3	Sent only for MR images.
Pixel Padding Value	(0028,0120)	3	Sent.

A.3.6 General Image Module

Attribute Name	Tag	Type	Notes
Patient Orientation	(0020,0020)	2C	Always sent zero length for SC images.
Content Date	(0008,0023)	2C	Generated for each image, always sent.
Content Time	(0008,0033)	2C	Generated for each image, always sent.
Image Type	(0008,0008)	3	Always sent.
Acquisition Number	(0020,0012)	3	Generated for each acquisition, always sent.
Acquisition Date	(0008,0022)	3	Generated for each acquisition, always sent.
Acquisition Time	(0008,0032)	3	Generated for each acquisition, always sent. Format is in fractional seconds as small as 1 millionth of a second.

A.3.7 VOI LUT Module

Attribute Name	Tag	Type	Notes
Window Center	(0028,1050)	1C	Window Center for display. Always sent.
Window Width	(0028,1051)	1C	Window Width for display. Always sent.

A.3.8 SOP Common Module

Attribute Name	Tag	Type	Notes
SOP Class UID	(008,0016	1	Always sent.
SOP Instance UID	(008,0018)	1	Always sent.
Specific Character Set	(0008,0005)	1C	ISO_IR 100
Image Number	(0020,0013)	2	Generated sequentially, always sent.

A.4 CT Image Modules

A.4.1 Image Plane Module

Attribute Name	Tag	Type	Notes
Slice Thickness	(0018,0050)	2	Value always sent.
Image Slice Location	(0020,1041)	3	Value always sent. Note: Slice Location reflects the gantry ISO center table location value for the image in mm. If the gantry is tilted, this value will differ from the image position (0020, 0032) Z value which reflects the upper left-hand voxel (center of the first voxel transmitted) of the grid, in mm in the registered Frame of Reference. The system can be configured to save the upper left-hand corner Z coordinate value into (0020, 1041) Slice Location instead of the gantry ISO center table location.
Image Position	(0020, 0032)	1	Always sent. System configuration allows images to be flipped and rotated. Default behavior is to not allow flip and rotate. Note that the Image Position reflects the x, y and z coordinate of the upper left corner of the first voxel transmitted instead of the center of the first voxel transmitted.
Image Orientation	(0020, 0037)	1	Always sent. System configuration allows images to be flipped and rotated. Default behavior is to not allow flip and rotate.
Pixel Spacing	(0028,0030)	1	Always sent

A.4.2 Image Pixel Module

Attribute Name	Tag	Type	Notes
Samples per Pixel	(0028,0002)	1	Always sent with value = 1
Photometric Interpretation	(0028,0004)	1	Always sent.
Rows	(0028,0010)	1	Always sent
Columns	(0028,0011)	1	Always sent
Bits Allocated	(0028,0100)	1	Always sent with value = 16
Bits Stored	(0028,0101)	1	Always sent with value = 16
High Bit	(0028,0102)	1	Always sent with value = 15
Pixel Representation	(0028,0103)	1	Always sent with value = 1
Pixel Data	(7FE0,0010)	1	Always sent

A.4.3 Contrast Bolus Module

Attribute Name	Tag	Type	Notes
Contrast/Bolus Agent	(0018,0010)	2	Sent if contrast exam, as entered in user interface.
Contrast/Bolus Route	(0018,1040)	3	Sent if contrast exam, as entered in user interface.

A.4.4 CT Image Module

Attribute Name	Tag	Type	Notes
Image Type	(0008,0008)	1	Always sent. Defined terms: Value 3: **AXIAL** **LOCALIZER** **SEGMENTED** **REFORMATTED** **PROCESSED** **COMBINED** **CTINTERVENTION** Value 4: **MIN IP** **MIP** **AVERAGE** **VOLREN** **INTEGRAL** **HD MIP** **RAYSUM** **SURFACE**

Attribute Name	Tag	Type	Notes
			MINMAX **FLUORO**
Samples per Pixel	(0028,0002)	1	Always sent with value = 1
Photometric Interpretation	(0028,0004)	1	Always sent
Bits Allocated	(0028,0100)	1	Always sent with value = 16
Bits Stored	(0028,0101)	1	Always sent with value = 16
High Bit	(0028,0102)	1	Always sent with value = 15
Rescale Intercept	(0028,1052)	1	Always sent (See Note 2 below)
Rescale Slope	(0028,1053)	1	Always sent (See Note 2 below)
Rescale Type	(0028,1054)	1C	Always sent with value = HU from reconstruction. (See Note 2 below)
KV	(0018,0060)	2	Value always sent.
Acquisition Number	(0020,0012)	2	Value always sent.
Scan Options	(0018,0022)	3	Value always sent. Defined Terms: **AXIAL MODE** **SCOUT MODE** **AXIAL XRON MODE** **AXIAL XROFF MODE** **STATIC XRON MODE** **STATIC XROFF MODE** **TUBE HEAT MODE** **DAS MODE** **TUBE CAL MODE** **BIOPSY MODE**

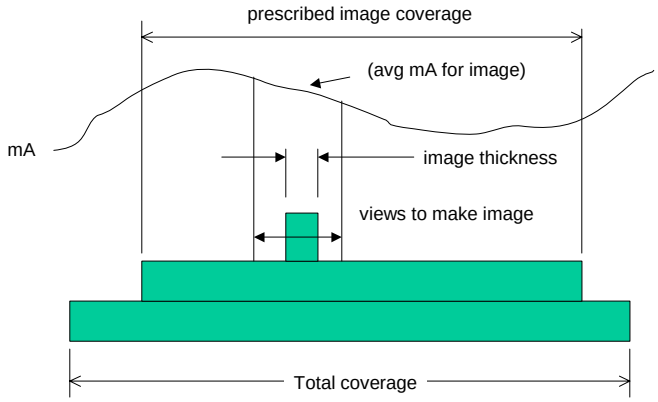
Attribute Name	Tag	Type	Notes
			CINE **HELICAL** **ROTGENCAL MODE** **FLUORO MODE**
Data Collection Diameter	(0018,0090)	3	Value always sent.
Reconstruction Diameter	(0018,1100)	3	Value sent for all images except scouts.
Distance Source to Detector	(0018,1110)	3	Value always sent.
Distance Source to Patient	(0018,1111)	3	Value always sent.
Gantry / Detector Tilt	(0018,1120)	3	Value always sent.
Table Height	(0018,1130)	3	Value always sent.
Rotation Direction	(0018,1140)	3	Not sent for scout or axial.
Exposure Time	(0018,1150)	3	Value always sent.
X-Ray Tube Current	(0018,1151)	3	Value always sent.
Exposure	(0018,1152)	3	Value always sent. (See Note below)
Filter Type	(0018,1160)	3	Sent. Defined terms: **BODY FILTER** **MEDIUM FILTER** **HEAD FILTER**
Generator Power	(0018,1170)	3	Always sent
Focal Spot	(0018,1190)	3	Sent. Fixed value of 0.7 or 1.2.
Convolution Kernel	(0018,1210)	3	Not sent for scouts. Defined terms: **SMOOTH** **SOFT** **STANDARD** **STD+** **DETAIL** **BONE** **BONEPLUS** **CHST** **EDGE** **SHARP** **LUNG** **HD LUNG** **STANDARD2**

Attribute Name	Tag	Type	Notes
			DETAIL2 **BONE2** **BONEPLUS2** **EDGE2** **STANDARDPLUS2** **DETAILPLUS2** **HD ULTA** **HD SOFT**
Revolution Time	(0018, 9305)	3	Sent for spiral scan only
Single Collimation Width	(0018, 9306)	3	Sent for spiral scan only
Total Collimation Width	(0018, 9307)	3	Sent for spiral scan only
Table Speed	(0018, 9309)	3	Sent for spiral scan only
Table Feed per Rotation	(0018, 9310)	3	Sent for spiral scan only
CT Pitch Factor	(0018, 9311)	3	Sent for spiral scan only

CAUTION

It is possible for the operator of GEHC CT system to change the table height while scanning a series of images. Therefore, implementations must use the Frame of Reference UID (0020,0052) in conjunction with the Table Height (0018,1130) to determine if two images are spatially related.

Decsciption of how to calculate the Dicom Exposure field (0018,1152)



exposure = (exposure time) * (image avg mA)* (slice thickness)/(total coverage)

exposure time = total x-ray on time
helical total coverage= (exposure time * table velocity)
axial or cine total coverage = macro row thickness * no of active rows
Slice thickness = nominal prospective reconstructed slice selection

Exposue.ppt
T. Toth 03-Aug-04

Note:

A.4.5 Frame of Reference Module

Attribute Name	Tag	Type	Notes
Frame of Reference UID	(0020,0052)	1	See Caution below.
Position Reference Indicator	(0020,1040)	2	Value as entered at the user interface.

CAUTION

It is possible for the operator of GEHC CT system to change the table height while scanning a series of images. Therefore, implementations must use the Frame of Reference UID (0020,0052) in conjunction with the Table Height (0018,1130) to determine if two images are spatially related.

A.4.6 Other Attributes

Attribute Name	Tag	Type	Notes
Temporal Position Index	(0020,9128)	3	Filled into CT image for some applications. Pass number for shuttle images.
Nominal Percentage of Cardiac Phase	(0020,9241)	3	Filled into CT image for some applications. Prescribed percentage of cardiac phase.

A.5 SC Image Modules

A.5.1 SC Equipment Module

Attribute Name	Tag	Type	Notes
Conversion Type	(0008,0064)	1	Always sent with value WSD
Modality	(0008,0060)	3	Modality of original image

A.5.2 Image Pixel Module

Attribute Name	Tag	Type	Notes
Samples per Pixel	(0028,0002)	1	Always sent with value = 1
Photometric Interpretation	(0028,0004)	1	Always sent.
Rows	(0028,0010)	1	Always sent
Columns	(0028,0011)	1	Always sent
Bits Allocated	(0028,0100)	1	Always sent with value = 16
Bits Stored	(0028,0101)	1	Always sent with value = 16
High Bit	(0028,0102)	1	Always sent with value = 15
Pixel Representation	(0028,0103)	1	Always sent with value = 1

Pixel Data	(7FE0,0010)	1	Always sent

A.5.3 Modality LUT Module

Attribute Name	Tag	Type	Notes
Rescale intercept	(0028,1052)	1C	Always sent
Rescale Slope	(0028,1053)	1C	Always sent
Rescale Type	(0028,1054	1C	Always sent with value = HU

APPENDIX B: Private Data Elements

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

B.1 CT Image IOD Private Data Elements Definition

B.1.1 Private Creator Identification (GEMS_IDEN_01)

Attribute Name	Tag	VR	VM
Full fidelity	(0009,1001)	LO	1
Suite id	(0009,1002)	SH	1
Product id	(0009,1004)	SH	1
Image actual date	(0009,1027)	SL	1
Equipment UID	(0009,10E3)	UI	1

Note: For all images created by GEHC CT system (0009,xx01) element will have the value “CT_LIGHTSPEED”.

B.1.2 Private Creator Identification (GEMS_ACQU_01)

Attribute Name	Tag	VR	VM
Number of cells I in Detector	(0019,1002)	SL	1
Cell number at Theta	(0019,1003)	DS	1
Cell spacing	(0019,1004)	DS	1
Horiz. Frame of ref.	(0019,100F)	DS	1
Series contrast	(0019,1011)	SS	1
First scan ras	(0019,1018)	LO	1
Last scan ras	(0019,101A)	LO	1
Table speed	(0019,1023)	DS	1
Mid scan time	(0019,1024)	DS	1
Mid scan flag	(0019,1025)	SS	1
Degrees of azimuth	(0019,1026)	SL	1
Gantry period	(0019,1027)	DS	1
Number of triggers	(0019,102C)	SL	1
Angle of first view	(0019,102E)	DS	1
Trigger frequency	(0019,102F)	DS	1
Scan FOV type	(0019,1039)	SS	1
Segment number	(0019,1042)	SS	1
Total segments requested	(0019,1043)	SS	1
View compression factor	(0019,1047)	SS	1
Recon post proc. Flag	(0019,1052)	SS	1
Dependent on #views processed	(0019,106A)	SS	1

B.1.3 Private Creator Identification (GEMS_RELA_01)

Attribute Name	Tag	VR	VM
Series from which Prescribed	(0021,1003)	SS	1
Series Prescribed From	(0021,1035)	SS	1
Image Prescribed From	(0021,1036)	SS	1
Biopsy position	(0021,1091)	SS	1
Biopsy T location	(0021,1092)	FL	1
Biopsy ref location	(0021,1093)	FL	1

B.1.4 Private Creator Identification (GEMS_STDY_01)

Attribute Name	Tag	VR	VM
Start time(secs) in first axial	(0023,1070)	FD	1

B.1.5 Private Creator Identification (GEMS_IMAG_01)

Attribute Name	Tag	VR	VM
Scout Type	(0027,1010)	SS	1
Vma mamp	(0027,101C)	SL	1
Vma mod	(0027,101E)	SL	1
GE Noise Index * 10	(0027,101F)	SL	1
Smart scan ON/OFF flag	(0027,1020)	SS	1
Plane Type	(0027,1035)	SS	1
Center R coord of plane image	(0027,1042)	FL	1
Center A coord of plane image	(0027,1043)	FL	1
Center S coord of plane image	(0027,1044)	FL	1
Normal R coord	(0027,1045)	FL	1
Normal A coord	(0027,1046)	FL	1
Normal S coord	(0027,1047)	FL	1
Table start location	(0027,1050)	FL	1
Table end location	(0027,1051)	FL	1

B.1.6 Private Creator Identification (GEMS_0039)

Attribute Name	Tag	VR	VM
SR Application Name	(0039,1095)	LO	1

B.1.7 Private Creator Identification (GEMS_CT_FLRO_1)

Attribute Name	Tag	VR	VM
CT Int Fluoro	(0029,1001)	SS	1
Image Precise Location	(0029,1002)	DS	1

B.1.8 Private Creator Identification (GEMS_PARM_01)

Attribute Name	Tag	VR	VM
Window value	(0043,1010)	US	1

Attribute Name	Tag	VR	VM
X-ray chain	(0043,1012)	SS	3
Number of overranges	(0043,1016)	SS	1
Delta start time	(0043,101E)	DS	1
Max overranges in a view	(0043,101F)	SL	1
Corrected after glow terms	(0043,1021)	SS	1
Reference channels	(0043,1025)	SS	6
No views ref chans blocked	(0043,1026)	US	4
Scan pitch ratio	(0043,1027)	SH	1
Unique image iden	(0043,1028)	OB	1
Private Scan Options	(0043,102B)	SS	4
RA cord of target recon center	(0043,1031)	DS	2
Trigger on position	(0043,1040)	FL	1
Degree of rotation	(0043,1041)	FL	1
DAS trigger source	(0043,1042)	SL	1
DAS fpa gain	(0043,1043)	SL	1
DAS output source	(0043,1044)	SL	1
DAS ad input	(0043,1045)	SL	1
DAS cal mode	(0043,1046)	SL	1
Start scan to X-ray on delay	(0043,104D)	FL	1
Duration of X-ray on	(0043,104E)	FL	1
Recon filter	(0043, 1064)	LO	1

B.1.9 Private Creator Identification(GEMS_HELIOS_01)

Note: Dicom elements (0045, 1030-1034) and (0045, 1036-1039) and (0045, 103B) are present only if the appropriate cardiac option is installed on the scanner.

Attribute Name	Tag	VR	VM
Number of Macro Rows in Detector	(0045, 1001)	SS	1
Macro width at ISO Center	(0045, 1002)	FL	1
DAS type	(0045, 1003)	SS	1
DAS gain	(0045, 1004)	SS	1
DAS Temprature	(0045, 1005)	SS	1
Table Direction	(0045, 1006)	CS	1
Z smoothing Factor	(0045, 1007)	FL	1
View Weighting Mode	(0045, 1008)	SS	1
Sigma Row number	(0045, 1009)	SS	1
Minimum DAS value	(0045, 100A)	FL	1
Maximum Offset Value	(0045, 100B)	FL	1
Number of Views shifted	(0045, 100C)	SS	1
Z tracking Flag	(0045, 100D)	SS	1
Mean Z error	(0045, 100E)	FL	1
Z tracking Error	(0045, 100F)	FL	1
Start View 2A	(0045, 1010)	SS	1
Number of Views 2A	(0045, 1011)	SS	1
Start View 1A	(0045, 1012)	SS	1
Sigma Mode	(0045, 1013)	SS	1
Number of Views 1A	(0045, 1014)	SS	1

Attribute Name	Tag	VR	VM
Start View 2B	(0045, 1015)	SS	1
Number Views 2B	(0045, 1016)	SS	1
Start View 1B	(0045, 1017)	SS	1
Number of Views 1B	(0045, 1018)	SS	1
Iterbone Flag	(0045, 1021)	SS	1
Perisstaltic Flag	(0045, 1022)	SS	1
CardiacReconAlgorithm	(0045, 1030)	CS	1
AvgHeartRateForImage	(0045, 1031)	CS	1
TemporalResolution	(0045, 1032)	FL	1
PctRpeakDelay	(0045, 1033)	CS	1
ActualPctRpeakDelay	(0045, 1034)	CS	1
EkgFullMaStartPhase	(0045, 1036)	CS	1
EkgFullMaEndPhase	(0045, 1037)	CS	1
EkgModulationMaxMa	(0045, 1038)	CS	1
EkgModulationMinMa	(0045, 1039)	CS	1
NoiseReductionImageFilterDesc	(0045, 103B)	LO	1
RPeakTimeDelay	(0045, 103F)	IS	1
ActualRPeakTimeDelay	(0045, 1044)	IS	1
CardiacScanOptions	(0045, 1045)	ST	1

B.1.10 Private Creator Identification (GEMS_CT_CARDIAC_001)

Note: Private Group 49 is present only if the appropriate cardiac option is installed on the scanner.

Attribute Name	Tag	VR	VM
CT Cardiac Sequence	(0049, 1001)	SQ	1
HeartRateAtConfirm	(0049, 1002)	CS	1
AvgHeartRatePriorToConfirm	(0049, 1003)	FL	1
MinHeartRatePriorToConfirm	(0049, 1004)	CS	1
MaxHeartRatePriorToConfirm	(0049, 1005)	CS	1
StdDevHeartRatePriorToConfirm	(0049, 1006)	FL	1
NumHeartRateSamplesPriorToConfirm	(0049, 1007)	US	1
AutoHeartRateDetectPredict	(0049, 1008)	CS	1
SystemOptimizedHeartRate	(0049, 1009)	CS	1
EkgMonitorType	(0049, 100A)	ST	1
NumReconSectors	(0049, 100B)	CS	1
RpeakTimeStamps	(0049, 100C	FL	1-256
EkgGatingType	(0049,1016)	SH	1
EkgWaveTimeOffFirstDataPoint	(0049,101B)	FL	1

B.1.11 Private Creator Identification (GEHC_CT_ADVAPP_001)

Attribute Name	Tag	VR	VM
ReconFlipRotateAnno	(0053, 1060)	SH	1
RespiratoryFlag	(0053, 1062)	SH	1

APPENDIX C: Private Data Elements 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.

C.2 Directory Information Module

C.2.1 CD-R/DVD-R Directory Information Module

Attribute Name	Tag	Type	Notes
Offset of the First Directory Record of the Root Directory Entity	(0004,1200)	1	Set by application
Offset of the Last Directory Record of the Root Directory Entity	(0004,1202)	1	Set by application
File-set Consistency Flag	(0004,1212)	1	0000H: no known inconsistencies.
Directory Record Sequence	(0004,1220)	2	Not supported.
>Offset of the Next Directory Record	(0004,1400)	!C	Set by application
>Record In-use Flag	(0004,1410)	1C	FFFFH: record is in use
>Offset of Referenced Lower-Level Directory Entity	(0004,1420)	1C	Set by application
>Directory Record Type	(0004,1430)	1C	PATIENT, STUDY, SERIES and IMAGE
>Private Record UID	(0004,1432)	1C	Not supported
>Referenced File ID	(0004,1500)	1C	Generated only for Image Directory Record, starting with A/A/A/A/Z01.
>MRDR Directory Record Offset	(0004,1504)	1C	Not generated
>Referenced SOP Class UID in File	(0004,1510)	!C	Generated for Image Directory Record
>Referenced SOP Instance UID in File	(0004,1511)	1C	Generated for Image Directory Record. Set to SOP Instance UID (0008,0018) during save to media.
>Referenced Transfer Syntax UID in File	(0004,1512)	1C	Not supported

C.2.2 MOD 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	Present only in IMAGE Directory Record
Referenced SOP Class UID in file	(0004,1510)	1C	Present only in IMAGE Directory Record
Referenced SOP Instance UID in File	(0004,1511)	1C	Present only in IMAGE Directory Record
Referenced Transfer Syntax UID in File	(0004,1512)	1C	Present only in IMAGE Directory Record

C.3 CD-R/DVD-R Directory Record Selection Keys

The STD-GEN-CD and STD-GEN-DVD Application Profiles will have only the Patient, Study, Series, and Image directory record types. Given below are the attributes supported under each of these directories.

C.3.1 CD-R/DVD-R Patient Keys

Attribute Name	Tag	Type	Notes
Specific Character Set	(0008,0005)	1C	ISO_IR 100.
Patient's Name	(0010,0010)	2	If present in composite object instances it will be set to same value, other wise set to NULL.
Patient ID	(0010,0020)	1	If present in composite object instances it will be set to same value, other wise set to NULL.
Patient Birth Date	(0010, 0030)	2	If present in composite object instances it will be set to same value, other wise set to NULL.
Patient Birth Time	(0010, 0032)	2	If present in composite object instances it will be set to same value, other wise set to NULL.
Patient Sex	(0010, 0040)	2	If present in composite object instances it will be set to same value, other wise set to NULL.

C.3.2 CD-R/DVD-R Study Keys

Attribute Name	Tag	Type	Notes

Specific Character Set	(0008,0005)	1C	ISO_IR 100.
Study Date	(0008,0020)	1	If present in composite object instances it will be set to same value, other wise set to NULL.
Study Time	(0008,0030)	1	If present in composite object instances it will be set to same value, other wise set to NULL.
Study Description	(0008,1030)	2	If present in composite object instances it will be set to same value, other wise set to NULL.
Study Instance UID	(0020,000D)	1C	This is set to value that is present in the composite object instances, otherwise composite object instances are not Archived.
Study ID	(0020,0010)	1	If present in composite object instances it will be set to same value, other wise set to NULL.
Accession Number	(0008,0050)	2	If present in composite object instances it will be set to same value, other wise set to NULL.

C.3.3 CD-R/DVD-R Series Keys

Attribute Name	Tag	Type	Notes
Specific Character Set	(0008,0005)	1C	ISO_IR 100
Modality	(0008,0060)	1	Set to one that is found in composite object instances.
Series Instance UID	(0020,000E)	1	This is set to value that is present in the composite object instances, otherwise check for presence of Referenced SOP Instance UID in File (0004,1511), if both not present, instance is not archived.
Series Number	(0020,0011)	1	If present in composite object instances it will be set to same value, other wise set to NULL.
Icon Image Sequence	(0088,0200)	3	Not supported
Manufacturer	(0008,0070)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Series Description	(0008,103E)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Manufacturer's Model Name	(0008,1090)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Image Type	(0008,0008)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Series Date	(0008, 0021)	2	If present in composite object instances it will be set to same value, other wise set to NULL

Performing Physician's Name	(0008,1050)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Series Type	(0054, 1000)	2	If present in composite object instances it will be set to same value, other wise set to NULL

C.3.4 CD-R/DVD-R Image Keys

Attribute Name	Tag	Type	Notes
Specific Character Set	(0008,0005)	1C	ISO_IR 100 .
Image Number	(0020,0013)	1	If present in composite object instances it will be set to same value, other wise set to NULL
Icon Image Sequence	(0088,0200)	3	Note supported
SOP Class UID	(0008,0016)	1	If present in composite object instances it will be set to same value, other wise set to NULL
Slice Thickness	(0018,0050)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Repetition Time	(0018,0080)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Echo Time	(0018,0081)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Inversion Time	(0018,0082)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Number of Averages	(0018,0083)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Spacing Between Slices	(0018,0088)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Data Collection Diameter	(0018,0090)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Contrast Bolus Route	(0018,1040)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Trigger Time	(0018,1060)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Reconstruction Diameter	(0018,1100)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Gantry Detector Tilt	(0018,1120)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Flip Angle	(0018,1314)	2	If present in composite object instances it will be set to same value, other wise set to NULL

Slice Location	(0020,1041)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Rows	(0028,0010)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Columns	(0028,0011)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Echo Numbers	(0008,0086)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Samples Per Pixel	(0028,0002)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Bits Allocated	(0028,0100)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Bits Stored	(0028,0101)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Referenced SOP Class UID in File	(0004,1510)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Referenced SOP Instance UID in File	(0004,1511)	2	If present in composite object instances it will be set to same value, other wise set to NULL
SOP Instance UID	(0008,0018)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Referenced Transfer Syntax UID in File	(0004,1512)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Frame of Reference UID	(0020,0052)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Sequence Variant	(0018,0021)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Convolution Kernel	(0018,1210)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Image Position Patient	(0020,0032)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Image Orientation Patient	(0020,0037)	2	If present in composite object instances it will be set to same value, other wise set to NULL
Pixel Spacing	(0028,0030)	2	If present in composite object instances it will be set to same value, other wise set to NULL

C.4 Directory Record Selection Keys

As indicated in table C.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.

C.4.1 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	

C.4.2 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	

C.4.3 Series Keys

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

C.4.4 Image Keys

Attribute Name	Tag	Type	Notes
Specific Character Set	(0008,0005)	1C	ISO_IR 100
SOP Instance UID	(0008,0018)	3	Redundant to (0004,1511)
Referenced Image Sequence	(0008,1140)	1C	Not included.
Sequence Variant	(0018,0021)	3	

Slice Thickness	(0018,0050)	3	
Repetition Time	(0018,0080)	3	
Echo Time	(0018,0081)	3	
Inversion Time	(0018,0082)	3	
Number of Averages	(0018,0083)	3	
Echo Number	(0018,0086)	3	MRI profile only.
Spacing Between Slices	(0018,0088)	3	
Data Collection Diameter	(0018,0090)	3	
Contrast/Bolus Route	(0018,1040)	3	
Trigger Time	(0018,1060)	3	
Reconstruction Diameter	(0018,1100)	3	
Gantry/Detector Tilt	(0018,1120)	3	
Convolution Kernel	(0018,1210)	3	
Flip Angle	(0018,1314)	3	
Image Number	(0020,0013)	1	
Image Position (Patient)	(0020,0032)	1C	
Image Orientation (Patient)	(0020,0037)	1C	
Frame of Reference UID	(0020,0052)	1C	Absent from PRI-CTMR-MOD12
Slice Location	(0020,1041)	3	
Samples Per Pixel	(0028,0002)	1C	
Photometric Interpretation	(0028,0004)	1C	Absent from all profiles.
Rows	(0028,0010)	1	
Columns	(0028,0011)	1	
Pixel Spacing	(0028,0030)	1C	
Bits Allocated	(0028,0100)	1C	
Bits Stored	(0028,0101)	1	MRI – Absent from profiles.
High Bit	(0028,0102)	1C	MRI – Absent from profiles.

APPENDIX D: Implementation UID for Product Versions

Product Model	Software Revision	Implementation UID
BrightSpeed Elite	10BW27.7	1.2.840.113619.6.55
BrightSpeed Elite Select	10BW27.7	1.2.840.113619.6.55
BrightSpeed Edge Select	10BW27.7	1.2.840.113619.6.55
BrightSpeed Excel Select	10BW27.7	1.2.840.113619.6.55
LightSpeed RT16	10BW27.7	1.2.840.113619.6.55
LightSpeed Xtra	10BW27.7	1.2.840.113619.6.55

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