



Technical Publications

Direction DOC1246512

Revision 2

LightSpeed¹⁶ (4x, 5x), LightSpeed Pro¹⁶

Dicom Conformance Statement

* Refer to section 1 for a list of products to which this Conformance Statement applies.





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REVISION HISTORY

| REV. | DATE | REASON FOR CHANGE | | | | | | | | | | | | | | | | | | |
|--|---|---|-------------------|-----------------------|--|---|---|--|--|---|--|--|--|--|--|--|--|--|--|--|
| 1 | 15/Jan./2013 | <p>Used DOC1200461 Rev 3 as baseline to create LightSpeed¹⁶ (4x, 5x), LightSpeed Pro¹⁶ Dicom Conformance Statement.</p> <table border="1"> <thead> <tr> <th>Changed Locations</th> <th>Description of Change</th> </tr> </thead> <tbody> <tr> <td> <ul style="list-style-type: none"> Cover Page CONFORMANCE STATEMENT OVERVIEW INTRODUCTION Appendix.D Implementation UID for Product Versions </td> <td> Updated/Added products and software versions <ul style="list-style-type: none"> Products: LightSpeed¹⁶ (4x, 5x), LightSpeed Pro¹⁶ Software Version: 07MW11.10_SP4-0-3 </td> </tr> <tr> <td> <ul style="list-style-type: none"> 7.6.3 Configurable DICOM Data </td> <td>Removed this section because they are not configurable</td> </tr> <tr> <td> <ul style="list-style-type: none"> 8. Grayscale Softcopy Presentation State </td> <td>Added the description of Save Sate function</td> </tr> <tr> <td> <ul style="list-style-type: none"> 9.4 SR Document Content Module </td> <td>Updated modules to comply with DICOM standard 2008</td> </tr> <tr> <td> <ul style="list-style-type: none"> 9.6 Implementation UID </td> <td>Added for new implementation UID specific to Dose SR</td> </tr> <tr> <td> <ul style="list-style-type: none"> A2.2 CT Dose Report SC Image Details </td> <td>Removed this section because no additional standard DICOM attribute is supported</td> </tr> <tr> <td> <ul style="list-style-type: none"> A. CT Image and Secondary Capture Modules/Attributes </td> <td>Updated all subsections as per specification</td> </tr> <tr> <td> <ul style="list-style-type: none"> B. Private Data Elements </td> <td>Updated all subsections as per specification</td> </tr> </tbody> </table> | Changed Locations | Description of Change | <ul style="list-style-type: none"> Cover Page CONFORMANCE STATEMENT OVERVIEW INTRODUCTION Appendix.D Implementation UID for Product Versions | Updated/Added products and software versions <ul style="list-style-type: none"> Products: LightSpeed¹⁶ (4x, 5x), LightSpeed Pro¹⁶ Software Version: 07MW11.10_SP4-0-3 | <ul style="list-style-type: none"> 7.6.3 Configurable DICOM Data | Removed this section because they are not configurable | <ul style="list-style-type: none"> 8. Grayscale Softcopy Presentation State | Added the description of Save Sate function | <ul style="list-style-type: none"> 9.4 SR Document Content Module | Updated modules to comply with DICOM standard 2008 | <ul style="list-style-type: none"> 9.6 Implementation UID | Added for new implementation UID specific to Dose SR | <ul style="list-style-type: none"> A2.2 CT Dose Report SC Image Details | Removed this section because no additional standard DICOM attribute is supported | <ul style="list-style-type: none"> A. CT Image and Secondary Capture Modules/Attributes | Updated all subsections as per specification | <ul style="list-style-type: none"> B. Private Data Elements | Updated all subsections as per specification |
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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 release of the product:

LightSpeed¹⁶ (4X, 5X), LightSpeed Pro¹⁶

07MW11.10_SP4-x

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

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:

LightSpeed¹⁶ (4x, 5x), LightSpeed Pro¹⁶

This document applies to the following software releases for LightSpeed Product:

LightSpeed¹⁶ (4x, 5x), LightSpeed Pro¹⁶ 07MW11.10_SP4-x

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://www3.gehealthcare.com/en/Products/Interoperability/DICOM/Workstations_DICOM_Conformance_Statements

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 Softcopy Presentation State. The Virtual Exam Split Option and Save State function for GEHC CT provide the DICOM Modality GSPS service as a service class user (SCU)

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

Appendix A specifies the CT IOD information object.

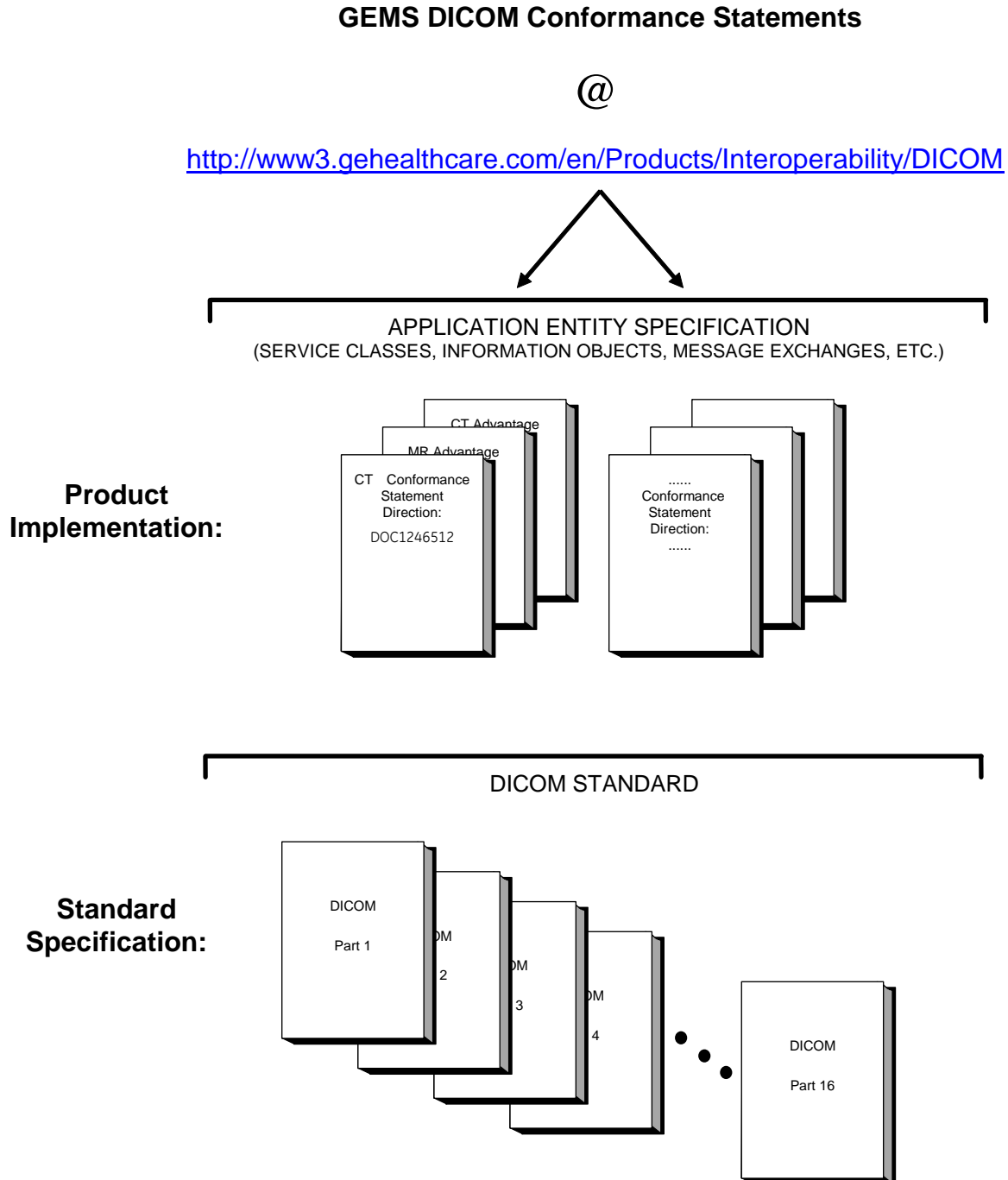
Appendix B specifies the private data element definition for CT IOD.

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:

LightSpeed¹⁶ (4x, 5x), LightSpeed Pro¹⁶ DICOM conformance statements
Direction DOC1246512

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 : +1.703.841.3200

1.3 Intended Audience

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM 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 Definitions used 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.

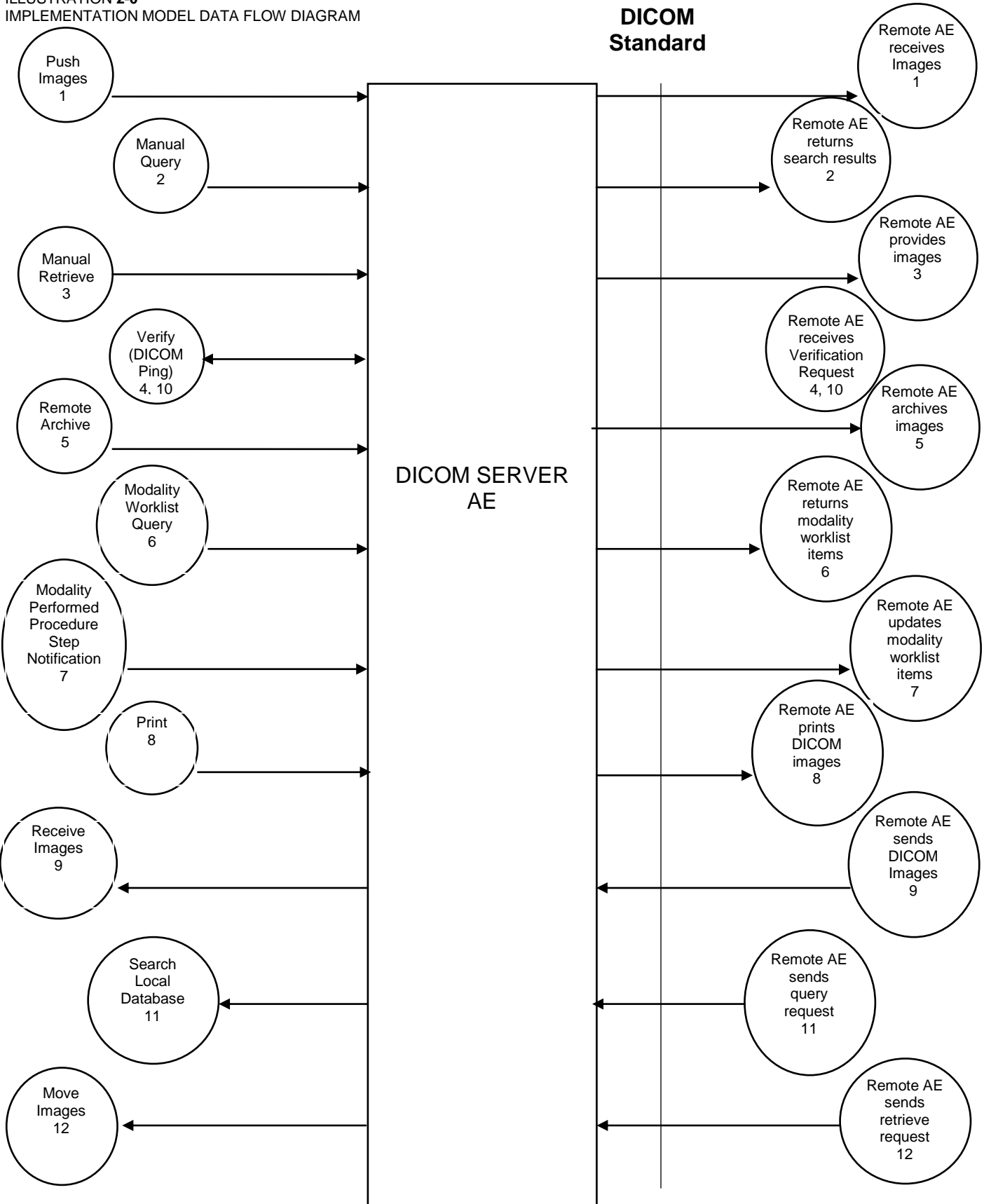
The GEHC CT product uses DICOM services to import images for possible further analysis and/or processing. It also uses DICOM services to export images to other DICOM-compliant machines.

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 several 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. Illustration 2.0 above shows basic Real-World Activities. In addition, Sections 3, 4, 5, 6, and 7 cover Media Storage, Print, Modality Worklist, Performed Procedure Step, and Storage Commit in more detail.

The following paragraphs describe the Real-World Activities of Illustration 2.0:

1. Push Images

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 "Send examination", "Send series" or "Send image from the "Network" pull-down menu on the local database manager to send the image(s) to a selected destination.

2. Manual Query

Real-World Activity, *Query Remote AE*, 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. Manual Retrieve

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. Verify (DICOM Ping)

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. Remote Archive

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 examination" 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.

6. Modality Worklist Query

The operator or the system initiates a modality worklist query to the modality worklist SCP with a given set of query parameters. The modality worklist SCP returns responses matching the query parameters. Worklist items from the returned worklist query responses are presented to the user. The user then chooses the desired worklist item and begins the image acquisition process.

7. Modality Performed Procedure Step Notification

When the user begins the image acquisition process and generates the first image, the DICOM SERVER AE sends N-CREATE message to the configured MPPS SCP to indicate that the image acquisition process has been started for the requested procedure.

The operator can close the acquisition session either by completing the acquisition process or discontinuing the ongoing scan. On closing the acquisition session, the DICOM SERVER AE sends N-SET message to the configured MPPS SCP to indicate the acquisition state of the requested procedure, with appropriate MPPS status (COMPLETED/DISCONTINUED).

8. Print

The Film Composer allows the operator to select printers and it also allows the user to drag and drop the images (from viewer application) into the film. When user presses the "Print" Button, the DICOM SERVER AE tries to establish the association with requested printer and sends the images for printing.

9. Receive Images

When remote DICOM hosts send DICOM images to DICOM SERVER AE, images are installed in the local database. The browser displays the content of the local database.

10. Receive Verification request

No operator action is required to respond to a verification message. 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.

11. Search Local Database

For this operation, a remote DICOM AE asks to obtain the list of data at Study/Series/Image level. 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.

12. Move Images

For this operation, a remote DICOM AE asks to send data at Study/Series/Image level from the local AE to another DICOM Remote AE. The Remote DICOM AE shall be declared locally on the system. The declaration of remote DICOM AE is done through a configuration tool.

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:

- **Verify (DICOM Ping):** 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 Images:** 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.
- **Manual 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.
- **Manual Retrieve:** 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:

- **Receive Verification request:** 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".
- **Receive Images:** 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.
- **Search Local Database:** 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.

- Move Images:** 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 |
| Grayscale Softcopy Presentation State Storage | 1.2.840.10008.5.1.4.1.1.11.1 |
| Enhanced SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.67 |
| RT Structure Set Storage | 1.2.840.10008.5.1.4.1.1.481.3 |
| 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 |
| Enhanced SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.67 |

| | |
|----------------------------------|-------------------------------|
| RT Structure Set Storage | 1.2.840.10008.5.1.4.1.1.481.3 |
| 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 Images

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 “Send examination”, “Send series”, or “Send 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 SCU

| 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 |
| Grayscale Softcopy Presentation State Storage | 1.2.840.10008.5.1.4.1.1.11.1 | 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 |
| 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 |
| RT Structure Set | 1.2.840.10008.5.1.4.1.1.48 | Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU | None |

| Presentation Context Table – Proposal | | | | | |
|---------------------------------------|---------------------------------|--|---|------|----------------------|
| Abstract Syntax | | Transfer Syntax | | Role | Extended Negotiation |
| Name | UID | Name List | UID List | | |
| Storage | 1.3 | Explicit VR Little Endian Explicit VR Big Endian | 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 | | |
| PET Image Storage | 1.2.840.10008.5.1.4.1.1.12 8 | 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, Warning 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. In case of warnings, the warnings will be logged.

Following are the status codes that are more specifically processed when receiving messages from Storage SCP equipment:

| Service Status | Status Code | Further Meaning | Application Behavior When Receiving Status Code |
|----------------|-------------|--|---|
| Failure | A700-A7FF | Refused: Out of resources | Error displayed in the Network status and browser job manager queue. |
| | A900-A9FF | Error: Data Set does not match SOP Class | Error displayed in the Network status and browser job manager queue. |
| | C000-CFFF | Error: Cannot Understand | Error displayed in the Network status and browser job manager queue. |
| | 0122 | SOP Class Not Supported | Error displayed in the Network status and browser job manager queue. |
| Warning | B000 | Coercion of Data Elements | Log-files updated |
| | B006 | Elements Discarded | Log-files updated |
| | B007 | Data Set does not match SOP Class | Log-files updated |
| Success | 0000 | | Success status displayed in the Network status and browser job manager queue. |

| | | | |
|---|---|-----------------------|--------------------|
| * | * | Any other status code | Treated as Failure |
|---|---|-----------------------|--------------------|

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 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 Manual Query

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.

To initiate a Query select “**Receive**” from “**Network**” pull-down menu. If "Custom Search" option is set then a small GUI will show up, operator will be able to enter custom query fields.

Note: Custom queries can be done on the following fields;

“**Patient name**”, “**Patient ID**”, “**Exam number**”, “**Accession number**” and “**Exam date**”

Note: The “Exam date” is a range of dates where a date is exactly 8 characters long and the format of the range is

- [All]: any date,
- [After] mm/dd/yyyy: any date on or after that year/month/day
- [Before] mm/dd/yyyy: any date on or before that year/month/day
- [Between] mm/dd/yyyy - mm/dd/yyyy : any date on or between those dates

- [Exactly] mm/dd/yyyy: only on that date

Note: Entering values in “Patient name” field will initiate wild card query for patient name. Entered values are searched through both last name and first name. Operator needs not to enter separator (^) to separate first name and last 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 “Manual Query” is initiated all presentation contexts shown in the following table are proposed during association establishment, but only the Query/Retrieve-FIND related contexts are applicable to this activity.

| Presentation Context Table – Proposal | | | | | |
|---------------------------------------|-----------------------------|---------------------------|-------------------|------|----------------------|
| 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 | 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 |

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.

The status codes that are more specifically processed when receiving messages from a Modality Worklist SCP equipment is described in Table 2.3.1.2.2.2.1-1.

Table 2.3.1.2.2.2.1-1 C-FIND Response Status Values

| Service Status | Status Code | Further Meaning | Application Behavior When Receiving Status Code |
|----------------|-------------|---|---|
| Failure | A700 | Refused: Out of resources | The remote AE association is closed and the operation terminated. |
| | A900 | Error: Identifier does not match SOP Class | The remote AE association is closed and the operation terminated. |
| | C000-CFFF | Error: Unable to process | The remote AE association is closed and the operation terminated. |
| Cancel | FE00 | Matching terminated due to cancel | The remote AE association is closed and the operation terminated. |
| Success | 0000 | Matching is complete - No final identifier is supplied | Query results displayed. |
| Pending | FF00 | Matches are continuing – Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys. | The matches will continue. |
| | FF01 | Matches are continuing – Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier. | The matches will continue. |

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 | Entered value if operator enters on popup, otherwise zero length |
| Study time | R | 0008,0030 | Zero length |
| Accession Number | R | 0008,0050 | Entered value if |

| Description | Type | Tag | Value |
|--------------------------------|------|-----------|--|
| | | | operator enters on popup, otherwise zero length |
| Study Description | O | 0008,1030 | Zero length |
| Patient's name | R | 0010,0010 | Entered value if operator enters on popup, otherwise zero length |
| Patient ID | R | 0010,0020 | Entered value if operator enters on popup, otherwise zero length |
| Study id | R | 0020,0010 | Entered value if operator enters on popup, otherwise zero length |
| Study Instance UID | U | 0020,000D | Zero length |
| Private Creator Identification | P | 0009,00xx | GEMS_IDEN_01 |
| Suite Id | P | 0009,xx02 | Zero Length |

Table 2.2.1.2.2.1-2: Requested Series Level Keys

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

Table 2.2.1.2.2.1-3: Requested Image Level Keys

| Description | Type | Tag | Value |
|--------------------------|------|-----------|-------------|
| Image number | R | 0020,0013 | Zero length |
| Image type | O | 0008,0008 | Zero length |
| SOP Instance UID | U | 0008,0018 | Zero length |
| Contrast/Bolus Agent | O | 0018,0010 | Zero length |
| Slice thickness | O | 0018,0050 | Zero length |
| Repetition time | O | 0018,0080 | Zero length |
| Echo time | O | 0018,0081 | Zero length |
| Inversion time | O | 0018,0082 | Zero length |
| Number of Averages | O | 0018,0083 | Zero length |
| Echo number | O | 0018,0086 | Zero length |
| Slice spacing | O | 0018,0088 | Zero length |
| Data collection diameter | O | 0018,0090 | Zero length |

| Description | Type | Tag | Value |
|-------------------------------------|------|-----------|--------------|
| Trigger Time | O | 0018,1060 | Zero length |
| Reconstruction diameter | O | 0018,1100 | Zero length |
| Gantry tilt | O | 0018,1120 | Zero length |
| Convolution kernel | O | 0018,1210 | Zero length |
| Flip angle | O | 0018,1314 | Zero length |
| Study Instance UID | O | 0020,000D | Study UID |
| Series Instance UID | O | 0020,000E | Series UID |
| Instance Number | O | 0020,0013 | Zero length |
| Slice Location | O | 0020,1041 | Zero length |
| Rows | O | 0028,0010 | Zero length |
| Columns | O | 0028,0011 | Zero length |
| Private Creator Identification | P | 0019,00xx | GEMS_ACQU_01 |
| Dfov Rect | P | 0019,001E | 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 Manual Retrieve

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 the following table are proposed during association establishment, but only the Query/Retrieve-MOVE related contexts are applicable to this activity.

| Presentation Context Table – Proposal | | | | | |
|---------------------------------------|-----------------------------|---------------------------|-------------------|------|----------------------|
| 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 | 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 |

2.3.1.2.3.2.1 SOP Specific Conformance Statement for C-MOVE SCU

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

Each C-MOVE SCU operation supports an “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with time out values of 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.

Table 2.3.1.2.3.2.1 describes the status codes that are more specifically processed for C-MOVE Responses.

Table 2.3.1.2.3.2.1 C-MOVE Response Status codes

| Service Status | Status Code | Further Meaning | Application Behavior When Receiving Status Code |
|----------------|-------------|---|--|
| Failure | A701 | Refused: Out of resources - Unable to calculate number of matches | A user attention pop-up will be posted if a failure status is received. The specific error message for the failure will be logged. |
| | A702 | Refused: Out of resources - Unable to perform sub-operations | A user attention pop-up will be posted if a failure status is received. The specific error message for the failure will be logged. |
| | A801 | Refused: Move Destination Unknown | A user attention pop-up will be posted if a failure status is received. The specific error message for the failure will be logged. |

| | | | |
|---------|-------------|--|--|
| | A900 | Error: Identifier does not match SOP Class | A user attention pop-up will be posted if a failure status is received. The specific error message for the failure will be logged. |
| | C000 - CFFF | Error: Unable to process | A user attention pop-up will be posted if a failure status is received. The specific error message for the failure will be logged. |
| | 0122 | SOP Class Not Supported | A user attention pop-up will be posted if a failure status is received. The specific error message for the failure will be logged. |
| Cancel | FE00 | Sub-operations terminated due to a Cancel indication | The job is cleared from the local database manager. |
| Warning | B000 | Sub-operations Complete - One or more Failures. | The application logs the warning but do not stop execution. |
| Success | 0000 | Sub-operations Complete - No Failure. | The images are retrieved from the Remote AE. |
| Pending | FF00 | Sub-operations are continuing | The sub-operations will continue. |

2.3.1.2.4 Verify (DICOM Ping)

2.3.1.2.4.1 Associated Real-World Activity

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

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

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

2.3.1.2.4.2 Proposed Presentation Context Table

Refer to the following table for the Proposed Presentation Contexts for DICOM Server AE and Real-World activity Verification.

| Presentation Context Table – Proposal | | | | | |
|---------------------------------------|-------------------|---------------------------|-------------------|------|----------------------|
| 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 | SCU | None |

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 Remote Archive

Refer **section.5 DICOM Storage Commitment SCU Conformance.**

2.3.1.2.6 Modality Worklist Query

Refer **section.6 Modality Worklist Information Model Definition.**

2.3.1.2.7 Modality Performed Procedure Step Notification

Refer **section.7 PERFORMED PROCEDURE STEP CONFORMANCE STATEMENT.**

2.3.1.2.8 Print

Refer **section.4 PRINT SCU CONFORMANCE.**

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 Images

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 2.3.1.3.1.2-1: 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 | | |
| 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 |
| 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 |
| 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 | SCP | None |
| RT Structure Set Storage | 1.2.840.10008.5.1.4.1.1.48.1.3 | 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 | 1.2.840.10008.5.1.4.1.1.12.8 | 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 for the request from the remote host in the Association.

The SCP does not have a default acceptance policy if more than one acceptable transfer syntax is proposed by the SCU. It is the responsibility of the SCU to make a selection from more than one transfer syntaxes accepted

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.

Each C-STORE SCP operation supports an "Association Timer", "Operation Inactivity Timer" and "Session Timer" with time out values of 900 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.
- C001 Cannot understand. The message was not properly DICOM-encoded. The request was not processed.
- 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.

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 “Association Timer”, “Operation Inactivity Timer” and “Session Timer” with time out values of 900 seconds, 15 seconds and 60 minutes respectively.

2.3.1.3.3 Search Local Database (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 |
| 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.

Each C-FIND 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.

Table 2.3.1.3.3.2.1-4 Status codes that can be sent back by the application

| Service Status | Status Code | Further Meaning | Application Behavior Triggering Sending Status Code |
|----------------|-------------|--|--|
| Cancel | FE00 | Matching terminated due to cancel | The application terminates the request due to cancel. |
| Success | 0000 | Matching is complete - No final identifier is supplied | The application sends a C-FIND response message with a status of "pending" for each matching entry |
| Failure | C000 | Unable to Process | The application will log the failure. |
| Pending | FF00 | Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys. | Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys. |
| | FF01 | Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier | Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier |

2.3.1.3.4 Move Images (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 |
| Grayscale Softcopy Presentation State Storage | 1.2.840.10008.5.1.4.1.1.11.1 |
| Enhanced SR storage | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR storage | 1.2.840.10008.5.1.4.1.1.88.67 |
| RT Structure Set Storage | 1.2.840.10008.5.1.4.1.1.481.3 |
| PET Image Information Storage | 1.2.840.10008.5.1.4.1.1.128 |

Following are the status codes the Application may send back to the SCU Equipment while performing the requested Retrieve:

| Service Status | Status Code | Further Meaning | Status Code Explanation | Related Fields Sent Back to the SCU |
|----------------|-------------|---|---|---|
| Failure | A701 | Refused: Out of resources - Unable to calculate number of matches | This status code is sent when local database query fails | (0000,0902) |
| | A702 | Refused: Out of resources - Unable to perform sub-operations | This status code is sent to Retrieve SCU when the association is rejected by the C-STORE SCP | (0000,0902) |
| | A801 | Error: Move Destination Unknown | This status code is sent when the destination AE named in the C-MOVE request is unknown to DICOM SERVER AE. | (0000,0902) |
| | A900 | Error: Invalid dataset | This status code is sent for the following reasons 1.When the retrieve request does not contain required information, like query retrieve level | (0000,0902) |
| | C001 | Error: Unable to process | This status code is sent for the following reasons 1.When Remote AE does not have permissions to use DICOM SERVER AEs retrieve service 2. Not able to connect to local database, because of max connection limit reached. 3. Database query fails. | (0000,0902) |
| Cancel | FE00 | Sub-operations terminated due to a Cancel indication | This status code is sent when DICOM SERVER AE receives C-MOVE-CANCEL request from the Remote AE. | (0000,1021) (0000,1022) (0000,1023) (0000,0902)) |
| Success | 0000 | Sub-operations Complete - No Failure. | All the composite SOP instances have been successfully sent to the C-MOVE destination | (0000,1021) (0000,1022) (0000,1023) |
| Pending | FF00 | Sub-operations are continuing - | For pending sub operation to remote AE | (0000,1020) (0000,1021) (0000,1022) (0000,1023) |

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 Communication Profiles

2.4.1 Supported Communication Stacks (part 8)

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

2.4.2 TCP/IP Stack

The TCP/IP stack is inherited from a UNIX operating system.

2.4.2.1 Physical Media Support

Ethernet v2.0, IEEE 802.3

2.4.3 Others

- DHCP is not supported.
- IPv6 is not supported.

2.5 Configuration

2.5.1 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.

2.5.2 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.

2.6 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.

If other extended character sets are received, the application installs the images on to the database and does not check for the character set when we receive the images.

2.7 Codes and Controlled Terminology

The product uses coded terminology as defined below.

2.7.1 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.

2.8 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), CD-RW (Compact Disc - ReWritable), DVD-R (Digital Video Disc - Recordable), DVD-RW (Digital Video Disc – ReWritable).

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.

The CD/DVD Archiver Server creates, display and restores the CD-R/DVD-R media for various DICOM SOP instances.

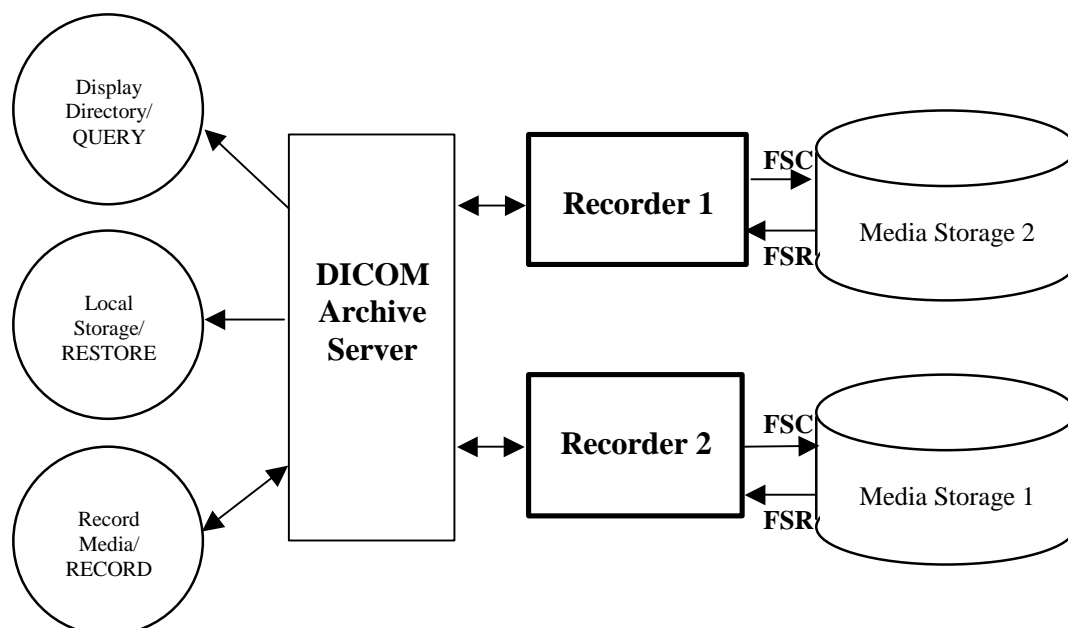
3.2.1 Application Data Flow Diagram

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.

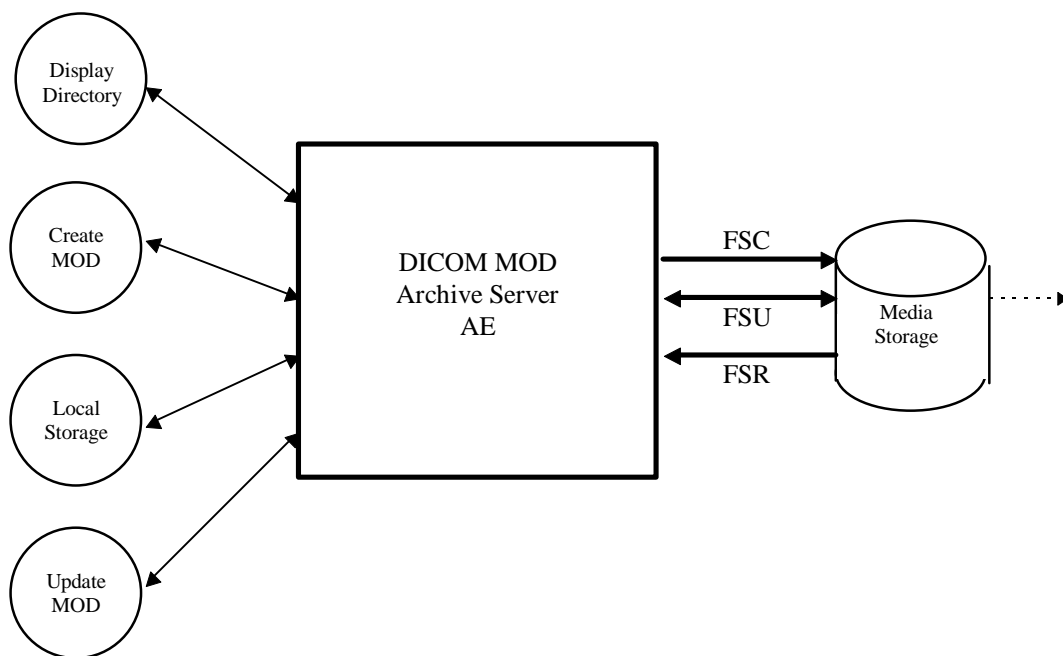
Illustration 3-1: Specific AE Application Model for the CD-R/DVD-R device



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 Archive

| 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-JPEG | CREATE DVD | FSC | Interchange |

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) Record Media

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 Windows2000, WindowsXP, Windows 7 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 unknown 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 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 SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.22 |

3.3.1.2 Real-world Activity (RWA) Display Directory/QUERY

The CD/DVD Archive Application acts as an FSR when requested to provide a directory listing from CD.

When requested to provide a directory listing it will read the File-set and display the DICOMDIR directory entries for those SOP instances in the File-set that correspond to the user selected Application Profile.

3.3.1.2.1 Application Profiles for the RWA: Display Directory/QUERY

For a list of application profiles that invoke this AE for the Display Directory/QUERY RWA, see Table 3.1-1.

3.3.1.3 Real-world Activity (RWA) Local Storage/RESTORE

The CD/DVD Archive Application acts as an FSR when copying from the CD to local storage.

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

3.3.1.3.1 Application Profiles for the RWA: Local Storage/RESTORE

For a list of application profiles that invoke this AE for the Local Storage/RESTORE RWA, see Table 3.1-1.

The supported SOP classes are in table below:

| 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 SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR Storage | 1.2.840.10008.5.1.4.1.1.88.67 |

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 3.1-2. 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 3.1-2.

The supported SOP classes are in table below:

| 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 |
| 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 SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR Storage | 1.2.840.10008.5.1.4.1.1.88.67 |

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 3.1-2.

The supported SOP classes are in table below:

| 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 |

| | |
|---|-------------------------------|
| 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 SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR Storage | 1.2.840.10008.5.1.4.1.1.88.67 |

3.3.2.2.2 Options:

Not 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 3.1-2.

The supported SOP classes are in table below:

| 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 |
| 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 SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR Storage | 1.2.840.10008.5.1.4.1.1.88.67 |

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 3.1-2. 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 Update MOD RWA, see Table 3.1-2.

The supported SOP classes are in table below:

| 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 |
| 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 SR Image Storage | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR Storage | 1.2.840.10008.5.1.4.1.1.88.67 |

3.3.2.2.4.2 Options:

Not applicable.

3.4 Augmented and Private Application Profiles

3.4.1 Augmented Application Profiles

The CD/DVD and MOD Media Archive Interchange AE does not support any augmented Application Profiles.

3.4.2 Private Application Profiles

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

3.4.2.1 PRI-CTMR-MOD12 Class Profile

3.4.2.1.1 SOP Classes and Transfer Syntax

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

The PRI-CTMR-MOD12 Application Profile uses the same SOP Classes and Transfer Syntaxes as the STD-CTMR-MOD12 Profile.

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 3.5.2 for details of the encoding problem unique to the PRI-CTMR-MOD12 profile.

3.4.2.1.2 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.

3.4.2.1.3 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.

3.4.2.1.3.1 Additional Keys

None.

3.4.2.1.4 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 3.5.2 for JPEG encoding problem in the PRI-CTMR-MOD12 profile.

3.4.2.1.4.1 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).

3.4.2.1.4.2 Attribute Value Precedence

None.

3.5 Extensions / Specializations / Privatizations

3.5.1 Extensions, Specialization’s and Privatizations of SOP Classes

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

3.5.1.1 SOP Specific Conformance Statement for Basic Directory SOP Class

Following attributes are Standard extensions for each Directory Record type.

| Key Attribute | Tag | Directory Record Type |
|---------------------------|-------------|-----------------------|
| Modality | (0008,0060) | STUDY |
| Image Type | (0008,0008) | SERIES |
| Manufacturer | (0008,0070) | SERIES |
| Series Description | (0008,103E) | SERIES |
| Manufacturer’s Model Name | (0008,1090) | SERIES |
| SOP Class UID | (0008,0016) | IMAGE |
| SOP Instance UID | (0008,0018) | IMAGE |
| Slice Thickness | (0018,0050) | IMAGE |
| Spacing Between Slices | (0018,0088) | IMAGE |
| Data Collection Diameter | (0018,0090) | IMAGE |
| Reconstruction Diameter | (0018,1100) | IMAGE |
| Gantry/Detector Tilt | (0018,1120) | IMAGE |
| Convolution Kernel | (0018,1210) | IMAGE |
| Slice Location | (0020,1041) | IMAGE |
| Samples Per Pixel | (0028,0002) | IMAGE |
| Bits Allocated | (0028,0100) | IMAGE |
| Bits Stored | (0028,0101) | IMAGE |
| Repetition Time | (0018,0080) | IMAGE |
| Echo Time | (0018,0081) | IMAGE |
| Inversion Time | (0018,0082) | IMAGE |
| Number of Averages | (0018,0083) | IMAGE |
| Contrast/Bolus Route | (0018,1040) | IMAGE |
| Trigger Time | (0018,1060) | IMAGE |
| Flip Angle | (0018,1314) | IMAGE |

| | | |
|------------------|-------------|-------|
| Echo Number | (0018,0086) | IMAGE |
| Sequence Variant | (0018,0021) | IMAGE |

Refer to **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.

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

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).

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 $(1 \ll 15) = 32768$).

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 |
| 4.1GB Optical Disk Drive | STD-CTMR-MOD41 |

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. The system will accept the images and installs them irrespective of the type of extended character sets.

4 PRINT SCU CONFORMANCE

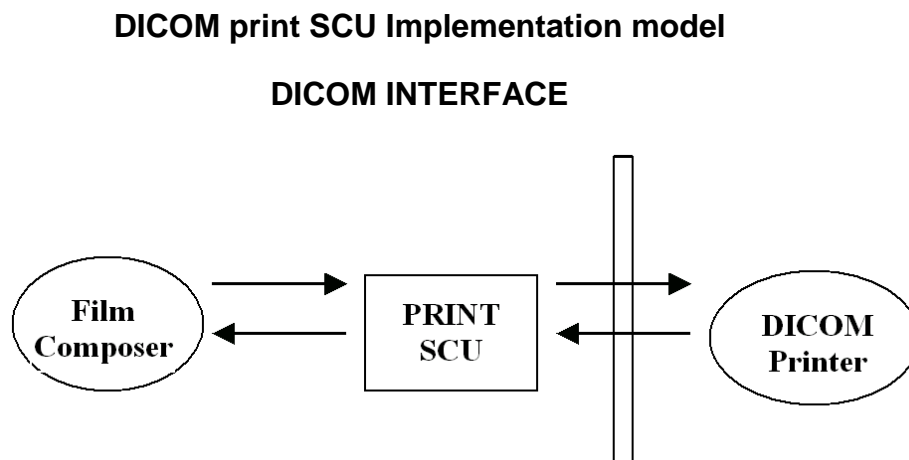
4.1 Introduction

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



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 image has 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

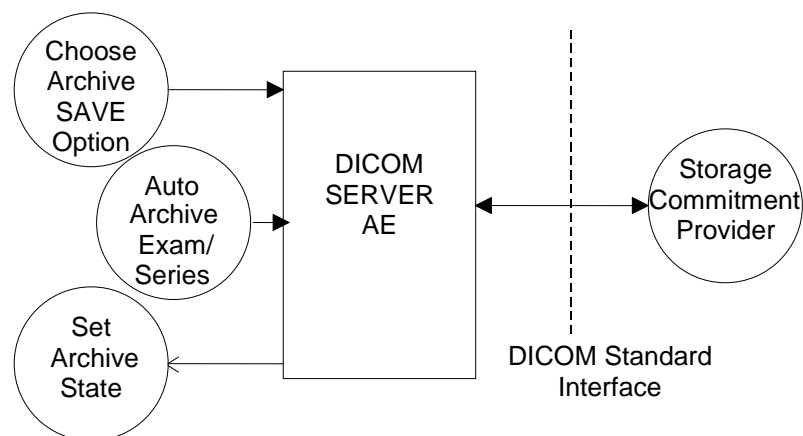
5.2.1 Application data flow diagram

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.

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

Illustration 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 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 Storage commitment AE title and the remote AE title are the same.

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.

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.

The delay for storage commitment request is not configurable.

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 |
| RT Structure Set Storage | 1.2.840.10008.5.1.4.1.1.481.3 |
| Enhanced SR Storage SOP Class | 1.2.840.10008.5.1.4.1.1.88.22 |
| X-Ray Radiation Dose SR Storage SOP Class | 1.2.840.10008.5.1.4.1.1.88.67 |
| Grayscale Softcopy Presentation State Storage SOP Class | 1.2.840.10008.5.1.4.1.1.11.1 |

5.3.1.2.2.1 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.

Following are the status codes that are more specifically processed when receiving N-Action responses from Storage Commitment SCP equipment.

| Service Status | Status Code | Further Meaning | Application Behavior When Receiving Status Code |
|----------------|-------------|-------------------------|---|
| Failure | 0119 | Class-instance conflict | System logs commitment fail message for all N-Action failure. |
| | 0210 | Duplicate invocation | |
| | 0115 | Invalid argument value | |
| | 0117 | Invalid SOP Instance | |
| | 0212 | Mistyped argument | |
| | 0123 | No such action | |
| | 0114 | No such argument | |
| | 0118 | No such SOP Class | |
| | 0112 | No such SOP Instance | |
| | 0110 | Processing failure | |
| | 0213 | Resource limitation | |
| | 0211 | Unrecognized operation | |
| Success | 0000 | | |

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.

The DICOM SERVER AE is indefinitely listening for associations. No operator action is required to receive a Storage Commitment notification (N-EVENT-REPORT).

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. CT System always sends success in N-EVENT-REPORT-RSP.

5.3.1.3.2.2 Commit response with FAILURE status

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 |
| 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)

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.

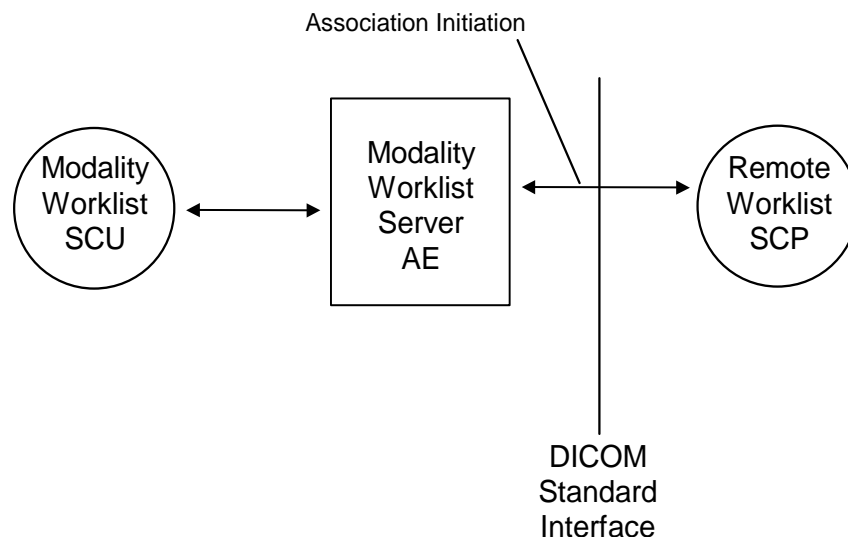
The ModalityWorklist option for GEHC CT allows a user to query for and display DICOM modality worklist information from a remote hospital or radiology department information system computer. For example, a user may wish to query for all procedures scheduled to be performed on the scanner. In this situation, 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.

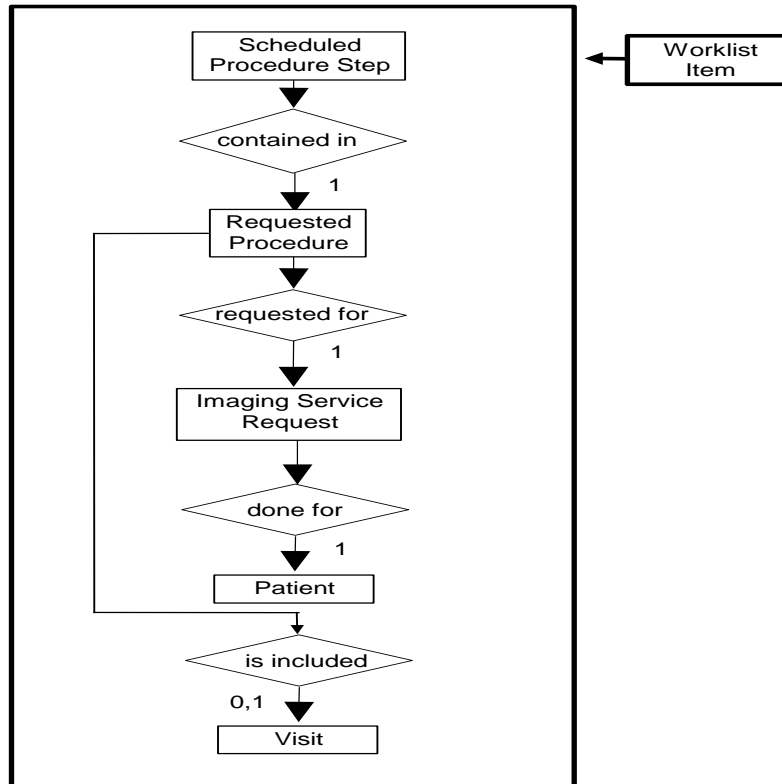
6.8.3 Modality Worklist Information Model Entity-Relationship Model

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: <ul style="list-style-type: none"> • all days, • today only, • today and a number of days before today, • today and a number of days after today, • today and a number of days before today and a number of days after today. Number of days before/after is specified by the user. Returned values must be exactly 8 numeric characters in YYYYMMDD format. |

| | | | | | |
|---------------------------------------|-------------|---|----|-----|---|
| Scheduled Procedure Step Start Time | (0040,0003) | R | 1 | No | This attribute is sent with zero-length. Returned values must be exactly 6 numeric characters in HHMMSS format. |
| Modality | (0008,0060) | R | 1 | Yes | Matching is supported as follows: either no Modality is supplied (universal matching), or the scanner's Modality is supplied for matching; this is user selectable. |
| Scheduled Performing Physician's Name | (0040,0006) | R | 2 | No | This attribute is sent with zero-length. 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 |
|---------------------------------|-------------|----------------------------|----------------------------|-----------------------|---|
| 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. |

| Attribute Name | Tag | Expected Matching Key Type | Expected Returned Key Type | Mapped into the Image | Note |
|-----------------------------------|-------------|----------------------------|----------------------------|-------------------------------|---|
| 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 | |
| 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 |
| 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 | No | 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 Ethnic Group
(0010,21b0) LT (no value available) # 0, 1 AdditionalPatientHistory
(0010,21c0) US (no value available) # 0, 0 PregnancyStatus
(0010,4000) LT (no value available) # 0, 0 Patient Comments
(0020,0000) UL 8 # 4, 1 ImageGroupLength
(0020,000d) UI (no value available) # 0, 0 StudyInstanceUID
(0032,0000) UL 64 # 4, 1 StudyGroupLength
(0032,1032) PN (no value available) # 0, 0 RequestingPhysician
(0032,1033) LO (no value available) # 0, 0 RequestingService
(0032,1060) LO (no value available) # 0, 0 RequestedProcedureDescription
(0032,1064) SQ (Sequence with explicit Length #=1) # 32, 1 RequestedProcedureCodeSequence
(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) | Not available. |
| 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) | Not available. |
| Study Instance UID (0020,000d) | Study instance UID (only displayed on the "More Info..." screen) | Study Instance UID, if User has set the preference to "Use MWL Study UID" . |
| Requested Procedure Id (0040,1001) | Requested Proc ID | Requested Procedure Id. |
| Pregnancy Status (0010,21C0) | Pregnancy Status (only displayed on the "More Info..." screen) | Not available. |
| Medical Alerts (0010,2000) | Medical Alerts (only displayed on the "More Info..." screen) | Not available. |
| Contrast Allergies (0010,2110) | Contrast Allergies (only displayed on the "More Info..." screen) | Not available. |
| Special Needs (0038,0050) | Special Needs (only displayed on the "More Info..." screen) | Not available. |
| Requested Contrast Agent (0032,1070) | Requested Contrast Agent (only displayed on the "More Info..." screen) | Not available. |
| Current Patient Location (0038,0300) | Current Patient Location (only displayed on the "More Info..." screen) | Not available. |
| Additional Patient History (0010,21B0) | Additional Patient History (only displayed on the "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).

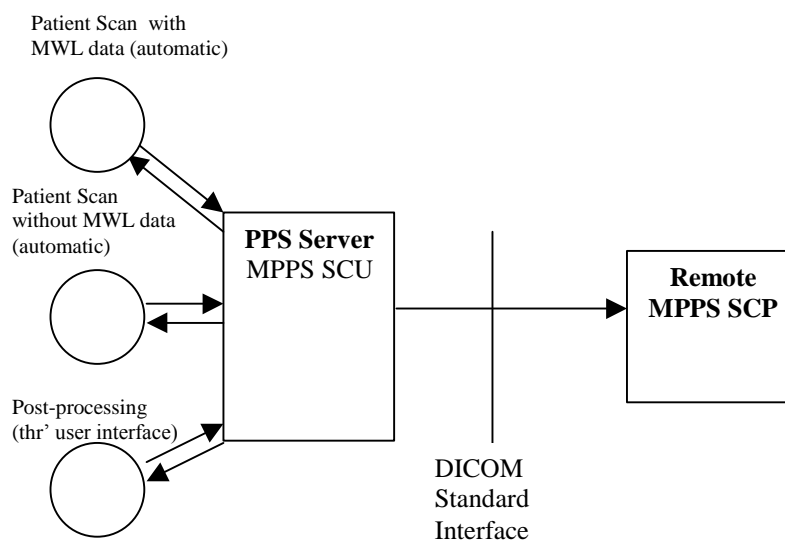
This feature works in conjunction with DICOM Modality Worklist feature, if installed. However the conformance of this feature is independent of Modality Worklist feature. For information on conformance of Modality Worklist feature to DICOM standard please refer to the appropriate section or document.

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

7.7 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 | Not sent as part of image header |
| >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 | (0008,1120) | Copied from | Not used | No item |

| Attribute Name | Tag | Usage in MPPS Instance | | |
|--------------------------------------|-------------|---|---|--|
| | | Acquisition with MWL data | Acquisition without MWL data | Post-Processing |
| Sequence | | SPS, if selected | | |
| Performed Procedure Step ID | (0040,0253) | Created at the scanner. Will have the following "PPS_ID_<exam number" | Created at the scanner. Will have the following "PPS_ID_<exam number" | New generated, may not be unique |
| Performed Station AE Title | (0040,0241) | Local 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 | Local system host-name |
| 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 |

| Attribute Name | Tag | Usage in MPPS Instance | | |
|---|-------------|--|---|--|
| | | Acquisition with MWL data | Acquisition without MWL data | Post-Processing |
| >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 present otherwise from user input on the scanner | User input on the scanner | Not sent as part of image header |
| >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 | (0040,0275) | Will be present only if SPS obtained from |

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

8 Grayscale Softcopy Presentation State

8.1 Introduction

To create Grayscale Softcopy Presentation State, there are 2 sequences in GEHC CT, Exam Split and Save State.

8.2 Exam Split

8.2.1 Overview

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).

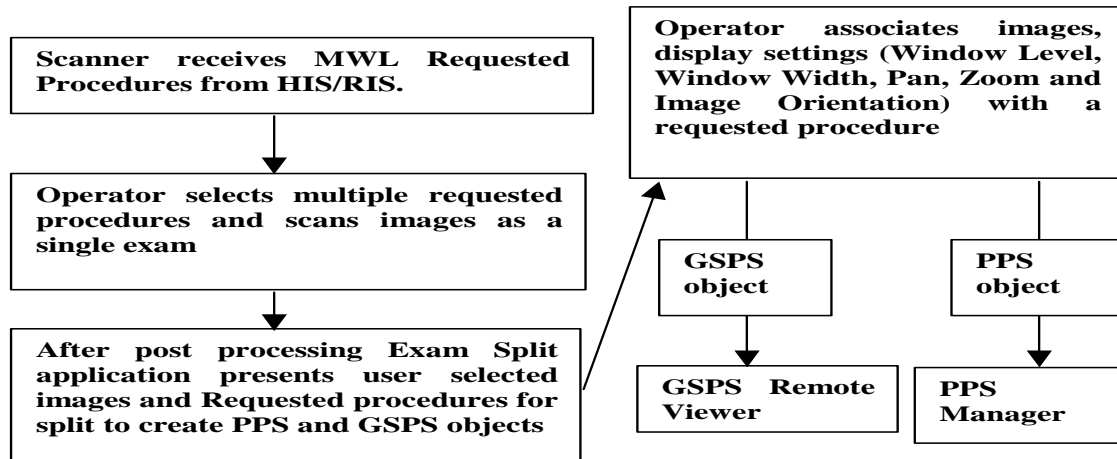
The Virtual Exam Split feature works in conjunction with the DICOM Modality Worklist feature and the Modality Performed Procedure Step feature to support the IHE PGP profile as an acquisition modality.

8.2.2 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.

8.2.3 Application Data Flow Diagram

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



8.2.4 Sequencing of Real-World Activities

8.2.4.1 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.

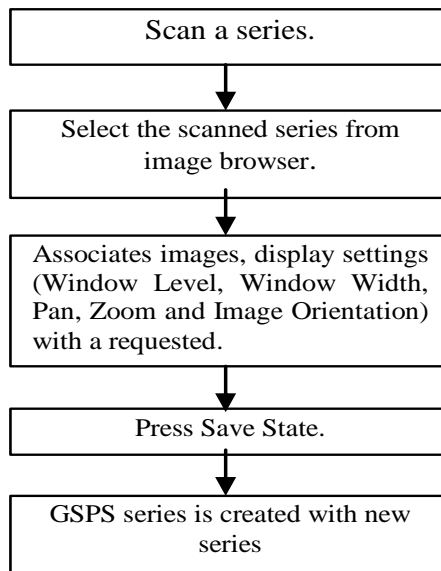
8.3 Save State

8.3.1 Implementation Model

Save State will create Grayscale Presentation State (GSPS) including user annotation.

8.3.2 Application Data Flow Diagram

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



8.3.3 Sequencing of Real-World Activities

8.3.3.1 GSPS Acquisition System with MWL data

- Operator takes some scans. After the scan finished, images shall be selected from image browser and select Viewer.
- Operator adds annotation or ROI on images, change WW or WL, zoom or roam images.
- After changing settings, operator shall select “Save State” on Viewer menu. Then, GSPS object shall be created with a new series number.

8.4 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 |
|----------------|---------------|
|----------------|---------------|

| SOP Class Name | SOP Class UID |
|---------------------------------------|------------------------------|
| Grayscale Softcopy Presentation State | 1.2.840.10008.5.1.4.1.1.11.1 |

8.4.1 Association Establishment Policies

8.4.1.1 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

8.4.1.2 Number of Associations

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

8.4.1.3 Asynchronous Nature

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

8.4.1.4 Implementation identifying information

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

8.4.2 Association Initiation Policy

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

8.4.2.1 Real-World Activity: GSPS

8.4.2.1.1 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.

8.4.2.1.2 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 |

8.4.2.1.2.1 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.

8.4.3 Association Acceptance Policy

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

8.5 Communication Profiles

8.5.1 Supported Communication Stacks (PS 3.8)

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

8.5.2 OSI Stack

The OSI Communication stack is not supported by this implementation.

8.5.3 TCP/IP Stack

The TCP/IP stack is inherited from the operating system

8.5.3.1 API

Not Applicable to this product.

8.5.3.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

8.5.4 Point-to-Point Stack

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

8.6 Extensions/Specialization/Privatization

8.6.1 Standard Extended/Specialized/Private SOPs

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

8.6.2 Private Transfer Syntaxes

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

8.7 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.

8.7.1 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

8.7.2 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>
- VES_ORIENTATION (environment variable for enable/disable Flip/Rotate functionality in VES)

8.8 Support of Extended Character Sets

GSPS feature supports ISO_IR 100 character set.

8.9 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.

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

8.10.1 Grayscale Softcopy Presentation State (GSPS) IOD Modules

| Entity Name | Module Name | Reference | Usage |
|--------------------|-----------------------------------|---|-------|
| Patient | Patient | 8.10.2 | M |
| Study | General Study | 8.10.3 | M |
| | Patient Study | 8.10.4 | U |
| Series | General Series | 8.10.5 | M |
| | Presentation Series | 8.10.6 | M |
| Equipment | General Equipment | 8.10.7 | M |
| Presentation State | Presentation State Identification | 8.10.8 | M |
| | Presentation State Relationship | 8.10.9 | 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 | 8.10.10 | 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 | 8.10.11 | C |
| | Softcopy VOI LUT | 8.10.12 | C |
| | Softcopy Presentation LUT | 8.10.13 | M |
| | SOP Common | 8.10.14 | M |

8.10.2 Patient Module

| Attribute Name | Tag | Type | Exam | Save | Notes |
|----------------|-----|------|------|------|-------|
|----------------|-----|------|------|------|-------|

| | | | Split | State | |
|----------------------|-------------|---|-------|-------|-----------------------------|
| Patient's Name | (0010,0010) | 2 | X | X | Copied from original images |
| Patient ID | (0010,0020) | 2 | X | X | Copied from original images |
| Patient's Birth Date | (0010,0030) | 2 | X | X | Copied from original images |
| Patient's Sex | (0010,0040) | 2 | X | X | Copied from original images |

8.10.3 General Study Module

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

8.10.4 Patient Study Module

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|----------------|-------------|------|------------|------------|-----------------------------|
| Patient's Age | (0010,1010) | 3 | X | X | Copied from original images |

| | | | | | |
|------------------------------|-------------|---|---|---|-----------------------------|
| Patient's Size | (0010,1020) | 3 | X | X | Copied from original images |
| Patient's Weight | (0010,1030) | 3 | X | | Copied from original images |
| Additional Patient's History | (0010,21b0) | 3 | X | | Copied from original images |

8.10.5 General Series Module

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|--------------------------------------|-------------|------|------------|------------|---|
| Series Number | (0020,0011) | 2 | X | X | Exam Split: Set to 1004 Save State: Set to [original Series Number + 10000] |
| Laterality | (0020,0060) | 2C | X | X | Always sent zero-length. |
| Series Date | (0008,0021) | 3 | | | Not Sent. |
| Series Time | (0008,0031) | 3 | | | Not Sent. |
| Modality | (0008,0060) | 1 | X | X | PR |
| Performing Physician's Name | (0008,1050) | 3 | | | Not Sent. |
| Protocol Name | (0018,1030) | 3 | | | Not Sent. |
| Series Description | (0008,103E) | 3 | X | X | Exam Split: This will be set as Requested Procedure Code Meaning. If Code Meaning absent, it will be Requested Procedure Description Save State: "Presentation Series" |
| Operators Name | (0008,1070) | 3 | | | Not Sent. |
| Series Instance UID | (0020,000E) | 1 | X | X | Generated for each series and always sent. |
| Performed Procedure Step Start Date | (0040,0244) | 3 | X | | Calculated and sent. |
| Performed Procedure Step Start Time | (0040,0245) | 3 | X | | Calculated and sent. |
| Performed Procedure Step ID | (0040,0253) | 3 | X | | Will be set as Requested Procedure ID (0040,1001) from (0040,0275) |
| Performed Procedure Step Description | (0040,0254) | 3 | X | | 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 | X | | 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 | X | | Always sent, copied from RIS |
| > Accession Number | (0008,0050) | 3 | X | | Value from worklist sent |
| > Referenced Study Sequence | (0008,1110) | 3 | X | | Value from worklist sent |
| > Study Instance UID | (0020,000D) | 3 | X | | Value from worklist sent |
| > Requested Procedure Desc | (0032,1060) | 3 | X | | Value from worklist sent |
| > Requested Procedure Code Sequence | (0032,1064) | 3 | X | | Value from worklist sent. |
| > Scheduled Procedure Step Desc | (0040,0007) | 3 | X | | Value from worklist sent |
| > Scheduled Protocol Code Sequence | (0040,0008) | 3 | X | | Value from worklist sent |
| > Scheduled Procedure Step ID | (0040,0009) | 3 | X | | Value from worklist sent |
| > Reason for Requested Procedure | (0040,1002) | 3 | | | Not Sent. |
| > Reason for Requested Procedure Code sequence | (0040,100A) | 3 | | | Not Sent. |
| Referenced Performed Procedure Step Sequence | (0008,1111) | 3 | X | | Value used for performed procedure step |
| >Referenced SOP Class UID | (0008,1150) | 1C | X | | Copied from original images |
| >Referenced SOP Instance UID | (0008,1155) | 1C | X | | Generated for each series and always 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.

8.10.6 Presentation Series Module

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|----------------|-------------|------|------------|------------|-------|
| Modality | (0008,0060) | 1 | X | X | PR |

8.10.7 General Equipment

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|--------------------------|-------------|------|------------|------------|-------------------------------------|
| Manufacturer | (0008,0070) | 2 | X | X | Always sent as "GE MEDICAL SYSTEMS" |
| Institution Name | (0008,0080) | 3 | X | | Copied from original images |
| Station Name | (0008,1010) | 3 | X | X | Copied from original images |
| Manufacturers Model Name | (0008,1090) | 3 | X | X | Copied from original images |
| Software Versions | (0018,1020) | 3 | X | X | Copied from original images |

8.10.8 Presentation State Identification Module

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|----------------------------|-------------|------|------------|------------|--|
| Presentation Creation Date | (0070,0082) | 1 | X | X | Calculated and sent. |
| Presentation Creation Time | (0070,0083) | 1 | X | X | Calculated and sent. |
| Instance Number | (0020,0013) | 1 | X | X | Set to 24 and sent. |
| Content Label | (0070,0080) | 1 | X | X | Exam Split: 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. Save State: "GEGSPS_*" |
| Content Description | (0070,0081) | 2 | X | X | Exam Split : String input on Comments box in Exam Split screen Save State: "SE (Series Number) IM (First Image Number) TO IM (Last Image |

| | | | | | |
|------------------------|-------------|---|---|---|---------------------------------|
| | | | | | Number)" |
| Content Creator's Name | (0070,0084) | 2 | X | X | Same as Station Name(0008,1010) |

8.10.9 Presentation State Relationship

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

8.10.10 Displayed Area

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|--|-------------|------|------------|------------|--|
| Displayed Area Selection Sequence | (0070,005A) | 1 | X | X | Exam Split Application will calculate values for pan and zoom being displayed. |
| >Referenced Image Sequence | (0008,1140) | 1C | X | X | Always sent. |
| >Displayed Area Top Left Hand Corner | (0070,0052) | 1 | X | X | Always sent. |
| >Displayed Area Bottom Right Hand Corner | (0070,0053) | 1 | X | X | Always sent. |
| >Presentation Size Mode | (0070,0100) | 1 | X | X | Always sent. |
| >Presentation Pixel Spacing | (0070,0101) | 1C | X | X | Always sent. |
| >Presentation Pixel Aspect Ratio | (0070,0102) | 1C | | | Not Sent. |
| >Presentation Pixel Magnification Ratio | (0070,0103) | 1C | X | X | Always sent. |

8.10.11 Modality LUT Module

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|-------------------------|-------------|------|------------|------------|---------------------|
| Rescale slope intercept | (0028,1052) | 1C | X | X | Always sent |
| Rescale slope | (0028,1053) | 1C | X | X | Always sent |
| Rescale type | (0028,1054) | 1C | X | x | Always sent as "HU" |

8.10.12 Softcopy VOI LUT Module

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|-------------------------------------|-------------|------|------------|------------|-------------|
| Softcopy VOI LUT Sequence | (0028,3110) | 1 | X | X | Always sent |
| > Reference Image Sequence | (0008,1140) | 1C | X | X | Always sent |
| > Window Center | (0028,1050) | 1C | X | X | Always sent |
| > Window Width | (0028,1051) | 1C | X | X | Always sent |
| > Window Center & Width Explanation | (0038,1055) | 3 | X | X | Always sent |

8.10.13 Softcopy Presentation LUT Module

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|---------------------------|-------------|------|------------|------------|-------------------------|
| Presentation LUT sequence | (2050,0010) | 1C | | | Not Sent. |
| Presentation LUT shape | (2050,0020) | 1C | X | X | Always sent as IDENTITY |

8.10.14 SOP Common Module

| Attribute Name | Tag | Type | Exam Split | Save State | Notes |
|------------------------|-------------|------|------------|------------|---------------------------|
| SOP Class UID | (0008,0016) | 1 | X | X | Always sent. |
| SOP Instance UID | (0008,0018) | 1 | X | X | Always sent. |
| Specific Character Set | (0008,0005) | 1C | X | X | Always sent as ISO_IR 100 |

Note: In sections from 8.10.2 to 8.10.14,
 ● Exam Split: GSPS created by Virtual Exam Split

- *Save State: GSPS created by Save State*
- *X: Sent*
- *Blank: Not Sent*

8.11 Image Header Changes Supporting GSPS

8.11.1 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.

8.11.2 Accession Number

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

If two or more of the accession numbers in the grouped case are different, the top level Accession Number (0008, 0050) will be sent empty.

9 Structured Report Object Implementation

GEHC CT system supports 2 types of SRs, Enhanced SR and X-ray Radiation Dose SR. Both of them support following attributes.

9.1 IOD Module Table

| 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 | 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.3.8 | 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 | (0040,A073) | 1C | Not sent per conditional |

| | | | |
|--|-------------|----|------------------------|
| Sequence | | | |
| >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 | | | CONT AINE R | 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 | > | | INCLU DE | DTID (1002) Observer Context | 1-n | M | See <i>TID 1002 Observer context</i> |
| 4 | > | HAS OBS CONTEXT | DATE TIME | EV (113809, DCM, "Start of X-ray Irradiation") | 1 | M | Sent |
| 5 | > | HAS OBS CONTEXT | DATE TIME | EV (113810, DCM, "End of X-ray Irradiation") | 1 | M | Sent |
| 6 | > | HAS OBS CONTEXT | CODE | EV (113705, DCM, "Scope of Accumulation") | 1 | M | Code sequence (113014, DCM, Study) sent |
| 7 | >> | HAS PROPERTI ES | UIDR EF | DCID (10001) UID Types | 1 | M | Study Instance UID sent |
| 8 | > | CONTAINS | INCLU DE | DTID (10012) CT Accumulated Dose Data | 1 | M | See <i>TID 10012 CT Accumulated Dose Data</i> table below for details |
| 9 | > | CONTAINS | INCLU DE | DTID (10013) CT Irradiation Event Data | 1-n | M | See <i>TID 10013 CT Irradiation Event Data</i> table below for details |
| 10 | > | CONTAINS | TEXT | EV (121106, DCM, "Comment") | 1 | U | Not sent |

Note: This implementation was produced in accordance with the 2008 edition of the DICOM Standard. Subsequently, the DICOM Standard added additional content items to this Template, which are not supported in this implementation.

9.4.2 TID 10012 – CT Accumulated Dose Data

| | NL | Rel with Parent | VT | Concept Name | VM | Req Type | Notes |
|---|----|--------------------|-------------------|--|----|-------------|-------|
| 1 | | | CONT AINE R | 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 Authority") | 1 | MC | Not sent |
| 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 Context") | 1 | U | Not sent |
| 6 | > | CONTAINS | UIDREF | EV (113769, DCM, "Irradiation Event UID") | 1 | M | Sent |
| 7 | > | CONTAINS | NUM | EV (113821, DCM, "X-ray Filter Aluminium Equivalent") | 1 | U | Not sent |
| 8 | > | CONTAINS | CONTAINER | EV (113822, DCM, "CT Acquisition Parameters") | 1 | M | Sent |
| 9 | >> | CONTAINS | NUM | EV (113824, DCM, "Exposure Time") | 1 | M | Sent |
| 10 | >> | CONTAINS | NUM | EV (113825, DCM, "Scanning Length") | 1 | M | Sent |
| 11 | >> | CONTAINS | NUM | EV (113826, DCM, "Nominal Single Collimation Width") | 1 | M | Sent |
| 12 | >> | CONTAINS | NUM | EV (113827, DCM, "Nominal Total Collimation | 1 | M | Sent |

| | | | | | | | |
|----|-----|----------|-----------|---|-----|----|---|
| | | | | Width") | | | |
| 13 | >> | CONTAINS | NUM | EV (113828, DCM, "Pitch Factor") | 1 | MC | Sent per conditional |
| 14 | >> | CONTAINS | NUM | EV (113823, DCM, "Number of X-ray Sources") | 1 | M | Sent |
| 15 | >> | CONTAINS | CONTAINER | EV (113831, DCM, "CT X-ray Source Parameters") | 1-n | M | Single item sent. |
| 16 | >>> | CONTAINS | TEXT | EV (113832, DCM, "Identification Number of the X-ray Source") | 1 | M | Sent |
| 17 | >>> | CONTAINS | NUM | EV (113733, DCM, "KVP") | 1 | M | Sent |
| 18 | >>> | CONTAINS | NUM | EV (113833, DCM, "Maximum X-ray Tube Current") | 1 | M | Sent |
| 19 | >>> | CONTAINS | NUM | EV (113734, DCM, "X-Ray Tube Current") | 1 | M | Sent |
| 20 | >>> | CONTAINS | NUM | EV (113834, DCM, "Exposure Time per Rotation") | 1 | MC | Sent per conditional |
| 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, | 1 | U | Not sent |

| | | | | | | | |
|----|----------|-----------------|------|--|---|----|----------|
| | | | | DCM, "Mean CTDIfreeair") | | | |
| 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 (121106, DCM, "Comment") | 1 | U | Not sent |

9.4.4 TID 1002 – Observer Context

| NL | Rel with Parent | VT | Concept Name | VM | Req Type | Note |
|----|-----------------|---------|--|----|----------|---|
| 1 | HAS OBS CONTEXT | CODE | EV (121005, DCM, "Observer Type") | 1 | MC | Sent as "Device". |
| 2 | HAS OBS CONTEXT | INCLUDE | DTID (1003) Person observer identifying attributes | 1 | MC | Not sent. |
| 3 | HAS OBS CONTEXT | INCLUDE | DTID (1004) Device observer identifying attributes | 1 | MC | See TID 1004 Device Observer Identifying Attributes table below for details. |

9.4.5 TID 1004 – Device Observer Identifying Attributes

| NL | Rel with Parent | VT | Concept Name | VM | Req Type | Note |
|----|-----------------|--------|--|----|----------|---|
| 1 | | UIDREF | EV (121012, DCM, "Device Observer UID") | 1 | M | Sent. Same as Implementation UID (0002,0012) See section 9.6. |
| 2 | | TEXT | EV (121013, DCM, "Device Observer Name") | 1 | U | Sent. Same as Station Name (0008,1010) |
| 3 | | TEXT | EV (121014, DCM, | 1 | U | Sent as "GE Medical |

| | | | | | | |
|---|--|------|---|-----|---|---|
| | | | “Device Observer Manufacturer”) | | | Systems”. |
| 4 | | TEXT | EV (121015,DCM, “Device Observer Model Name”) | 1 | U | Sent. Same as Manufacturer’s Model Name (0008,1090) |
| 5 | | TEXT | EV (121016,DCM, “Device Observer Serial Number”) | 1 | U | Sent. Same as Device Serial Number (0018,1000) |
| 6 | | TEXT | EV (121017,DCM, “Device Observer Physical Location during observation”) | 1 | U | Not Sent. |
| 7 | | CODE | EV (113876, DCM, “Device Role in Procedure”) | 1-n | U | Not Sent. |

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: Dose Alert values and Dose Notification values are not supported.

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 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 PACS and workstation 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).

SR setting can be configured in “Dose Report” in reconfig menu as below.

- “Full” will produce the X-Ray Radiation Dose SR SOP class
- “On” will produce the Enhanced SR SOP class.
- “Off” will not produce any SOP class.

9.6 Implementation UID

Implementation UID for Structured Report is identified in the following table.

| Product Model | Software Revision | Implementation UID |
|--|-------------------|----------------------|
| LightSpeed ¹⁶ (4x, 5x), LightSpeed Pro ¹⁶ | 07MW11.10_SP4-x | 1.2.840.113619.6.343 |

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 | 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 |
| | 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. <i>Supports 5 different components delimited by “^”.</i> <i>Supports a maximum length of 32 characters including the delimiter .</i> 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. |

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 |

| Attribute Name | Tag | Type | Notes |
|------------------------------------|-------------|------|---|
| | | | 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. |
| 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. |
| Referenced Study Sequence | (0008,1110) | 3 | Value from the worklist |
| >Referenced SOP Class UID | (0008,1150) | 1C | Value from the worklist |
| >Referenced SOP Instance UID | (0008,1155) | 1C | Value from the worklist |

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 | Not sent. |
| 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 | (0040,0008) | 3 | Value from worklist sent |

| | | | |
|--|-------------|----|---|
| Code Sequence | | | |
| > Scheduled Procedure Step ID | (0040,0009) | 3 | Value from worklist sent |
| > Reason for Requested Procedure | (0040,1002) | 3 | Not sent. |
| > Reason for Requested Procedure Code sequence | (0040,100A) | 3 | Not sent. |
| Body Part Examined | (0018,0015) | 3 | Not sent. |
| Referenced Performed Procedure Step Sequence | (0008,1111) | 3 | Value used for performed procedure step |
| >Referenced SOP Class UID | (0008,1150) | 1C | Value used for performed procedure step |
| >Referenced SOP Instance UID | (0008,1155) | 1C | Value used for performed procedure step |

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 | Sent if present in image. |
| 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 |
|---------------------|-------------|------|--|
| Image Number | (0020,0013) | 2 | Generated sequentially, always sent. |
| 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. |
| Referenced Image Sequence | (0008,1140) | 3 | Value from the worklist |
| >Reference SOP Class UID | (0008,1150) | 1 | Value from the worklist |
| >Reference SOP Instance UID | (0008,1155) | 1 | Value from the worklist |
| Irradiation Event UID | (0008, 3010) | 3 | Not sent. |

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 | (0008,0016) | 1 | Always sent. |
| SOP Instance UID | (0008,0018) | 1 | Always sent. |
| Specific Character Set | (0008,0005) | 1C | ISO_IR 100 |
| Instance Creation Date | (0008,0012) | 3 | Always sent. |
| Instance Creation Time | (0008,0013) | 3 | Always sent. |
| Image Number | (0020,0013) | 3 | 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

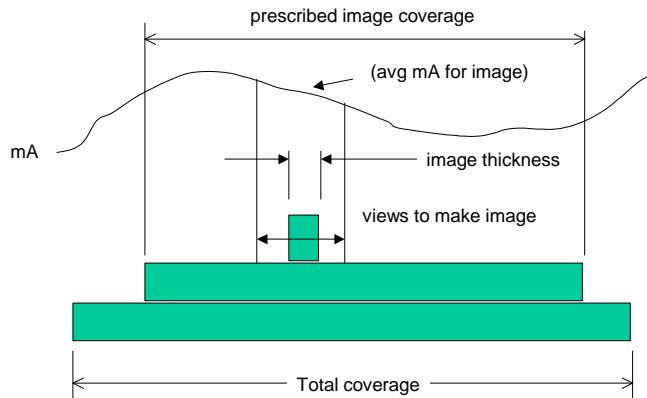
| Attribute Name | Tag | Type | Notes |
|----------------------------|-------------|------|--|
| Image Type | (0008,0008) | 1 | Always sent. Defined terms: Value 3: AXIAL LOCALIZER SEGMENTED REFORMATTED PROCESSED COMBINED CTINTERVENTION Value 4: MIN IP MIP AVERAGE VOLREN INTEGRAL HD MIP RAYSUM SURFACE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

| Attribute Name | Tag | Type | Notes |
|-----------------------------|-------------|------|--|
| 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 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 |

| Attribute Name | Tag | Type | Notes |
|--------------------------|--------------|------|---|
| | | | 1.2. |
| Convolution Kernel | (0018,1210) | 3 | Not sent for scouts. Defined terms: SMOOTH SOFT STANDARD STD+ DETAIL CHST BONE EDGE SHARP LUNG BONEPLUS |
| 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.

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



$$\text{exposure} = (\text{exposure time}) * (\text{image avg mA}) * (\text{slice thickness}) / (\text{total coverage})$$

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

Exposure.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.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 feed | (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 |
| 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 Temperature | (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 |

| Attribute Name | Tag | VR | VM |
|-------------------------------|--------------|----|----|
| 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 |
| 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 |
| Itebone Flag | (0045, 1021) | SS | 1 |
| Peristaltic 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 |

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 |

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.1 Basic Directory IOD Definition

| Module | Usage | Notes |
|-------------------------|-------|-------|
| Directory Information | U | Sent |
| File Set Identification | M | Sent |

C.2 File Set Identification Module

| Attribute Name | Tag | Type | Notes |
|----------------|-------------|------|--------------------|
| File Set ID | (0004,1130) | 2 | Set by application |

C.3 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 | Supported. |
| >Offset of the Next Directory Record | (0004,1400) | 1C | 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 Keys : "PATIENT" Study Keys : "STUDY" Series Keys : "SERIES" Image Keys : "IMAGE" |
| >Referenced File ID | (0004,1500) | 1C | Generated only for Image Directory Record, starting with A/A/A/A/Z01. |
| >Referenced SOP Class UID in File | (0004,1510) | 1C | 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 included |
| >Record Selection Keys | | | See C.5 |

C.4 MOD 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 | Set by application |
| Directory Record Sequence | (0004,1220) | 2 | Supported. |
| >Offset of the Next Directory Record | (0004,1400) | 1C | 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", "IMAGE", "SR DOCUMENT", "PRESENTATION" |
| >Referenced File ID | (0004,1500) | 1C | Generated only for Image, Presentation and SR Document Directory Records starting with GEMS/A/A/Z00. |
| >Referenced SOP Class UID in file | (0004,1510) | 1C | Generated only for Image, Presentation and SR Document Directory Records |
| >Referenced SOP Instance UID in File | (0004,1511) | 1C | Generated only for Image, Presentation and SR Document Directory Records |
| >Referenced Transfer Syntax UID in File | (0004,1512) | 1C | Generated only for Image, Presentation and SR Document Directory Records |
| >Record Selection Keys | | | See C.6 |

C.5 CD-R/DVD-R Directory Record Selection Keys

The STD-GEN-CD and STD-GEN-DVD-JPEG 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.5.1 CD-R/DVD-R Patient Keys

| Attribute Name | Tag | Additional Tag | Type | Notes |
|------------------------|--------------|----------------|------|---|
| Specific Character Set | (0008,0005) | NO | 1C | ISO_IR 100. |
| Patient's Name | (0010,0010) | NO | 2 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Patient ID | (0010,0020) | NO | 1 | If present in composite object instances it will be set to same value, otherwise Patient ID is set as "NO_ID", if it is NULL. |
| Patient Birth Date | (0010, 0030) | YES (DVD-R) | 1C | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Patient Sex | (0010, 0040) | YES (DVD-R) | 1C | If present in composite object instances it will be set to same value, otherwise set to NULL. |

C.5.2 CD-R/DVD-R Study Keys

| Attribute Name | Tag | Additional Key | Type | Notes |
|------------------------|-------------|----------------|------|--|
| Specific Character Set | (0008,0005) | NO | 1C | ISO_IR 100. |
| Study Date | (0008,0020) | NO | 1 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Study Time | (0008,0030) | NO | 1 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Accession Number | (0008,0050) | NO | 2 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Modality | (0008,0060) | NO | 3 | If present in composite object instance it will be set to same value, otherwise an error is returned and the object not put on media |
| Study Description | (0008,1030) | NO | 2 | If present in composite object instances it will be set to same value, otherwise set to NULL. |

| | | | | |
|--------------------|-------------|----|----|--|
| Study Instance UID | (0020,000D) | NO | 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) | NO | 1 | If present in composite object instances it will be set to same value, otherwise set to NULL. |

C.5.3 CD-R/DVD-R Series Keys

| Attribute Name | Tag | Additional Key | Type | Notes |
|-----------------------------|-------------|----------------|------|---|
| Specific Character Set | (0008,0005) | NO | 1C | ISO_IR 100 |
| Image Type | (0008,0008) | NO | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Modality | (0008,0060) | NO | 1 | If present in composite object instance it will be set to same value, otherwise set to NULL. |
| Manufacturer | (0008,0070) | NO | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Institution Name | (0008,0080) | YES (DVD-R) | 1C | Not included |
| Institution Address | (0008,0081) | YES (DVD-R) | 1C | If present in composite object instances it will be set to same value, otherwise not sent |
| Series Description | (0008,103E) | NO | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Performing Physician's Name | (0008,1050) | YES (DVD-R) | 1C | Not included |
| Manufacturer's Model Name | (0008,1090) | NO | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Series Instance UID | (0020,000E) | NO | 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) | NO | 1 | If present in composite object instance, it will be set to same value, otherwise set to NULL. |

C.5.4 CD-R/DVD-R Image Keys

| Attribute Name | Tag | Additional Key | Type | Notes |
|------------------------|-------------|----------------|------|------------|
| Specific Character Set | (0008,0005) | NO | 1C | ISO_IR 100 |

| | | | | |
|-----------------------------|-------------|-------------------------|----|--|
| Image Type | (0008,0008) | Yes (CD-R/ DVD-R) | 1C | Not Included. |
| SOP Class UID | (0008,0016) | NO | 3 | If present in composite object instances it will be set to same value, otherwise abort |
| SOP Instance UID | (0008,0018) | NO | 3 | If present in composite object instances it will be set to same value, otherwise same as 0x0008,0x0016 |
| Slice Thickness | (0018,0050) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Spacing Between Slices | (0018,0088) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Data Collection Diameter | (0018,0090) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Reconstruction Diameter | (0018,1100) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Gantry/Detector Tilt | (0018,1120) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Convolution Kernel | (0018,1210) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove. |
| Image Number | (0020,0013) | NO | 1 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Image Position (Patient) | (0020,0032) | YES (DVD-R) | 1C | If present in composite object instances it will be set to same value, otherwise removed |
| Image Orientation (Patient) | (0020,0037) | YES (DVD-R) | 1C | If present in composite object instances it will be set to same value, otherwise remove. |
| Frame of Reference UID | (0020,0052) | YES (DVD-R) | 1C | If present in composite object instances it will be set to same value, otherwise removed |
| Slice Location | (0020,1041) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Samples Per Pixel | (0028,0002) | NO | 3 | If present in composite object instances it will be set to same value, otherwise handled. |
| Rows | (0028,0010) | YES (DVD-R) | 1 | If present in composite object instances it will be set to same value, otherwise handled. |
| Columns | (0028,0011) | YES (DVD-R) | 1 | If present in composite object instances it will be set to same value, otherwise handled. |

| | | | | |
|----------------------|-------------|----------------|----|---|
| Pixel Spacing | (0028,0030) | YES (DVD-R) | 1C | If present in composite object instances it will be set to same value, otherwise remove. |
| Bits Allocated | (0028,0100) | NO | 3 | If present in composite object instances it will be set to same value, otherwise handled. |
| Bits Stored | (0028,0101) | NO | 3 | If present in composite object instances it will be set to same value, otherwise handled. |
| Repetition Time | (0018,0080) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Echo Time | (0018,0081) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Inversion Time | (0018,0082) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Number of Averages | (0018,0083) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Contrast/Bolus Route | (0018,1040) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Trigger Time | (0018,1060) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Flip Angle | (0018,1314) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Echo Number | (0018,0086) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove. |
| Sequence Variant | (0018,0021) | NO | 3 | If present in composite object instances it will be set to same value, otherwise remove |

C.6 MOD Directory Record Selection Keys

The PRI-CTMR-MOD12, STD-CTMR-MOD23, STD-CTMR-MOD12 and STD-CTMR-MOD41 application profiles will have only the Patient, Study, Series and Image directory record types. Given below is the list of attributes supported under each of these directories.

C.6.1 MOD 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, otherwise set to NULL. |
| Patient ID | (0010,0020) | 1 | If present in composite object instances it will be set to same value, otherwise Patient ID is set as "NO_ID", if it is NULL. |
| Patient Birth Date | (0010, 0030) | 1C | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Patient Sex | (0010, 0040) | 1C | If present in composite object instances it will be set to same value, otherwise set to NULL. |

C.6.2 MOD 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, otherwise set to NULL. |
| Study Time | (0008,0030) | 1 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Accession Number | (0008,0050) | 2 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Study Description | (0008,1030) | 2 | If present in composite object instances it will be set to same value, otherwise 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, otherwise set to NULL. |

C.6.3 MOD Series Keys

| Attribute Name | Tag | Type | Notes |
|------------------------|-------------|------|------------|
| Specific Character Set | (0008,0005) | 1C | ISO_IR 100 |

| | | | |
|-----------------------------|--------------|----|---|
| Image Type | (0008,0008) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Modality | (0008,0060) | 1 | If present in composite object instance it will be set to same value, otherwise set to NULL. |
| Manufacturer | (0008,0070) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Institution Name | (0008, 0080) | 1C | Not included |
| Institution Address | (0008, 0081) | 1C | If present in composite object instances it will be set to same value, otherwise not sent |
| Series Description | (0008,103E) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Performing Physician's Name | (0008,1050) | 1C | Not included |
| Manufacturer's Model Name | (0008,1090) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| 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 instance, it will be set to same value, otherwise set to NULL. |

C.6.4 MOD Image Keys

| Attribute Name | Tag | Type | Notes |
|------------------------|-------------|------|--|
| Specific Character Set | (0008,0005) | 1C | ISO_IR 100 |
| Image Type | (0008,0008) | 1C | Not Included. |
| SOP Instance UID | (0008,0018) | 3 | If present in composite object instances it will be set to same value, otherwise same as 0x0008,0x0016 |
| Sequence Variant | (0018,0021) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Slice Thickness | (0018,0050) | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Repetition Time | (0018,0080) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Echo Time | (0018,0081) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Inversion Time | (0018,0082) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL. |

| | | | |
|-----------------------------|-------------|----|---|
| Number of Averages | (0018,0083) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Spacing Between Slices | (0018,0088) | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Data Collection Diameter | (0018,0090) | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Contrast/Bolus Route | (0018,1040) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Trigger Time | (0018,1060) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Reconstruction Diameter | (0018,1100) | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Gantry/Detector Tilt | (0018,1120) | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Convolution Kernel | (0018,1210) | 3 | If present in composite object instances it will be set to same value, otherwise remove. |
| Flip Angle | (0018,1314) | 3 | If present in composite object instances it will be set to same value, otherwise set to NULL. |
| Image Number | (0020,0013) | 1 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Image Position (Patient) | (0020,0032) | 1C | If present in composite object instances it will be set to same value, otherwise removed |
| Image Orientation (Patient) | (0020,0037) | 1C | If present in composite object instances it will be set to same value, otherwise remove. |
| Frame of Reference UID | (0020,0052) | 1C | If present in composite object instances it will be set to same value, otherwise removed |
| Slice Location | (0020,1041) | 3 | If present in composite object instances it will be set to same value, otherwise remove |
| Rows | (0028,0010) | 1 | If present in composite object instances it will be set to same value, otherwise handled. |
| Columns | (0028,0011) | 1 | If present in composite object instances it will be set to same value, otherwise handled. |
| Pixel Spacing | (0028,0030) | 1C | If present in composite object instances it will be set to same value, otherwise remove. |

C.6.5 MOD Presentation Keys

| Attribute Name | Tag | Type | Notes |
|-------------------------------|-------------|------|--|
| SOP Instance UID | (0008,0018) | 3 | Same as (0004,1511) |
| Referenced Series Sequence | (0008,1115) | 1C | Calculated and sent. |
| > Referenced Image Sequence | (0008,1140) | 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 |
| Image Number | (0020,0013) | 1 | If present in composite object instances it will be set to same value, otherwise set to NULL |
| Content Label | (0070,0080) | 1 | Exam Split : 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. Save State : "GEGSPS_* |
| Content Description | (0070,0081) | 2 | Exam Split : String input on Comments box in Exam Split screen Save State : "SE (Series Number) IM (First Image Number) TO IM (Last Image Number)" |
| Presentation Creation Date | (0070,0082) | 1 | Calculated and sent. |
| Presentation Creation Time | (0070,0083) | 1 | Calculated and sent. |
| Content Creator's Name | (0070,0084) | 2 | Same as Station Name(0008,1010) |

C.6.6 MOD SR Document Keys

| Attribute Name | Tag | Type | Notes |
|------------------------|-------------|------|---|
| Specific Character Set | (0008,0005) | 1C | ISO_IR 100 |
| Image Date | (0008,0023) | 1 | Generated for each image, always sent. |
| Image Time | (0008,0033) | 1 | Generated for each image, always sent. |
| Image Number | (0020,0013) | 1 | If present in composite object instances it will be set to same |

| | | | |
|-----------------------------|-------------|----|--|
| | | | value, otherwise set to NULL |
| Concept Name Code Sequence | (0040,A043) | 1 | A coded representation of the document title. |
| >Code Value | (0008,0100) | 1 | Always sent |
| >Coding Scheme Designator | (0008,0102) | 1 | Always sent |
| >Code Meaning | (0008,0104) | 1 | Always sent |
| Completion Flag | (0040,A491) | 1 | COMPLETE sent |
| Verification Flag | (0040,A493) | 1 | UNVERIFIED sent |
| Verifying Observer Sequence | (0040,A073) | 1C | <p>he person or persons authorized to verify documents of this type and accept responsibility for the content of this document.</p> <p>One or more Items may be included shall be included in this sequence.</p> <p>Required if Verification Flag (0040,A493) is VERIFIED.</p> <p>Note: In HL7 Structured Documents, the comparable attribute is the "legalAuthenticator".</p> |
| >Verification DateTime | (0040,A030) | 1 | Date and Time of verification by the Verifying Observer Name (0040,A075). |
| >Verifying Observer Name | (0040,A075) | 1 | The person authorized by the Verifying Organization (0040,A027) to verify documents of this type and who accepts responsibility for the content of this document. |

APPENDIX D: Implementation UID for Product Versions

| Product Model | Software Revision | Implementation UID |
|--|-------------------|---------------------|
| LightSpeed ¹⁶ (4x, 5x), LightSpeed Pro ¹⁶ | 07MW11.10_SP4-x | 1.2.840.113619.6.55 |

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