Technical Publications

Direction DOC2125962
Revision 01

Invenia ABUS 2.0 Version 2.0.x
DICOM CONFORMANCE STATEMENT

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CONFORMANCE STATEMENT OVERVIEW

Invenia Automated Breast Ultrasound System Invenia ABUS collects the ultrasound data. On the Invenia ABUS patient information can be entered manually or patients may be selected from a list that is generated from information obtained using the DICOM Modality Worklist.

Table 0.1 provides an overview of the network services supported by Invenia ABUS.

Table 0.1 – NETWORK SERVICES

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Ultrasound Multi-frame Image Storage	Yes	No
Grayscale Softcopy Presentation State	Yes	No
Verification SOP Class	Yes	No
Workflow Management		
Modality Worklist	Yes	No
Modality Performed Procedure Step	Yes	No

TABLE OF CONTENTS

1. INTRODUCTION

1.1 OVERVIEW

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

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

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

Section 3 (US Multi-frame Information Object Implementation), which specifies the use of the DICOM US Image IOD to represent the information included in US Images produced by this implementation. Corresponding attributes are conveyed using the module construct.

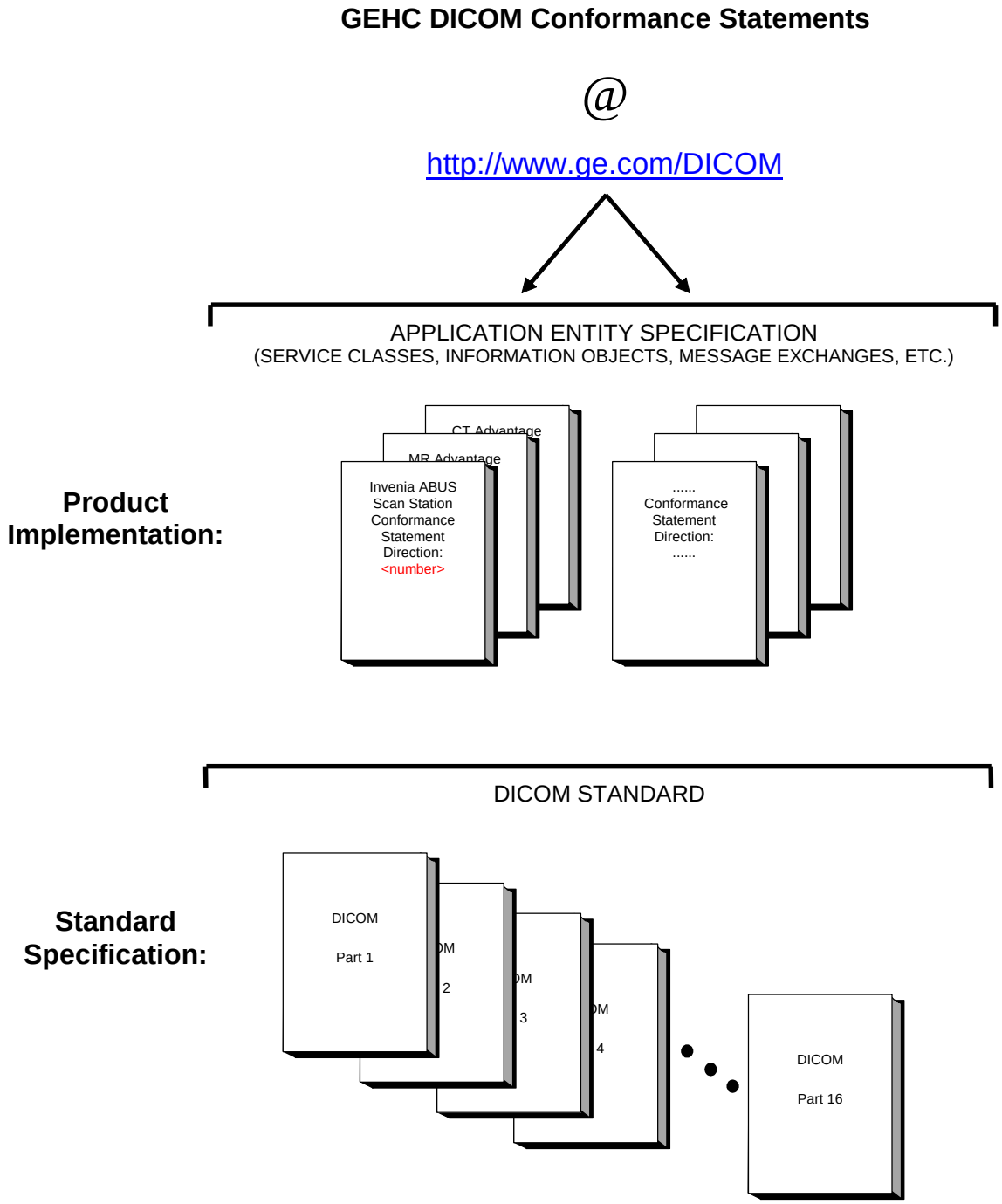
Section 4 (Grayscale Softcopy Presentation State Information Object Implementation) which specifies the use of the DICOM GSPS IOD to represent the information included in GSPS objects produced by this implementation. Corresponding attributes are conveyed using the module construct.

Section 5 (Modality Worklist Query Implementation) which specifies the use of the DICOM MW Query to retrieve the relevant workflow information necessary for use by this implementation.

Section 6 Modality Performed Procedure Step Implementation which specifies the use of the DICOM MPPS event notifications relevant to the workflow for this implementation.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT 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:

*Invenia **ABUS 2.0 Version 2.0.x***
Conformance Statement for DICOM
Direction DOC2125962

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 which 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 which define all data elements 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 which are sent by GEHC devices.

1.5 IMPORTANT REMARKS

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

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non–GE systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.

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

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

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

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

1.6 REFERENCES

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 element.

1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
ANSI	American National Standards Institute
DICOM	Digital Imaging and Communications in Medicine
DOB	Date Of Birth
IEEE	Institute of Electrical and Electronics Engineers
IOD	Information Object Definition
LAN	Local Area Network
PDU	Protocol Data Unit
SCP	Service Class Provider
SCU	Service Class User

SOP	Service Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
VR	Value Representation
ABUS	Automated Breast Ultrasound System

The following terms are used in various tables to indicate how attributes are used.

VNAP	Value Not Always Present (attribute sent zero length if no value is present)
ANAP	Attribute Not Always Present
ALWAYS	Always Present
EMPTY	Attribute is sent without a value
ABSENT	Attribute is not used.

The following terms are used in various tables to indicate the source of attributes.

MWL	The attribute value source Modality Worklist
USER	The attribute value source is from User input
AUTO	The attribute value is generated automatically
MPPS	The attribute value is the same as that use for Modality Performed Procedure Step
CONFIG	The attribute value source is a configurable parameter

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the Invenia ABUS 2.0 compliance to DICOM requirements for **Networking** features.

2.2 IMPLEMENTATION MODEL

The Invenia ABUS 2.0 acquires and stores images and patient data directly on the system's hard disk. All images and patient data are retained locally on the system (storage space permitting) allowing this data to be sent or re-sent at the operators' discretion to the Invenia ABUS Viewer or a DICOM storage server.

2.2.1 Application Data Flow Diagram

The network application model for the Invenia ABUS 2.0 is shown in the following drawing:

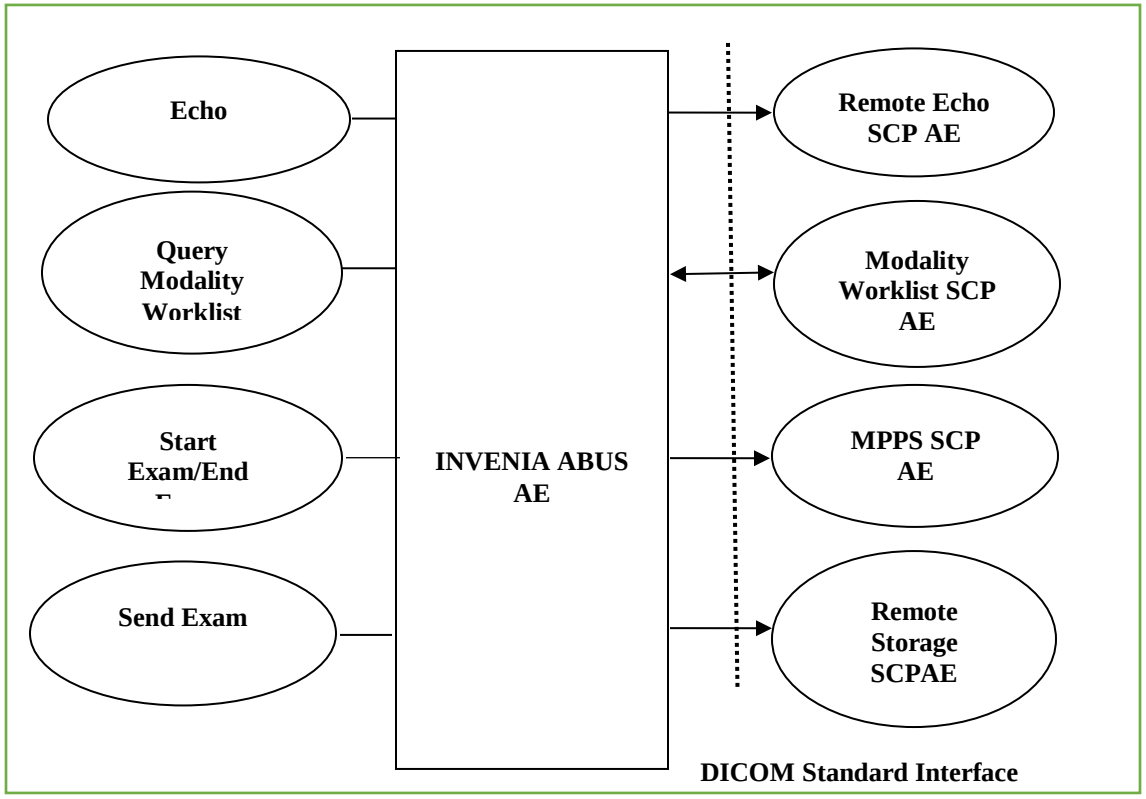


Figure 2–1 Invenia ABUS Network Application Model and Data Flow Diagram

The Invenia ABUS Application Entity (AE) is an application that handles DICOM protocol communication. The INVENIA ABUS AE is automatically brought up when the Invenia ABUS 2.0 is initialized.

The INVENIA ABUS AE is invoked by the following Real World Activities:

- **Query Modality Worklist**

The user initiates a Query Modality Worklist manually using the GUI to perform a query with a given set of query parameters to the remote Modality Worklist SCP AE. The Modality Worklist AE returns responses matching the query parameters. Worklist items and presented to the user. The user then chooses the desired worklist item and prepares the system to start the Exam.

- **Start Exam /End Exam**

The user initiates the Start Exam by initiating the first image acquisition. The INVENIA ABUS AE sends a N-CREATE message to the configured remote MPPS SCP AE indicating the image acquisition process has started for the Scheduled Procedure Step.

The user ends the Exam after completing the "Verify" of the acquired images. The INVENIA ABUS AE sends a N-SET message to the configured remote MPPS SCP AE to indicate that the image acquisition process is completed for the Scheduled Procedure Step with the MPPS status (COMPLETED).

- **Send Exam**

Send Exam is automatically sent to the previously selected Remote Storage SCP AE once the exam is completed. Exam is completed by either selecting the Next Patient button on the verification screen or by selecting Log Out.

Send Exam may be initiated manually to one or more Remote Storage SCP AEs by selecting the Resend Button and the destination in the worklist screen.

- **Echo**

The INVENIA ABUS AE automatically sends a verification request to a remote Application Entity upon configuration and periodically every 30 seconds thereafter. The success or failure result is indicated on the GUI icon next to the remote destination selection and the configuration entry.

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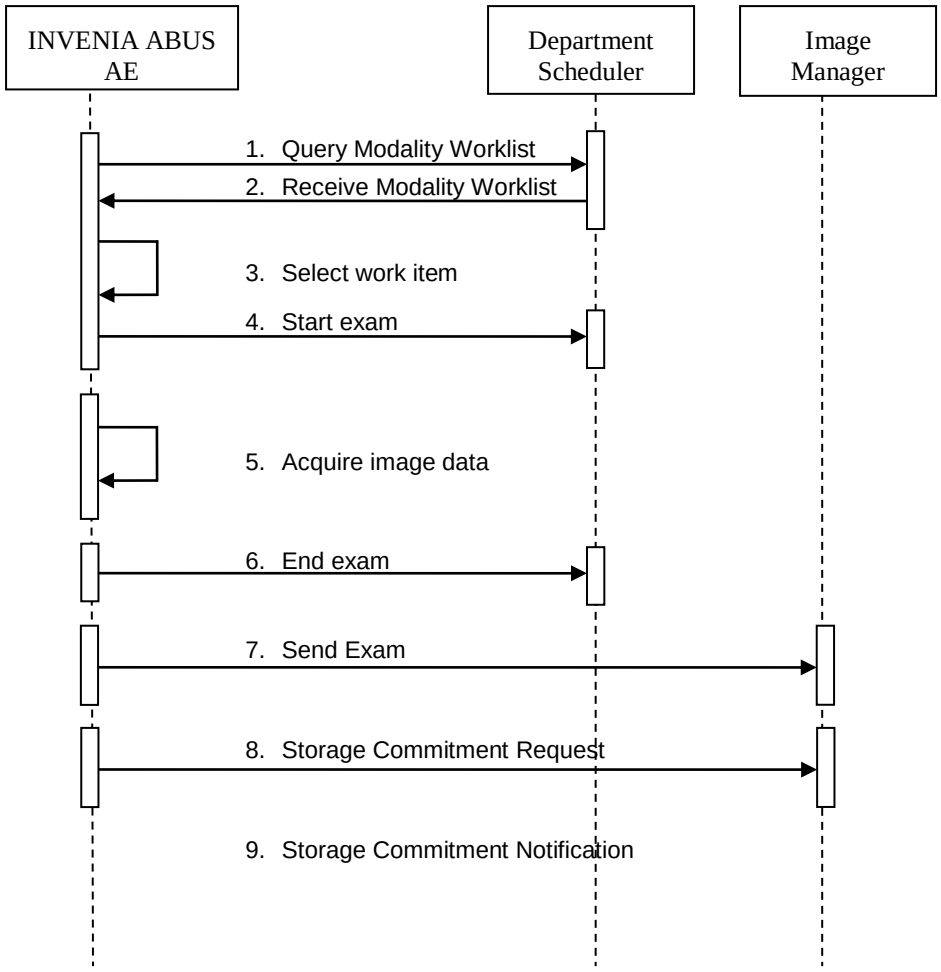
2.2.2 Functional Definition of AE's

The Invenia ABUS has a single AE that performs all the required DICOM related tasks.

INVENIA ABUS AE initiates DICOM associations automatically as part of Invenia ABUS application startup.

2.2.3 Sequencing of Real-World Activities



Under normal scheduled workflow conditions the sequencing constraints illustrated in above Figure apply:

1. Query Modality Worklist for matching items
2. Receive Modality Worklist matches
3. Select item from the Modality Worklist
4. Start exam initiates the MPPS creation and setting of the status to in-progress.
5. Acquire image data (multi frame images)
6. End exam initiate the MPPS status to be set to completed.
7. Send Exam (acquired image data) to the image manager.

Other workflow situations (e.g. unscheduled procedure steps) will have other sequencing constraints.

2.3 AE SPECIFICATIONS

2.3.1 INVENIA ABUS AE Specification

The Invenia ABUS Application Entity provides Standard Conformance to the following DICOM SOP Classes as an **SCU** and/or as an **SCP**:

SOP Class Name	SOP Class UID	SCU	SCP
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Yes	No
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Yes	No
Verification SOP Class	1.2.840.10008.1.1	Yes	No`
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Yes	No

2.3.1.1 Association Establishment Policies

2.3.1.1.1 General

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

Application Context Name	1.2.840.10008.3.1.1.1

The maximum length PDU receive size for the INVENIA ABUS AE is:

Maximum Length PDU	16KB

2.3.1.1.2 Number of Associations

The INVENIA ABUS AE will initiate a maximum of 4 simultaneous associations to remote nodes.

The INVENIA ABUS AE will support a maximum of 4 associations initiated by remote nodes.

2.3.1.1.3 Asynchronous Nature

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

2.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM Implementation is:

INVENIA ABUS AE Implementation UID	1.2.276.0.7230010.3.0.3.6.1
INVENIA ABUS AE Implementation Version Name	OFFIS_DCMTK_361

2.3.1.2 Association Initiation Policy

When the Invenia ABUS Application Entity initiates an Association for any Real-World Activity, it will propose the Presentation Contexts for all Real-World Activities; i.e., there is only a single, comprehensive Presentation Context Negotiation proposed for the AE.

The INVENIA ABUS AE proposes only a single Transfer Syntax in each Presentation Context; i.e., for each Abstract Syntax in the following Presentation Context Tables, the AE proposes one Presentation Context for each specified Transfer Syntax.

2.3.1.2.1 Real-World Activity: Echo

2.3.1.2.1.1 Associated Real-World Activity

For each remote SCP AE configured, the INVENIA ABUS AE automatically initiates a verification of a remote Application Entity:

- upon system initialization
- when a remote AE is configured or
- after 30 seconds since the previous verification request.

The Invenia ABUS will update the DICOM Status ICON color associated with the Remote SCP AE for each configured Remote SCP AE with any status changes.

- GREEN color indicates Success of the C-ECHO response for the last C-ECHO Request initiated.
- RED color indicates an error condition as listed in the table in Section 2.3.1.2.1.3.1.2.

2.3.1.2.1.2 Proposed Presentation Context

Presentation Context Accepted by INVENIA ABUS AE for Activity Echo

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Verification SOP Class	1.2.840.10008.1.1	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None

2.3.1.2.1.3 SOP Specific Conformance to Verification SOP Class

The INVENIA ABUS AE provides standard conformance.

2.3.1.2.1.3.1.1 Verification C-ECHO Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The association is closed.

2.3.1.2.1.3.1.2 Verification Communications Failure Behavior

Error condition	Behavior
Timeout expires for an expected DICOM PDU or TCP/IP packet.	The color of the status indicator changes to red. Any error information is logged.
Association A-REJECTed by the SCP.	
Association A-ABORTed by the SCP.	
Network layer indicates communication loss (i.e., low-level TCP/IP socket closure).	

2.3.1.2.2 Real-World Activity: Query Modality Worklist

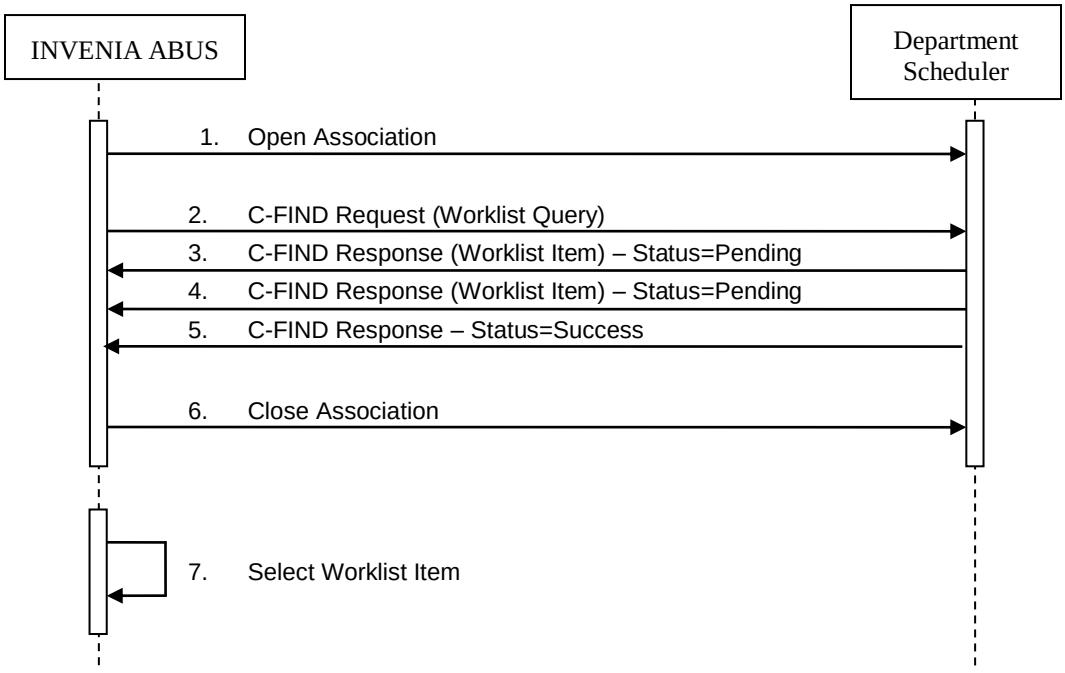
2.3.1.2.2.1 Associated Real-World Activity

The user of the system initiates a query for a modality worklist by one action:

- System startup
- User login
- User selects Refresh in the Worklist screen.

In this case, the worklist users display is purged of Scheduled Procedure Steps not performed or scheduled by this INVENIA ABUS AE. A new association is opened with the for the C-FIND request. The C-FIND will be created and sent. The INVENIA ABUS AE then waits for responses and as they arrive adds new items to the users worklist display.

On receiving the last C-FIND response or an error condition the association is closed.



A possible sequence of interactions between the INVENIA ABUS AE and a Departmental Scheduler (e.g. a device such as a RIS or HIS which supports the Modality Worklist SOP Class as an SCP) is illustrated in the Figure above:

1. The INVENIA ABUS AE opens an association with the Departmental Scheduler.

2. The INVENIA ABUS AE sends a C-FIND request to the Departmental Scheduler containing the Worklist Query attributes.

3. The Departmental Scheduler returns a C-FIND response containing the requested attributes of the first matching Worklist Item.

4. The Departmental Scheduler returns another C-FIND response containing the requested attributes of the second matching Worklist Item.

5. The Departmental Scheduler returns another C-FIND response with status Success indicating that no further matching Worklist Items exist. This example assumes that only 2 Worklist items match the Worklist Query.

6. The INVENIA ABUS AE closes the association with the Departmental Scheduler.

7. The query response records are retained by the INVENIA ABUS AE, with a subset of each response displayed to the user in a list. The user selects a Scheduled Procedure Step from that list, and the corresponding data from the record is used to populate the meta-data for the Exam (and hence is included in subsequent storage of that Exam).

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

US Modality:

Modality, (0008,0060) - set to US.

ABUS Modality:

Modality, (0008,0060) - set to the GE proprietary modality code, ABUS.

All Modalities:

Modality, (0008,0060) – zero-length (universal matching).

The scheduled dates of procedures steps of interest can be specified for query by selecting a specific date range. The choices are Today, This Week and This Month. These selections and their effects on worklist query parameters are given below:

Today:

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

This Week:

The user can set the date range to days of the current week starting with Saturday to Friday, including the current day, Scheduled Procedure Step Start Date, (0040,0002) - set to (YYYYMMSA)-(YYYYMMFR), where YYYYMMSA is the Saturday of the current week, and YYYYMMFR is the Friday of the current week with respect to the current date.

This month:

The user can set the date range to days of the current month starting with 1st calendar day of the current month to last day of the current month for the current day, Scheduled Procedure Step Start Date, (0040,0002) - set to Date Range:

Scheduled Procedure Step Start Date, (0040,0002) - set to YYYYMM01-YYYYMMLA, where both dates are set based on the current month.

A user can select the following "Optional Worklist Columns" to include in the Worklist Display:

- Procedure
- Referring Physician
- Accession Number
- Study ID

The user can select one of the following DICOM tags to be displayed in the "Procedure" Worklist column:

- [0032,1060] *Requested Procedure Description*
- [0032,1064][0008,0100] *Requested Procedure Code Sequence, code value*
- [0032,1064][0008,0104] *Requested Procedure Code Sequence, code meaning*
- [0040,0100][0040,0007] *Scheduled Procedure Step Sequence, Scheduled Procedure Step Description*
- [0040,0100][0040,0008][0008,0100] *Scheduled Procedure Step Sequence, Scheduled Protocol Code Sequence, Code Value*
- [0040,0100][0040,0008][0008,0104] *Scheduled Procedure Step Sequence, Scheduled Protocol Code Sequence, Code Meaning*
- [0040,0100][0040,0009] *Scheduled Procedure Step Sequence, Scheduled Procedure Step ID*
- [0040,1001] *Requested Procedure ID*

Selecting a worklist item will display the following items:

- Patient ID
- Patient Name
- DOB
- Scheduled Date:
- Procedure
- Accession Number
- Study ID
- Referring Physician Name
- Comments

A Scheduled Procedure Step worklist item provides the content displayed for all the above items with the exception of Comments. Comments are only entered with manual scheduling.

A Scheduled Procedure Step worklist item, from a Modality Worklist SCP AE is not user editable.

A manually Scheduled Procedure Step allows for the entry of the following items:

- Patient ID
- Patient Name
- DOB
- Scheduled Date:
- Procedure
- Accession Number
- Study ID
- Referring Physician Name
- Comments

Optionally, a previously scanned patient may be selectable for manual entry. When selecting a previously scanned patient, the following items are copied to the manuals scheduled Procedure Step

- Patient ID
- Patient Name
- DOB
- Procedure
- Accession Number
- Referring Physician Name

Note that the Study Instance UID will not be reused. The system does not explicitly support the "Append to an Existing Study" use case.

2.3.1.2.2.2 Proposed Presentation Context

The following table shows the proposed presentation contexts for the INVENIA ABUS AE after real-world activity "Modality Worklist Query" has been initiated:

PRESENTATION CONTEXT– PROPOSED BY INVENIA ABUS AE FOR ACTIVITY MODALITY WORKLIST QUERY

Presentation Context Table - Accepted by AE INVENIA ABUS AE for Activity Query Worklist					
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	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None

2.3.1.2.2.3 SOP Specific DICOM Conformance Statement for the Modality Worklist Information Model FIND SOP Class

If the remote AE does not support the proposed Presentation Context, an appropriate error is logged and the user is notified by the connection graphic.

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 Modality Worklist SCP AE is parsed to verify the length/type of the items in the response. Upon detecting any error in the response data, the response is discarded and the next response (if any) is considered.

If a received worklist item includes a Study Instance UID, currently used in an existing Study on the Invenia ABUS or in a worklist item, the received worklist item will be discarded.

If a received worklist item includes the Scheduled Procedure Step Status, the status will be confirmed. If the status is READY, SCHEDULED or ARRIVED, the worklist item may be included on the Invenia ABUS Worklist.

Each C-FIND SCU operation supports an "Association Timer" and "Operation Inactivity Timer" using QueryAssociationTimeout and QueryResponseTimeout. Values are 30 seconds, 3 minutes respectively.

In case of ERROR, persisted worklist item(s) from previous request to the configured SCP would be shown.

User cannot cancel the ongoing worklist query. C-FIND-CANCEL request is not supported.

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

STATUS CODES RECEIVED BY INVENIA ABUS AE FOR ACTIVITY QUERY MODALITY WORKLIST

Service Status	Status Code	Further Meaning	Status Code Explanation	Related Fields Sent Back to the SCU
Failure	A700	Refused: Out of resources	The association is closed or aborted. Any error information is logged.	(0000,0902)
	A900	Error: Identifier does not match SOP Class	The association is closed or aborted. Any error information is logged.	(0000,0901) (0000,0902)
	Cxxx	Error: Unable to process	The association is closed or aborted. Any error information is logged.	(0000,0901) (0000,0902)
Success	0000	Matching is complete - No final identifier is supplied	The SCP has completed the matches. The association is closed and the returned information is retained and displayed on the user interface.	None
Pending	FF00	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	The returned information is retained and displayed on the user interface.	Identifier
	FF01	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier	The returned information is retained and displayed on the user interface.	Identifier

2.3.1.2.2.3.1 Modality Worklist Communications Failure Behavior

Error condition	Behavior
Timeout expires for an expected DICOM PDU or TCP/IP packet.	No worklist information shows on the user interface. Any error information is logged.
Association A-REJECTed by the SCP.	
Association A-ABORTed by the SCP.	
Network layer indicates communication loss (i.e., low-level TCP/IP socket closure).	

2.3.1.2.3 Real-World Activity: Start Exam/End Exam

2.3.1.2.3.1 Description and Sequencing of Activity

The INVENIA ABUS AE initiates association to the remote MPPS SCP AE for the following functions during real world activity *START EXAM/END EXAM*:

Start Exam: The user selects the Start Exam button, a DICOM association is sent 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 SCU will issue a request to create the SOP instance in the remote AE via the N-CREATE service.

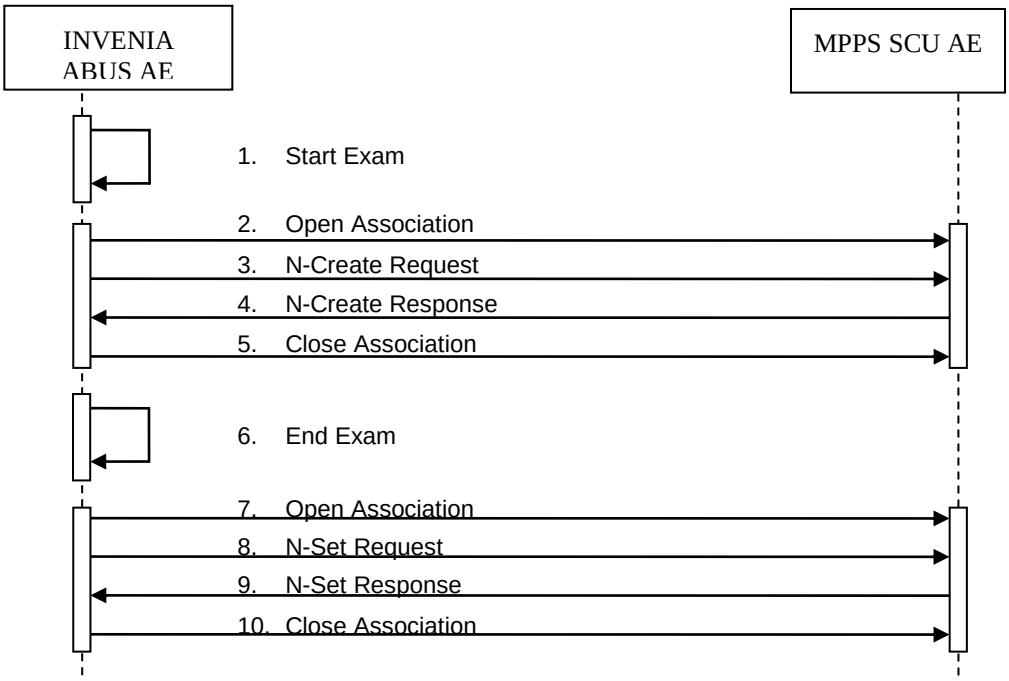
End Exam: The user selects:

- Next Patient in the Worklist screen, or
- Log out button

The INVENIA ABUS AE 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 SCU 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 Exam: The MPPS Status, ‘DISCONTINUED’ is not supported.

In each case a new association is opened. The INVENIA ABUS AE then waits for responses. On receiving the response or an error condition the association is closed.



2.3.1.2.3.2 Proposed Presentation Context Table

Presentation Context Table - Accepted by Invenia ABUS AE for Activity Start Exam/End Exam					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Modality Performed Procedure Step SOP Class	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None

2.3.1.2.3.3 SOP Specific Conformance to Modality Performed Procedure Step SOP Class N-Set

2.3.1.2.3.3.1 Modality Performed Procedure Step Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The association is closed.

2.3.1.2.3.3.2 Communications Failure Behavior

Error condition	Behavior
Timeout expires for an expected DICOM PDU or TCP/IP packet.	The MPPS N-Set request aborts and error information is logged.
Association A-REJECTed by the SCP.	
Association A-ABORTed by the SCP.	
Network layer indicates communication loss (i.e., low-level TCP/IP socket closure).	

2.3.1.2.4 Real-World Activity: Send Exam

2.3.1.2.4.1 Associated Real-World Activity

There are three real-world activities which would initiate the INVENIA ABUS AE to open a new association with the configured Destinations for sending an exam. The process may be initiated by the User:

- Selecting the Resend button from the worklist screen.
- Selecting the Log out button in the screen.
- Selecting the Next Patient button in the verification screen(Batch mode).
- Completion of an image reconstruction on the Invenia ABUS(Direct Send mode).

The Invenia ABUS, Scanning Protocol is configurable to Send Exam as a "Batch Send" or a "Direct Send".

In each case a new association is opened for the transfer of each individual image. On completion of the transfer, successful or otherwise, the association is closed.

2.3.1.2.4.2 Proposed Presentation Context Table

Presentation Context Table – Proposed by AE Invenia ABUS for Activity Send Exam					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian Implicit VR Little Endian Lossless JPEG	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.4.70	SCU	None
Grayscale Softcopy Presentation State	1.2.840.10008.5.1.4.1.1.11.1	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2		

2.3.1.2.4.3 SOP Specific DICOM Conformance Statement to Ultrasound Multi-frame Image Storage SOP Class

The Invenia ABUS, Destinations configuration allows for the selection of Image Type associated with the Destination AE for the Send Exam.

The configurable Image Types are:

- Native ABUS(Flat Transverse)
- Curved Transverse
- Coronal

Native ABUS(Flat Transverse) image type utilizes the spatial encoding of the pixel data relative to the ABUS transducer. Image Type (0008,0008) is encoded as "/ORIGINAL/PRIMARY/BREAST/0000/Flat Transverse". The Flat Transverse Image Type is the preferred format for the Invenia ABUS Viewer.

Curved Transverse image type is is the standard DICOM Coordinate System and includes ultrasound scan data encoded as spatially-related frames. The Frame Increment Pointer(0028,0009) is set to the Spacing Between Slices (0018,0088). Image data, encoded as spatially related frames, are non-square pixels.

The Invenia ABUS is configurable to export DICOM images using the DICOM Compression technique, Lossless JPEG with the Send Exam.

The Invenia ABUS is configurable to export GSPS to send with the Send Exam.

The Ultrasound Multi-frame Image Storage SOP Class includes the GE proprietary Spatial Coordinate System for encoding of ultrasound scan data. The GE proprietary spatial encoding is declared in Image Type(0008,0008), fourth value, "0000". The Image Type 5th value provides the proprietary GE coordinate system modifier with one of two declared values;

a. Coronal
b. Flat Transverse.

Coronal is the "Curved Plane" GE Proprietary Coordinate System, utilizing a rendered Curved Plane relative to the ABUS Transducer. The intended use is for rendering the rendered display of the Coronal view as a curved plane. The first column is spatially registered to the shared Frame of Reference UID.

The **Coronal**, **Flat Transverse** and **Curved Transvers** Image Types shares the Frame Of Reference UID, valid only for the first and last column of each frame.

Series Instance UID may be unique for each image or for each View during an exam session.

This implementation performs one C-STORE operation over a single association.

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

Upon receiving a C-STORE confirmation containing a Refused status, this implementation will consider the current request to be a failure and will terminate the association.

For all C-STORE statuses other than success or warnings received, this implementation will consider the current request to be a failure and will terminate the association.

Each C-STORE operation supports an "Association Timer". This timer starts when the association request is sent and stops when the association is established. Time-out is 60 seconds.

Each C-STORE operation supports an "Operation Inactivity Timer". This timer starts when a C-STORE request is emitted and is reset each time a C-STORE response has been received, or when subsequent C-STORE are received. Time-out is 300 seconds.

If any of the 2 timers mentioned above expires, the connection is aborted and the operation is considered as failed.

2.3.1.2.4.4 SOP Specific DICOM Conformance Statement to Ultrasound Multi-frame Image Storage SOP Class

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

STATUS CODES RECEIVED BY INVENIA ABUS AE FOR ACTIVITY *SEND EXAM*

Service Status	Status Code	Further Meaning	Status Code Explanation	Related Fields Sent Back to the SCU
Failure	A700–A7FF	Refused: Out of Resources	The image transfer has failed. Association is closed and the DICOM send status indicator is set to red (transfer error). Any error information is logged.	(0000,0902)
	A900–A9FF	Error: Data Set does not match SOP Class		(0000,0901) (0000,0902)
	C000-CFFF	Error: Cannot understand		(0000,0901) (0000,0902)
Warning	B000	Coercion of Data Elements	The image transfer has completed. The association is closed and the DICOM send status indicator is set to green (no errors).	(0000,0901) (0000,0902)
	B007	Data Set does not match SOP Class		(0000,0901) (0000,0902)
	B006	Elements Discarded		(0000,0901) (0000,0902)
Success	0000	Success	The image transfer has completed. The association is closed and the DICOM send status indicator is set to green (no errors).	None

2.3.1.2.4.4.1 Ultrasound Multi-frame Image Storage Communications Failure Behavior

Error condition	Behavior
Timeout expires for an expected DICOM PDU or TCP/IP packet.	The image transfer has failed. The DICOM send status indicator is set to red (transfer error). Any error information is logged.
Association A-REJECTed by the SCP.	
Association A-ABORTed by the SCP.	
Network layer indicates communication loss (i.e., low-level TCP/IP socket closure).	

2.4 COMMUNICATION PROFILES

2.4.1 Supported Communication Stacks

The DICOM Upper Layer Protocol is supported using TCP/IP, as specified in DICOM PS3.8.

The TCP/IP stack is inherited from the Windows 64 Bit Operating System.

2.4.2 Physical Media Support

The ABUS Viewer supports a single network interface. One of the following physical network interfaces will be available:

Supported Physical Network Interface

Ethernet 1000baseT
Ethernet 100baseT

The Invenia ABUS only supports IPv4 connections.

2.5 EXTENSIONS / SPECIALIZATIONS/ PRIVATIZATIONS

2.5.1 Standard Extended / Specialized / Private SOP Classes

Specialized or private SOP classes are not supported.

2.5.1.1 Extended Ultrasound Multi-frame Image Storage SOP Class

The Ultrasound Multi-frame Image Storage SOP Class is extended to create a Standard Extended SOP Class by addition of private attributes to the created SOP Instances as documented in section 3.

The Ultrasound Multi-frame Image Storage SOP Class is extended to create non-Standard Extended SOP Class by addition of private Image types,

attributes to the created SOP Instances as documented in section 3.

2.5.1.2 Extended Grayscale Softcopy Presentation State Storage SOP Class

The Grayscale Softcopy Presentation State Storage SOP Class is extended to create a Standard Extended SOP Class by addition of private attributes to the created SOP Instances as documented in section 4.

2.5.2 Private Transfer Syntaxes

No Private Transfer Syntax is supported.

2.6 CONFIGURATION

There are many DICOM and networking parameters that can be changed on the Invenia ABUS. The user can change many of these settings but there are some that can only be changed by a GE authorized service representative.

2.6.1 AE Title/Presentation Address Mapping

2.6.2 Configurable Parameters

The following fields are configurable for this AE (local):

- Local AE Title
- Local IP Address

- Local Listening Port Number and its values are not configurable.

The following fields are configurable for every remote DICOM AE:

- Remote AE Title
- Remote IP Address
- Listening TCP/IP Port Number

NOTE **:** All configurations must be performed by a GE Field Engineer

2.7 SUPPORT OF CHARACTER SETS

The Invenia ABUS supports the encoding of the following Character Sets:

- ISO_IR 100
- ISO_IR 192

The system may be configured to encode using either supported character set.

Parameter	User Configurable (Yes/No)	Service Configurable (Yes/No)	Default Value
General Parameters			
Supported Transfer Syntaxes	No	No	Explicit VR Little Endian Explicit VT Big Endian Implicit VR Little Endian
Maximum PDU receive size	No	No	16kB
Maximum PDU send size	No	No	16kB (smaller sizes are negotiated per association)
Timeout waiting for acceptance or rejection response to an Association Open Request	No	No	20s
General DIMSE level time-out values	No	No	Infinite
Modality Worklist Parameters			
Maximum number of Worklist Items	No	No	10000
Query Worklist for specific Modality Value	Yes	Yes	“US”
Query Worklist for specific Scheduled Station AE Title	Yes	Yes	“ABUSApp”
Query Worklist for Scheduled Procedure Step Start Date	Yes	Yes	Current Week

2.8 SECURITY PROFILES

The Invenia ABUS does not support any specific security measures. It is assumed that the Invenia ABUS is used within a secured environment that includes at a minimum:

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

Additional security features may be established by the local security policy and are beyond the scope of this conformance statement.

3. US MULTI-FRAME INFORMATION OBJECT IMPLEMENTATION

3.1 INTRODUCTION

This section specifies the use of the DICOM US Image IOD to represent the information included in US Images produced by this implementation. Corresponding attributes are conveyed using the module construct.

3.2 INVENIA ABUS MAPPING OF DICOM ENTITIES

The Invenia ABUS maps DICOM Information Entities to local Information Entities in the product's database and user interface.

TABLE 3-1
MAPPING OF DICOM ENTITIES TO INVENIA ABUS ENTITIES

DICOM IE	Invenia ABUS Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image

3.3 IOD MODULE TABLE

The Ultrasound Image Information Object Definition comprises the modules of the following table, plus Standard Extended and Private attributes. Standard Extended and Private attributes are described in Section 3.5.

TABLE 3-2
US IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Used	3.4.1.1
	Clinical Trial Subject	Absent	NA
Study	General Study	Used	3.4.2.1
	Patient Study	Used	NA
	Clinical Trial Study	Absent	NA
Series	General Series	Used	3.4.3.1
	Clinical Trial Series	Absent	NA

Frame of Reference	Frame of Reference	Used	3.4.4.1
	Synchronization	Absent	NA
Equipment	General Equipment	Used	3.4.5.1
Image	General Image	Used	3.4.6.1
	Image Pixel	Used	3.4.6.2
	Contrast/Bolus	Absent	NA
	Cine	Not Used	NA
	Multi-frame	Used	3.4.6.3
	Frame Pointers	Absent	NA
	Palette Color Lookup Table	Absent	NA
	Device	Absent	NA
	US Region Calibration	Absent	NA
	US Image	Used	3.4.6.4
	Overlay Plane	Absent	NA
	VOI LUT	Used	3.4.6.5
	SOP Common	Used	3.4.6.6

3.4 INFORMATION MODULE DEFINITIONS

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

3.4.1 Patient Entity Modules

3.4.1.1 Patient Module

TABLE 3-3
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	From MWL or entered from user interface, Otherwise, sent empty
Patient ID	(0010,0020)	2	From MWL or entered from user interface, otherwise sent empty
Patient's Birth Date	(0010,0030)	2	From MWL or entered from user interface, Otherwise, sent empty
Patient's Sex	(0010,0040)	2	From MWL or Set to "F"
Other Patient IDs	(0010,1000)	3	ID generated by the Invenia ABUS, only
Patient Comments	(0010,4000)	3	sent empty

3.4.2 Study Entity Modules

3.4.2.1 General Study Module

TABLE 3-4
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	From MWL or system generated
Study Date	(0008,0020)	2	Set to current date when study is started
Study Time	(0008,0030)	2	Set to current time when study is started
Referring Physician's Name	(0008,0090)	2	From MWL or entered from user interface, Otherwise, sent empty
Study ID	(0020,0010)	2	From MWL, using information in Requested Procedure ID (0040, 1001), otherwise system generated
Accession Number	(0008,0050)	2	From MWL, Otherwise, sent empty
Study Description	(0008,1030)	3	From MWL, using Requested Procedure Description (0032,1060) Otherwise, sent empty

3.4.3 Series Entity Modules

3.4.3.1 General Series Module

TABLE 3-5
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	"US"
Series Instance UID	(0020,000E)	1	System generated. User may select unique for each series or unique for each view in study
Series Number	(0020,0011)	2	System generated.

Series Date	(0008,0021)	3	Current date when series is created
Series Time	(0008,0031)	3	Current time when series is created
Series Description	(0008,103E)	3	See section 3.4.3.1.1
Operators' Name	(0008,1070)	3	See section 3.4.3.1.2
Body Part Examined	(0018,0015)	3	“BREAST”

3.4.3.1.1 Series Description

Series Description is configurable to append the content of view Name(0008,2127) as the value.

The content is appended with “Coronal View Series” when image type(0008,0008) value 5 is “Curved_Plane,

The content is appended with “Curved Transverse View Series” when image type(0008,0008) value 4 is “0400”.

3.4.3.1.2 Operator’s Name

Operator’s name is set to the user’s Login account name.

WARNING: No component delimiter (Caret) is included.

3.4.4 Frame Of Reference Entity Modules

3.4.4.1 Frame Of Reference Module

Images sharing the same Frame of Reference UID are created using common scanned acquisition data and are spatially related.

TABLE 3-6
FRAME OF REFERENCE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	See 3.4.4.1.1 for further explanation.
Position Reference Indicator	(0020,1040)	2	sent empty, not used

3.4.4.1.1 Frame Of Reference UID

The Frame of Reference UID may be used to spatially relate images with common scanned acquisition data. Common Images utilizing the same Frame of Reference UID, have the a common View Name (0008,2127). Image type(0008,0008) may specify images which include pixel data in a proprietary coordinate system. The relationship between images with the proprietary coordinate system is not specified in this document. Images with the standard Cartesian Coordinate System and be spatially related based standard DICOM attributes.

3.4.5 Equipment Entity Modules

3.4.5.1 General Equipment Module

TABLE 3-7
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	"GE Healthcare"
Institution Name	(0008,0080)	3	Entered from user interface, Otherwise Empty
Station Name	(0008,1010)	3	Entered from user interface Otherwise Empty
Manufacturer's Model Name	(0008,1090)	3	"Invenia ABUS 2.0"
Software Version(s)	(0018,1020)	3	Invenia ABUS software version

3.4.6 Image Entity Modules

3.4.6.1 General Image Module

TABLE 3-8
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	Image number in series, 1 through n
Content Date	(0008,0023)	2C	Date when image acquired
Patient Orientation	(0020,0020)	2C	See section 3.4.6.1.1
Content Time	(0008,0033)	2C	Time when image was acquired
Image Type	(0008,0008)	3	See section 3.4.6.1.2
Derivation Description	(0008,2111)	3	See section 3.5.1.1.1
Derivation Code Sequence	(0008,9215)	3	See section 3.5.1.1.2
> Code Value	(0008,0100)	1C	See section 3.5.1.1.2
> Coding Scheme Designator	(0008,0102)	1C	See section 3.5.1.1.2
> Code Meaning	(0008,0104)	1	See section 3.5.1.1.2
Image Icon Sequence	(00888,0200)	3	
>Samples per Pixel	(0028,0002)	1	1
>Photometric Interpretation	(0028,0004)	1	MONOCHROME2
>Rows	(0028,0010)	1	300
>Columns	(0028,0011)	1	300
>Bits Allocated	(0028,0100)	1	8
>Bits Stored	(0028,0101)	1	8
>High Bit	(0028,0102)	1	7
>Pixel Representation	(0028,0103)	1	0
> Pixel Data	(7FE0,0010)	1	Generated Icon Pixel data

3.4.6.1.1 Patient Orientation

Patient Orientation has a VR of 2. Values may include the capital letters:

- A (anterior)

- P (posterior)
- L(left)
- R (right)

3.4.6.1.2 Image Type

For Value 1, only "ORIGINAL" is supported.

For Value 2, only "PRIMARY" is supported.

For value 3, only "BREAST" is supported.

For Value 4, the bit maps supported are,

- 0000 – GE Proprietary Spatial Coordinate Systems
- 0400 – Spatially Related Frames

Value 5 is a modifier for when value 4=0000 (GE Proprietary Spatial Coordinate System)

- FLAT_TRANSVERSE
- CURVED_PLANE

The GE proprietary spatial coordinate system is not defined in the DICOM standard. Images are intended for processing/display by compatible devices, such as the Invenia Review Software.

3.4.6.1.3 Derivation Description

When Lossless JPEG compression is applied to the Pixel Data, the system automatically populates this field with the compression type, selection value, point transform, and resulting compression ratio. The image type is "ORIGINAL" and not "DERIVED". The automatic generation of this content is retained. Otherwise, this attribute is not used when the image type is "ORIGINAL".

3.4.6.1.4 Derivation Code Sequence

When Lossless JPEG compression is applied to the Pixel Data, the system automatically populates this sequence with

- Code Value: 121327
- Coding Scheme Designator: DCM
- Code Meaning: Full Fidelity Image

The image type is "ORIGINAL" and not "DERIVED". The automatic generation of this content is retained. Otherwise, this attribute is not used when the image type is "ORIGINAL".

3.4.6.2 Image Pixel Module

TABLE 3-8
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description

Samples per Pixel	(0028,0002)	1	1
Photometric Interpretation	(0028,0004)	1	MONOCHROME2
Rows	(0028,0010)	1	Image dependent
Columns	(0028,0011)	1	Image dependent
Bits Allocated	(0028,0100)	1	8
Bits Stored	(0028,0101)	1	8
High Bit	(0028,0102)	1	7
Pixel Representation	(0028,0103)	1	0
Pixel Data	(7FE0,0010)	1	Generated pixel data

3.4.6.3 Multi-frame Module Attributes

TABLE 3-9
MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Image dependent
Frame Increment Pointer	(0028,0009)	1	Spacing Between Slices (0018,0088)

3.4.6.4 US Image Module

TABLE 3-10
US IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Use
Samples Per Pixel	(0028,0002)	1	1
Photometric Interpretation	(0028,0004)	1	MONOCHROME2
Bits Allocated	(0028,0100)	1	8
Bits Stored	(0028,0101)	1	8
High Bit	(0028,0102)	1	7
Pixel Representation	(0028,0103)	1	0
Frame Increment Pointer	(0028,0009)	1	Spacing Between Slices (0018,0088)
Image Type	(0008,0008)	2	See section 3.4.6.2.1
View Name	(0008,2127)	3	See section 3.4.6.4.1
Transducer Data	(0018,5010)	3	Transducer specific
Mechanical Index	(0018,5022)	3	Transducer Specific
Soft Tissue Thermal Index	(0018,5027)	3	Transducer Specific

3.4.6.4.1 View Name

View Name is set by the acquisition protocol selected by the user. The value may be one of the following:

View Type	Description	View Type	Description
RAP	Right Anterior Posterior	LAP	Left Anterior Posterior

RAX	Right Axilla	LAX	Left Axilla
RLAT	Right Lateral	LLAT	Left Lateral
RMED	Right Medial	LMED	Left Medial
RINF	Right Inferior	LINF	Left Inferior
RSUP	Right Superior	RSUP	Right Superior
RUOQ	Right Upper Outer Quadrant	LUOQ	Left Upper Outer Quadrant
RUIQ	Right Upper Inner Quadrant	LUIQ	Left Upper Inner Quadrant
RLOQ	Right Lower Outer Quadrant	LLOQ	Left Lower Outer Quadrant

3.4.6.5 VOI LUT

TABLE 3-11
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	1C	Sequence Not created
>LUT Descriptor	(0028,3002)	1	
>LUT Explanation	(0028,3003)	3	
>LUT Data	(0028,3006)	1	
Window Center	(0028,1050)	1C	Protocol defined preset value.
Window Width	(0028,1051)	1C	Protocol defined preset value.
Window Center & Width Explanation	(0028,1055)	3	Not used.

3.4.6.6 SOP Common Module

TABLE 3-12
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	SOP Class of Instance created
SOP Instance UID	(0008,0018)	1	System generated
Specific Character Set	(0008,0005)	1C	ISO_IR 100
Instance Creation Date	(0008,0012)	3	Date Instance Created
Instance Creation Time	(0008,0013)	3	Time Instance Created
Instance Number	(0020,0013)	3	System generated Instance Number

3.5 STANDARD EXTENDED AND PRIVATE DATA ATTRIBUTES

3.5.1 Standard Attributes

The Product supports the following attributes, not specified in the US Multi-Frame IOD, in SOP Instances as Type 3 data elements.

TABLE 3-13
STANDARD EXTENDED ATTRIBUTES

Information Entity Name	Attribute Name	Tag	Use
Image	Pixel Spacing	(0028,0030)	adjacent row spacing and adjacent column spacing in mm
	Spacing Between Slices	(0018, 0088)	Spacing between two slices in mm
	Slice Thickness	(0018,0050)	Thickness between two slices in mm
	Transducer Frequency	(0018,6030)	Transducer Dependent
	Image Position (Patient)	(0020,0032)	Image position for acquisition
	Image Orientation(Patient)	(0020,0037)	Image orientation for acquisition
	Image Laterality	(0020,0062)	L or R (BREAST)
	Derivation Description	(0008,2111)	See section 3.5.1.1.1
	Derivation Code Sequence	(0008,9215)	See section 3.5.1.1.2
	> Code Value	(0008,0100)	See section 3.5.1.1.2
	> Coding Scheme Designator	(0008,0102)	See section 3.5.1.1.2
	> Code Meaning	(0008,0104)	See section 3.5.1.1.2

3.5.1.1.1 Derivation Description

When Lossless JPEG compression is applied to the Pixel Data, the system automatically populates this field with the compression type, selection value, point transform, and resulting compression ratio. The image type is “ORIGINAL” and not “DERIVED”. The automatic generation of this content is retained. Otherwise, this attribute is not used when the image type is “ORIGINAL”.

3.5.1.1.2 Derivation Code Sequence

When Lossless JPEG compression is applied to the Pixel Data, the system automatically populates this sequence with

- Code Value: 121327
- Coding Scheme Designator: DCM
- Code Meaning: Full Fidelity Image

The image type is “ORIGINAL” and not “DERIVED”. The automatic generation of this content is retained. Otherwise, this attribute is not used when the image type is “ORIGINAL”.

3.5.2 Private Group: General Electric Company

Private Group, “General Electric Company” is modeled as part of the Image Information Entity.

TABLE 3-14
PRIVATE GROUP: GENERAL ELECTRIC COMPANY

Attribute Name	Tag	VR	VM	Attribute Description and Use
Private Creator Identification	(0021,0010)	LO	1	General Electric Company 01
Nipple Position	(0021,1020)	DS	3	X/Y/Z pixel coordinates of the Nipple Marker Position
First Element Position	(0021,1021)	SH	1	Side of the image that the first element is on (L (left) or R (right))
Curvature Radius (Probe)	(0021,1040)	DS	1	Radius of curvature of the ABUS transducer in mm
Curvature Radius (Track)	(0021,1041)	DS	1	Radius of curvature of the track that probe movement follows in mm
Region Arc Angle	(0021,1050)	DS	1	Used by the renderer of Image Type(0008,0008) ORIGINAL/PRIMARY/BREAST/0000/FLAT_TRANSVERSE
Region Arc Angle	(0021,1051)	DS	1	Used by the renderer of Image Type(0008,0008) ORIGINAL/PRIMARY/BREAST/0000/FLAT_TRANSVERSE
Region Inner Radius	(0021,1052)	DS	1	Used by the renderer of Image Type(0008,0008) ORIGINAL/PRIMARY/BREAST/0000/FLAT_TRANSVERSE
Region Offset Orientation	(0021,1053)	DS	1	Used by the renderer of Image Type(0008,0008) ORIGINAL/PRIMARY/BREAST/0000/FLAT_TRANSVERSE
Region Offset X	(0021,1054)	DS	1	Used by the renderer of Image Type(0008,0008) ORIGINAL/PRIMARY/BREAST/0000/FLAT_TRANSVERSE
Region Offset Y	(0021,1055)	DS	1	Used by the renderer of Image Type(0008,0008) ORIGINAL/PRIMARY/BREAST/0000/FLAT_TRANSVERSE
Region Outer Width	(0021,1056)	DS	1	Used by the renderer of Image Type(0008,0008) ORIGINAL/PRIMARY/BREAST/0000/FLAT_TRANSVERSE
Region Width	(0021,1057)	DS	1	Width of the volume
Region Height	(0021,1058)	DS	1	Height of the volume
Region Depth	(0021,1059)	DS	1	Depth of the volume
Steering Angle	(0021,1060)	DS	1	Ultrasound beam steering angle in degrees
Max Cut	(0021,1061)	DS	1	Number of padding elements represented in normalized length
Line Density	(0021,1062)	DS	1	Number of ultrasound scan lines per transducer element

Attribute Name	Tag	VR	VM	Attribute Description and Use
Scan Depth	(0021,1063)	DS	1	Depth of scan in cm
ABUSApp Build Number	(0021,1064)	SH	1	Software build number
Elevation Scanned Ratio	(0021, 1065)	DS	1	Ratio between the distance scanned to the full scan plane distance.
Compression Level	(0021,1090)	SH	1	Level of mechanical compression on the breast during an ABUS scan (F, L, M, H)
Ball joint lock status while scanning	(0021,1091)	SH	1	Whether the ball joint was locked while scanning
TEA	(0021,10A0)	SH	1	Tissue equalization algorithm (True or False)
SRI	(0021,10A2)	LO	1	Version of the speckle reduction imaging, if any (Null, Speckle 1, or Speckle 2)
Nipple Marker Update Allowed	(0021,10C0)	SH	1	Nipple marker update is not allowed for a volume scanned with In-progress send option.

3.5.3 Private Group General Electric Company 01

Private Group General Electric Company 01 is modeled as part of the Image Information Entity.

TABLE 3-15
PRIVATE GROUP GENERAL ELECTRIC COMPANY 01

Attribute Name	Tag	VR	VM	Attribute Description and Use
Private Creator Identification	(0021,0011)	LO	1	General Electric Company 02
Breast Border Geometry	(0021,1100)	OB	1	Breast Border Geometry in GE Proprietary Data format.
Chest Wall Geometry	(0021,1110)	OB	1	Chest Wall Geometry in GE Proprietary Data format.
Rib Geometry	(0021,1120)	OB	1	Rib Geometry in GE Proprietary Scan Data.
Histogram Peak Value	(0021,1130)	FD	1	Histogram Peak Value
Histogram Lower Range	(0021,1132)	FD	1	Histogram Lower Range
Histogram Upper Range	(0021,1133)	FD	1	Histogram Upper Range
Histogram Average SD	(0021,1134)	FD	1	Histogram Average SD

4. GRAYSCALE SOFTCOPY PRESENTATION STATE INFORMATION OBJECT IMPLEMENTATION

4.1 INTRODUCTION

This section specifies the use of the DICOM Grayscale Softcopy Presentation State (GSPS) IOD to represent the information included in GSPSs produced by this implementation. Corresponding attributes are conveyed using the module construct.

4.2 INVENIA ABUS MAPPING OF DICOM ENTITIES

The Invenia ABUS maps DICOM Information Entities to local Information Entities in the product's database and user interface.

TABLE 4-1
MAPPING OF DICOM ENTITIES TO INVENIA ABUS ENTITIES

DICOM IE	Invenia ABUS Entity
Patient	Patient
Study	Exam
Series	Series
Presentation State	Presentation State

4.3 IOD MODULE TABLE

The Grayscale Softcopy Presentation State Information Object Definition comprises the modules of the following table.

TABLE 4-2
GSPS IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Used	3.4.1.1
	Clinical Trial Subject	Absent	NA
Study	General Study	Used	3.4.2.1
	Patient Study	Used	NA
	Clinical Trial Study	Absent	NA
Series	General Series	Used	3.4.3.1
	Presentation Series	Used	3.7.5.1
Equipment	General Equipment	Used	3.4.5.1

Presentation State	Presentation State Identification	Used	4.6.1
	Presentation State Relationship	Used	4.6.2
	Presentation State Shutter	Not Used	NA
	Presentation State Mask	Not Used	NA
	Mask	Not Used	NA
	Display Shutter	Not Used	NA
	Bitmap Display Shutter	Not Used	NA
	Overlay Plane	Not Used	NA
	Overlay Activation	Not Used	NA
	Displayed Area	Used	4.6.3
	Graphic Annotation	Not Used	NA
	Spatial Transformation	Not Used	NA
	Graphic Layer	Not Used	NA
	Modality LUT	Not Used	NA
	Softcopy VOI LUT	Used	4.6.4
	Softcopy Presentation LUT	Used	4.6.5
	SOP Common	Used	3.4.6.6

4.4 INFORMATION MODULE DEFINITIONS

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

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes <supported> <and/or> <expected>. Type 1 & Type 2 Attributes are also included for completeness and to define <what values they may take and where these values are obtained from when generating the instance> <as well as> <what are the expected values when loading such instance>. It should be noted that they are the same ones as defined in the DICOM Standard Part 3 (Information Object Definitions). Also note that Attributes not present in tables are not supported.

4.5 SERIES ENTITY MODULES

4.5.1 Presentation Series Module

TABLE 4-3
PRESENTATION SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Use
Modality	(0008,0060)	1	Value = PR

4.6 PRESENTATION STATE ENTITY MODULES

4.6.1 Presentation State Identification Module

TABLE 4-4
PRESENTATION STATE IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Use
Presentation Creation Date	(0070,0082)	1	Date Presentation State created
Presentation Creation Time	(0070,0083)	1	Time Presentation State created
Instance Number	(0020,0013)	1	Generated by application
Content Label	(0070,0080)	1	ABUS_IMAGE_MASK
Content Description	(0070,0081)	2	See section 4.6.1.1
Content Creator's Name	(0070,0084)	2	Login User Name

4.6.1.1 Content Description

Identifies the ABUS Image Mask applied. Content s may include as an appended character string:

- BreastBorder
- ChestWall
- RibGeometry

4.6.2 Presentation State Relationship Module

TABLE 4-5
PRESENTATION STATE RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Type	Use
Referenced Series Sequence	(0008,1115)	1	
>Series Instance UID	(0020,000E)	1	Series referenced by presentation state
>Referenced Image Sequence	(0008,1140)	1	
>>Referenced SOP Class UID	(0008,1150)	1	SOP Class referenced by presentation state
>>Referenced SOP Instance UID	(0008,1155)	1	SOP Instance referenced by presentation state
>>Referenced Frame Number	(0008,1160)	1C	Frames referenced by presentation state
>>Referenced Segment Number	(0062,000B)	1C	Not Used

4.6.3 Displayed Area Module

TABLE 4-6
DISPLAYED AREA MODULE ATTRIBUTES

Attribute Name	Tag	Type	Use
Displayed Area Selection Sequence	(0070,005A)	1	
>Referenced Image Sequence	(0008,1140)	1C	Used
>>Referenced SOP Class UID	(0008,1150)	1	Referenced SOP Class
>>Referenced SOP Instance UID	(0008,1155)	1	Referenced SOP Instance
>>Referenced Frame Number	(0008,1160)	1C	Not Used.
>>Referenced Segment Number	(0062,000B)	1C	Not Used.
>Displayed Area Top Left Hand Corner	(0070,0052)	1	1\1
>Displayed Area Bottom Right Hand Corner	(0070,0053)	1	Full image
>Presentation Size Mode	(0070,0100)	1	SCALE TO FIT
>Presentation Pixel Spacing	(0070,0101)	1C	Used. pixel spacing for image
>Presentation Pixel Aspect Ratio	(0070,0102)	1C	Not Used.
>Presentation Pixel Magnification Ratio	(0070,0103)	1C	Not Used.

4.6.4 Softcopy VOI LUT Module

<If no attributes from this module are used, state it in the IOD Modules Table and delete this Section. If present, describe the conditions under which this module is present in this implementation>

TABLE 4-7
SOFTCOPY VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Use
Softcopy VOI LUT Sequence	(0028,3110)	1	
>Referenced Image Sequence	(0008,1140)	1C	Used
>>Referenced SOP Class UID	(0008,1150)	1C	Referenced SOP Classs
>>Referenced SOP Instance UID	(0008,1155)	1C	Refereenced SOP Instance
>>Referenced Frame Number	(0008,1160)	1C	Not Used.
>>Referenced Segment Number	(0062,000B)	1C	Not Used.
>VOI LUT Sequence	(0028,3010)	1C	Not Used.
>Window Center	(0028,1050)	1C	Set from standard protocol defined preset values.
>Window Width	(0028,1051)	1C	Set from standard protocol defined preset values.
>Window Center & Width Explanation	(0028,1055)	3	Not Used.
>VOI LUT Function	(0028,1056)	3	Not Used.

4.6.5 Softcopy Presentation LUT Module

TABLE 4-8
SOFTCOPY PRESENTATION LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Use
Presentation LUT Sequence	(2050,0010)	1C	Not Used.
Presentation LUT Shape	(2050,0020)	1C	IDENTITY

4.7 PRIVATE DATA ATTRIBUTES

Private Group General Electric Company is a proprietary Information Entity. See section 3.5.2 for the description of this group.

5. MODALITY WORKLIST QUERY IMPLEMENTATION

5.1 INTRODUCTION

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

5.2 INVENIA ABUS MAPPING OF DICOM ENTITIES

The Invenia ABUS maps DICOM Information Entities to local Information Entities in the product's database and user interface.

TABLE 5-1
MAPPING OF DICOM ENTITIES TO INVENIA ABUS ENTITIES

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

5.3 WORKLIST QUERY MODULE TABLE

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

TABLE 5-2
MODALITY WORKLIST INFORMATION MODEL MODULES

Entity Name	Module Name	Reference
Scheduled Procedure Step	SOP Common	5.4.1.1
	Scheduled Procedure Step	5.4.1.2
Requested Procedure	Requested Procedure	5.4.2.1
Imaging Service Request	Imaging Service Request	5.4.3.1
Visit	Visit Identification	5.4.4.1
	Visit Status	5.4.4.2
	Visit Relationship	5.4.4.3
	Visit Admission	5.4.4.4
Patient	Patient Relationship	5.4.5.1
	Patient Identification	5.4.5.2
	Patient Demographic	5.4.5.3
	Patient Medical	5.4.5.4

5.4 WORKLIST QUERY MODULE DEFINITIONS

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) for a description of each of the query key attributes contained within the Modality Worklist Information Model.

5.4.1 Common Scheduled Procedure Step Entity Modules

5.4.1.1 SOP Common Module

TABLE 5-3
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Specific Character Set	(0008,0005)	O	1C	No/ No	Requested/Not Used
HL7 Structured Document Reference Sequence	(0040,A390)	O	1C	No/ No	Requested/Not Used

5.4.1.2 Scheduled Procedure Step Module

TABLE 5-4
SCHEDULED PROCEDURE STEP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Scheduled Procedure Step Sequence	(0040,0100)	R	1	No/No	

>Scheduled Station AE Title	(0040,0001)	R	1	No/No	Not Requested
>Scheduled Procedure Step Start Date	(0040,0002)	R	1 *	No/No	Range Matching for Today, This Week, This Month See section 2.3.1.2.2.3
>Scheduled Procedure Step Start Time	(0040,0003)	R	1 *	No/No	Displayed in Worklist
>Scheduled Procedure Step End Date	(0040,0004)	O	3	No/No	Requested/Not Used
>Scheduled Procedure Step End Time	(0040,0005)	O	3	No/No	Requested/Not Used
>Modality	(0008,0060)	R	1 *	No/No	Single Value Matching supported for US and ABUS(Proprietary value)
>Scheduled Performing Physician's Name	(0040,0006)	R	2	No/ No	Not Requested
>Scheduled Procedure Step Description	(0040,0007)	O	1C *	No/ No	Optional to Display in Worklist Procedure. Procedure Column Display is User Optional.
>Scheduled Station Name	(0040,0010)	O	2	No/No	Not Requested
>Scheduled Procedure Step Location	(0040,0011)	O	2	No/No	Not Requested
>Scheduled Protocol Code Sequence	(0040,0008)	O	1C	No/ Yes	
>>Code Value	(0008,0100)	O	1*	No/Yes	Optional to Display in Worklist Procedure. Column is Optional for user to Display.
>>Coding Scheme Designator	(0008,0102)	O	1	No/Yes	Requested, Not used
>>Coding Scheme Version	(0008,0103)	O	3	No/Yes	Requested, Not used
>>Code Meaning	(0008,0104)	O	3 *	No/Yes	Optional to Display in Worklist Procedure. Column is Optional for user to Display.
>Pre-Medication	(0040,0012)	O	2C	No/No	
>Scheduled Procedure Step ID	(0040,0009)	O	1 *	No/Yes	Optional to Display in Worklist Procedure Column. Column is Optional for user to Display.
>Requested Contrast Agent	(0032,1070)	O	2C	No/ No	Not Requested
>Scheduled Procedure Step Status	(0040,0020)	O	3	No/ No	Not Requested

>Comments on the Scheduled Procedure Step	(0040,0400)	O	3	No/No	Not Requested

Note: * in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

5.4.2 Common Requested Procedure Entity Modules

5.4.2.1 Requested Procedure Module

TABLE 5-5
REQUESTED PROCEDURE MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Requested Procedure ID	(0040,1001)	O	1 *	Yes /Yes	Mapped to Study ID in Instance. Displayed as Study ID in Worklist Study ID Column is Optional for user to Display.
Requested Procedure Description	(0032,1060)	O	1C *	Yes /Yes	Optional to Display in Worklist Procedure. Procedure Column is Optional for user to Display.
Requested Procedure Code Sequence	(0032,1064)	O	1C		
>Code Value	(0008,0100)	O	1	No/ No	Requested, not Used.
>Coding Scheme Designator	(0008,0102)	O	1	No/ No	Requested, not Used.
>Coding Scheme Version	(0008,0103)	O	3	No/ No	Requested, not Used.
>Code Meaning	(0008,0104)	O	3 *	No/ No	Optional to Display in Worklist Procedure. Procedure Column is Optional for user to Display.
Study Instance UID	(0020,000D)	O	1	Yes /Yes	
Study Date	(0008,0020)	O	3	No/No	Not requested.
Study Time	(0008,0030)	O	3	No/No	Not requested.
Referenced Study Sequence	(0008,1110)	O	2	No/No	Not requested
>Referenced SOP Class UID	(0008,1150)	O	1C	No/No	Not requested
>Referenced SOP Instance UID	(0008,1155)	O	1C	No/No	Not requested
Requested Procedure Priority	(0040,1003)	O	2	No/No	Not requested
Patient Transport Arrangements	(0040,1004)	O	2	No/No	Not requested
Requested Procedure Location	(0040,1005)	O	3	No/No	Requested. Not Used.
Confidentiality Code	(0040,1008)	O	3	No/No	Not requested

Reporting Priority	(0040,1009)	O	3	No/No	Not requested
Names of Intended Recipients of Results	(0040,1010)	O	3	No/No	Not requested
Reason for the Requested Procedure	(0040,1002)	O	3	No/No	Not requested
Requested Procedure Comments	(0040,1400)	O	3	No/No	Not requested

Note: * in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

5.4.3 Common Imaging Service Request Entity Modules

5.4.3.1 Imaging Service Request Module

TABLE 5-6
IMAGING SERVICE REQUEST MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Accession Number	(0008,0050)	O	2 *	Yes / Yes	Accession Number Column is Optional for user to Display.
Requesting Physician	(0032,1032)	O	2	No/No	Requested. Not Used.
Referring Physician's Name	(0008,0090)	O	2 *	Yes / No	Referring Physician Column is Optional for user to Display.
Requesting Service	(0032,1033)	O	3	No/No	Not Requested
Reason for the Imaging Service Request	(0040,2001)	O	3	No/No	Not Requested
Imaging Service Request Comments	(0040,2400)	O	3	No/No	Not Requested
Issue Date of Imaging Service Request	(0040,2004)	O	3	No/No	Not Requested
Issue Time of Imaging Service Request	(0040,2005)	O	3	No/No	Not Requested
Placer Order Number / Imaging Service Request	(0040,2016)	O	3	No/No	Not Requested
Filler Order Number / Imaging Service Request	(0040,2017)	O	3	No/No	Not Requested
Order entered by ...	(0040,2008)	O	3	No/No	Not Requested
Order Enterer's Location	(0040,2009)	O	3	No/No	Not Requested
Order Callback Phone Number	(0040,2010)	O	3	No/No	Not Requested
Issuer of Admission ID (Retired)	(0038,0011)	O	e	No/No	Requested. Not Used.

Note: * in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

5.4.4 Common visit Entity Modules

5.4.4.1 Visit Identification

TABLE 5-7
VISIT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Admission ID	(0038,0010)	O	2	No/Yes	
Institution Name	(0008.0080)	O	3	No/ No	Requested/Not used
Institution Address	(0008,0081)	O	3	No/ No	Not requested
Institution Code Sequence	(0008,0082)	O	3	No/ No	Not requested
Issuer of Admission ID Sequence	(0038,0014)	O	3	No/ No	Requested/Not used
Issuer of Service Episode ID Sequence	(0038,0064)	O	3	No/ No	Requested/Not used

5.4.4.2 Visit Status

TABLE 5-8
VISIT STATUS MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Current Patient Location	(0038,0300)	O	2	No/No	Requested/Not used
Visit Status ID	(0038,0008)	O	3	No/No	Not requested
Patient's Institution Residence	(0038,0400)	O	3	No/No	Not requested
Visit Comments	(0038,4000)	O	3	No/No	Not requested

5.4.4.3 Visit Relationship

TABLE 5-9
VISIT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Referenced Patient Sequence	(0008,1120)	O	2	No/No	Not requested
>Referenced SOP Class UID	(0008,1150)	O	1C	No/No	Not requested

>Referenced SOP Instance UID	(0008,1155)	O	1C	No/No	Not requested

5.4.4.4 Visit Admission

TABLE 5-10
VISIT ADMISSION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Referring Physician's Address	(0008,0092)	O	3*	Yes /No	
Referring Physician's Phone Numbers	(0008,0094)	O	3	No/ No	Not Requested
Admitting Diagnoses Description	(0008,1080)	O	3	No/ No	Not Requested
Admitting Diagnoses Code Sequence	(0008,1084)	O	3	No/ No	Not Requested
Route of Admissions	(0038,0016)	O	3	No/ No	Not Requested
Admitting Date	(0038,0020)	O	3	No/ No	Requested, Not Used
Admitting Time	(0038,0021)	O	3	No/ No	Requested, Not Used

Note: * in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

5.4.5 Common Patient Entity Modules

5.4.5.1 Patient Relationship

TABLE 5-11
PATIENT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Referenced Visit Sequence	(0008,1125)	O	3	No/No	Not Requested
>Referenced SOP Class UID	(0008,1150)	O	3	No/No	Not Requested
>Referenced SOP Instance UID	(0008,1155)	O	3	No/No	Not Requested
Referenced Patient Alias Sequence	(0038,0004)	O	3	No/No	Not Requested
>Referenced SOP Class UID	(0008,1150)	O	3	No/No	Not Requested
>Referenced SOP Instance UID	(0008,1155)	O	3	No/No	Not Requested

5.4.5.2 Patient Identification

TABLE 5-12
PATIENT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Patient's Name	(0010,0010)	R	1*	Yes/Yes	
Patient ID	(0010,0020)	R	1*	Yes/Yes	
Issuer of Patient ID	(0010,0021)	O	3	No/No	Requested, not used
Other Patient IDs	(0010,1000)	O	3	No/ No	Requested, not used
Other Patient Names	(0010,1001)	O	3	No/ No	Not requested
Patient's Birth Name	(0010,1005)	O	3	No/ No	Not requested
Patient's Mother's Birth Name	(0010,1060)	O	3	No/ No	Not requested
Medical Record Locator	(0010,1090)	O	3	No/ No	Not requested

Note: * in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

5.4.5.3 Patient Demographic

TABLE 5-13
PATIENT DEMOGRAPHIC MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Patients Birth Date	(0010,0030)	O	2 *	Yes /Yes	
Patient's Sex	(0010,0040)	O	2	Yes /Yes	
Patient's Weight	(0010,1030)	O	2	No/No	Requested, not used
Confidentiality constraint on patient data	(0040,3001)	O	2	No/No	Requested, not used
Patient's Size	(0010,1020)	O	3	No/No	Requested, not used
Patient's Address	(0010,1040)	O	3	No/No	Not requested
Patient's Telephone Numbers	(0010,2154)	O	3	No/No	Not requested
Patient's Age	(0010,1010)	O	3	No/No	Not requested
Occupation	(0010,2180)	O	3	No/No	Not requested
Patient's Birth Time	(0010,0032)	O	3	No/No	Not requested
Patient's Insurance Plan Code Sequence	(0010,0050)	O	3	No/No	Not requested
> 'Code Sequence Macro'					
Patient's Primary Language Code Sequence	(0010,0101)	O	3	No/No	Not requested

> 'Code Sequence Macro'					
> Patient's Primary Language Code Modifier Sequence	(0010,0102)	O	3	No/No	Not requested
>> 'Code Sequence Macro'					
Military Rank	(0010,1080)	O	3	No/No	Not requested
Branch of Service	(0010,1081)	O	3	No/No	Not requested
Country of Residence	(0010,2150)	O	3	No/No	Not requested
Region of Residence	(0010,2152)	O	3	No/No	Not requested
Patient's Telephone Numbers	(0010,2154)	O	3	No/No	Not requested
Ethnic Group	(0010,2160)	O	3	No/No	Not requested
Patient's Religious Preference	(0010,21F0)	O	3	No/No	Not requested
Patient Comments	(0010,4000)	O	3	No/No	Not requested

Note: * in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

5.4.5.4 Patient Medical

TABLE 5-14
PATIENT MEDICAL MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance / MPPS	Note
Patient State	(0038,0500)	O	2	No/No	Not requested
Pregnancy Status	(0010,21C0)	O	2 *	No/No	Not requested
Medical Alerts	(0010,2000)	O	2 *	No/No	Not requested
Contrast Allergies	(0010,2110)	O	2 *	No/No	Not requested
Special Needs	(0038,0050)	O	2	No/No	Not requested
Smoking Status	(0010,21A0)	O	3	No/No	Not requested
Additional Patient History	(0010,21B0)	O	3	No/No	Not requested
Last Menstrual Date	(0010,21D0)	O	3	No/No	Not requested

6. MODALITY PERFORMED PROCEDURE STEP IMPLEMENTATION

6.1 INTRODUCTION

This section specifies the use of the DICOM Modality Performed Procedure Step information to be communicated to the Hospital/Radiology information system.

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 in this document.

6.2 RELATIONSHIP BETWEEN SCHEDULED AND PERFORMED PROCEDURE STEPS

The Invenia ABUS supports a one-to-one relationship and a zero-to-one relationship (Unscheduled Case or Acquisition without MWL Data) between the between Scheduled Procedure Step and PPS,

Multiple-to-one relationship (aka Group Case) or the one/multiple-to-multiple relationship (aka Append) is not supported.

6.3 MODALITY PERFORMED PROCEDURE STEP MODULE TABLE

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

TABLE 6-1
MODALITY PERFORMED PROCEDURE STEP MODULES

Module Name	Reference
SOP Common	6.4.1
Performed Procedure Step Relationship	6.4.2
Performed Procedure Step Information	6.4.3
Image Acquisition Results	6.4.4

6.4 MODALITY PERFORMED PROCEDURE STEP MODULE DEFINITIONS

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) for a description of each of the attributes contained within the Modality Performed Procedure Step Information Object Definition.

6.4.1 SOP Common Module

TABLE 6-2
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Specific Character Set	(0008,0005)	1C	1C	Not used

6.4.2 Performed Procedure Step Relationship Module

TABLE 6-3
PERFORMED PROCEDURE STEP RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU - N-CREATE	
		Acquisition without MWL Entry	Acquisition with MWL Entry
Scheduled Procedure Step Attributes Sequence	(0040,0100)	Single entry	Single entry
>Study Instance UID	(0020,000D)	Created by Invenia ABUS	Filled from SPS, if received, Otherwise, system generated.
>Referenced Study Sequence	(0008,1110)	Sent Empty	Sent Empty
>>Referenced SOP Class UID	(0008,1150)	Not sent	Not sent
>>Referenced SOP Instance UID	(0008,1155)	Not sent	Not sent
>Filler Order Number/Imaging Service Request	(0040,2017)	Not sent	Not sent
>Requested Procedure ID	(0040,1001)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
>Requested Procedure Code Sequence	(0032,1064)	Not sent	Not sent
>Requested Procedure Description	(0032,1060)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
>Scheduled Procedure Step ID	(0040,0009)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
>Scheduled Procedure Step Description	(0040,0007)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
>Scheduled Protocol Code Sequence	(0040,0008)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
>>Code Value	(0008,0100)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty

>>Coding Scheme Designator	(0008,0102)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
>>Coding Scheme Version	(0008,0103)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
>>Code Meaning	(0008,0104)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
Patient's Name	(0010,0010)	From User Interface	Filled from SPS
Patient ID	(0010,0020)	From User Interface	Filled from SPS
Issuer of Patient ID	(0010,0021)	Not sent	Not sent
Patient's Birth Date	(0010,0030)	From User Interface	Filled from SPS
Patient's Sex	(0010,0040)	System generated, ALWAYS “F”	Filled from SPS
Referenced Patient Sequence	(0008,1120)	Sent Empty	Sent Empty
>Referenced SOP Class UID	(0008,1150)	Not sent	Not sent
>Referenced SOP Instance UID	(0008,1155)	Not sent	Not sent
Admission ID	(0038,0010)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
Issuer of Admission ID	(0038,0011)	Sent Empty	Filled from SPS, if present, Otherwise, sent empty
Service Episode ID	(0038,0060)	Not sent	Not sent
Issuer of Service Episode ID	(0038,0061)	Not sent	Not sent
Service Episode Description	(0038,0062)	Not sent	Not sent

6.4.3 Performed Procedure Step Information Module

TABLE 6-4
PERFORMED PROCEDURE STEP INFORMATION MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Performed Procedure Step ID	(0040,0253)	1	-	Set to Requested Procedure ID from SPS for the scheduled case, Internally generated for the unscheduled case. IHE *GROUPED* and *APPEND* cases not supported
Performed Station AE Title	(0040,0241)	1	-	Scan Station's AE Title.
Performed Station Name	(0040,0242)	2	-	Empty
Performed Location	(0040,0243)	2	-	Empty
Performed Procedure Step Start Date	(0040,0244)	1	-	Date at start of Image Acquisition
Performed Procedure Step Start Time	(0040,0245)	1	-	Time at start of Image Acquisition
Performed Procedure Step Status	(0040,0252)	1	3	N-CREATE: Status is set to IN PROGRESS. N-SET: Status is set to COMPLETED Status DISCONTINUED is not used
Performed Procedure Step Description	(0040,0254)	2	3	N-CREATE set to Requested Procedure Step Description from SPS N-SET: Absent
Performed Procedure Type Description	(0040,0255)	2	3	N-CREATE Present and empty N-SET Absent
Procedure Code Sequence	(0008,1032)	2	3	N-CREATE Present and empty N-SET Absent
>Code Value	(0008,0100)	1	1	Absent
>Coding Scheme Designator	(0008,0102)	1	1	Absent
>Coding Scheme Version	(0008,0103)	3	3	Absent
>Code Meaning	(0008,0104)	3	3	Absent
Performed Procedure Step End Date	(0040,0250)	2	3	N-CREATE Present and empty N-SET Date set when user ends scan session
Performed Procedure Step End Time	(0040,0251)	2	3	N-CREATE Present and empty N-SET Time set when user ends scan session
Comments on the Performed Procedure Step	(0040,0280)	3	3	Absent
Performed Procedure Step Discontinuation Reason Code Sequence	(0040,0281)	3	3	Absent
>Code Value	(0008,0100)	1	1	Absent
>Coding Scheme Designator	(0008,0102)	1	1	Absent

>Coding Scheme Version	(0008,0103)	3	3	Absent
>Code Meaning	(0008,0104)	3	3	Absent

6.4.4 Image Acquisition Results Module

TABLE 6-5
IMAGE ACQUISITION RESULTS MODULE ATTRIBUTES

Attribute Name	Tag	Type for SCU N-CREATE	Type for SCU N-SET	Use
Modality	(0008,0060)	1	-	Set to US
Study ID	(0020,0010)	2	-	EMPTY
Performed Protocol Code Sequence	(0040,0260)	2	3	N-CREATE Empty N-SET Not Sent
>Code Value	(0008,0100)	1	1	Not Sent
>Coding Scheme Designator	(0008,0102)	1	1	Not Sent
>Coding Scheme Version	(0008,0103)	3	3	Not Sent
>Code Meaning	(0008,0104)	3	3	Not Sent
Performed Series Sequence	(0040,0340)	2	3	N-CREATE Empty N-SET Sent
>Performing Physician's Name	(0008,1050)	2	2	N-CREATE Not Sent N-SET Sent
>Protocol Name	(0018,1030)	1	1	N-CREATE Not Sent N-SET Sent
>Operator's Name	(0008,1070)	2	2	N-CREATE Not Sent N-SET Sent with Login account name
>Series Instance UID	(0020,000E)	1	1	N-CREATE Not Sent N-SET Sent
>Series Description	(0008,103E)	2	2	Not Sent
>Retrieve AE Title	(0008,0054)	2	2	Not Sent
> Archive Requested	(0040,A494)	3	3	Not Sent
>Referenced Image Sequence	(0008,1140)	2	2	Not Sent
>>Referenced SOP Class UID	(0008,1150)	1	1	Not Sent
>>Referenced SOP Instance UID	(0008,1155)	1	1	Not Sent
>Referenced Non-Image Composite SOP Instance Sequence	(0040,0220)	2	2	Not Sent
>>Referenced SOP Class UID	(0008,1150)	1	1	Not Sent
>>Referenced SOP Instance UID	(0008,1155)	1	1	Not Sent