



Technical Publications

**Direction 2059568-023
Revision B**

**MUSE™ v9.0 \
MUSE™ DICOM Gateway Pro
Conformance Statement for DICOM v3.0**



GE Healthcare

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CONFORMANCE STATEMENT OVERVIEW

Table 0.1 provides an overview of the network services supported by MUSE

Table 0.1 – NETWORK SERVICES

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
12-lead ECG Waveform Storage	Yes	Yes
General ECG Waveform Storage	Yes	No
Encapsulated PDF Storage	Yes	Yes
Workflow Management		
Storage Commitment Push Model SOP Class	Yes	Yes
Modality Worklist Information Model – FIND SOP Class	Yes	No



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1. INTRODUCTION

1.1 OVERVIEW

This DICOM Conformance Statement describes in detail the DICOM support provided by MUSE v9.0 and MUSE DICOM Gateway Pro. The difference between MUSE v9.0 and MUSE DICOM Gateway Pro with respect to DICOM support is that MUSE DICOM Gateway Pro does not support the Storage SCP and Storage Commitment SCP. For sections that are not applicable to MUSE DICOM Gateway Pro, a note is added at the beginning of the section mentioning the same.

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

- Section 1** (**Introduction**) describes the overall structure, intent, and references for this Conformance Statement.
- Section 2** (**Network Conformance Statement**) specifies compliance of MUSE to DICOM v3.0 Standards requirements for network communication for all SOP classes it supports. This part generally follows the DICOM Standard Conformance Statement as specified in the DICOM Standard V3.0, Part 2. General network operations are described in this section. In the places that individual real-work activities should be described, references to the following sections are made, instead of including all SOP classes in this part.
- Section 2.3** (**Application Entity Specifications**) provides a set of Application Entity Specifications. There is one specification for each Application Entity MUSE supports. Each individual AE Specification has a subsection. There are as many of these subsections as there are different AE's in the implementation.
- Section 2.3.1** (**AE Specification – All Application Entities**) specifies a set of common compliance elements of all MUSE DICOM Application Entities to DICOM v3.0 Standards requirements for all SOP Classes.
- Section 2.3.2** (**AE Specification - DICOM Storage Service SCU**) specifies compliance of MUSE SOP Instance send functions to DICOM v3.0 Standards requirements for Storage SOP Classes.
- Section 2.3.3** (**AE Specification - DICOM Storage Service SCP**) specifies compliance of MUSE SOP Instance receive functions to DICOM v3.0 Standards requirements for Storage SOP Classes.
- Section 2.3.4** (**AE Specification - DICOM Storage Commitment – Push Model SCU**) specifies the compliance of the MUSE SOP Instance Storage Commitment request functions to DICOM v3.0 Standards requirements for Storage Commitment – Push Model SOP Classes.



Section 2.3.5

(AE Specification - DICOM Storage Commitment – Push Model SCP) specifies the compliance of the MUSE SOP Instance Storage Commitment response functions to DICOM v3.0 Standards requirements for Storage Commitment – Push Model SOP Classes.

Section 2.3.6

(AE Specification - DICOM Modality Worklist – Find SCU) specifies the compliance of MUSE Modality Worklist – Find query functions to DICOM v3.0 Standards requirements for querying for Modality Worklist items.



1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GE Healthcare Conformance Statements and their relationship to the DICOM v3.0 Conformance Statements is shown in the illustration below.

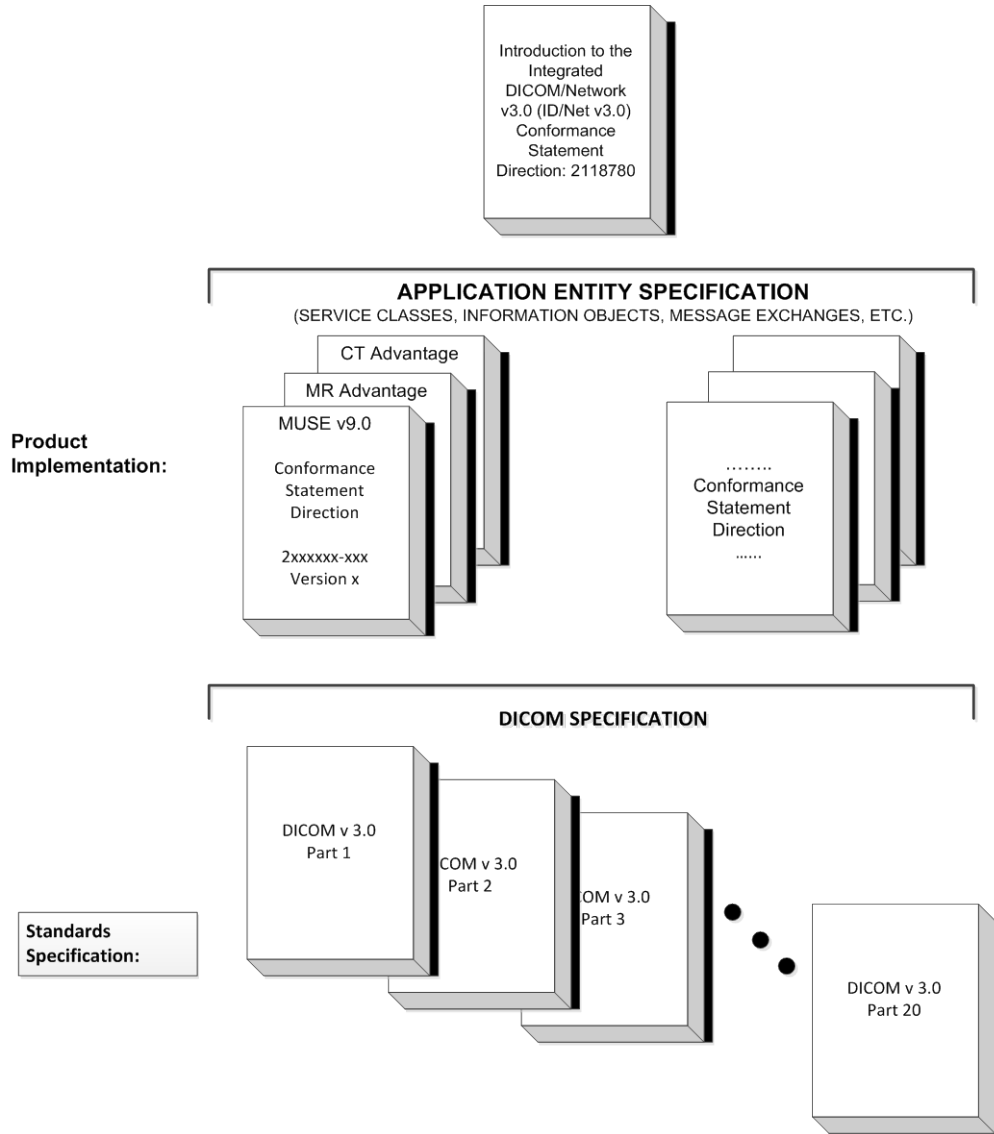


FIGURE 1-1: DICOM CONFORMANCE STATEMENT DOCUMENT ORGANIZATION

The documentation structure depicted in the illustration above shows the overall documentation structure for all GE ID/Net v3.0 Conformance Statements. This document specifies the DICOM v3.0 implementation supported by the GE Healthcare’s MUSE Cardiology Information System.

It is entitled:

*MUSE Version 9.0\ MUSE DICOM Gateway Pro
Conformance Statement for DICOM V3.0
Direction 2059568-023*



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

The GE Healthcare 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 v3.0 Standard and with the terminology and concepts which are used in that standard.

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

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

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document, in conjunction with the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*, to provide an unambiguous specification for GE ID/Net v3.0 implementations. This specification, called a Conformance Statement, includes a DICOM v3.0 Conformance Statement and is necessary to ensure proper processing and interpretation of GE Healthcare data exchanged using DICOM v3.0. The GE ID/Net v3.0 Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GE Healthcare devices are capable of using different Information Object Definitions. For example, a GE Healthcare 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 the GE ID/Net v3.0 implementation. If the user encounters unspecified private data elements while parsing a GE Dataset, the user is well advised to ignore those data elements (per the DICOM v3.0 standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and retransmit all of the private data elements which are sent by GE Healthcare 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 interoperation 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, as well as 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 GE Healthcare 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

A list of symbols and abbreviations which is applicable to all GE Healthcare Conformance Statements is included in the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*.

Below is a list of abbreviations used in this document over and above the ones in the referred document.

CPOE	Computerized Physician Order Entry
CSI	Client Server Interface
ECG	Electrocardiogram
EMR	Electronic Medical Records
Hilltop	Internal proprietary binary data format for ECG Studies in MUSE
HIS	Hospital Information System
IS	Information Systems
MAC	Microprocessor Augmented Cardiograph
MUSE	Marquette Universal System for Electrocardiography
PDF	Portable Document Format
DICOM	Digital Imaging and Communications in Medicine
AE	Application Entity
SCP	Service Class Provider
SCU	Service Class User
MWL	Modality Work List



2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the MUSE v9.0 and MUSE DICOM Gateway Pro compliance to DICOM requirements for networking features.

- Send DICOM SOP Instances to remote DICOM devices. The following SOP Classes are supported:
 - 12-Lead Electrocardiogram (for resting ECGs of 10 seconds or less).
 - Encapsulated PDF SOP Instances (for resting ECGs, Exercise and Ambulatory ECGs).
- As a part of the Send activity, MUSE can optionally request Storage Commitment for the SOP Instances transmitted from the remote Application Entity.
- Receive DICOM SOP Instances from remote DICOM devices into MUSE for storage. The following DICOM SOP Instances can be received by MUSE
 - 12-Lead Electrocardiogram SOP Instances.
 - General Electrocardiogram SOP Instances.
 - Encapsulated PDF SOP Instances.
- Respond to Storage Commitment requests for the SOP Instances raised by remote Application Entities who have transmitted such SOP Instances.

Note: Receive DICOM SOP Instances and Storage Commitment requests for SOP Instances are not supported by MUSE DICOM Gateway Pro application.

- Listen to DICOM Modality Worklist provider, receive, convert to GE format and distribute the Worklist items to GE MAC Electrocardiograph devices.
- Respond to DICOM echo requests from remote Application Entities.
- Request verification from other remote Application Entities.

The MUSE system creates a number of DICOM Application Entities (AEs) to support these services. Each such DICOM Application Entity will be dedicated to a particular type of the DICOM service, as explained in the rest of the document.

Note: In this document, we use the term “DICOM Storage SOP Instance” or “SOP Instance” in places where the term “Image” is usually used. A SOP Instance generally refers to a DICOM v3.0 Standards Composite IOD, which can be an image or non-image dataset. In most cases, the SOP class to which an instance is associated determines the data type of the instance. For details, the reader is referred to DICOM Standard parts PS 3.3 and 3.4.



In this document, the term “MUSE” refers to the “MUSE DICOM interface,” a collection of all of its DICOM Application Entities, their common properties and behaviors. Please note that these services are selectively installed based on customer requirements and not all services will be available at every installation. In general, the MUSE DICOM interface runs as a subsystem comprised of a set of processes installed on the same or different servers, working in tandem with the MUSE.

The DICOM interfaces typically start automatically when the server on which they are installed is booted.

2.2 IMPLEMENTATION MODEL

MUSE provides a number of DICOM Standard services with separate DICOM Application Entities (AEs):

- SOP Instance Send and Storage Commitment request Application Entity (Storage SCU AE)
- SOP Instance Receive/Store and Storage Commitment response Application Entity (Storage SCP AE)
- Modality Worklist request Application Entity (Modality Worklist SCU AE)

2.2.1 Application Data Flow Diagram

The network application model for the MUSE v9.0 is shown in the following illustrations:

2.2.1.1 Application Data Flow Diagram – Storage SCU AE

The **Storage SCU AE** implements the SCU role for the DICOM Storage SOP Classes and transmits SOP Instances to a remote AE. It optionally makes a DICOM Storage Commitment request from the remote AE, if configured and if the remote AE supports Storage Commitment.

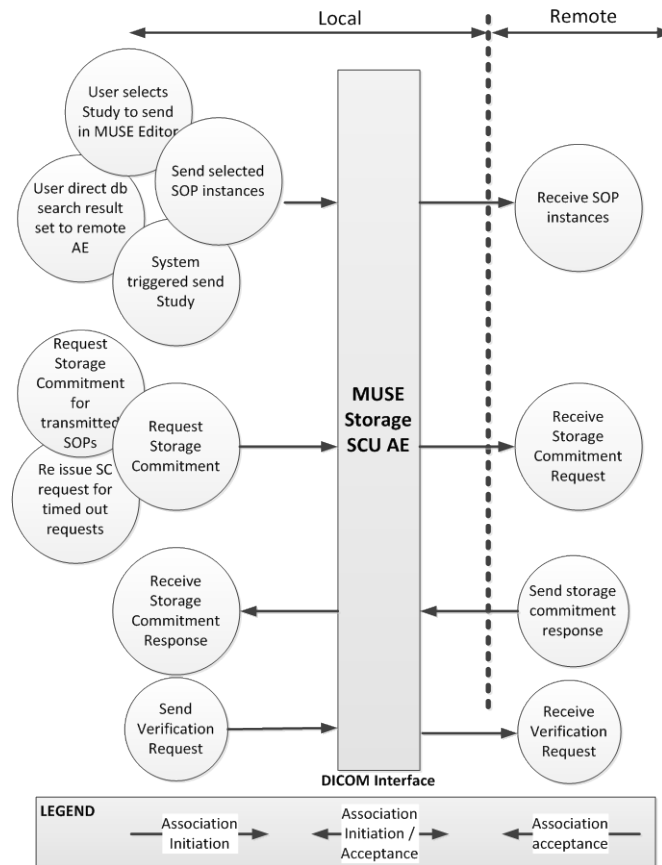


FIGURE 2-1: APPLICATION DATA FLOW DIAGRAM FOR STORAGE SCU AE

2.2.1.2 Application Data Flow Diagram - Storage SCP AE

The **Storage SCP AE** implements both the SCP role for the DICOM Storage SOP Classes and the SCP role for the DICOM Storage Commitment SOP Class. The SCP role of the DICOM Storage SOP class is responsible for receiving DICOM SOP Instances from a remote AE. The SCP role of the DICOM Storage Commitment SOP class responds to Storage Commitment requests made by a remote AE.

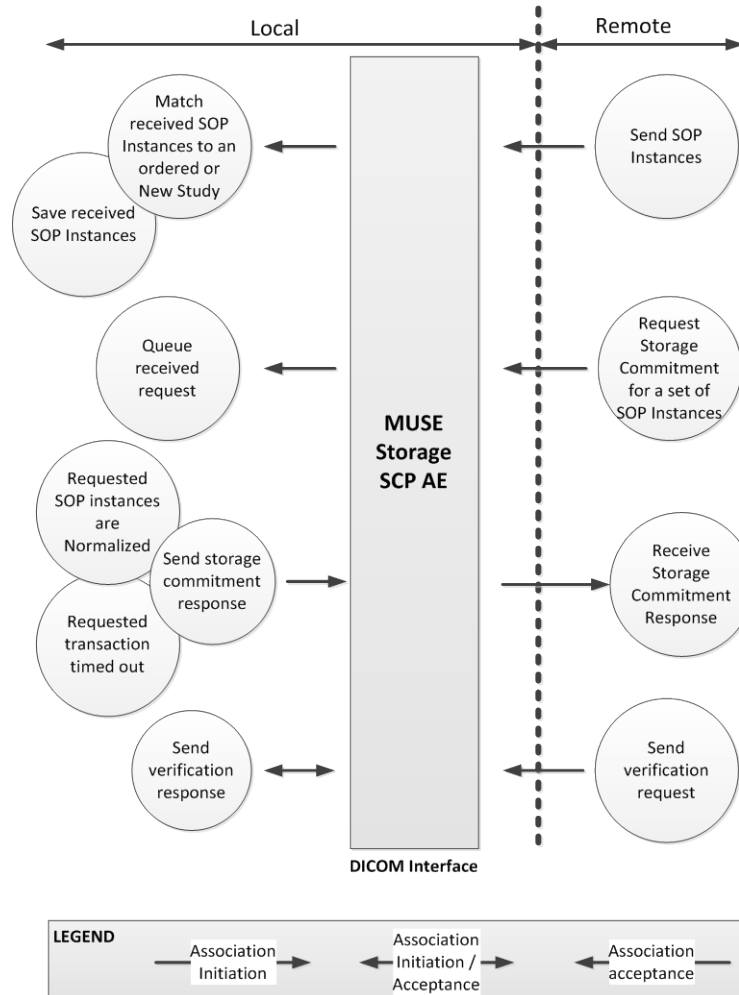


FIGURE 2-2: APPLICATION DATA FLOW DIAGRAM FOR STORAGE SCP AE

2.2.1.3 Application Data Flow Diagram - Modality Worklist SCU AE

The Modality Worklist SCU AE implements DICOM Modality Worklist SOP Classes for receiving Modality Worklist items from a remote AE and distributes the worklist items to GE MAC Electrocardiograph devices in the network upon request.

The Modality Worklist SCU AE periodically queries a remote Modality Worklist SCP AE for worklist items. Upon receiving the responses from the remote AE, it maps the returned items to an internal MUSE database and uses proprietary CSI protocol to support the Order and Patient demographic queries raised by GE Electrocardiograph devices.

Note: MUSE supports an HL7 interface for ADT and Orders. Modality Worklist SCU is normally not enabled in MUSE by default and is not required when the HL7 ADT/Order interface is



in effect. This SCU is provided only in alternate environments where such an HL7 interface is not available or feasible, and instead the institution can provide a Modality Worklist feed to MUSE. This is true only for GE MAC Electrocardiograph devices, since these devices do not have a built in Modality Worklist SCU.

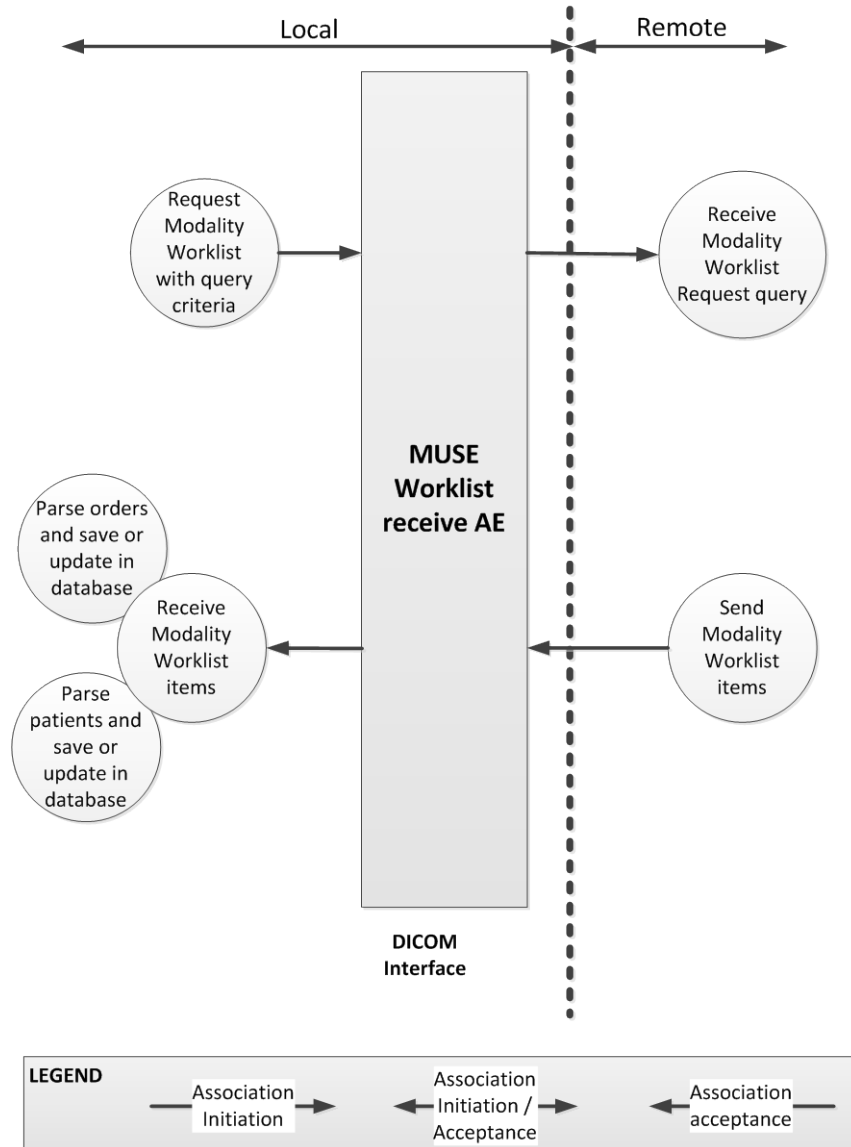


FIGURE 2-3: APPLICATION DATA FLOW DIAGRAM FOR MODALITY WORKLIST SCU AE



2.2.2 Functional Definition of AE's

The DICOM Application Entities of MUSE initiate or receive the DICOM associations to support a number of application functions for the MUSE system.

2.2.2.1 Functional Definition – MUSE DICOM Storage Service (SCU) AE

The MUSE DICOM Storage Service (SCU) AE supports the following application-level function:

Transmission related:

- Transfer the selected test(s) from MUSE to a remote AE as DICOM SOP Instances.

Storage Commitment related:

- If all the intended SOP Instances are transferred without failures, the following steps will be executed.
 - Send Storage Commitment request for the SOP Instances that were successfully transmitted as above.
 - Receive the Storage Commitment response from the Storage Commitment Provider on the same association or on a different association.
 - If the Storage Commitment response indicates “Success”, mark the transmission request to a “Success”. The status is reflected in the MUSE transmission/routing logs.
 - If the Storage Commitment response indicates “Failure” or “Unknown,” mark the transmission request as “Failure” or “Unknown”.
- If there are any failures in transfer, the transmission request will be marked as “Failed” and the Storage Commitment request will not be sent.
 - If configured for retry, the SOP Instances would be retried on a separate association and a new Storage Commitment request would be generated if the retry succeeds.

Note: Due to the data coercion, the SOP Instances sent to a remote AE may be different from the originally received SOP Instances in certain data elements. See [2.3.3.2.1.7](#) for possible data corrections in MUSE.

2.2.2.2 Functional Definition – MUSE DICOM Storage Service (SCP) AE

Note: MUSE DICOM Storage Service (SCP) AE is not applicable to MUSE DICOM Gateway Pro

The MUSE DICOM Storage Service (SCP) AE supports the following application-level functions:

Storage related:

- Receive SOP Instances from a remote DICOM AE.



- Profile each received instance to an Ordered Scheduled Study in MUSE by matching the Patient / Study information in the instance's dataset to the information in the database.
- If no match is found, create a new (unordered) Study by directly using the Patient / Study information in the received dataset and relate the SOP Instance to the created study.

Note: When relating a SOP Instance to an Ordered study, the Storage SCP AE may alter the values of some data elements using the values from the counterpart data fields of the matched study in the MUSE database. In addition, the SOP Instances may also be changed by the Patient Study update information received from EMR/HIS or entered by the MUSE Editor operator. MUSE does not create a new SOP Instance for these data changes. A list of the data elements that may undergo data coercion are given in [2.3.3.2.1.7](#). Data coercion is performed for data correction purposes.

- Store the Patient, Study, Series, and SOP Instance relationship permanently in the MUSE.
- Store the SOP Instances in the MUSE for use in MUSE Editor and for long-term storage.

Note: MUSE will properly save all SOP Instances successfully received via the Storage SCP AE. However, MUSE cannot guarantee that all received SOP Instances can be properly displayed and printed. Section [2.3.3.3](#) lists the detailed application level functions that MUSE is able to support for the successfully received SOP Instances.

Storage Commitment related:

- Receive a DICOM Storage Commitment request from a remote AE.
- Create a request entry in the MUSE Storage Commitment Queue. The request is identified by the Transaction UID in the received request and associated with a timer of a configurable time-out value.
- Poll the Storage Commitment Queue for a pending request which is either confirmed by normalization process or timed out.
- Send a Storage Commitment response to remote AE.

Note: The Storage SCP AE supports a Storage Commitment request for the SOP Instances unknown to the MUSE at the moment. The Storage SCP AE assumes that these SOP Instances will be received at a later time.

Verification related:

- Respond to a DICOM Verification (Echo) request from a remote AE.

2.2.2.3 Functional Definition - Modality Worklist SCU AE

The Modality Worklist SCU AE supports the following application-level function:

Modality Worklist request:

- MUSE will periodically query the remote Modality Worklist SCP AE for the worklist items pertinent to its environment. The query attributes used by MUSE are configurable.



- Typically MUSE will query items marked for “ECG” modality that pertain to the locations managed by the MUSE server initiating the query.

Modality Worklist receipt and process:

- Upon receiving the worklist items in the response from the remote Modality Worklist SCP AE, MUSE will parse the items and translate them into Orders and/or Patient demographics and store them in its database.

2.2.3 Sequencing of Real-World Activities

2.2.3.1 Sequencing – Storage SCU AE

Following real-world activities will cause the Storage SCU AE to initiate a DICOM association to a remote AE to route the MUSE tests.

1. MUSE allows a user to select and route DICOM or non-DICOM tests stored internally to remote Application Entities in one or more of the following ways:
 - A MUSE Administrator user has set up routing rules to route the tests to other IS entities based on various stages of the workflow automatically.
 - A MUSE user, who has the appropriate privilege, queries the MUSE Cardiology Information System for tests meeting selection criteria in the MUSE Editor application and routes the result set to a remote AE.
 - A MUSE user, who has the appropriate privilege, selects a desired set of tests manually and routes it to a remote AE for further research.

The exact trigger mechanism and the configuration method for these triggers are beyond the scope of this document.

Under these conditions:

1. In response to this action, MUSE will enter the requests in a routing queue and process the referenced studies (and hence the SOP Instances) to be transmitted to the remote AE.
2. MUSE will process these requests per internal order of priority and initiate a DICOM transmission to the remote AE identified in the request.

The ECG tests will be transmitted as one of the Information Object types per the table in [Section 3.2.1](#), based on test types.

2.2.3.1.1 Send Storage Commitment Request

MUSE implements an optional Storage Commitment request/response during the real-world activity where tests in MUSE are transmitted to a remote AE for storage.



If the remote AE supports Storage Commitment, the MUSE application can be configured to request a Storage Commitment response from the remote Storage SCP AE to build in additional reliability.

Other than configuring the necessary remote AE information in MUSE, which only needs to be done once, no additional real-world activity is needed to request Storage Commitment. MUSE automatically sends Storage Commitment requests to the remote AE upon successful transmission of SOP Instances if configured.

2.2.3.2 Sequencing - Storage SCP AE

Note: MUSE DICOM Storage Service (SCP) AE is not applicable to MUSE DICOM Gateway Pro.

A physician orders an ECG test for the patient at their CPOE/EMR/HIS application. At the time the study is ordered, the third party information system sends the study order and patient information to MUSE, which creates an ordered study and then expects to receive SOP Instances associated with this study.

The following real-world activities are associated with the receiving Storage SOP Instance operations:

1. Either the modality is able to query the Modality Worklist from a DICOM Modality Worklist Provider or a technologist enters the patient / study information manually in the electrocardiograph. The technologist then acquires the ECG from the patient.
2. The electrocardiograph acquires the ECG as a DICOM Storage SOP Instance and sends these to the Storage SCP Application Entity of MUSE.
3. The Storage SCP Application Entity matches the DICOM objects received from the electrocardiograph to an ordered study in the database.

After acquiring one or more ECGs in a device that is capable of sending ECGs using the DICOM protocol, the electrocardiograph operator shall use the vendor provided UI to initiate a single or batch transmission of ECGs to MUSE Storage SCP AE.

This would cause the electrocardiograph's Storage SCU AE to initiate an association with the MUSE Storage SCP AE and transmit the ECG(s). For this action to be successful, the MUSE Storage SCP AE information needs to be configured in the vendor's electrocardiograph with the help of relevant vendor manuals.

2.2.3.2.1 Send Storage Commitment Response

If the electrocardiograph that transmitted the ECG SOP Instances is capable of requesting a Storage Commitment request (please refer to vendor documentation on how to configure this in your respective device), the device can request the Commitment either



on the same association in which it sent the SOP Instances or it can chose to initiate a dedicated association for this purpose.

No local real-world activity is required for the Storage SCP AE to respond to incoming DICOM associations for Storage Commitment requests. The Storage SCP AE is always listening for an incoming association and will automatically respond to requests.

Upon receiving a Storage Commitment request, the Storage SCP AE will start the following real-world activities:

1. The request is entered in the Storage Commitment request queue in the MUSE database.
2. A timer for a configured time-out value associated with the request is started.
3. The Storage SCP AE periodically polls all outstanding Storage Commitment requests and sends Storage Commitment responses back to the remote AE under the following conditions:
 - All outstanding commitment requests for SOP Instances queued have been successfully “Normalized” into the MUSE database.
 - The pre-configured time-out has expired, but not all SOP Instances requested have been successfully “Normalized.”

2.2.3.3 Sequencing - Modality Worklist SCU AE

The Modality Worklist SCU AE in MUSE is provided for a special purpose. This SCU AE is aimed towards extending and enhancing GE MAC Electrocardiograph units that are operating in customer environments where DICOM Modality Worklist Servers are used for order management in addition to the MUSE Server or in the absence of a MUSE server.

If the MUSE server does not exist in such an environment, this SCU AE will be part of the MUSE DICOM Gateway Pro and will allow the GE MAC Electrocardiograph units to download orders from the MWL SCP.

If the MUSE does exist in such an environment, this SCU AE is required **only if** an HL7 ADT/Orders interface is not available, or a Modality Worklist interface is preferred by the customer in lieu of the HL7 ADT/Orders.

The following real-world activities will cause the Modality Worklist SCU AE to trigger a query to a Modality Worklist SCP:

1. An operator on a GE MAC Electrocardiograph uses a barcode scanner to scan the barcode on a paper based order, or enters the Patient ID in the Patient demographics screen to request a “Patient Demographic” query.



2. Alternatively, the operator on a GE MAC Electrocardiograph uses the Order Manager Module to request “Open Orders” to be executed.
3. If the query from the electrocardiograph device is for “Patient Demographics” then MUSE will look up the patient details from its database and send the patient data object to the electrocardiograph.
4. If the query is for an “Open Orders” list:
 - A. The MUSE DICOM interface looks into its database and composes a list of any open orders. It then sends the list of open orders back to the GE MAC Electrocardiograph.
 - B. If there are no open orders in the MUSE database at this time, the following actions take place.
 - a. The MUSE DICOM interface would trigger a Modality Worklist query for the ECG modalities with query parameters configured in the MUSE interface to the remote Modality Worklist SCP AE using the Modality Worklist SCU AE.
 - b. Upon receiving the response from the remote Modality Worklist SCP AE, MUSE will parse the worklist items and matches them against the entries in its database for their current status.

If there are any new worklist items in the response:

- i. MUSE will create the corresponding entries in the MUSE database for the Patients, Orders and Visit information obtained from the Modality Worklist item.
- ii. The MUSE interface will mark these new entries as open Orders, and composes an open Orders list and send it back to the requesting Electrocardiograph to complete the workflow.
- c. If there are no new worklist items in the response, then MUSE will send an empty response to GE MAC Electrocardiograph.

2.3 AE SPECIFICATIONS

This section provides the specifications for all the Application Entities supported by MUSE 9.0\MUSE DICOM Gateway Pro.

2.3.1 AE Specification - All Application Entities

This section provided a list of Application AE attributes that are common across all the AEs supported in MUSE. The individual AEs to which these sections are applicable will have refer back to this section.



2.3.1.1 Maximum Length of Protocol Data Unit

The Maximum Length of Protocol Data Unit (PDU) negotiation is included in all association establishment requests. The Maximum Length of PDU proposed for all associations initiated by the MUSE is configurable and is up to:

Maximum Length of PDU	65535 Bytes (Configurable)
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The number given above (65535 bytes) is also the Maximum Length of PDU in all DICOM associations that the interface can accept.

MUSE does not support SOP class Extended Negotiation in any DICOM associations its AEs accept.

The user information items sent by the AEs of MUSE are:

- Maximum Length of PDU
- Implementation Class UID
- Implementation Version Name

2.3.1.2 Association Policies

This section describes the common behaviors of all Application Entities of the MUSE DICOM interface with respect to the DICOM network association establishment. Specific behaviors of each individual AE will be described in the respective Application Entity Specification sections.

2.3.1.2.1 General

The DICOM Application Context Name (ACN) proposed by the MUSE for all Application Entities is:

SOP Class name	SOP Class UID
DICOM Application Context Name	1.2.840.10008.3.1.1.1

2.3.1.2.2 Asynchronous Nature

MUSE Application Entities **DO NOT** support asynchronous operations (i.e. multiple concurrent operations in one association). All operations will be performed synchronously.

2.3.1.2.3 Implementation Identifying Information

All MUSE AEs provide the same implementation class UID, which is:

Implementation Class UID	1.2.840.113619.6.302
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All MUSE AEs provide the same implementation version name, which is:

Implementation Version Name	MUSE_9.0
-----------------------------	----------

Any exception to this is noted under the respective AE Specification.

2.3.1.2.4 Transfer Syntaxes Supported

The following table shows the transfer syntaxes supported by all the Application Entities in the MUSE DICOM interface:

Presentation Context Table		
List name	Name list	UID list
Transfer Syntax List 1	Explicit VR Little Endian	1.2.840.10008.1.2.1
	Implicit VR Little Endian	1.2.840.10008.1.2
	Explicit VR Big Endian	1.2.840.10008.1.2.2

TABLE 1

2.3.1.3 Timers

2.3.1.3.1 Association Timers

MUSE supports an association timer for an association in which MUSE plays the role of an association initiator. The association timer starts when the association request is sent and stops when the association is established.

2.3.1.3.2 Operation Inactivity Timer

MUSE supports an operation inactivity timer for an association in which MUSE plays the role of an association initiator. The operation inactivity timer restarts every time a DIMSE service request has been issued.

2.3.2 AE Specification – MUSE DICOM Storage Service (SCU)

The MUSE DICOM Storage Service (SCU) Application Entity provides Standard Conformance to the following DICOM SOP Classes as an **SCU**.

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes	No
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Yes	No



General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Yes	No
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	No
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	No

TABLE 2: SOP CLASSES SUPPORTED BY STORAGE SCU AE

Note: The MUSE DICOM Storage Service (SCU) AE uses the same AE title for requesting both storage and storage commitment from the SCP. Hence MUSE provides a single configuration for the AE title for both Storage and Storage Commitment. However, the MUSE DICOM Storage Service (SCU) AE uses a different port for receiving the N-Event-Report for storage commitment. The remote SCPs need to configure the storage commitment port of the SCU using the same AE details as the Storage SCU details, but with a different port number.

For every SOP instance that MUSE transmits to a remote AE either manually or due to an automatic routing rule, MUSE sends a storage commitment request provided it is configured to do so and only if the remote AE supports storage commitment.

The MUSE DICOM Storage Service (SCU) Application Entity proposes a presentation context for the Storage Commitment – PUSH Model SOP Class as a dedicated association, or in a single association together with presentation contexts for DICOM Storage SOP Classes.

2.3.2.1 Association Establishment Policies

Please refer to [2.3.1](#) for the common association policies that are applicable for all Application Entities. This section describes policies and/or deviations that are applicable to this Application Entity.

2.3.2.1.1 General

Please refer to [2.3.1.2.1](#) for the Application Context Name presented by this Application Entity.

Please refer to [2.3.1.1](#) for the maximum PDU receive size for this Application Entity.

2.3.2.1.2 Number of Associations

The MUSE DICOM Storage Service (SCU) will initiate a maximum of 5 simultaneous associations to remote nodes.

The maximum number of concurrent associations that the MUSE DICOM Storage Service (SCU) Application Entity can initiate for sending the SOP Instances is configurable. By default this value is set to 5.

The MUSE DICOM Storage Service (SCU) will support a maximum of 1 simultaneous associations initiated by remote nodes to receive N-Event-Reports for the outstanding Storage Commitment transactions.



2.3.2.1.3 Asynchronous Nature

Please refer to [2.3.1.2.2](#) for asynchronous association policy for this Application Entity.

2.3.2.1.4 Implementation Identifying Information

Please refer to [2.3.1.2.3](#) for Implementation Identification information for this Application Entity.

2.3.2.2 Association Initiation Policy

When the MUSE DICOM Storage Service (SCU) 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 MUSE DICOM Storage Service (SCU) 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.

Provided the Storage Commitment request has been configured in MUSE, the MUSE DICOM Storage Service (SCU) Application Entity will queue a request for storage commitment in an internal queue. This request will be processed by a dedicated thread that sends the storage commitment requests to the storage commitment SCU in a different association.

Storage SCU Application Entity will initiate associations only to those remote AEs configured in the “Permissible Remote Destination” devices in MUSE.

2.3.2.2.1 Real-World Activity - Send SOP Instance(s) to Remote AE

2.3.2.2.1.1 Associated Real-World Activity

When ECG tests are selected from MUSE based on the automatic routing rules, or manual GUI events in the MUSE Editor application where a routing to a remote AE is initiated, the Storage requests are entered into a send queue.

These requests are processed by the MUSE DICOM Storage Service (SCU) Application Entity one by one. Storage SCU AE accepts help from other MUSE software modules to construct the DICOM Information Object(s) as appropriate for the test(s) referred by the queue requests.

The MUSE DICOM Storage Service (SCU) Application Entity will then initiate an association with the remote AE indicated in the queue request.

If the association request is declined or times out due to network issues, the request is marked for retry as configured in MUSE. The number of retries is configurable in MUSE. The default is set to three tries.



If the association is successfully negotiated, the MUSE DICOM Storage Service (SCU) Application Entity will perform C-STORE operation to support this real-world activity.

The MUSE DICOM Storage Service (SCU) Application Entity can perform multiple C-STORE operations over one single association. If the request contains multiple SOP Instances then multiple C-STORE requests will be issued over the same association. The MUSE DICOM Storage Service (SCU) Application Entity does not use the C-STORE priority attribute.

The MUSE DICOM Storage Service (SCU) Application Entity will propose all presentation contexts as the list of SOP Instances to be sent dictates, and will send all SOP Instances as long as the required presentation contexts are accepted.

Upon receiving a C-STORE-RSP containing a “Success” status, the MUSE DICOM Storage Service (SCU) Application Entity will perform the next C-STORE operation. The association will be maintained if possible.

Upon receiving a C-STORE-RSP that contains a “Refused” status, the Storage SCU AE will terminate the association. The remaining SOP Instances will not be transmitted.

Upon receiving a C-STORE-RSP which contains any status other than “Success or Refused,” the Storage SCU AE will consider the current request to be “Failure,” but will continue to attempt to send the remaining SOP Instances on the same association.

2.3.2.2.1.1.1 Data Retrieval from MUSE Using the Store SCU

MUSE can be configured to send not only the DICOM ECGs, but also DICOM ECGs that are stored in MUSE. Non-DICOM ECGs will be translated to a suitable DICOM IOD and transmitted to the remote AE based on the receiving AE titles’ capabilities.

The following table describes the test types in MUSE and the corresponding DICOM IOD that would be attempted by MUSE based on the remote AE capabilities. The automatic selection can be overruled in MUSE through configuration elements.

Test type in MUSE	DICOM IOD	SOP Class
12-lead ECGs <= 500 Hz, <= 10 sec	12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1
	Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1
12-lead ECGs <= 500 Hz, > 10 sec	General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2
	Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1
15-lead ECGs all frequencies, all durations	General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2
	Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1
All other test types	Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1

TABLE 3: MUSE TEST TYPE TO DICOM IOD TRANSLATION RULES



Note: As pointed out previously, SOP Instances sent to the remote AE may have undergone correction / modification in certain data elements. A list of the data elements that may undergo data coercion is given in [2.3.3.2.1.7](#)

2.3.2.2.1.1.2 Sending the Original IOD as Received

MUSE can be configured to send a 12-lead ECG waveform, General ECG waveform, or an Encapsulated PDF in the original format and its original SOP Instance UID without any modification if it had been acquired into the MUSE system using the DICOM Storage SCP. If this option is selected, MUSE will ignore the translated test stored in MUSE and send the original IOD in the same format as it was received. All the private fields will be preserved and sent.

If the above option is not selected, MUSE will convert the latest version of the test in MUSE into a DICOM IOD and send it to the SCP. All the private fields received in the original IOD will be lost. The IOD that is transmitted will contain any changes that were made to the fields in the MUSE after it was acquired.

If this option is selected, but the test is a Non-DICOM ECG stored 30

in the MUSE, the option will be ignored and the Non-DICOM ECG will be converted to DICOM and sent to the SCP.

2.3.2.2.1.2 Proposed Presentation Context Table

The following table shows the Presentation Contexts proposed by MUSE DICOM Storage Service (SCU) Application Entity to remote AEs to send DICOM SOP Instances:

Presentation Context Table – Proposed by AE MUSE DICOM Storage Service (SCU) for Activity Send SOP Instance(s) to Remote AE					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

TABLE 4: PROPOSED PRESENTATION CONTEXTS BY STORAGE SCU AE

NOTE: Please note that based on the test type listed in Table 4: Proposed Presentation Contexts by Storage SCU AE, the SCU would present either 12-lead and Encapsulated PDF or General Waveform



and Encapsulated PDF in its Proposed Presentation Context, never all three. In order to send a SOP Instance, the Storage SCU Application Entity requires the remote Storage SCP to select the presentation context that matches the SOP Instance that is stored in MUSE. Otherwise, the Storage SCU Application Entity will not be able to send the SOP Instance.

In case more than one presentation context is accepted by the remote AE, MUSE will choose either 12-lead OR General Waveform IOD to be sent to the receiving AE. Encapsulated PDF is the least preferred IOD.

2.3.2.2.1.2.1 SOP Specific DICOM Conformance Statement for All Storage SOP Classes

If configured to send the original IOD, all private elements, which exist in the Storage SOP Instance, will be sent. The existence of private elements depends on the equipment that is sending SOP Instances to the MUSE.

2.3.2.2.1.2.1.1 C-STORE-RESPONSE processing

The Storage SCU Application Entity has the following command response behavior:

Service status	Further meaning	Error code	Behavior
Success	Image transmitted	0000	Image successfully sent. The send request in the queue is marked SUCCESS
Refused	Out of Resource	A700	The send request in the queue is set for RETRY .
Error	Dataset does not match SOP class	A900	The send request in the queue is set for FAILED .
	Cannot Understand	C000	The send request in the queue is set for RETRY .
Warning	Coercion of data elements	B000	The send request in the queue is set to a SUCCESS .
	Dataset does not match SOP class	B007	The send request in the queue is set to a FAILED .
	Elements discarded	B006	The send request in the queue is set to a SUCCESS .

TABLE 5: COMMAND RESPONSE STATUS HANDLING IN STORAGE SCU AE

The behavior of the Storage SCU Application Entity during communication failure is summarized in a table as follows:

Exception	Behavior
Timeout	The Association is aborted using A-ABORT and the command is marked as failed. The reason is logged and reported to the user.
Association aborted	The command is marked as failed. The reason is logged and reported to the user.



TABLE 6: COMMAND COMMUNICATION FAILURE BEHAVIOR OF STORAGE SCU AE

2.3.2.2.1.2.1.2 Extended Character Sets

MUSE may perform data coercion in a SOP Instance sent out while updating the dataset with the information maintained in the MUSE database. MUSE will support the character sets as listed in 2.7. The Patient Name can be encoded using any of the sets in the list.

If a Kanji name is present for the patient, MUSE will send the Kanji name in the Phonetic Patient name encoded using ISO-IR-87 character set.

In the current release, MUSE will not add text information encoded with extended character sets into other data elements.

2.3.2.3 Association Acceptance Policies

The MUSE DICOM Storage Service (SCU) will listen on a configurable port for N-EVENT-REPORT corresponding to all the outstanding storage commitment transactions. The remote storage commitment SCP is expected to open an unsolicited association to send an N-EVENT-REPORT response for these requests.

2.3.3 AE Specification – MUSE DICOM Storage Service (SCP)

The MUSE DICOM Storage Service (SCP) Application Entity provides Standard Conformance to the following DICOM SOP Classes as an SCU:

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	No	Yes
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	No	Yes
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	No	Yes
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	No	Yes
Storage Commitment Push Model	1.2.840.10008.1.20.1	No	Yes

TABLE 7: SOP CLASSES SUPPORTED BY STORAGE SCP AE

2.3.3.1 Association Establishment Policies

Please refer to 2.3.1 for the common association policies that are applicable for all Application Entities. This section describes policies and/or deviations that are applicable to this Application Entity.



2.3.3.1.1 General

Please refer to [2.3.1.2.1](#) for the Application Context Name presented by this Application Entity.

Please refer to [2.3.1.1](#) for the maximum PDU receive size for this Application Entity.

2.3.3.1.2 Number of Associations

The DICOM Storage Service (SCP) will be able to accept a maximum of 5 associations from a remote AE.

The maximum number of concurrent associations that the DICOM Storage SCP Application Entity can accept for receiving SOP Instances is configurable. By default this value is set to 5.

The maximum number of concurrent associations that the DICOM Storage SCP Application Entity can initiate for sending a Storage Commitment Response is set to 1.

2.3.3.1.3 Asynchronous Nature

Please refer to [2.3.1.2.2](#) for asynchronous association policy for this Application Entity.

2.3.3.1.4 Implementation Identifying Information

Please refer to [2.3.1.2.3](#) for Implementation Identification information for this Application Entity.

2.3.3.2 Association Acceptance Policy

The DICOM Storage Service (SCP) Application Entity initiates a DICOM association to send Storage Commitment responses to a remote AE, in response to a previously received Storage Commitment request. Apart from this, the DICOM Storage Service (SCP) does not initiate any associations with remote nodes.

MUSE accepts association only from those remote AEs that are in its list of registered AEs.

MUSE uses a single AE for both Storage and Storage Commitment. Hence MUSE provides a single configuration for both Storage and Storage Commitment services.

2.3.3.2.1 Real-World Activity - Receive SOP Instance from Remote AE

2.3.3.2.1.1 Associated Real-World Activity

When a DICOM based electrocardiograph user selects the ECGs to be transmitted to MUSE and initiates a transmission, the Storage SCU AE in the remote device initiates a DICOM Association Request to MUSE.



There is no local real-world activity required for the MUSE DICOM Storage Service (SCP) AE to respond to incoming DICOM associations to receive SOP Instances. The MUSE DICOM Storage Service (SCP) AE is always listening for an incoming association and will automatically respond to a request. This includes verification requests.

Upon receiving a SOP Instance, the MUSE DICOM Storage Service (SCP) AE will start the following local real-world activities:

1. Profile the received SOP Instance to an ordered study or create a new study (unordered study) if no match is found.
2. Each incoming ECG is parsed and stored in the internal MUSE database in the format internal to MUSE.

Note: The Storage SCP AE always saves a successfully received SOP Instance. However, the MUSE DICOM Storage Service (SCP) AE does not guarantee that the data will be acquired into the MUSE database (successfully parsed into MUSE). It is highly recommended that the remote AE submitting data to MUSE Storage SCP AE verifies the acquisition by sending a Storage Commitment request.

2.3.3.2.1.1.1 Description and Sequencing of Activities

1. If the association request is accepted by MUSE, the remote AE can start transmitting the ECGs through C-STORE operations.
2. Storage SCP Application Entity can support multiple C-STORE operations over a single association. If the remote AE needs to send multiple SOP Instances then multiple C-STORE requests can be issued over the same association. The Storage SCP Application Entity does not use the C-STORE priority attribute.
3. The MUSE DICOM Storage Service (SCP) Application Entity can support many presentation contexts.
4. Upon receiving a SOP Instance, the MUSE DICOM Storage Service (SCP) AE would validate the SOP Instance and send a C-STORE-RSP containing a “**Success**” status if there are no errors. The SOP Instance is then submitted for parsing and storage in MUSE to the acquisition request queue.
5. If any issues are found at this stage, the MUSE DICOM Storage Service (SCP) Application Entity would send a C-STORE-RSP containing a “**Failure**” status.
6. If there are issues with the permission of the remote AE, for example, licensing or network issues, etc., that prevent the received SOP Instances from being submitted for acquisition, a C-STORE-RSP of a “**Refused**” status is returned.
7. The remote Storage SCU AE can then perform the next C-STORE operation. The association will be maintained by the Storage SCP Application Entity if possible.



2.3.3.2.1.2 Accepted Presentation Context Table

The following table shows the presentation contexts acceptable for this Application Entity for receiving SOP Instances.

Presentation Context Table - Accepted by AE DICOM Storage Service (SCP) for Activity Receive SOP Instance from Remote AE					
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 Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None

TABLE 8: ACCEPTABLE PRESENTATION CONTEXT FOR STORAGE SCP AE

2.3.3.2.1.2.1 SOP Specific Conformance Statement for all Storage SOP Classes

The MUSE DICOM Storage Service (SCP) Application Entity provides standard conformance to the DICOM Storage Service Class as SCP. No specialized or privatized Storage SOP Class can be accepted.

This Application Entity conforms to the DICOM Storage SOP Classes at Level 2 (full) as specified in DICOM Standard PS 3.4, Appendix B.4.1. No elements are discarded. All private data elements (including Unknown VR data element) will be accepted and stored as is.

2.3.3.2.1.3 C-STORE Response Status

The Storage SCP Application Entity will abort the association with an A-ABORT when the processing of store requests cannot be completed due to system failures like MUSE middle-tier and/or the database subsystem failures.

The Storage SCP will return the following status codes in a C-STORE-RSP message:

Service status	Status code	Further meaning	Status code sending explanation	Related fields send back to SCU
Success	0000	Image Accepted	Image successfully received to a Study object in the MUSE.	None
Refused	A700	Out of Resource	Processing of Store Requests cannot be	None



			completed because the MUSE database subsystem is not functioning.	
Error	A900	Cannot Understand	Following generally required data elements in the SOP Instance missed: SOP Instance UID SOP Class UID Study Instance UID Series Instance UID	None
	C000	Cannot Understand	Processing of Store Requests cannot be completed due to failure of Study Profiling (e.g., no match found and the called AE Title is unable to create new Patient / Study.).	
Warning	B000	Coercion of data elements	Some data elements have been changed to suit MUSE database elements and storage. See 2.3.3.2.1.7 For details.	None
	B007	Dataset does not match SOP class	A valid dataset was received, but there is a mismatch between what is declared and what is received.	None
	B006	Elements discarded	Some data elements have been discarded and are not stored in the MUSE database.	None

TABLE 9: STATUS CODES RETURNED IN C-STORE-RSP BY STORAGE SCP AE

2.3.3.2.1.4 SOP Instance Storage and Abnormal Association Termination

2.3.3.2.1.4.1 Data Caching

The Storage SCP Application Entity can cache several SOP Instances in memory during the receipt operation. After each SOP Instance is received, the SCP will acknowledge the receipt of the instance with a C-STORE-RSP, but will not necessarily write it to the MUSE storage system. MUSE will store the instance to the MUSE storage system only after it finishes the internal processing of the message. This will be an asynchronous operation and can continue even if the association is closed. To verify whether the instance was successfully stored to the MUSE, the SCU should use the storage commitment service.

2.3.3.2.1.4.2 SOP Instance Storage Status Conditions in the SCP

It is possible for this Storage SCP Application Entity to fail in a manner where the cached data is unrecoverable, such as a power failure. The remote SCU shall use the following rules to decide if the transmitted SOP Instances have been stored safely in MUSE:

- If the remote SCU issues an association abort (A-ABORT) or receives a provider-initiated abort (A-P-ABORT) from this Storage SCP Application Entity, the success or failure of the Storage SCP to retain any object sent on the association is undefined.
- If an association is terminated because of any network operation failure or time-out, the ability of the Storage SCP Application Entity to retain any object sent on the association is undefined.



The remote SCU implementations are strongly recommended to use the DICOM Storage Commitment service to verify the permanent storage status of the submitted SOP Instances.

2.3.3.2.1.5 Data Elements of Unknown Value Representation

The SCP will store all unknown data elements as “unknown VR (UN)”. Therefore, besides the data change / correction, certain data elements may be recomputed for the sake of the data storage, like group length, sequence length, etc.

Some data fields in the MUSE database may have a smaller field size than the size specified in the DICOM Standard. Any data values exceeding the field size of the database will be truncated:

Data Element	DICOM Size	Database Size	Behavior
Patient ID	64 Char	16 Char	The characters exceeding the size allowed by the database will be truncated. No warning returned to the SCU.
Patient Name	64 Char (Alphabetic)	Last name (40 Char), First name (20 Char)	The Patient Name will first be converted to the database format (see Table 11 : Data Elements that might be impacted by Coercion of SOP Instances) and then truncated if the size exceeds the size allowed by the database. No warning returned to the SCU.
Patient Name	Ideographic	NA	This name group will be ignored since MUSE database does not support this name.
Patient Name	Phonetic	64 char	Phonetic name is supported for Japanese Kanji names that might be sent to the MUSE encoded using ISO-IR-87. Names sent encoded in other character sets will be dropped since MUSE does not support them.

TABLE 10: DATA ELEMENTS THAT MAY BE TRUNCATED WHEN STORED IN MUSE DATABASE

2.3.3.2.1.6 Test Type Mapping for Received SOPs

MUSE determines the type of ECG received using the DICOM tag (0008,0060). Since MUSE supports only the 12 lead and general ECG waveform IODs, these are mapped to the type “ECG” in MUSE. In the case of encapsulated PDFs, MUSE will not be able to determine the difference between ECG, Stress and Holter, hence all these tests will be mapped to “ECG” and displayed as “ECG” in the MUSE UI.

2.3.3.2.1.7 Data Coercion

When MUSE receives SOP Instances, some of the DICOM data elements in the SOP Instance(s) could change. There are several reasons why this could happen and why it is necessary.

MUSE either uses interfaces to customer IS products like HIS/EMR systems or its own internal capabilities to create Patient / Study data. MUSE always assumes that the data from the HIS/EMR is the “source,” as its Patient / Study data is more accurate than the



data received from the electrocardiographs' transmitted SOP Instances. Therefore, the HIS/EMR information is always used to correct any data entry errors.

The following table lists all data elements of the SOP Instances that may undergo a data correction in MUSE. They can be different from the original values when a remote AE receives them from the Storage SCU AE of MUSE.

Attribute Name	Tag	Change Reason
Patient ID	(0010,0020)	SOP Instance is associated to another patient, or wrong Patient ID is included in the dataset.
Patient's Name	(0010,0010)	Wrong data in dataset. Most likely manual input. Please note that Patient Name may be multi-valued and encoded with extended character sets.
Patient's Birth Date	(0010,0030)	Wrong data in dataset. Most likely manual input.
Patient's Sex	(0010,0040)	Wrong data in dataset. Most likely manual input.
Other Patient IDs	(0010,1000)	Data corrected or supplemented.
Study Instance UID	(0020,000D)	SOP Instance is associated to another study. Please note, if these UID values are changed, the original values are saved in the dataset as private tags.
Accession Number	(0008,0050)	Wrong data in dataset. Most likely manual input.
Study Date	(0008,0020)	Study with multiple steps performed on different devicea, MUSE takes the earliest study date / time.
Study Time	(0008,0030)	See above.
Referring Physician's Name	(0008,0090)	Wrong data in dataset. Most likely manual input.
Study Description	(0008,1030)	Study with multiple steps performed on different devices; MUSE can only take one.
Requested Procedure ID	(0040,1001)	Data corrected or supplemented.
Series Instance UID	(0020,000E)	Series Instance UID is associated to another series. Please note, if these UID values are changed, the original values are saved in the dataset as private tags.
Series Number	(0020,0011)	User specific reasons.
SOP Instance UID	(0008,0018)	SOP Instance UID is associated to another SOP Instance. Please note, if these UID values are changed, the original values are saved in the dataset as private tags.
Image Number	(0020,0013)	User specific reasons.
Number of Images in Acquisition	(0020,1002)	User specific reasons.

TABLE 11: DATA ELEMENTS THAT MIGHT BE IMPACTED BY COERCION OF SOP INSTANCES

2.3.3.2.1.8 Presentation Context Acceptance Criterion

The MUSE DICOM Storage Service (SCP) evaluates each Presentation Context independently and accepts any Presentation Context that matches an Abstract Syntax for any real-world activity.



2.3.3.2.1.9 Transfer Syntax Selection Policies

Within each Presentation Context, the MUSE DICOM Storage Service (SCP) will accept the first proposed transfer syntax that MUSE also supports for that Abstract Syntax.

2.3.3.3 Supported Uses of SOP Instances

MUSE is usually used in the Cardiology practice for ECG management, storage, display, print, distribution etc. This DICOM Conformance Statement specifies which DICOM Storage SOP Classes are supported by MUSE as Storage SCP, i.e., they can be received by MUSE. This does not automatically confirm that all SOP Instances can be displayed, printed and/or processed in MUSE applications. This section provides information on the supported uses of those SOP Instances that can be received and successfully Normalized into MUSE.

2.3.3.3.1 Data Storage

MUSE will store all successfully received SOP Instances in its database.

2.3.3.3.2 Information Routing and Distribution

MUSE supports routing of received Studies to remote AE(s), as configured, upon successful receipt of the SOP Instances or a variety of status changes to the SOP Instance that was normalized to its database.

MUSE also provides its users the ability to manually select or run complex queries and direct the result set to remote AE(s).

2.3.3.3.3 Data Display

MUSE Editor and MUSE Web clients are able to display these SOP Instances.

2.3.3.3.4 Printing data

MUSE Editor is able to print these SOP Instances.

2.3.4 AE Specification - DICOM Storage Commitment Service – Push Model (SCU)

If configured, MUSE sends Storage Commitment requests to a remote Storage Commitment SCP for SOP Instances it transmits as a result of an automatic routing rule or manual initiation.

The Storage Commitment SCU Application Entity proposes a presentation context for the Storage Commitment – PUSH Model SOP Class as a dedicated association, or in a single association together with presentation contexts for DICOM Storage SOP Classes.

The Storage Commitment SCU Application Entity provides Standard Conformance to the following SOP Classes as SCP:



SOP Class Name	SOP Class UID	SCU	SCP
Storage Commitment (Push model)	1.2.840.10008.1.20.1	Yes	No

TABLE 12: SOP CLASS SUPPORTED FOR STORAGE COMMITMENT REQUEST IN MUSE DICOM STORAGE SCP AE

Note: The MUSE DICOM Storage Service (SCU) AE uses the same AE title for requesting both storage and storage commitment from the SCP. Hence MUSE provides a single configuration for the AE title for both Storage and Storage Commitment. However, the MUSE DICOM Storage Service (SCU) AE uses a different port for receiving the N-Event-Report for storage commitment. The remote SCPs need to configure the storage commitment port of the SCU using the same AE details as the Storage SCU details but different port number.

2.3.4.1 Association Establishment Policies

Please refer to [2.3.1](#) for the common association policies that are applicable for all Application Entities.

2.3.4.1.1 General

Please refer to [2.3.1.2.1](#) for the Application Context Name presented by this Application Entity.

Please refer to [2.3.1.1](#) for the maximum PDU receive size for this Application Entity.

The maximum number of concurrent associations and the maximum PDU size for MUSE DICOM Storage Commitment (SCU) Application Entity is the same as the maximum concurrent associations and maximum PDU size configured for the Storage SCU. A separate configuration is NOT provided for the Storage Commitment.

2.3.4.1.2 Asynchronous Nature

Please refer to [2.3.1.2.2](#) for asynchronous association policy for this Application Entity.

2.3.4.1.3 Implementation Identifying Information

Please refer to [2.3.1.2.3](#) for Implementation Identification information for this Application Entity.

2.3.4.2 Association Acceptance Policies

The MUSE DICOM Storage Service (SCU) will listen on a configurable port for N-EVENT-REPORT corresponding to all the outstanding storage commitment transactions. The remote storage commitment SCP is expected to open an unsolicited association to send an N-EVENT-REPORT response for these requests.



2.3.4.2.1 Real-World Activity - Receive Storage Commitment Response from Remote AE

2.3.4.2.1.1 Associated Real-World Activity

2.3.4.2.1.1.1 Description and Sequencing of Activities

The following real-world activities are associated with the Sending Storage Commitment response receive operation.

1. Remote Storage Commitment SCP initiates an unsolicited N-EVENT-REPORT on a dedicated association. No operator intervention is required to receive these reports.
2. Upon receipt of N-EVENT-REPORT, the MUSE DICOM Storage Service (SCU) Application Entity will inspect the response and perform the following:
 - If MUSE is functioning as a forwarding node to a DICOM destination, it will delete the local copy of the SOP Instance for which a “Successful” response was received.
 - Otherwise, MUSE will mark the transmission requests that caused these responses a “Success.”

2.3.4.2.1.2 Accepted Presentation Context Table

Presentation Context Table – Accepted by AE DICOM Storage Service (SCU) for Activity Receive storage commitment response from Remote AE					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment (Push model)	1.2.840.10008.1.20.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	SCU/SCP role selection

TABLE 13: ACCEPTED PRESENTATION CONTEXT FOR STORAGE COMMITMENT BY STORAGE SCU AE

The DICOM Storage Service (SCU) will support SCU/SCP Role Reversal selection negotiation for the presentation contexts of the Storage Commitment - PUSH Model SOP Class.

2.3.4.2.1.2.1 SOP Specific DICOM Conformance Statement for Storage Commitment (Push Model)

Storage SCU Application Entity uses a N-EVENT-REPORT DIMSE service element for the Storage Commitment response processing. Once the response is received, the following actions will be taken depending on the status of response.



2.3.4.2.1.3 Commit response with SUCCESS status

The following attributes are expected as part of the dataset for N-EVENT-REPORT from the remote Storage Commitment 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

2.3.4.2.1.4 Commit Response with FAILURE Status

The following attributes are expected as part of the dataset 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

The “Success” flag is set for the transmission request for all the successful instances. In case of complete/partial failure, the Storage SCU Application Entity would update the transmission request to “Failed” or “Partial Failure” and the request will be marked for a retry. The number of retries for a failed job is configurable in MUSE and is set to 3 by default. Retry requests will be treated as new requests and will go through the whole sequence of operations once again.

The failure reason, if returned by remote Storage Commitment SCP, will be logged as part of the status of the transmission request process. The failed SOP Instances will not be deleted if “Auto delete upon transmission” has been set on the remote AEs.

2.3.4.2.1.5 Presentation Context Acceptance Criterion

The MUSE DICOM Storage Service (SCU) evaluates each Presentation Context independently, and accepts any Presentation Context that matches an Abstract Syntax for any real-world activity.

2.3.4.2.1.6 Transfer Syntax Selection Policies

Within each Presentation Context, the MUSE DICOM Storage Service (SCU) will accept the first proposed transfer syntax that it also supports for that Abstract Syntax.



2.3.4.3 Association Initiation Policy

Storage Commitment Requests are queued in MUSE right after a successful C-STORE-RSP is received for the transmitted SOP Instances. The remote AE to which the storage commitment requests are to be sent can either be the same as the remote AE to which the C-Store request was sent, or it can be a different AE. A separate Storage commitment thread will then initiate an association to the remote storage commitment SCP to send the requests using N-ACTION.

MUSE allows different AE titles for the Storage Commitment request and the Store SCP in the remote AE configuration.

2.3.4.3.1 Real-World Activity - Send Storage Commitment Request to the Remote AE

2.3.4.3.1.1 Associated Real-World Activity

If the remote AE is configured to support Storage Commitment, and MUSE is configured to take advantage of this option, the MUSE DICOM Storage Service (SCU) Application Entity will initiate a request for Storage Commitment. The following DIMSE service elements are supported for the Storage Commitment request processing.

As explained earlier, the SOP Instances in the selected tests are sent to the remote Storage SCP AE using DICOM C-STORE operations.

- If there are any C-STORE-RSP failures in the transfers, the Storage Commitment request will not be sent. The corresponding send request will be marked as “Failed” and the user will be notified of the request’s status.
- For the SOP Instances for which a C-STORE-RSP of “Success” is received, the Storage SCU Application Entity initiates DIMSE N-ACTION requesting Storage Commitment in a separate association.
- The Storage SCU Application Entity then waits for an N-ACTION-REPORT from the Storage Commitment SCP on a different association for a configurable amount of time. This association has to be initiated by the remote Storage Commitment SCP.
- Storage SCU Application Entity will then change the transmission request status to “Waiting for Storage Commitment” indicating the request is waiting for the response from the remote Storage Commitment SCP AE.
- Storage SCU Application Entity will eventually mark the request as “Failed” if the response is not received within the stop time. Stop time is the maximum duration the request can wait for responses. Optionally these failed attempts could be retried.
- A New transaction UID will be created for each retry by the user. The old transaction UID is not applicable for these requests.



2.3.4.3.1.2 Proposed Presentation Context Table

The following table shows the Presentation Context proposed by the MUSE DICOM Storage Service (SCU) Application Entity when requesting Storage Commitment to remote AEs to send DICOM SOP Instances:

Presentation Context Table - Proposed by AE The MUSE DICOM Storage Service (SCU) for Activity Send Storage Commitment Request to the Remote AE					
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	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

TABLE 14: PROPOSED PRESENTATION CONTEXT FOR STORAGE COMMITMENT REQUESTS BY STORAGE SCU AE

2.3.4.3.1.2.1 SOP Specific DICOM Conformance Statement for the Storage Commitment Push Model SOP Class SCU

The DICOM Storage Commitment (SCU) will only accept the SCU role (which must be proposed via SCP/SCU Role Selection Negotiation) within a Presentation Context for the Storage Commitment Push Model SOP Class.

Upon receiving a Storage Commitment N-EVENT-REPORT (Storage Commitment Result), the DICOM Storage Service (SCU) will validate the Transaction UID against its list of outstanding Storage Commitment Request Transaction UIDs. If it matches an outstanding Request, the AE will mark all SOP Instances for which a success status is indicated as archived and change the status of the corresponding storage request from “waiting for storage commitment” to “Success.”

If the Storage Commitment Result indicates any failure status, the status of the corresponding storage request will be changed to "Failed." The storage and storage commitment for the corresponding transaction will be attempted again for a configurable number of times before failing the request permanently. An error message will be logged, including the Failure Reason (0008,1197) attribute values.

The Storage SCP AE provides the following data elements in the dataset in its request:

Data Element	Tag	Description	Value sent to the SCP
Transaction UID	(0008,1195)	UID to identify this request	YES
Referenced SOP Sequence	(0008,1199)	A list of SOP Instances for which storage commitment is requested	YES
> Referenced SOP Class UID	(0008,1150)	SOP Class UID of the instance	YES
> Referenced SOP Instance UID	(0008,1155)	SOP Instance UID of the instance	YES

TABLE 15: DATA ELEMENTS SENT IN STORAGE COMMITMENT REQUEST BY STORAGE SCU AE



The Storage SCU AE does not use the following data elements in a Storage Commitment request.

Data Element	Tag	Description	Value sent to the SCP
Storage Media File-Set ID	(0088,0130)	The DICOM File-Set from all SOP Instances can be retrieved.	Not Set
Storage Media File-Set UID	(0088,0140)		
Referenced Study Component Sequence	(0008,1111)	The Study Component that contains all SOP Instances listed in the referenced SOP sequence.	Not set

TABLE 16: DATA ELEMENTS UNUSED IN STORAGE COMMITMENT REQUEST BY STORAGE SCU AE

The MUSE DICOM Storage Service (SCU) does not send back any status codes to the SCP in its response N-Event-Report except for success (0000). In case of failure, the DICOM Storage Service (SCU) will log the error internally.

2.3.5 AE Specification - DICOM Storage Commitment Service – Push Model (SCP)

The MUSE DICOM Storage Commitment (SCP) Application Entity provides Standard Conformance to the following DICOM SOP Classes as an SCU:

SOP Class Name	SOP Class UID	SCU	SCP
Storage Commitment Push Model	1.2.840.10008.1.20.1	No	Yes

TABLE 17: SOP CLASSES SUPPORTED BY STORAGE COMMITMENT SCP AE

2.3.5.1 Association Establishment Policies

Please refer to 2.3.1 for the common association policies that are applicable for all Application Entities. This section describes policies and/or deviations that are applicable to this Application Entity.

2.3.5.1.1 General

Please refer to 2.3.1.2.1 for the Application Context Name presented by this Application Entity.

Please refer to 2.3.1.1 for the maximum PDU receive size for this Application Entity.

2.3.5.1.2 Number of Associations

The DICOM Storage Service (SCP) will be able to accept a maximum of 5 associations from a remote AE.



The maximum number of concurrent associations that the DICOM Storage SCP Application Entity can accept for receiving SOP Instances is configurable. By default this value is set to 5.

The maximum number of concurrent associations that the DICOM Storage SCP Application Entity can initiate for sending Storage Commitment Response is set to 1.

2.3.5.1.3 Asynchronous Nature

Please refer to [2.3.1.2.2](#) for asynchronous association policy for this Application Entity.

2.3.5.1.4 Implementation Identifying Information

Please refer to [2.3.1.2.3](#) for Implementation Identification information for this Application Entity.

2.3.5.2 Association Initiation Policy

The DICOM Storage Commitment Service (SCP) Application Entity initiates a DICOM association to send Storage Commitment responses to a remote AE, in response to a previously received Storage Commitment requests. MUSE accepts association only from those remote AEs that are in its list of registered AEs.

2.3.5.2.1 Real-World Activity - Send Storage Commitment response to remote AE

2.3.5.2.1.1 Associated Real-World Activity

The MUSE DICOM Storage Commitment (SCP) Application Entity initiates a DICOM association to send Storage Commitment responses to a remote AE, in response to previously received Storage Commitment requests.

2.3.5.2.1.1.1 Description and sequencing of activities

The MUSE DICOM Storage Commitment (SCP) AE will always initiate a new DICOM association to send DICOM Storage Commitment responses. It will never send a DICOM Storage Commitment response in the same DICOM association in which a request was received.

The MUSE DICOM Storage Commitment (SCP) AE will always initiate one single DICOM association for sending the Storage Commitment report simultaneously. Multiple Storage Commitment reports will be sent subsequently.

2.3.5.2.1.2 Proposed Presentation Context

The MUSE DICOM Storage Commitment (SCP) Application Entity will propose the following presentation context to send a Storage Commitment report to a remote AE.



The following table shows the presentation contexts acceptable for this Application Entity for receiving SOP Instances.

Presentation Context Table - Proposed by AE MUSE DICOM Storage Commitment (SCP) for Activity Send Storage Commitment response to remote AE					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment – Push Model	1.2.840.10008.1.20.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	SCP/SCU Role Selection Negotiation

TABLE 18: PROPOSED PRESENTATION CONTEXT FOR STORAGE COMMITMENT REPORT

The MUSE DICOM Storage Commitment (SCP) AE will propose SCU/SCP Role Reversal selection negotiation for the presentation contexts of the Storage Commitment - PUSH Model SOP Class.

2.3.5.2.1.2.1 SOP Specific DICOM Conformance Statement for the Storage Commitment Push Model SOP Class SCP

The DICOM Storage Commitment (SCP) AE will propose the SCP role (via SCP/SCU Role Selection Negotiation) within a Presentation Context for the Storage Commitment Push Model SOP Class. If the destination does not accept that Role Negotiation, the AE will not be able to send Storage Commitment Results using N-Event-Report Requests.

The Storage SCP Application Entity will invoke the N-EVENT-REPORT operation in the established association to send a Storage Commitment response to the remote AE, in response to a previously received Storage Commitment transaction.

The Storage SCP Application Entity can send one or more Storage Commitment responses over a single association. MUSE guarantees storage of the committed SOP Instances.

The Storage SCP Application Entity will use the Event Type ID value 1 to send a Success Storage Commitment response and will include the following data elements in the data part of N-EVENT-REPORT-RQ:

Data Element	Tag	Description
Transaction UID	(0008,1195)	UID to identify this Storage Commitment transaction to respond.
Referenced SOP Sequence	(0008,1199)	A list of SOP Instances to be committed in MUSE. This sequence should match the requested sequence in the corresponding Storage Commitment request.
> Referenced SOP Class UID	(0008,1150)	SOP Class UID of the instance.
> Referenced SOP Instance UID	(0008,1155)	SOP Instance UID of the instance.

TABLE 19: DATA ELEMENTS INCLUDED IN SUCCESSFUL STORAGE COMMITMENT REPORT



The Storage SCP Application Entity will use the Event Type ID value 2 to send a “Failure” response and will include the following data elements in the data part of N-EVENT-REPORT-RQ:

Data Element	Tag	Description
Transaction UID	(0008,1195)	UID used to identify the Storage Commitment transaction to respond to.
Referenced SOP Sequence	(0008,1199)	A list of SOP Instances that are successfully committed for long-term archiving in MUSE.
> Referenced SOP Class UID	(0008,1150)	SOP Class UID of the instance.
> Referenced SOP Instance UID	(0008,1155)	SOP Instance UID of the instance.
Failed SOP Sequence	(0008,1150)	A list of SOP Instances that are NOT committed for long-term archiving in MUSE.
> Referenced SOP Class UID	(0008,1150)	SOP Class UID of the instance.
> Referenced SOP Instance UID	(0008,1155)	SOP Instance UID of the instance.
> Failure Reason	(0008,1197)	Reason that the SOP Instance is not committed for long-term archiving.

TABLE 20: DATA ELEMENTS INCLUDED IN FAILED STORAGE COMMITMENT RESPONSE BY STORAGE SCP AE

For any status response received for the N-Event-Report other than success (0000), the DICOM Storage Service (SCP) will record an error in the MUSE logs.

2.3.5.3 Association Initiation Policy

2.3.5.3.1 Real-World Activity - Receive Storage Commitment Request from Remote AE

2.3.5.3.1.1 Associated Real-World Activity

The Storage SCP Application Entity is able to accept a Presentation Context for the Storage Commitment – PUSH Model SOP Class either in a dedicated association or in a single association together with Presentation Contexts for Storage SOP Classes. The behavior of the Storage SCP AE with respect to the Storage Commitment service is the same in both cases.

The following real-world activities are associated with the Receive Storage Commitment Request operation:

- Typically remote Storage SCU AE would also send a Storage Commitment Request in the same association in which they perform the C-STORE operation with Storage SCP Application Entity. MUSE does not send Storage Commitment just based on the mere success of having received a SOP Instance. MUSE confirms storage only upon its ability to successfully “Normalize” the SOP Instance.
- Hence, MUSE Storage SCP Application Entity will place a request in the MUSE Storage Commitment Queue for a response to be sent to the remote Storage SCU AE at a later time.



- The request would include all SOP Instances requested for Storage Commitment, as well as the calling remote DICOM AE Title.
- For each request, a timer is started when it is added to the Storage Commitment Queue.
- The Storage SCP Application Entity constantly polls the queue for requests for which a response can be sent back to the original requester. For this, it relies on MUSE internal software processes to update the request indicating that the SOP Instance could be “**Normalized**” into MUSE database.

Note: Other components of MUSE will process the Storage Commitment Queue and update the status of the requests (pending / completed / failed / time-out). This implementation is beyond the scope of this conformance statement document.

2.3.5.3.1.2 Accepted Presentation Context Table

Presentation Context Table - Accepted by AE DICOM Storage Service (SCP) for Activity Receive Storage Commitment Request from Remote AE					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment (Push model)	1.2.840.10008.1.20.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None

2.3.5.3.1.2.1 SOP Specific Conformance Statement for Storage Commitment SOP Class

The MUSE DICOM Storage Service (SCP) Application Entity provides standard conformance to the DICOM Storage Commitment Service as SCP. The Storage SCP Application Entity uses the DIMSE service element N-ACTION to receive a Storage Commitment request.

The Storage SCP Application Entity supports the following data elements in the dataset received in the N-ACTION request:

Data Element	Tag	Description
Transaction UID	(0008,1195)	UID to identify this request.
Referenced SOP Sequence	(0008,1199)	A list of SOP Instances to be requested for storage commitment.
> Referenced SOP Class UID	(0008,1150)	SOP Class UID of the instance.
> Referenced SOP Instance UID	(0008,1155)	SOP Instance UID of the instance.

TABLE 21: DATA ELEMENTS SUPPORTED IN STORAGE COMMITMENT REQUEST BY STORAGE SCP AE

The MUSE DICOM Storage Service (SCP) Application Entity will ignore the following data elements if they are included in a Storage Commitment request.



Data Element	Tag	Description
Storage Media File-Set ID	(0088,0130)	The DICOM File-Set from all SOP Instances can be retrieved.
Storage Media File-Set UID	(0088,0140)	
Referenced Study Component Sequence	(0008,1111)	The Study Component that contains all SOP Instances listed in the referenced SOP sequence.

TABLE 22: DATA ELEMENTS IN STORAGE COMMITMENT REQUEST IGNORED BY STORAGE SCP AE

The MUSE DICOM Storage Service (SCP) Application Entity will accept a Storage Commitment request for referenced SOP Instances already received (known objects) as well as those not yet received at that moment (unknown objects).

If the unknown objects are received and stored successfully at a later time (before the Storage Commitment timer expires), a “Success” response will be sent to the requester.

The MUSE DICOM Storage Service (SCP) AE will return a “Success” Status Code in N-ACTION-RSP to indicate that the Storage Commitment transaction is received successfully and queued in the MUSE for processing. A Storage Commitment response will be sent to the remote AE via the N-EVENT-REPORT operation.

The MUSE DICOM Storage Service (SCP) AE will return a “Failure” Status Code in N-ACTION-RSP to indicate that the receipt of the Storage Commitment request failed or the transaction cannot be processed. No Storage Commitment response will be sent to the remote AE.

2.3.5.3.1.3 Presentation Context Acceptance Criterion

The MUSE DICOM Storage Service (SCP) evaluates each Presentation Context independently and accepts any Presentation Context that matches an Abstract Syntax for any real-world activity.

2.3.5.3.1.4 Transfer Syntax Selection Policies

Within each Presentation Context the MUSE DICOM Storage Service (SCP) will accept the first proposed transfer syntax that it also supports for that Abstract Syntax.

2.3.6 AE Specification - MUSE DICOM Modality Worklist Find (SCU)

The MUSE Modality Worklist SCU Application Entity supports querying a remote Worklist SCP for items with query keys as described in this Implementation.

This Application Entity provides Standard Conformance to the following SOP Class:

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes	No



Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	No
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TABLE 23: SOP CLASS FOR MODALITY WORKLIST SCU AE

2.3.6.1 Association Establishment Policies

Please refer to [2.3.1](#) for the common association policies that are applicable for all Application Entities. This section describes policies and/or deviations that are applicable to this Application Entity.

2.3.6.1.1 General

Please refer to [2.3.1.2.1](#) for the Application Context Name presented by this Application Entity.

Please refer to [2.3.1.1](#) for the maximum PDU receive size for this Application Entity.

2.3.6.1.2 Number of Associations

MUSE DICOM Modality Worklist Find (SCU) will initiate a maximum of 5 simultaneous associations to remote nodes.

2.3.6.1.3 Asynchronous Nature

Please refer to [2.3.1.2.2](#) for asynchronous association policy for this Application Entity.

2.3.6.1.4 Implementation Identifying Information

Please refer to [2.3.1.2.3](#) for Implementation Identification information for this Application Entity.

2.3.6.2 Association Initiation Policy

MUSE DICOM Modality Worklist Find (SCU) Application Entity would open a dedicated association with a remote Worklist SCP for querying Worklist items at scheduled intervals.

2.3.6.2.1 Real-World Activity - Query Modality Worklist items from a remote AE

2.3.6.2.1.1 Associated Real-World Activity

2.3.6.2.1.1.1 Description and Sequencing Activities

In order to obtain Modality Worklist items, the MUSE Modality Worklist SCU Application Entity performs the following steps.



1. Once the association is successful, the MUSE Modality Worklist SCU Application Entity issues DIMSE C-FIND command with the query attributes.
2. MUSE DICOM Modality Worklist Find (SCU) then keeps this association open and waits for the C-FIND-RSP from the remote Worklist SCP.
3. The remote Modality Worklist SCP might provide more than one C-FIND-RSP object. The association is kept open until a C-FIND-RSP with a Status of **“Complete”** (0000) is received.
4. As each response comes in, the Modality Worklist SCU Application Entity parses the content and creates the corresponding entries in the MUSE database.

2.3.6.2.1.2 Proposed Presentation Context Table

The following table shows the Presentation Contexts proposed by DICOM Modality Worklist – Find (SCU) Application Entity to remote AEs:

Presentation Context Table – Proposed by MUSE DICOM Modality Worklist Find (SCU) for Activity Query Modality Worklist items from a remote AE					
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 Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

TABLE 24: PROPOSED PRESENTATION CONTEXT BY MODALITY WORKLIST SCU AE

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

The following elements are used by the Modality Worklist SCU Application Entity as query fields to filter the Modality Worklist. The query fields are configurable. A wildcard asterisk character (*) might be used in the query fields to do a broad query.

Description / Module	Tag
Scheduled Procedure Step	
Scheduled Procedure Step Sequence	(0040,0100)
>Scheduled Station AE Title	(0040,0001)
Imaging Service Request	
Current Patient Location	(0038,0300)

TABLE 25: FIELDS USED FOR FILTERING MODALITY WORKLIST

At regular intervals of time, which are configurable, the MUSE DICOM Modality Worklist Find (SCU) makes a broad based query to the SCP. The MUSE parses the matching responses, converts them into its internal format, and displays them as orders in its UI.



2.3.6.2.1.2.1.1 Processing Modality Worklist C-Find responses

MUSE Modality SCU expects the following return keys for proper functioning and delivery of full workflow capabilities as described by the product literature. Integrators are advised to check with the remote Modality Worklist SCP conformance statement and confirm that these are available in the response from the SCP.

The Modality Worklist SCU Application Entity will reject the association if it does not find the following keys in the response from the remote Modality Worklist SCP AE it is querying against

Description / Module	Tag
Scheduled Procedure Step	
Scheduled Procedure Step Sequence	(0040,0100)
>Scheduled Station AE Title	(0040,0001)
>Scheduled Procedure Step Start Date	(0040,0002)
>Scheduled Procedure Step Start Time	(0040,0003)
>Modality	(0008,0060)
>Scheduled Performing Physician's Name	(0040,0006)
>Scheduled Procedure Step Description	(0040,0007)
>Scheduled Procedure Step Location	(0040,0011)
Requested Procedure	
Requested Procedure ID	(0040,1001)
Requested Procedure Description	(0032,1060)
Requested Procedure Code Sequence	(0032,1064)
>Code Value	(0008,0100)
>Code Meaning	(0008,0104)
Study Instance UID	(0020,000D)
Study Date	(0008,0020)
Study Time	(0008,0030)
Referenced Study Sequence	(0008,1110)
>Referenced SOP Class UID	(0008,1150)
>Referenced SOP Instance UID	(0008,1155)
Requested Procedure Priority	(0040,1003)
Imaging Service Request	
Accession Number	(0008,0050)
Requesting Physician	(0032,1032)
Referring Physician's Name	(0008,0090)
Visit Identification	
Admission ID	(0038,0010)
Current Patient Location	(0038,0300)
Patient Identification	
Patient's Name	(0010,0010)
Patient ID	(0010,0020)
Patient Demographic	
Patients Birth Date	(0010,0030)
Patient's Sex	(0010,0040)
Patient's Weight	(0010,1030)
Patient Medical	
Medical Alerts	(0010,2000)

TABLE 26: MODALITY WORKLIST RESPONSE KEY MAPPING INFORMATION



For any response code other than success (0000) MUSE will log an error to internal error logs.

2.3.6.2.1.2.1.1.1 Extended Character Sets

The Patient Name (0010, 0010) may be multi-valued to include Ideographic and Phonetic name groups in addition to an Alphabetic Name. While the Alphabetic Name is always encoded with ISO-IR-8859-1 character sets, the Ideographic and Phonetic Names (other than Kanji names) will be ignored. Refer to page [59](#) for the list of supported character sets.

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.

2.4.2 Physical Media Support

None of the MUSE Application Entities make assumptions or have limitations pertaining to the physical media over which the TCP/IP stack is implemented.

2.5 EXTENSIONS / SPECIALIZATIONS/ PRIVATIZATIONS

2.5.1 Standard Extended / Specialized / Private SOP Classes

MUSE Application Entities do not implement any private/extended/specialized SOP class.

2.5.2 Private Transfer Syntaxes

No Private Transfer Syntax is supported.

2.6 CONFIGURATION

The exact method for configuring each configurable item is specified in other MUSE documentation. The following sections describe only certain configurable items.

2.6.1 AE Title/Presentation Address Mapping

All configurations below are to be made by qualified GE Field Engineers.



2.6.2 Configurable Parameters

2.6.2.1 Local AE Title

- AE Titles of the Storage SCP AE for receiving SOP Instances and Storage Commitment requests.
- AE Titles of the Storage SCU AE for sending SOP Instances.
- AE Titles of the Storage SCU AE for receiving Storage Commitment reports.
- AE Titles of the Modality Worklist SCU AE for querying and receiving DICOM modality worklists from remote Modality Worklist SCPs.

2.6.2.2 Remote AE Title

- AE Titles of the remote AEs with which MUSE will interact for receiving / sending SOP Instances, serving Storage Commitment requests and Modality Worklist requests.
- A local mechanism is provided to configure a remote AE Title / Presentation Address mapping table. This table contains the following data items for each AE entry:
 - AE Title
 - AE Name
 - TCP/IP addresses
 - TCP Port Number

If the remote AE is a Storage SCP, an additional configuration to request Storage Commitment can be configured as shown below:

- Request Storage Commitment?
- Storage Commitment SCP (Can be the same as Storage SCP)
 - AE Title
 - AE Name
 - TCP/IP addresses
 - TCP Port Number



2.6.3 Maximum PDU Size Accepted

The Maximum Length of PDU negotiated by MUSE is configurable up to the maximum value of 65535 bytes.

2.6.4 MUSE DICOM Time-out

The following time-out values are configurable on the MUSE side.

- Association time-out
- Association operation inactivity time-out
- Storage Commitment SCU request association wait-time
- Storage Commitment SCU request stop-time
- Storage Commitment SCP request / response time-out
- Modality Worklist query time-out

2.6.4.1.1 Remote AE Title / Presentation Address Mapping

2.7 SUPPORT OF EXTENDED CHARACTER SETS

MUSE supports following character sets:

- ISO-IR-87 (Japanese Kanji)
- ISO-IR-149 (Korean)
- ISO-IR-192 (Unicode UTF-8)
- ISO 8859 (Latin)
- ISO 10646

In some Application Entities of MUSE, restrictions may apply to the extended character sets. See the “Extended Character Sets” subsection found under Association Policies which is located under the scope of each Application Entities for details.

2.8 CODES AND CONTROLLED TERMINOLOGY

The product uses no coded terminology.

2.9 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))

END OF DOCUMENT