SoliPACS Server

DICOM Conformance Statement
Volume 3
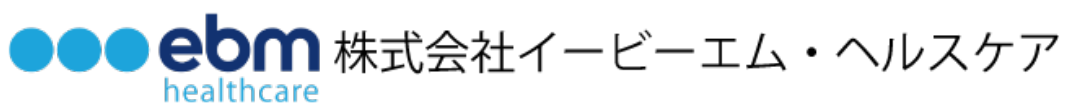
<Workflow Option>

Revision 1.0
Software Version 11.1 and after

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Prepared for

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1. CONFORMANCE STATEMENT OVERVIEW

This document is DICOM Conformance Statement of SoliPACS Server that supports DICOM SOP Classes associated with a Radiology Information System or Hospital Information System. The document is compiled in accordance with DICOM PS 3.2-2004 (Supplement 64 "Revised Part 2 (Conformance)").

As part of PACS Integration, SoliPACS Server supports several DICOM Service Classes to provide the following capabilities:

- Allowing Modalities to query for worklist of procedures to be performed and for patient and procedure demographics. SoliPACS Server processes these queries by directly accessing the SoliPACS Server database, which is automatically updated with appropriate data through the normal operations of the HIS/RIS.

- Updating the SoliPACS Server database in response to Procedure Step transactions initiated by Modalities as they perform examinations. Relevant data contained in these transactions may be viewed on client PCs.

Networking Service Classes	User of Service	Provider of Service
Workflow Management		
Modality Worklist	No	Yes
Modality Performed Procedure Step	No	Yes

2. TABLE OF CONTENTS

3. Introduction

3.1 Revision History

Document Revision	Date	Author	Description
1.0	January 15, 2008	M. Kobayashi	Initial

3.2 Audience

This document is intended for hospital staff, health system integrators, software designers or implementers. It is assumed that the reader has a working understanding of DICOM.

3.3 Remarks

DICOM, by itself, does not guarantee interoperability. However, the Conformance Statement facilitates a first-level validation for interoperability between different applications supporting the same DICOM functionality.

This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended.

The scope of this Conformance Statement is to facilitate communication between the SoliPACS Server and other DICOM systems. The Conformance Statement should be read and understood in conjunction with the DICOM Standard [DICOM]. However, by itself it is not guaranteed to ensure the desired interoperability and a successful interconnectivity.

The user should be aware of the following important issues:

— The comparison of different Conformance Statements is the first step towards assessing interconnectivity between SoliPACS Server and other DICOM conformant equipment.

— Test procedures should be defined to validate the desired level of connectivity.

— The DICOM standard will evolve to meet the users' future requirements. SoliPACS Server is actively involved in developing the standard further and therefore reserves the right to make changes to its products or to discontinue its delivery.

3.4 Definitions and Abbreviation

AE	Application Entity
DICOM	Digital Imaging and Communications in Medicine
IE	Information Entity
IOD	Information Object Definition
ISO	International Standards Organization
PDU	Protocol Data Unit
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
VM	Value Multiplicity
VR	Value Representation
HIS	Hospital Information System
MWL	Modality Worklist
MPPS	Modality Performed Procedure Step
SPS	Scheduled Procedure Step

4. NETWORKING

4.1 Implementation Model

4.1.1 Application Data Flow
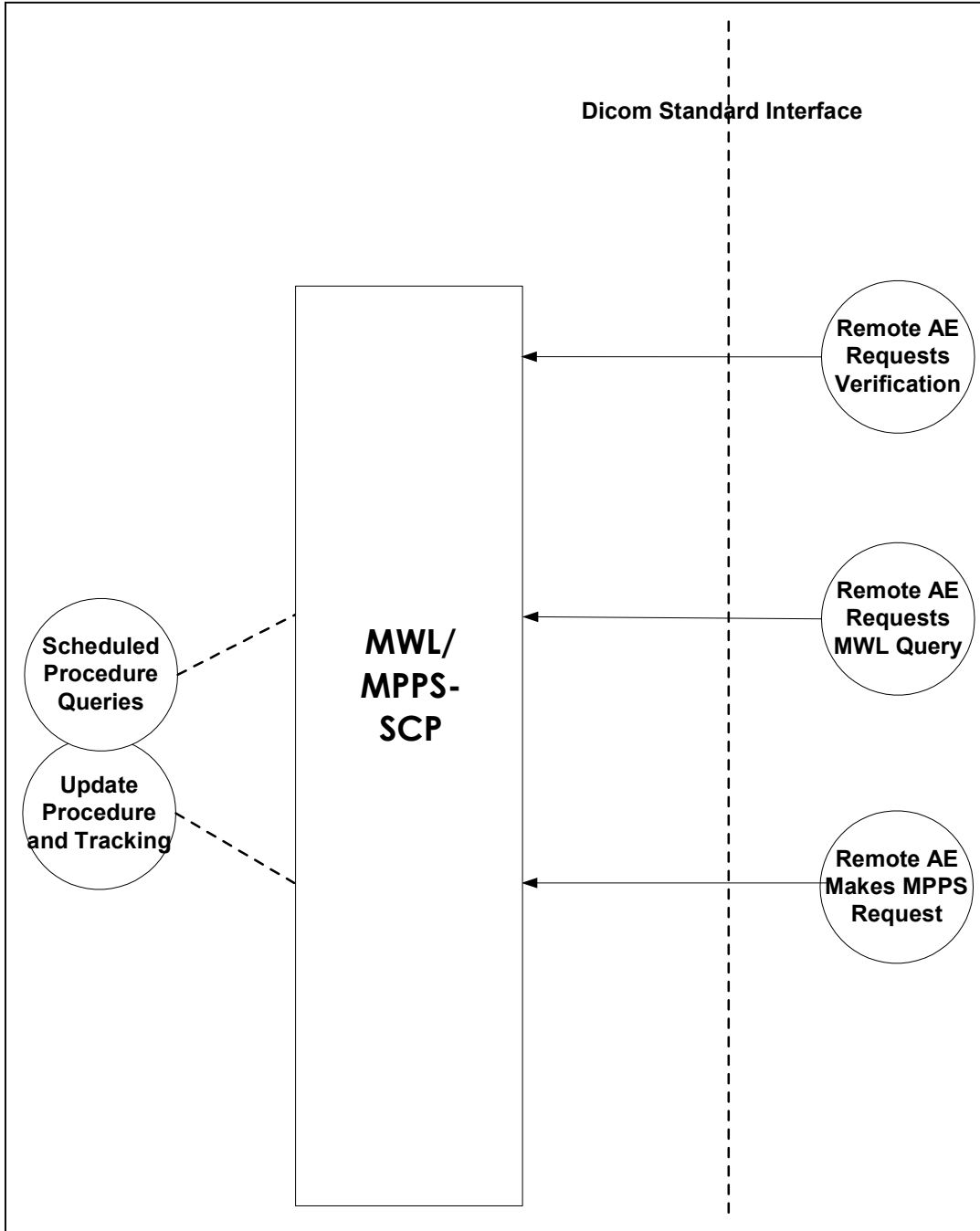
FIGURE 4.1-1

DATA FLOW DIAGRAM

The SoliPACS Server MWL/MPPS-SCP application provides access to Scheduled Procedure information. The various flows in the diagram above are described as

follows:

MWL/MPPS-SCP accepts associations for Verification from Verification SCUs and responds automatically with Success status

MWL/MPPS-SCP accepts Association Requests for from MWL SCUs and responds to queries from these SCUs. When a query is received MWL/MPPS-SCP engages in local real-world activity Scheduled Procedure Queries. This results in a set of matching responses that MWL/MPPS-SCP returns to the Worklist SCU.

MWL/MPPS-SCP accepts Association Requests for Modality Performed Procedure Step from MPPS SCUs and responds to N-CREATE and N-SET Requests from these SCUs. When an N-CREATE or N-SET is received, MWL/MPPS-SCP engages in local real-world activity Update Procedure and Tracking. This results in updates to the SoliPACS Server database per the contents of the received message. MWL/MPPS-SCP then returns N-SET or N-CREATE status to the MPPS SCU.

4.1.2 Functional Definition of AEs

4.1.2.1 Functional Definition of MWL/MPPS-SCP Application Entity

MWL/MPPS-SCP is a background process running on a Windows Server 2003. Multiple instances of MWL/MPPS-SCP may be running at any one time. The application may be started/restarted interactively via a utility. In addition, there is a monitoring process that restarts the application automatically should its listening port be closed by failure or malfunction.

MWL/MPPS-SCP will listen for connection requests at the Presentation Address configured for its AE Title. This application is an implementation of a concurrent server; it forks a new process for each connection request it receives. Each forked process exists for the life of a single association and then exits. MWL/MPPS-SCP will accept Presentation Contexts for the Modality Worklist Management, Modality Performed Procedure Step and Verification SOP Classes. Validation of DICOM Service Request messages is performed and may return Failure status in the event of an invalid Service Request according to the specifications in the standard. Upon receipt of a Verification Request MWL/MPPS-SCP will respond with a successful Verification response. When a Worklist query is received MWL/MPPS-SCP will query the SoliPACS Server database for a list of Scheduled Procedure Steps matching the query and will return a pending C-Find response for each match. Before SoliPACS Server can include patient and order information in response to a Modality Worklist query, patient and order information must be registered in the SoliPACS Server database. Patient and order information is typically interfaced to SoliPACS Server

from a HIS but can also be entered directly into SoliPACS Server using dedicated client application or interface application. Reception of an MPPS N-CREATE or N-SET request may result in updates to various tables in the SoliPACS Server database and may result in changes to the tracking status of the Requested Procedure(s) referenced within the message.

4.1.3   Sequencing of Real World Activities
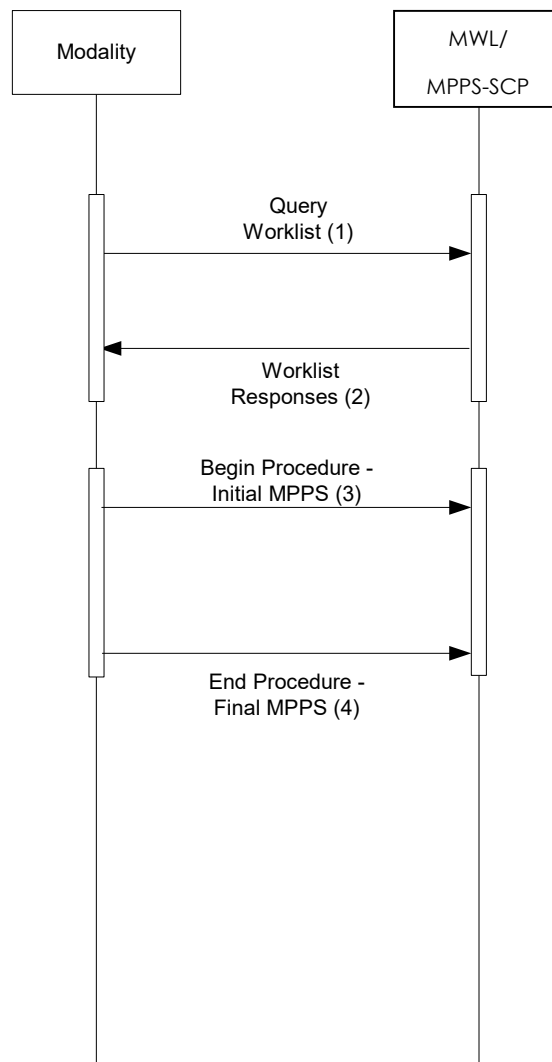
Figure 4.1.-2

SEQUENCING CONSTRAINTS

Under normal circumstances the sequencing depicted above applies:

1.   The Modality queries for a worklist of Scheduled Procedure Steps

2.   MWL/MPPS-SCP searches its database and returns matches to the query

3. The Modality begins performance of a Procedure Step and sends the MPPS N-CREATE with status of IN PROGRESS

4. The Modality completes or discontinues the procedure and sends the MPPS N-SET with status of COMPLETED or DISCONTINUED

The workflow above is not the only one possible sequence. For example, in an unscheduled flow there may be no worklist query prior to the performance of the procedure and the sending of MPPS messages. The flow would also be altered, if the Modality did not support both Modality Worklist and MPPS. The Description and Sequencing of Activities and the SOP Specific Conformance sections below for the respective Real World Activities provide additional details.

4.2 AE Specifications

4.2.1 MWL/MPPS-SCP AE Specification

This application provides Standard Conformance to the following DICOM 3.0 SOP Classes:

4.2.1.1 SOP Classes

Table 4.2-1

SOP CLASSES FOR AE MWL/MPPS-SCP

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	No	Yes
Modality Worklist Management	1.2.840.10008.5.1.4.31	No	Yes
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	No	Yes

4.2.1.2 Association Policies

4.2.1.2.1 General

The Application Context Name for DICOM 3.0 is the only Application Context proposed.

Table 4.2-2

DICOM APPLICATION CONTEXT

Application Context Name	1.2.840.10008.3.1.1.1

4.2.1.2.2 Number of Associations

MWL/MPPS-SCP will support up to 64 simultaneous associations requested by MWL SCUs.

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Table 4.2-3

NUMBER OF ASSOCIATIONS AS AN SCP FOR AE MWL/MPPS-SCP

</div>

Maximum number of simultaneous associations	64

4.2.1.2.3 Asynchronous Nature

Asynchronous communication (multiple outstanding transactions over a single association) is not supported.

4.2.1.2.4 Implementation Identifying Information

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Table 4.2-4

DICOM IMPLEMENTATION CLASS AND VERSION FOR MWL/MPPS-SCP

</div>

Implementation Class UID	1.2.840.113820.60
Implementation Version Name	EBM_DICOM_30

4.2.1.3 Association Initiation Policy

MWL/MPPS-SCP does not initiate Associations.

4.2.1.4 Association Acceptance Policy

MWL/MPPS-SCP will accept associations for the MWL, MPPS and Verification SOP Classes as an SCP. The job runs in the background and forks a new process for each connection request from a Remote AE.

4.2.1.4.1 Activity - Configured AE Requests Worklist Query

4.2.1.4.1.1 Description and Sequencing of Activities
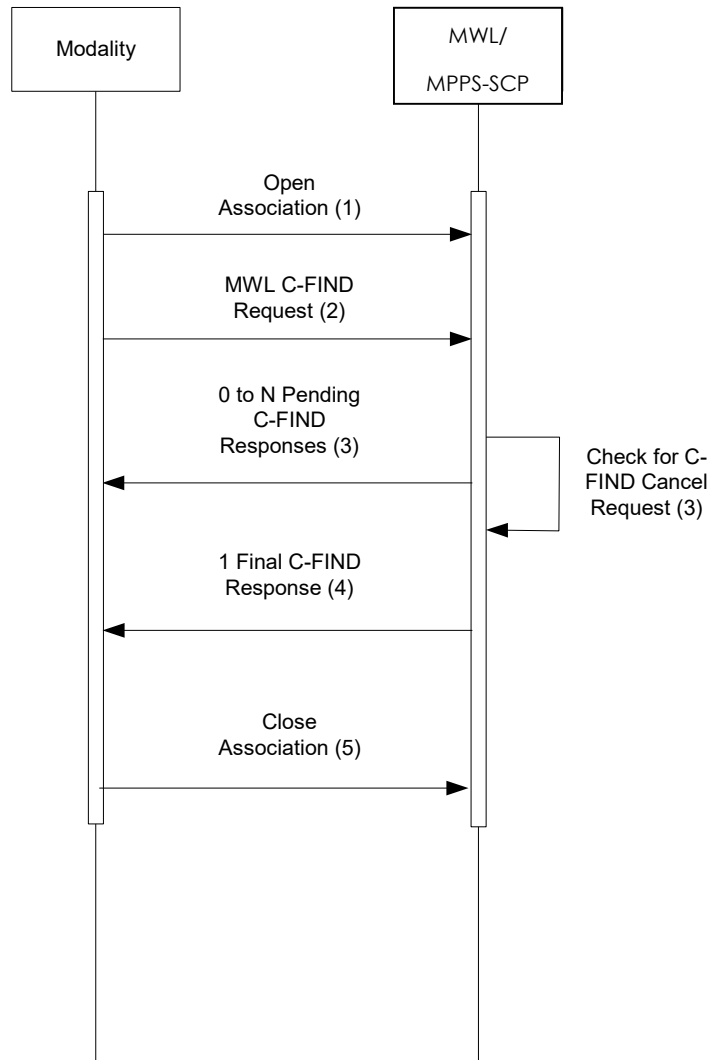
Figure 4.2-3

SEQUENCING DIAGRAM FOR ACTIVITY: CONFIGURED AE REQUESTS WORKLIST QUERY

The figure above is a possible sequence of messages between a Modality Worklist SCU and MWL/MPPS-SCP.

1. The Modality opens an Association with MWL/MPPS-SCP for the purpose of sending querying for a Modality Worklist

2. The Modality sends a Worklist C-FIND query to MWL/MPPS-SCP

3. MWL/MPPS-SCP queries its database using the attributes from the C-FIND Request and returns 0 to N C-FIND responses depending on matches returned from the

database. MWL/MPPS-SCP checks for a C-FIND Cancel Request after a configured number of responses are sent. If a Cancel is received then no further Pending responses are sent.

4. MWL/MPPS-SCP sends the final C-FIND response

5. The Modality closes the Association

The MWL/MPPS-SCP AE may reject Association attempts as shown in Table 4.2-5. The Result, Source and Reason/Diag columns represent the values returned in the corresponding fields of an ASSOCIATE-RJ PDU (see PS 3.8, Section 9.3.4).   The following abbreviations are used in the Source column:

a. 1 – DICOM UL service-user

b. 2 – DICOM UL service-provider (ASCE related function)

c. 3 – DICOM UL service-provider (Presentation related function)

Table 4.2-5
ASSOCIATION REJECTION REASONS

Result	Source	Reason/Diag	Explanation
2 – rejected-transient	c	1 – temporary-Congestion	The maximum number of simultaneous Associations has been reached. An Association request with the same parameters may succeed at a later time.
2 – rejected-transient	c	2 – local-limit-Exceeded	No Associations can be accepted at this time due to insufficient resources. An Association request with the same parameters may succeed at a later time.
1 – rejected-permanent	A	2 – application-context-name-not-supported	The Association request contained an unsupported Application Context Name. An association request with the same parameters will not succeed at a later time.
1 – rejected-permanent	a	7 – called-AE-title-not-Recognized	The Association request contained an unrecognized Called AE Title. An Association request with the same parameters will not succeed at a later time unless configuration changes are made. This rejection reason normally occurs when the Association initiator is incorrectly configured and attempts to address the Association acceptor using the wrong AE Title.

| 1 – rejected-permanent | a | 3 – calling-AE-title-not-recognized | The Association request contained an unrecognized Calling AE Title.   An Association request with the same parameters will not succeed at a later time unless configuration changes are made. This rejection reason normally occurs when the Association acceptor has not been configured to recognize the AE Title of the Association initiator. |
| 1 – rejected -permanent | b | 1 – no-reason-Given | The Association request could not be parsed.   An Association request with the same format will not succeed at a later time. |

4.2.1.4.1.2 Accepted Presentation Contexts

Table 4.2-6

ACCEPTABLE PRESENTATION CONTEXTS FOR AE MWL/MPPS-SCP

AND REAL-WORLD ACTIVITY 'CONFIGURED AE REQUESTS WORKLIST QUERY'

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCP	None

4.2.1.4.1.3 Presentation Context Acceptance Criterion

MWL/MPPS-SCP may accept multiple Presentation Contexts containing the same Abstract Syntax.

4.2.1.4.1.4 Transfer Syntax Selection Policy

If multiple Transfer Syntaxes are proposed per Presentation Context, then only the first supported Transfer Syntax is accepted.

4.2.1.4.1.5 SOP Specific Conformance for Modality Worklist SOP Class

MWL/MPPS-SCP supports return key attributes and matching as described in the table below.

Table 4.2-7

MODALITY WORKLIST C-FIND SCP SUPPORTED ATTRIBUTES

Data Module Name Attribute Name	Tag	VR	Types of Matching
SOP Common			
Specific Character Set	0008,0005	CS	NONE
Scheduled Procedure Step			
Scheduled Procedure Step Sequence	0040,0100	SQ	NONE
> Scheduled Station AE Title	0040,0001	AT	S, U
> Scheduled Procedure Step Start Date	0040,0002	DA	S, R, U
> Scheduled Procedure Step Start Time	0040,0003	TM	S, R, U
> Modality	0008,0060	CS	S, *, U
> Scheduled Performing Physician's Name	0040,0006	PN	S, *, U
> Scheduled Procedure Step Description	0040,0007	LO	NONE
> Scheduled Station Name	0040,0010	SH	NONE
> Scheduled Procedure Step Location	0040,0011	SH	NONE
> Pre-Medication	0040,0012	LO	NONE
> Schedule Procedure Step ID	0040,0009	SH	NONE
Requested Procedure			
Requested Procedure ID	0040,1001	SH	NONE
Requested Procedure Description	0032,1060	LO	NONE
Study Instance UID	0020,000D	UI	NONE
Requested Procedure Priority	0040,1003	SH	NONE
Patient Transport Arrangements	0040,1004	LO	NONE
Confidentiality Code	0040,1008	LO	NONE
Imaging Service Request			
Accession Number	0008,0050	SH	S, *, U
Requesting Physician	0032,1032	PN	NONE
Requesting Service	0032,1033	LO	NONE
Referring Physician's Name	0008,0090	PN	NONE
Visit Identification			
Admission ID	0038,0010	LO	S, *, U
Visit Status			
Current Patient Location	0038,0300	LO	NONE
Patient's Institution Residence	0038,0400	LO	NONE
Patient Identification			
Patient's Name	0010,0010	PN	S, *, U
Patient ID	0010,0020	LO	S, *, U

Patient Demographic			
Patient's Birth Date	0010,0030	DA	NONE
Patient's Sex	0010,0040	CS	NONE
Patient Size	0010,1020	DS	NONE
Patient Weight	0010,1030	DS	NONE
Occupation	0010,2180	SH	NONE
Patient Medical			
Patient State	0038,0500	LO	NONE
Pregnancy Status	0010,21C	US	NONE
Medical Alerts	0010,2000	LO	NONE
Contrast Allergies	0010,2110	LO	NONE
Special Needs	0038,0050	LO	NONE

NOTE: Patient's Name (0010,0010) matching is case insensitive.

The tables should be read as follows:

Attribute Name: Attributes supported for returned C-FIND Responses.

Tag: Appropriate DICOM tag for this attribute.

VR: Appropriate DICOM VR for this attribute.

Types of Matching: The types of Matching supported by the C-FIND SCP. An "S" indicates the identifier attribute can specify Single Value Matching, an "R" will indicate Range Matching, a "*" will denote wildcard matching, a 'U' will indicate universal matching, and 'L' will indicate that UID lists are supported for matching.   "NONE" indicates that no matching is supported, but that values for this Element in the database can be returned.

MWL/MPPS-SCP returns C-FIND response statuses as specified below.

Table 4.2-8

WORKLIST C-FIND RESPONSE STATUS AND RETURN BEHAVIOR

Service Status	Further Meaning	Status Code	Behavior
Success	Success	0000	Matching is complete. No final identifier is supplied.
Refused	Out of Resources	A700	System reached the limit in resource usage. Error message is output to the Communication Log.
Failed	Identifier does not match SOP Class	A900	The C-FIND query identifier contains invalid Elements or values, or is missing mandatory Elements or values for the specified SOP Class. Error message is output to the Communication Log.
	Unable to process	C000	The C-FIND query identifier is valid for the specified SOP Class but cannot be used to query the database. Error message is output to the Communication Log.
Pending	Matches are continuing and current match is supplied.	FF00	Indicates that the search for further matches is continuing. This is returned when each successful match is returned and when further matches are forthcoming. This status code is returned if all Optional keys in the query identifier are actually supported.
	Matches are continuing but one or more Optional Keys were not supported.	FF01	Indicates that the search for further matches is continuing. This is returned when each successful match is returned and when further matches are forthcoming. This status code is returned if there are Optional keys in the query identifier that are not supported.

4.2.1.4.2 Activity - Configured AE Makes Procedure Step Request

4.2.1.4.2.1 Description and Sequencing of Activities

As mentioned above, MWL/MPPS-SCP is started at system boot time and is thus ready to process MPPS messages at any time thereafter. The sequencing diagram below specifies a common flow of messages related to this activity. Prior to this sequence of messages it is necessary that orders have been received from the HIS interface or created via SoliPACS Server Ordering and Scheduling application.

Attributes from the orders and created procedures, usually queried using Worklist, will be included in the MPPS messages the Modality sends to MWL/MPPS-SCP. Key attributes in the MPPS N-CREATE and N-SET are extracted and matched against values in the SoliPACS Server database. A match allows full update of all applicable SoliPACS Server database tables.
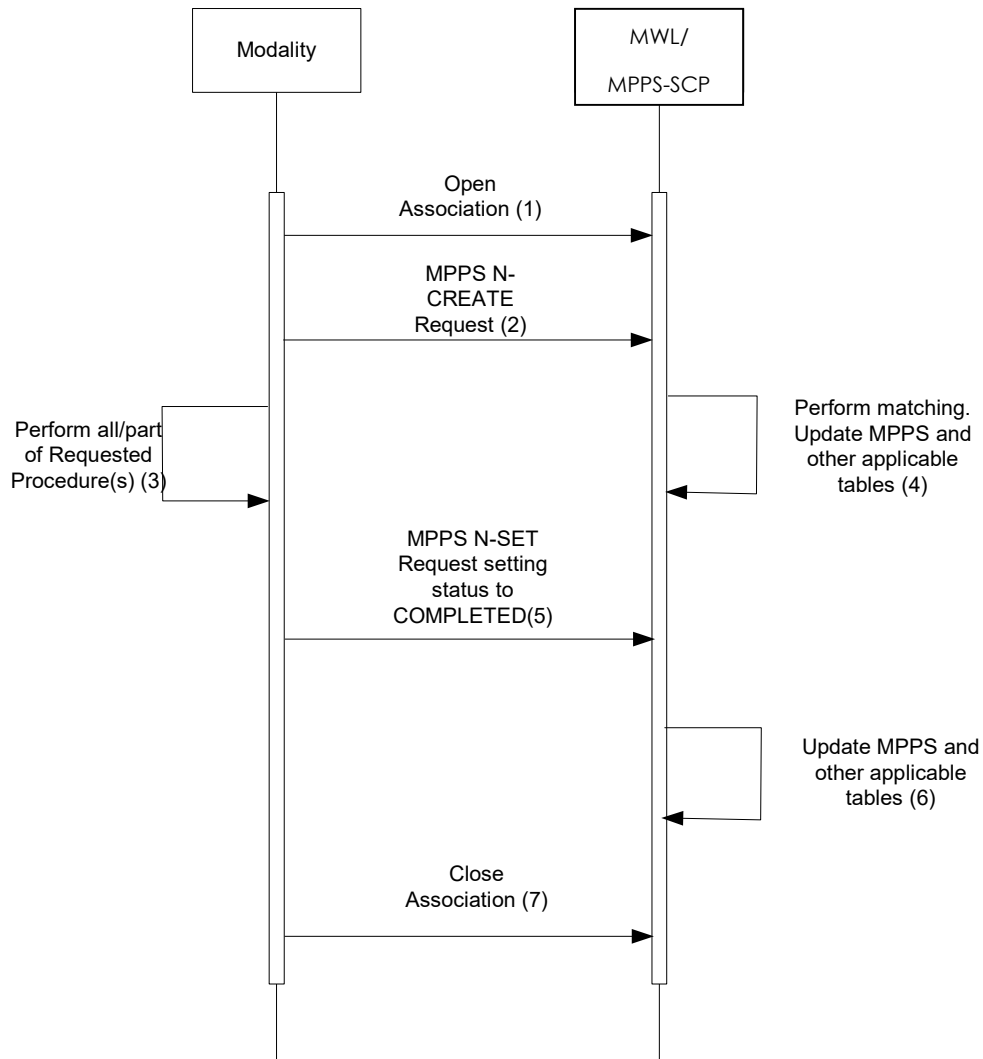
Figure 4.2-4

SEQUENCING DIAGRAM FOR ACTIVITY: CONFIGURED AE MAKES PROCEDURE STEP REQUEST

The figure above is a possible sequence of messages and events for the Configured AE Makes Procedure Step Request activity.

1. The Modality opens an Association to update MWL/MPPS-SCP using MPPS

2. The Modality sends an N-CREATE Request to indicate that it is performing one or more Requested Procedures

3. The Modality performs all or part of the procedure(s)

4. MWL/MPPS-SCP stores the MPPS and executes the matching algorithm described in the conformance section below. If a successful match is found, then updates to various tables per the N-CREATE are performed. In the matching case, tracking status of the procedure(s) referenced in the MPPS is updated if so configured

5. The Modality sends an N-SET setting the status of the MPPS to COMPLETED

6. MWL/MPPS-SCP stores the MPPS If the N-CREATE for this step matched then updates are performed as specified in step 4

7. The Modality closes the Association

4.2.1.4.2.2 Accepted Presentation Contexts

Table 4.2-9

ACCEPTABLE PRESENTATION CONTEXTS FOR AE MWL/MPPS-SCP

AND REAL-WORLD ACTIVITY "CONFIGURED AE MAKES PROCEDURE STEP REQUEST"

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Performed Procedure Step SOP Class	1.2.840.10008 .3.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCP	None

4.2.1.4.2.3 SOP specific Conformance for Modality Performed Procedure Step SOP Class

The list below details the behavior of MWL/MPPS-SCP on occurrence of certain MPPS events and with respect to the coercion of attributes and duration of storage of MPPS messages:

— **Reception of a New MPPS Instance** – The MPPS message is stored in the database.

    — Update its database with values contained in the N-CREATE.

— **Update of MPPS to 'DISCONTINUED' or 'COMPLETED'** – The N-SET is stored in the database. If the preceding N-CREATE matched then the following is done:

    — The attribute values in the N-SET will be used to update the SoliPACS Server.

— **Storage Duration for MPPS Messages** – MPPS messages are purged from the SoliPACS Server database after 60 days has elapsed since the scheduled start date.

Table 4.2-10

MPPS N-CREATE/N-SET RESPONSE STATUS REASONS

Service Status	Further Meaning	Error Code	Reasons
Success	Successful completion of the N-SET or N-CREATE Request	0000	The response status code and meaning are logged in the communication log file.
Failure	Processing Failure	0110	Internal error within MWL/MPPS-SCP. The response status code and meaning are logged in the log file.
	Duplicate SOP Instance	0111	This status is returned when the SCU has attempted to N-CREATE a SOP Instance that has already been created. The response status code and meaning are logged in the job log file
	No such SOP Instance	0112	Status returned when the SCU is trying to SET a SOP instance which has not been created. The response status code and meaning are logged in the log file
	Invalid Attribute	0106	This status is returned if request message contains invalid attribute value. The response status code and meaning are logged in the log file.

4.2.1.4.3 Activity - Configured AE Requests Verification

4.2.1.4.3.1 Description and Sequencing of Activities

A remote AE sends an Echo Request to verify that MWL/MPPS-SCP is awake and listening. MWL/MPPS-SCP responds with success status as long as the request can be parsed.

4.2.1.4.3.2 Accepted Presentation Contexts

Table 4.2-11

ACCEPTABLE PRESENTATION CONTEXTS FOR AE MWL/MPPS-SCP AND

REAL-WORLD ACTIVITY CONFIGURED AE REQUESTS VERIFICATION

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

4.2.1.4.3.3 SOP Specific Conformance

MWL/MPPS-SCP provides Standard conformance to the DICOM Verification service class.

4.2.1.4.3.4 Presentation Context Acceptance criterion

Depending on configuration, MWL/MPPS-SCP may accept multiple presentation contexts containing the same abstract syntax.

4.2.1.4.3.5 Transfer Syntax Selection Policy

If multiple Transfer Syntaxes are proposed per Presentation Context, then only the first supported Transfer Syntax is accepted.

4.3 Physical Network Interfaces

4.3.1 Supported Communication Stacks

4.3.1.1 TCP/IP Stack

The SoliPACS Server DICOM applications are implemented using the TCP/IP stack supplied with the Unix Operating System.

4.3.2 Physical Media

The SoliPACS Server DICOM applications are indifferent to the physical medium over which TCP/IP executes.

4.3.3 Additional Protocols

SoliPACS Server does not support additional protocols.

4.4   Configuration

4.4.1   AE Title/Presentation Address Mapping

The mapping from AE Title to TCP/IP addresses and ports is configurable and set at the time of installation by Installation Personnel.

4.4.1.1 Local AE Titles

The mapping from AE Title to TCP/IP addresses and ports is configurable and set at the time of installation by Installation Personnel.

Table 4.4-1

AE TITLE CONFIGURATION TABLE

Application Entity	Default AE Title	Default TCP/IP Port
MWL/MPPS-SCP	SoliPACS Server	104

4.4.1.2 Remote AE Title/Presentation Address Mapping

The mapping of external AE Titles to TCP/IP addresses and ports is configurable and set at the time of installation by Installation Personnel.

4.4.2 Default Parameters

Table 4.4-2

DEFAULT PARAMETERS

Parameter	Configurable	Default Value
General Parameters		
Maximum PDU size I can receive	Yes	64kbytes
Maximum PDU size I can send	Yes	64kbytes
Time-out waiting for A-ASSOCIATE RQ PDU on open TCP/IP connection. (ARTIM timeout)	No	5 minutes
Time-out waiting for acceptance or rejection response to an Association Open Request. (Application Level timeout)	No	5 minutes

DIMSE Parameters		
QUERY-RETRIEVE-SCP AE time-out waiting on an open Association for the next message (C-FIND-RQ, Association Close Request. etc.) (DIMSE timeout)	No	5 minutes

5. Media Storage

SoliPACS Server does not support Media Storage.

6. Support for Extended Character Sets

For Japan market only

In addition to DICOM default character set ISO 2022 IR 6, SoliPACS Server supports the following Japanese character sets for all SOP Classes:

ISO 2022 IR 13   Japanese katakana (phonetic) characters (94 characters)

ISO 2022 IR 87   Japanese kanji (ideographic), hiragana (phonetic), and katakana (phonetic) characters (942 characters, 2-byte)

7. Security

The SoliPACS Server does not support any of the DICOM Security profiles.