DICOM Conformance Statement

FORUM® Hospital IT Integration Version 3.0

VNA Support Module Version 1.7

Carl Zeiss Meditec AG

Goeschwitzer Strasse 51-52

07745 Jena

Germany

www.zeiss.com/med

 Document Number: 0000132416 **Revision:** 9

1 Conformance Statement Overview

The FORUM VNA Support Module addresses the problem of the ever growing storage demands for Ophthalmology departments by offloading DICOM data to a centralized DICOM storage architecture, such as a Vendor Neutral Archive, or PACS system. The VNA Support Module maintains one local storage cache only. The volume of data in the local cache can only grow to a customer defined level (e.g. 75 % of the disk). The VNA Support Module has a separate installer. It is an integrated application including a database which keeps records of the status of all SOP Instances and an application responsible for the VNA workflow and configuration management.

The minimum requirement for the VNA Support Module 1.7 is FORUM Archive 4.4.

Once activated, the VNA Support Module will process and archive all new incoming data. After a defined period of time all DICOM files are forwarded from the local storage location to the configured VNA. Once the available free storage space reaches a defined value, the VNA archived files are deleted from the local storage location. DICOM files can be retrieved from VNA on user request or via automatic pre-fetching.

This document is structured as suggested in the DICOM Standard (PS 3.2: Conformance).

Table 1-1 Network Services Supported by FORUM AE (with VNA Support Module)

The following Table only describes the delta between the Network Services Supported by FORUM AE of the FORUM DICOM Conformance Statement and the FORUM VNA Support Module DICOM Conformance Statement.

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Verification		
See FORUM DICOM Conformance Statement		
Transfer Image Storage SOP Classes		
See FORUM DICOM Conformance Statement		
Transfer Video Image Storage SOP Classes		
See FORUM DICOM Conformance Statement		
Transfer Other Storage SOP Classes		
See FORUM DICOM Conformance Statement		
Workflow Management		
Storage Commitment Push Model SOP Class	Yes	Yes
See FORUM DICOM Conformance Statement		
Query / Retrieve		
Study Root Query/Retrieve Information Model – FIND	Yes	Yes
Study Root Query/Retrieve Information Model – MOVE	Yes	Yes
See FORUM DICOM Conformance Statement		

2 Table of Contents

3 Introduction

3.1 Revision History

Document Version	Date	Changes
1.0	2016-07-28	Initial revision for Hospital IT Integration v1.0
1.1	2017-11-30	Update for VNA Support Module version 1.5 - Support and configuration of Extended Negotiation and Relation Query Support - Support of Hierarchical Queries - White- and blacklist - Application Entities can be configured for every Service Class - Reassign of archived SOP Instances supported
01	2023-07-24	Update for Hospital IT Integration v3.0 / VNA Support v1.7 - Update of SW versions and document numbers - Editorial changes in application flow diagram - Hub workflow removed - Update of configuration parameters

3.2 Audience

This document is written for the people that need to understand how FORUM VNA Support Module will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. This document contains some basic DICOM definitions so that any reader may understand how this product implements DICOM features. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the product's functionality, and how that functionality integrates with other devices that support compatible DICOM features.

3.3 Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between FORUM VNA Support Module and an external Vendor Neutral DICOM Archive (VNA). The Conformance Statement should be read and understood in conjunction with the DICOM Standard. DICOM by itself does not guarantee interoperability. The Conformance Statement does, however, facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:

- The comparison of different Conformance Statements is just the first step towards assessing interconnectivity and interoperability between the product and other DICOM conformant equipment.
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility.

3.4 Definitions and Terms

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.

Picture Archive and Communication System (PACS)

is a digital system for processing, administrating and archiving medical images and data.

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.

Query Key

A input value for a query process. Query Keys denote the set of DICOM tags that are sent from the SCU to SCP and thus control the query result.

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.

Vendor Neutral Archive (VNA)

A central storage for all data generated in a clinic

3.5 Abbreviations

Table 3-1 Abbreviations used in this document

Abbreviation	Definition
AE	Application Entity
AET	Application Entity Title
DICOM	Digital Imaging and Communications in Medicine
EMR	Electronic Medical Record
HL7	Health Level Seven
ILE	Implicit Little Endian
IOD	Information Object Definition
MWL	Modality Worklist
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair, union of a specific DICOM service and related IOD.
TCP/IP	Transmission Control Protocol / Internet Protocol
UI	User Interface
UID	Unique Identifier
VNA	Vendor Neutral Archive
XML	Extensible Markup Language

3.6 References

NEMA PS3 / ISO 12052, Digital Imaging and Communications in Medicine (DICOM) Standard, National Electrical Manufacturers Association, Rosslyn, VA, USA (available free at http://medical.nema.org/)

DICOM Conformance Statements for FORUM (available free at www.zeiss.com/dicom)

HL7 Conformance Statements for FORUM (available free at www.zeiss.com/hl7)

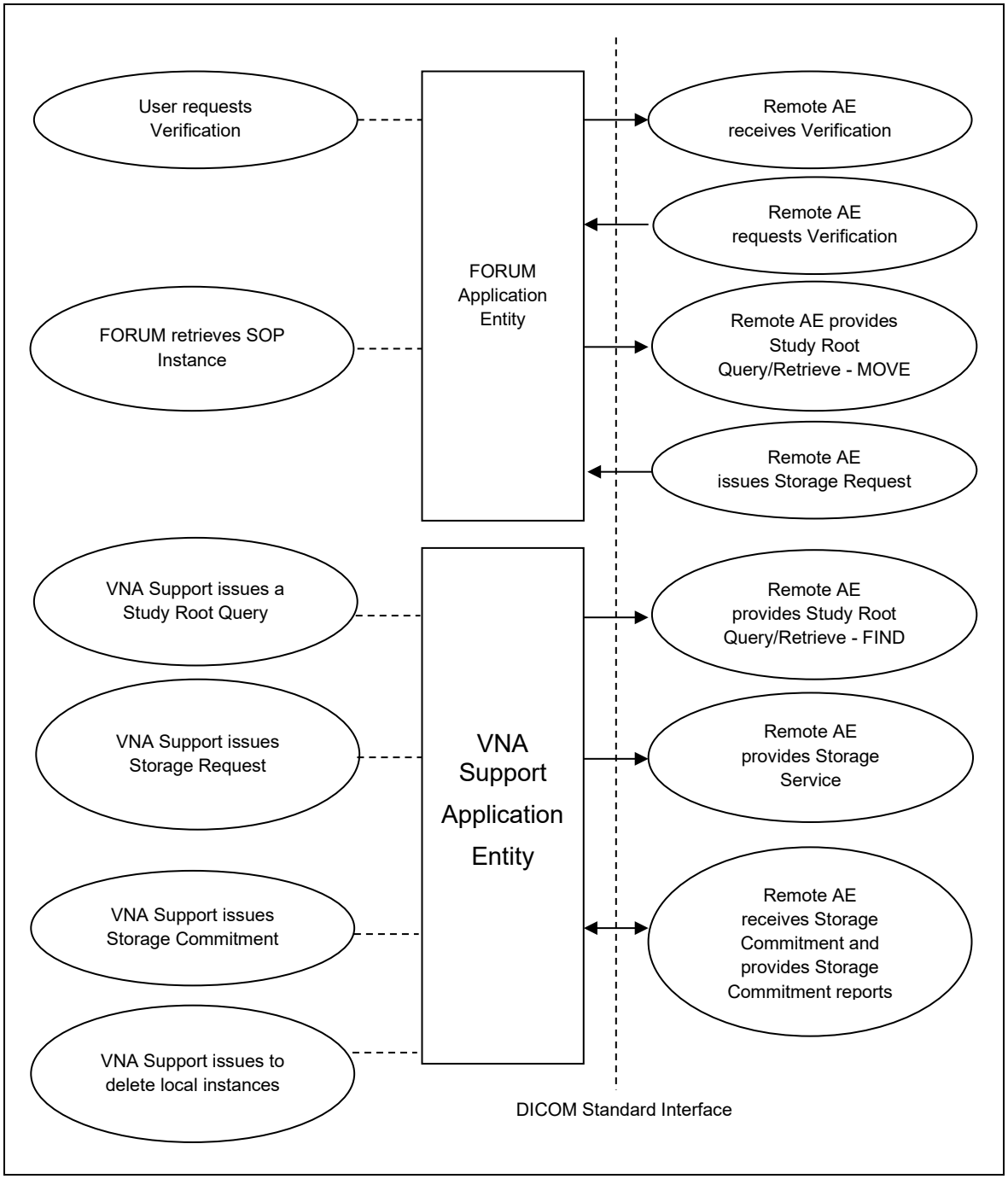
4 Networking

4.1 Implementation Model

4.1.1 Application Data Flow

For FORUM Archive and FORUM Modality Worklist Functional Overview: See FORUM DICOM Conformance Statement

Figure 4-1 FORUM VNA Support Module – Functional Overview



4.1.2 Functional Definition of AEs

For FORUM Archive and FORUM Modality Worklist Functional Definition: See FORUM DICOM Conformance Statement

4.1.2.1 Functional Definition of FORUM VNA Support Module

The VNA Support Module allows the configuration of four different remote Application Entities:

VNA AE for C-FIND
This AE is used as C-FIND SCP to check if an instance is already forwarded.

VNA AE for C-STORE
This AE is used as C-STORE SCP to send an instance.

VNA AE for C-MOVE
This AE is used as C-MOVE SCP for object retrieval.

VNA AE for N-ACTION (Storage Commitment)
This AE is used as N-ACTION SCP for Storage Commitment

The VNA Support Module uses the functionality of the FORUM Application Entity described in the FORUM DICOM Conformance Statement. In addition FORUM AE has been extended to implement a Service Class User (SCU) for the following services:

The VNA Support AE initiates an association and requests

- Relational Study Root Query using SOP Instance UID as query key to check if an instance has been stored already in the VNA (Study Root Query/Retrieve Information Model – FIND)
- the Storage of incoming instances (see FORUM DICOM Conformance Statement)
- Storage Commitment for forwarded instances. A successful Storage Commitment is a precondition to delete a DICOM file from FORUM Archive.

The VNA Support AE waits in the background for connections, and

- Answers Verification requests
- Processes Storage Commitment responds

The FORUM AE initiates an association and requests

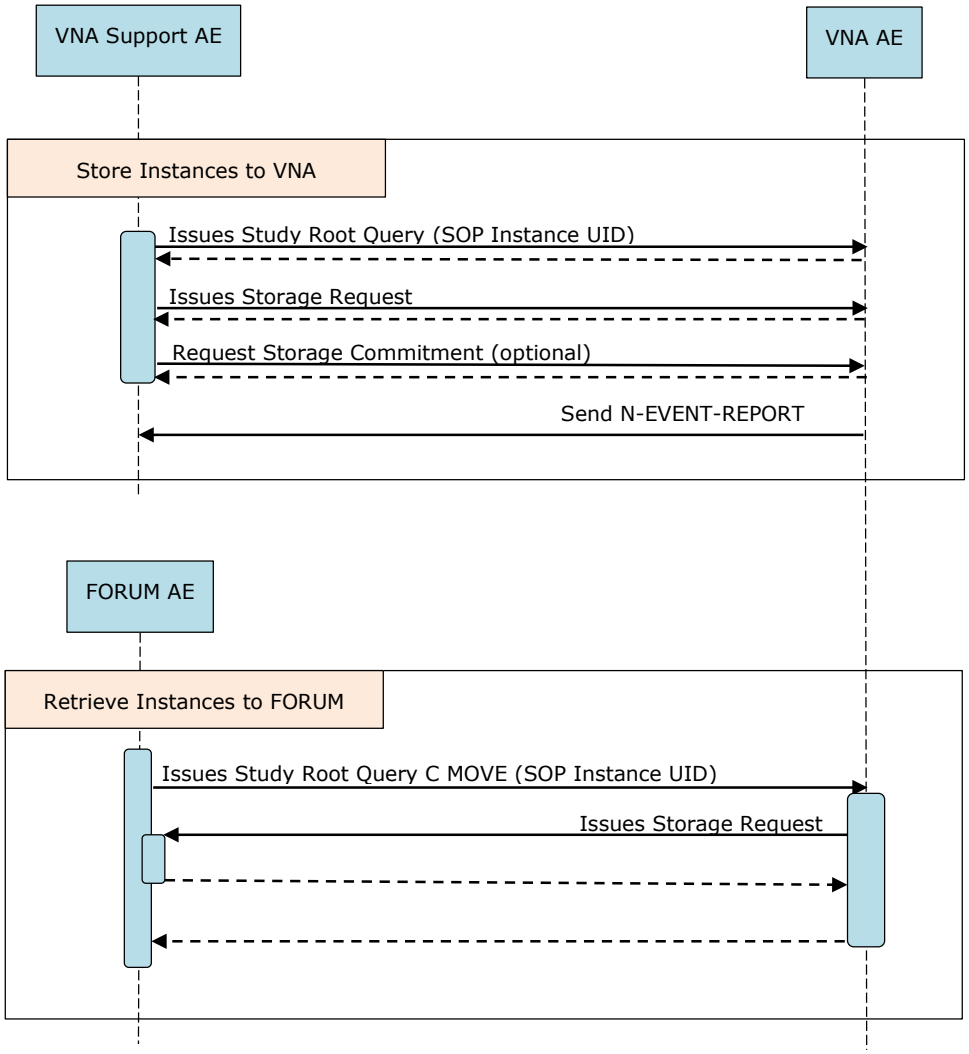
- the Retrieve of instances only stored on the VNA (Study Root Query/Retrieve Information Model – MOVE)

For the use of the VNA Support Module, it is required that the patient demographics are kept in sync with a leading patient management system.

4.1.3 Sequencing of Real-World Activities

To realize the real world activities, the different entities work together. The sequence diagrams shall depict the intended workflow.

Figure 4-2 FORUM VNA Support Module



4.2 AE Specifications

4.2.1 FORUM Application Entity Specification

4.2.1.1 SOP Classes

Table 4-1 SOP Classes for FORUM AE and FORUM MWL AE

See FORUM DICOM Conformance Statement. The corresponding Activities are not part of this Integration DICOM Conformance Statement.

The following Table only describes the delta between the SOP Classes Supported by FORUM AE of the FORUM DICOM Conformance Statement and the FORUM VNA Support Module DICOM Conformance Statement

Table 4-2 SOP Classes for FORUM AE (with VNA Support Module)

SOP Class Name	SOP Class UID	SCU	SCP
Study Root Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	Yes

Table 4-3 SOP Classes for VNA Support AE

SOP Class Name	SOP Class UID	SCU	SCP
See FORUM DICOM Conformance Statement			
Study Root Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	Yes
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	Yes

4.2.1.2 Associations Policies

4.2.1.2.1 General

See FORUM DICOM Conformance Statement.

4.2.1.2.2 Number of Associations

See FORUM DICOM Conformance Statement.

4.2.1.2.3 Asynchronous Nature

See FORUM DICOM Conformance Statement.

4.2.1.2.4 Implementation Identifying Information

See FORUM DICOM Conformance Statement.

4.2.1.3 Association Initiation Policy

4.2.1.3.1 Activity – User Requests Verification (SCU)

See FORUM DICOM Conformance Statement.

4.2.1.3.2 Activity – VNA Support issues a Study Root Query (SCU)

4.2.1.3.2.1 Description and Sequencing of Activities

A Study Root Query is used to check if a certain SOP Instance can be found on the VNA. Therefore, a relational query by SOP Instance UID is triggered.

VNA Support **uses the** VNA AE for C-FIND.

VNA Support triggers a C-FIND-RQ with the SOP Instance UID .

4.2.1.3.2.2 Proposed Presentation Contexts

Table 4-4 Proposed Presentation Contexts for Activity "FORUM issues a Study Root Query (SCU)"

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Study Root Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	ILE	1.2.840.10008.1.2	SCU	Yes[1]

[1]: Use of Extended Negotiation is configurable in the Service Tool (VNA Support Module). Default: "Extended Negotiation disabled"

4.2.1.3.2.3 SOP Specific Conformance – Find Objects

The VNA Support AE provides standard conformance to the DICOM Query/Retrieve Service Class as an SCU. The VNA Support AE uses relational-queries (optional 'hierarchical', see configuration parameter 'Use Relational Queries'). The following tables contain detailed information on matching and return keys.

Table 4-5 Matching Types

Abbreviation	Description
UNIQUE	Unique query key for the respective level

Table 4-6 Instance Level Attributes

Description	Tag	Matching Type
SOP Instance UID	(0008,0018)	UNIQUE
SOP Class UID	(0008,0016)	return key only

Table 4-7 Query C-FIND Response Status Handling Behavior

Service Status	Further Meaning	Status Code	Behavior
Success	Matching is complete – No final Identifier is supplied	0000	The Software Application stops receiving responses.
Pending	Matches are continuing – Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys	FF00	Log message.
Pending	Matches are continuing – Warning that one or more Optional Keys were not supported for existence and / or matching for this Identifier.	FF01	Log error message with status and patient ID

	All other responses code meaning	All other responses code	Log error message with status and patient ID

4.2.1.3.3 Activity - FORUM retrieves SOP Instance (SCU)

This activity is triggered whenever a locally deleted DICOM file will be accessed in FORUM.

A C-MOVE request on IMAGE level using the SOP Instance UID as Query key is used to retrieve a DICOM file.

FORUM uses the VNA AE for C-MOVE

FORUM will trigger a C-MOVE-RQ of the SOP Instance UID on the VNA AE for C-MOVE.

In case there are differences in basic patient data or UID's of instances stored in FORUM and the VNA, the DICOM header of the retrieved instances will get updated with the data stored in FORUM database.

The update of the DICOM header applies to

- Patient demographics
  - Issuer of Patient ID
  - Patient ID
  - Patient's Name
  - Patient's Sex
  - Patient's Birth Date
  - Other Patient ID's
  - Ethnic Group
  - Patient Comments
- Study Instance UID
- Series Instance UID

4.2.1.3.3.1 Description and Sequencing of Activities

4.2.1.3.3.2 Proposed Presentation Contexts

Table 4-8 Proposed Presentation Contexts for Activity "FORUM retrieves SOP Instance (SCU)"

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Study Root Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	ILE	1.2.840.10008.1.2	SCU	Yes[1]

[1]: Use of Extended Negotiation is configurable in the Service Tool (VNA Support Module). Default: "Extended Negotiation disabled"

4.2.1.3.3.3 SOP Specific Conformance – Move Objects

The following tables contain detailed information on supported matching keys:

Table 4-9 Instance Level Attributes, Query/Retrieve Level: IMAGE

Description	**Tag**	**Matching Type**

SOP Instance UID	(0008,0018)	UNIQUE

4.2.1.3.4 Activity – VNA Support issues Storage Request (SCU)

Table 4-10 C-STORE Response Status Handling Behavior

Service Status	Further Meaning	Status Code	Behavior
SUCCESS		0000	None
Duplicate SOP Instance		0111	None
Other than SUCCESS and Duplicate SOP Instance		> 0000 < 0111 > 0111	Log error message including Status Code and retry until the maximum number of retries exceeded

4.2.1.3.5 Activity – VNA Support issues Storage Commitment (SCU)

The FORUM VNA Support Module will request storage commitment for all provided instances if the remote VNA is configured as Storage Commitment Provider (see configuration parameter 'Require Storage Committed before deleting files') and a presentation context for the Storage Commitment Push Model has been accepted.

Storage commitment N-ACTION will be requested for documents, which exist on the VNA.

4.2.1.3.5.1 Description and Sequencing of Activities

The VNA Support AE issues an N-ACTION requests.

4.2.1.3.5.2 Proposed Presentation Contexts

The VNA Support AE may request the following Presentation Contexts listed in the following table.

Table 4-11 Proposed Presentation Contexts for Activity "FORUM issues Storage Commitment (SCU)"

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Storage Commitment Push Model	1.2.840.10008.1.20.1	ILE	1.2.840.10008.1.2	SCU	No

4.2.1.3.5.3 SOP Specific Conformance – Storage Commitment

The VNA Support AE expects at any time the asynchronous N-EVENT report in a separate association.

The behavior of VNA Support AE when encountering status codes in an N-ACTION response is summarized in the table below:

Table 4-12 Storage Commitment N-ACTION Response Status Handling Behavior

Service Status	Further Meaning	Status Code	Behavior
Failure	All available status codes with different code meanings.		The N-ACTION-RQ will be repeated.

4.2.1.4 Association Acceptance Policy

FORUM accepts only associations from registered AE titles.

4.2.1.4.1 Activity – Remote AE Requests Verification (SCP)

See FORUM DICOM Conformance Statement.

4.2.1.4.2 Activity – FORUM issues Storage Commitment (SCU)

4.2.1.4.2.1 Description and Sequencing of Activities

Storage commitment N-EVENT reports will be received. This should be a result to the N-ACTION Request of the VNA Support AE.

4.2.1.4.2.2 Accepted Presentation Contexts

Table 4-13 Acceptable Presentation Context for Activity "FORUM issues Storage Commitment (SCU)"

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID 1.2.840.10008. ...**	**Name List**	**UID List 1.2.840.10008. ...**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	ILE	1.2.840.10008.1.2	SCU	No

4.2.1.4.2.3 SOP Specific Conformance - Storage Commitment

4.2.1.4.2.3.1 Storage Commitment Operations (N-EVENT-REPORT)

VNA Support AE is capable of receiving an N-EVENT-REPORT notification if it has successfully negotiated a Presentation Context for the Storage Commitment Push.

The behavior of VNA Support AE when receiving Event Types within the N-EVENT-REPORT is summarized in the table below.

Table 4-14 Storage Commitment N-EVENT-REPORT Request Failure Reasons

Service Status	Further Meaning	Failure Reason	Behavior
Failure		All Failure Reasons	The SOP Instance is also considered as not being committed. The Failure Reason will not be interpreted by FORUM.

4.2.1.4.3 Activity – FORUM retrieves SOP Instance (SCP)

4.2.1.4.3.1 Description and Sequencing of Activities

This chapter describes the aspect of association acceptance of the activity "FORUM retrieves SOP Instance from remote AE". The VNA initiates a C-STORE-RQ to FORUM AE.

4.2.1.4.3.2 Accepted Presentation Contexts

See FORUM DICOM Conformance Statement.

4.2.1.4.3.3 SOP Specific Conformance – Store Objects

The FORUM AE provides standard conformance.

4.3 Network Interfaces

See FORUM DICOM Conformance Statement.

4.4 Configuration

See FORUM DICOM Conformance Statement.

4.4.1 AE Title/Presentation Address Mapping

See FORUM DICOM Conformance Statement.

4.4.2 Parameters

4.4.2.1 General Parameters

The general parameters are shared for associations to any of the configured AE.
See FORUM DICOM Conformance Statement for the standard parameters.

Table 4-15 DICOM Configuration Parameters Table for the FORUM VNA Support Module

Parameter	Configurable (Yes/No)	Default Value
Vendor Neutral Archive (VNA) Support Module		
Require Storage Committed before deleting files	YES	Checked (activated)
DICOM Settings VNA Support		
VNA Support AE Title	YES	FORUM_VNAS
VNA Support AE port	YES	11121
Use source AE Title	YES To send the DICOM files to the VNA with the Source AE Title as the sending AE Title.	Unchecked (disabled)
VNA Settings		
Activate communication to VNA	Yes To temporarily disable the communication to VNA for maintenance purposes	Checked (activated)
Use Extended Negotiation	Yes	Unchecked (disabled)
Use Relational Queries	Yes	Checked (Enabled)
VNA AE for C-FIND	Yes	
VNA AE for C-MOVE	Yes	
VNA AE for C-STORE	Yes	
VNA AE for N-ACTION (Storage Commitment)	Yes	

4.4.2.2 DICOM TLS Parameters

See also FORUM DICOM Conformance Statement for general DICOM TLS Parameters.

Parameter	Configurable (Yes/No)	Default Value
DICOM TLS Parameters VNA Support		
tls.vnaCommunicationSecured	Yes Is set to true, the communication to the VNA uses TLS.	false

5 Media Interchange

See FORUM DICOM Conformance Statement.

6 Support of Character Sets

See FORUM DICOM Conformance Statement.

7 Security

See FORUM DICOM Conformance Statement.

8 Annexes

See FORUM DICOM Conformance Statement.

Carl Zeiss Meditec AG
Goeschwitzer Strasse 51-52
07745 Jena
Germany
http://www.zeiss.com/forum
http://www.zeiss.com/dicom
http://www.zeiss.com/med

